



# Master's degree thesis

**LOG950 Logistics**

**Time spent on retail and e-tail warehouse activities:  
An empirical study of two companies**

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Molde, 24.05.2019



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## **Preface**

This thesis is my final work of a two-year Master of Science in Logistics program at Molde University College and is written between January and May 2019.

I would like to thank all the people who helped and contributed to this research. I want to give a special thanks to my supervisor Berit Irene Helgheim, for sharing her knowledge, giving me guidance and encouraging me throughout the process of writing this thesis. Further, I would like to thank Birgithe E. Sanbæk for informative discussions and feedback.

Special thanks to the companies, and especially the warehouse employees, for participating in this study and sharing essential information. Without you, conducting this research would have been impossible.

I would like to express my gratitude to friends, fellow students, and family for motivation and support during my studies.

*Molde, May 2019*  
*Emma K. L. Alendal*

## **Abstract**

**Purpose:** The trends in the market and technological developments in retailing have had a substantial impact on warehouse operations. The purpose of this paper is to investigate the time spent on retail and e-tail warehouse activities. Analyzing how the time is spent can be essential to detect potential areas of improvement and for optimal labor utilization.

**Methods:** Warehouse employees recorded data through a smartphone application. The data for set activities were recorded over 2-3 weeks in 2019. Two companies contributed to the study.

**Results:** The results show that for Company 1, retail activities stand for 84 percent of the time spent in the warehouse, and 81 percent for Company 2. Respectively 16 percent and 19 percent for e-tail activities. The two activities that account for the major share of time under retail was “order picking” and “packing.” The retail activity “order picking” and “packing” stand for 59 percent for Company 1 and 40 percent for Company 2. The most time-consuming activity under e-tail was “packing,” amounting to around 40 percent of the total time spent.

**Conclusions:** The results show that expanding to an online channel gives an additional cost of almost 20 percent in the form of increased consumption of labor resources in the warehouse. “Order picking” was the most time-consuming retail activity while it was “packing” under the e-tail category. For the retail industry, the result may be important for appropriately planning, and efficient utilization of resources in the warehouse.

**Originality/value:** The author contributes by presenting the proportion of time used on different activities in a warehouse, becoming one of the first empirical research papers of its kind in multiple channel retailing research.

**Keyword:** Multi-channel, Omni-channel, e-commerce, e-tail, retail, warehouse operations

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# Chapter 1

## Introduction

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## 1.0 Introduction

Integration of physical and online stores is a recent phenomenon which has changed the retail industry. This development has made a major impact on retail logistics over the last decade (Hübner et al., 2016). To create a seamless shopping experience for the end-customers, the retailers are now faced with the challenge of redesigning their warehouse operations. The warehouse secures supply and contributes with value-adding activities, such as material handling and order preparing. With the development of expanding online, warehouses that previously only processed store orders may also need to serve end-customers through the online store. This makes the warehouse an important part of the supply chain that serves as a link between producers and customers.

With the use of the internet, e-commerce is growing rapidly and is increasing in both reach and size. In Norway, 91 percent of the population uses the internet daily (SSB, n.d), and it has opened a new way for companies to present themselves to customers. Retailing has, therefore, become more complicated, and it is crucial for companies to evaluate this change. There has been a significant increase in Norwegian online shopping, and it grows faster than offline sales. This shows the importance of e-commerce. Numbers from SSB (2018), show that online stores in Norway sold for over 21 billion NOK in 2017, which is an increase of 13,5 percent compared to the year before. In total, the retail industry in Norway sold for 488 billion NOK in 2017, an increase of 2,5 percent. Although online retail only stands for 4,30 percent of the total retail market, it has had a substantial increase due to new shopping patterns. This pattern is driven by the rise in sales from existing online channels and the trend where retailers expand online (Hübner et al., 2015).

Gu et al. (2007) address the gap in warehouse operation literature where there has been a strong focus on storage and order picking while research on receiving and shipping is lacking. Hübner et al. (2015) point out that literature dealing with individual operations planning problems are emerging while there is still a lack of research focusing on warehouse operations and capacity management. The shortage of reviews on warehouse operations and design for retail and e-tail is also elaborated on in the literature overview written by Kembro et al. (2018). Based on the lack of deep insight research conducted on warehouse operations

in retail and e-tail, this study attempts to fill the gap by investigating the time spent on retail and e-tail warehouse activities.

According to the Norwegian Centre for Research Data (NSD), this study does not need to be notified. This is confirmed by a test NSD provides, and a phone call to the customer service conducted 14<sup>th</sup> of January 2019.

## **1.1 Purpose and research question**

The retail industry is under change, and retailers are starting to use online channels to reach their consumers. In the literature, there is limited information on how time is spent in different warehouses within retail and e-tail. This may prevent the utilization of resources and efficient planning in the warehouse.

The main purpose of this study is to examine the distribution of time used in a warehouse that serves both physical stores and end-customers through an online platform. Only warehouses with finished goods will be analyzed. The research aims to identify which activities warehouse employees spend the highest amount of time on, and if there is a difference between the time consumed on activities associated with retail and e-tail. In order to accomplish this, warehouse employees recorded set activities through an app on their smartphone to provide data so a quantified analysis could be conducted. Through the analysis, knowledge could be extracted about how e-commerce has affected the warehouse operations and potential areas of improvements.

In the literature, there is a focus on challenges with individual operations and capacity management. Based on the lack of empirical research conducted on warehouse operations in retail and e-tail, this research will attempt to narrow this gap. This study aims to gather additional knowledge about the distribution of time on different activities in warehouses, simultaneously serving both physical and online stores. The overall research question will be:

**Investigate the time spent on retail and e-tail warehouse activities for two companies.**

## **1.2 Delimitations**

This research has been conducted under a limited timeframe, and therefore, some restrictions have been made. The study is limited towards the retail sector and is only looking on finished goods warehouses for two companies. The warehouses are located in Norway, and therefore, this study may not be representative for other countries. However, this research may bring valuable insight, and companies in other countries may gain knowledge from this research.

This research is based on quantitative data and in-depth interviews with the employees will not be conducted, and the research will, therefore, not focus on questions of why things are done in the operations.

## **1.3 The e-commerce markets**

The internet has opened up a new marketplace for millions of customers to shop and gives companies previously unknown opportunities by using new business models and technology. Laudon and Traver (2018) divide the retail industry into seven segments: durable goods, general merchandise, groceries, specialty stores, gasoline and fuel, mail order/telephone order, and online retail firms. The author states that all the segments have the ability to offer online retail, but in society today, the use of online channels still differs. However, according to Chopra (2018), the channel that is best suited to serve the customer depends on both the characteristics of the product and the customers need for said product.

Although the use still differs, e-commerce is growing rapidly. Emarketer (2018) illustrates the predicted e-commerce sales worldwide where growth is predicted every year (Figure 1). This paper will, however, focus on the Norwegian e-commerce market.

**Retail Ecommerce Sales Worldwide, 2016-2021**  
trillions, % change and % of total retail sales

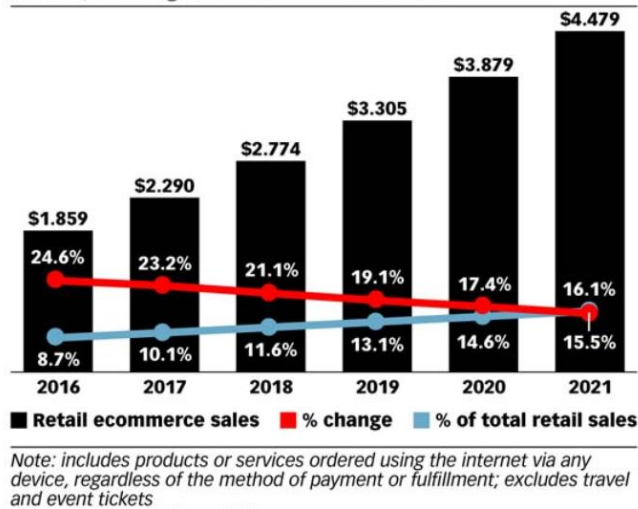


Figure 1 Retail e-commerce sales worldwide, 2016-2021 (Emarketer, 2018).

The DIBS annual report on Norwegian e-commerce predicts that Norwegians will spend around 144,8 billion NOK online in 2018, amounting to an increase of 17 percent compared to the year before. This includes spending on travel, physical goods, and services (DIBS, 2019). PostNord (2018) predicts that Norwegians will use 49,1 billion on physical goods. The explanation for this increase is, among other things, that not only the youth are shopping online. Now, other age groups are increasingly using the internet to shop (DIBS, 2019; Postnord 2018)

Online shopping has also become easier, and companies have seen the importance of adapting their websites to mobile devices. Online stores are always open, and with the use of smartphones, Norwegians can shop wherever and whenever they want. According to Criteo (2018), Norway is the runner up in mobile shopping in Europe only eclipsed by Sweden. Results showing that 57 percent of the population has shopped online with a mobile phone, almost the matching results from the DIBS (2019) survey, which shows 60 percent. The result from PostNord (2018) display that 42 percent has shopped online with a mobile phone during December 2018.

DIBS (2019) predicts that, in 2018, 45 percent of the total spending was on travel, 34 percent on physical goods, and 21 percent on services (Figure 2).

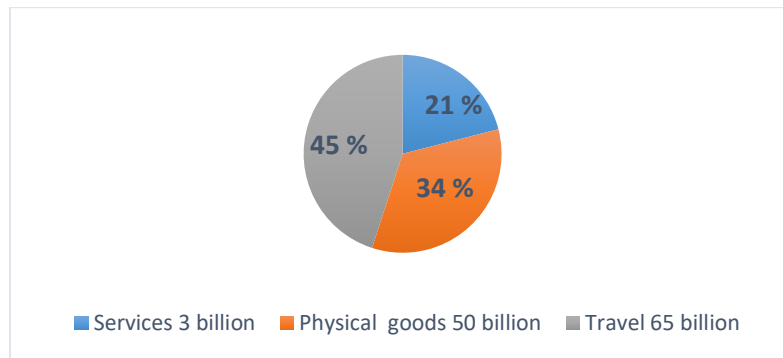


Figure 2 E-commerce spending in percentage and total spending, 2018 (DIBS, 2019)

Under the category of physical goods, there are several subcategories. Based on survey results from two different reports (DIBS 2019, PostNord 2018), Figure 3 shows the percentage of the Norwegian population that has purchased physical goods online. In both of the reports, clothes and shoes represent the categories that most Norwegians has bought online. In DIBS report home décor stands for 21 percent, while in PostNord the results show 10 percent. Despite the differing results, both reports predicts growth in the online spending, and it may be essential for companies to be aware that consumers increasingly shop aforementioned goods online.

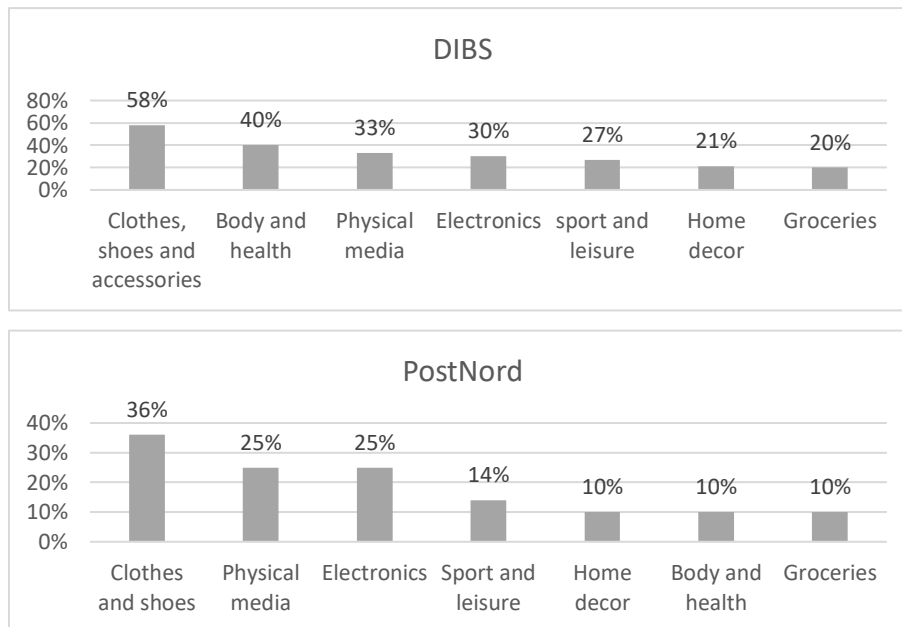


Figure 3 Share of the population that purchases physical goods online from two reports, 2018 (DIBS,2019; PostNord,2018).



In the DIBS report, a survey was conducted to ascertain the reasoning behind why people shop online. The result shows that it is important for the Norwegian consumer to save time and that they find online shopping easy to do (Figure 4). 25 percent stated that saving time and that online shopping is convenient as their primary reasons for shopping online. 24 percent of Norwegians shop online to get a better price, and state that the internet has made it easier for the consumer to compare prices. An essential difference between physical stores and online stores is that online stores are always open, and 13 percent of Norwegians says that this is important for them.



Figure 4 Reasons why people shop online (DIBS, 2019)

## 1.4 Structure of the thesis

This thesis is written in a research-based format and consists of two parts. The first part is an introduction part where the first chapter presents the research purpose, research question, delimitations, followed by an introduction to the e-commerce markets. The second chapter presents the case description, where the companies and their operations will be introduced. The third chapter presents the theoretical framework for this study and comprises of the role of the warehouse, description of terms in retailing, the e-commerce supply chain, the impact of e-commerce and challenges with having multiple channels. The fourth chapter presents the methodology and the data collection. The final chapter in the introduction part, the fifth chapter summaries the introduction part, followed by managerial implications, limitations, and areas of further research.

The second part presents the research paper.



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## Chapter 2

### Case description

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## **2.0 Case description**

The analysis was performed on activity data, recorded by warehouse employees in two companies. Both of the companies warehouses are located in Akershus County in Norway. The study is only conducted on retailers with multiple channels. This means that the companies have physical stores as well as an online channel. The companies will be given fictive names; Company 1 and Company 2, hereafter referred to as C1 and C2 respectively.

The warehouses are similar in terms of functions and flow, these being divided into several activities such as receiving, repacking, put away, order picking, cross-docking, and shipping. However, the companies have different methods to perform these tasks. Also, warehouse size, the number of employees, and the number of orders handled per day differs. In the warehouse, the activities are separated based on channel - retail or e-tail. C1 has one store with a corresponding online store, while C2 has four brand stores where two of the brands has online stores.

This chapter will give a brief description of the companies in section 2.1 and 2.2. Furthermore, in Section 2.3, information about the working hours and job rotation will be given, followed by the difference between retail and e-tail orders in Section 2.4. Additionally, in Section 2.5, a brief description will be given regarding delivery and product returns. In Section 2.6, a description of the storage layout and warehouse operations will be elaborated upon.

### **2.1 Company 1**

C1 specializes in curtains and other fabrics for the home, having over 60 years of experience in the business. The company focuses on safe products for the whole family and is a large actor in the interior and home textile segment with 150 stores spread across the country. In 2017 their revenue was around 879 million NOK. The company has 1131 employees, and around 20 of these are employed in the company's warehouse. The head office and warehouse are placed in the same location and is around 9 500 square meters in total.

In 2010, C1 expanded online. The online store stands for 4 percent of the total turnover, and the company expects growth.

## **2.2 Company 2**

C2 is one of the leading companies in the fashion and textile trade segment in Norway and has over 30 years of experience. The company has 240 stores distributed on four different store brands. In 2017, they had a revenue of around 1 718 million NOK. The company has 1596 employees, where around 12 of them work at the warehouse. The head office and warehouse are located in different areas, about 30 minutes apart in driving distance. The estimated storage space for this research paper is 4 944 square meters.

The company expanded online in 2017 with one brand store, and the second online store was established in 2018. A third online store was established a few weeks after the research was conducted and will not be taken into consideration in this paper. The online stores are relatively new, and the online sales were stated to be a small percent of the total turnover. However, the company is expecting growth.

## **2.3 Working hours and job rotation**

In Norway, a normal workweek is 37,5 hours, and this is also the norm for the employees in the warehouses. This means that a typical working day is 8 hours, including a 30 minutes break. Regular working hours for the warehouse employees at C1 is 07:00-15:00 and 08:00-16:00 depending on which activity the employees are performing. For C2, the regular working hours is between 08:00-16:00.

Both companies have job rotation where warehouse employees rotate between the activities. This means that, for example, an employee is set to pick orders the entire workday and switch to another activity like packing the next day. The work schedule can vary, and an employee could get tasked a single job for a day or an entire week. It was mentioned that the reason behind the rotation is both physical and mental. The most important reason was boredom from only performing one activity for a longer period of time.

## **2.4 Difference between retail and e-tail orders**

While conversing with the companies, the major differences between retail and e-tail orders were illuminated. For retail, the warehouse customer is the stores owned by the company while for e-tail, it is the end-customer. The stores can be looked at as a known customer while for e-tail, the end-customers can either be a returning or new customer.

The stores have fewer orders with many order lines (product purchased), and deliveries to the stores are done periodically. One store can get several deliveries during the week, depending on sales. For the end-customers orders can be classified as rather impulsive, compared to the predictability of the stores. The orders from end-customers can be many and typically has one or just a few order-lines. For the companies, order picking is usually done in batches for the stores while the order picking for the end-customer is done in pieces. Order size and delivery addresses affect how the delivery is done. For retail, the deliveries are typically sent on pallets to a set address while under e-tail the orders are sent in packages to either the companies store or to the end-customer's local post office.

## **2.5 Delivery and product return**

The companies offer the customer to either shop in their physical stores or through the online store. For an online purchase, the customer can choose to "click-and-collect" or get the product delivered to their local post office. Through the "click-and-collect"-function, online orders can be picked up in a physical store where the product is sent from the warehouse.

With the offering of a seamless shopping experience across all the retail platforms, problems have presented themselves in the form of challenges with the product returns (Bernon et al., 2016). The two companies experience returns in different ways. For both companies, the goods bought in a physical store is typically returned through the same channels. It is the returns of orders done through the online store that can be challenging. Both companies offer the possibility of returning products bought online to either one of the companies physical stores or directly to the warehouse.

C1's, experience with product returns from the online store, is in a very low degree directed to the warehouse. It was stated from the company that it was almost absent. Most of their

customers are returning the ordered products to one of the physical stores, where the store subsequently adds the product to their inventory. The store then sells the product to the original price if the product is in stock or puts it on sale if the product has expired from the assortment. For C2, products bought online and returned by the customer is sent to the warehouse for processing. This is done from either the customer through mail or from the store where the customer has conducted the return. Hübner et al. (2016) research show that it is typical for fashion retailers to forward return to the warehouse, which generates transportation and handling costs. The reasoning behind this is based on product characteristics, and that the company does not necessarily want to keep the products in the store.

Since C1 is experiences returns directly to the warehouse in such a low degree, for analysis purposes, processing of returns will only be measured for C2 in this research.

## **2.6 Storage layout and warehouse operations**

Both companies have increased in volume by expanding online, which has affected the size and complexity of the warehouse operations. The firms have stated that they have outgrown their facilities and are planning to expand in the future. Below a brief description of the storage layout and how the companies are performing the warehouse operations will be presented. A theoretical review of warehouse operations is presented under Section 3.1.1 Warehouse operations.

### **2.6.1 Storage layout**

The company's storage location for the physical stores and online store are separated. It was stated that the main reason for this was that the order picking for the physical stores is often done in batches while online store order picking is done in pieces. However, C2 shares a common picking zone for single pieces for both online and store orders. Activities at the warehouse are mostly done manually by the warehouse employees. An exception is C1 where they have an automatic conveyor belt that sorts the picked orders.

The warehouses use single-deep selective racks, see Figure 5. The rack may vary in heights and width. By using these racks, stored goods can be immediately accessed. When goods are removed, space is immediately available. It has the lowest cost per position, easy load access, and it is easy to do inventory control compared to other unit load storage systems (Tompkins et al., 1996). In the warehouses, the racks can contain one pallet. The racks are placed back to back, with an aisle on each side.

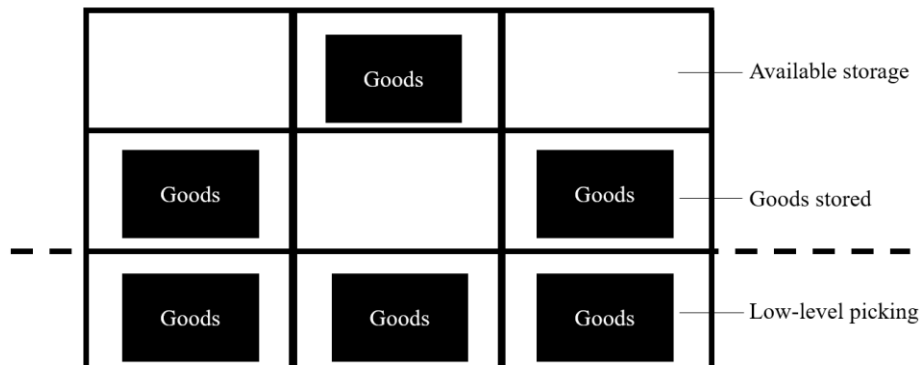


Figure 5 Single-deep selective rack

Both warehouses use a low-level order-picking system where the warehouse employees pick orders from the lower part of the storage racks while moving along the storage aisles (de Koster et al., 2007). The reserve storage is placed in the higher parts of the racks (over the dotted line in Figure 5) and is handled with a forklift. When the lower-level needs to be refilled, a forklift is used to move goods from the higher part of the rack to the lower-level so the order picking can continue.

## 2.6.2 Company 1: warehouse operation

The warehouse operations start with the receiving activity where a shipping container needs to be unloaded. The container is emptied, goods are sorted based on classification (type, quantity, and color), registered and moved onto pallets. Pallets can be control checked here. Further, the pallets are moved into the main storage and usually placed in the higher parts of the racks.



Every morning starts with restocking where pallets are moved from the higher parts of the racks to the low-level for order picking. The operation is done with a forklift. Because of the company's safety policy, no manual labor is allowed in the immediate vicinity to active operations with forklifts.

Each order picker is assigned racks where they will primarily be order picking from. The order pickers will be given a picking list and referred locations for the goods on the assigned racks. It is essential to point out that the order pickers are picking several orders simultaneously. When the location of the goods is found, the order picker is picking the right amount and marking the goods with labels. Further, the goods are placed in a container. When the container is full, it is moved close to a conveyor belt where another employee places the goods from the container onto the belt. The belt will then automatically sort the goods and send them to the packing station. The warehouse employees move the sorted goods from the belt onto pallets. Subsequently, the pallets are wrapped and labeled. The pallet is then ready for shipping.

The storage for the online store is separate from the main storage, on another floor in fact. Restocking is done by taking batches from the main storage and splitting it into pieces. Online orders are picked, packed, and ready for shipment. Click-and-collect orders are sent to the main storage to be placed together with store orders on pallets.

### **2.6.3 Company 2: warehouse operation**

For C2 the shipping container is emptied on to a conveyor belt. At the end of the belt, warehouse employees are sorting the goods based on classification, goods are then registered and moved onto pallets. Pallets can be control checked here. Further, the pallets are transported and placed in racks in the main storage with forklifts. Some goods get cross-docked where the goods are unloaded from the shipping container, goods are then registered and moved straight to the shipping docks.

The store orders are picked in batches and in pieces. Usually, new products are sent in batches, and the refill is done in pieces. This means that the storage contains both zones with batch picking and pieces picking. Each order picker has responsibility for a set of orders. The order pickers move around the warehouse with scooters. One order is processed at a

time. The products are placed in a box, and when the order is fulfilled, the box is wrapped and ready to be shipped. Restocking where pallets are moved from the higher parts of the racks to the low-level for order picking with a forklift is done as needed during the day. C2 also has a safety policy, where no manual labor is allowed in the immediate vicinity to active operations with forklifts.

C2 has a separated storage for the online store but are also using the main storage to pick some products. The order pickers are moving around the online and main storage with a cage trolley that allows them to pick several orders at a time and keeps the orders separated. The orders are packed differently depending on which online store the order comes from. From one store the items are packed in a plastic bag with the wrapping from the manufacturer still on. The other store can be categorized as more exclusive and is packed in a cardboard box. The cardboard box comes flatpack, and the warehouse employee needs to put it together before use. Also, the wrapping from the manufacturer is removed, and the items are wrapped in tissue paper. Stickers with the store logo are put on the items before placing them in the said box. A third-party logistics company then takes care of the shipping after packing.

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# Chapter 3

## Theoretical framework

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### 3.0 Theoretical framework

Retail has been around for centuries, and during this time, retail has been under constant development. However, in the last two last decades, it has been evolving especially rapidly compared to earlier. Binnie (2018) tries to express the speed and level of development in Figure 6. In the figure, we can see that retail has been affected by human inventions and technologies. The time we are in now is interesting because we now can see how the relationship between online shopping and physical stores are affecting each other (Binnie, 2018). However, the rapid development has produced a lack of literature where current literature analyzes subproblems and not how to develop in the industry (Kembro et al., 2018).

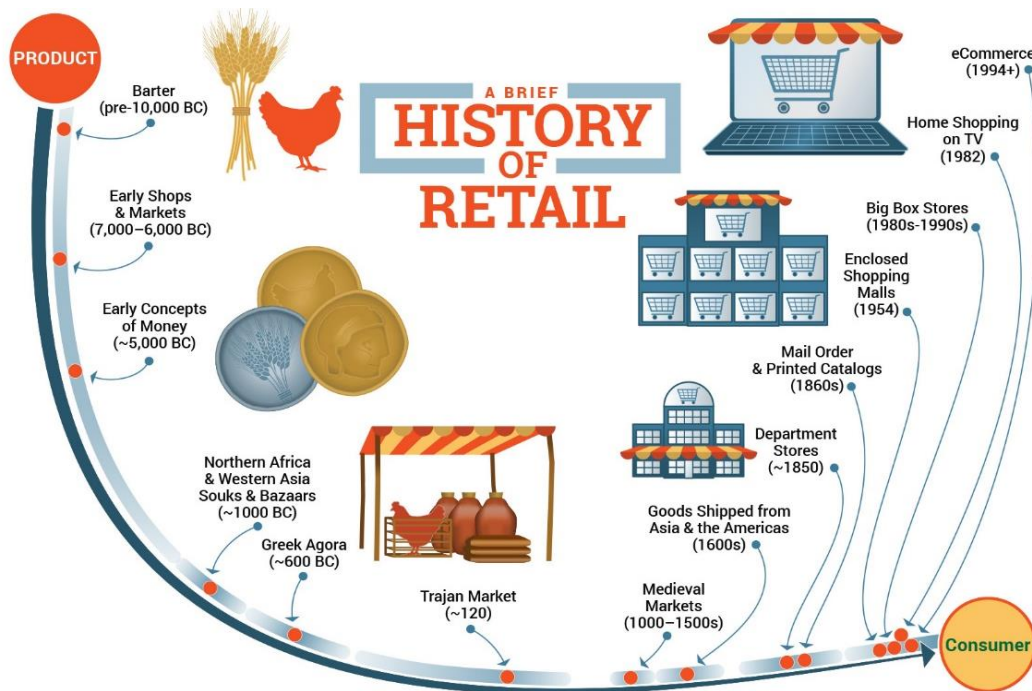


Figure 6 The history of retail (Binnie, 2018)

In this chapter, we will go through warehouse and e-commerce literature. This chapter starts with a brief introduction to the role of the warehouse. In Section 3.2, a description of the different retail terms: dual-, multi-, cross, and omni-channel will be given, followed by e-commerce supply chain in Section 3.3. Further, Section 3.4 describes the impact e-commerce has had, and Section 3.5 addresses challenges with having multiple channels.

### 3.1 The role of the warehouse

An important part of the supply chain is the warehouse. The supply chain relies on the warehouse to deliver the right product, in the right quantity to the right time (Richards, 2014). To accomplish this, the warehouse needs to ensure that value-adding activities like pricing, kitting, customized packaging, and labeling (Gu et al., 2007) is done correctly to meet the deadline. Finally, the warehouse operations need to be done cost-efficiently to create value out of the invested money (Richards, 2014). It is also essential that the warehouse holds a buffer of items to meet variation in, for example, product seasonality and product demand (Gu et al., 2007).

For many businesses, holding inventory is considered to be the largest asset on the balance sheet. In the United States, the average cost of inventory is 30 to 35 percent of its value (Chase et al., 2006). Lambert (1998) lists several reasons for holding inventory at a warehouse, and the contribution it has on the business operations:

- *Achieve transportation economies*
- *Achieve production economies*
- *Take advantage of quantity purchase discounts and forward buys*
- *Maintain a source of supply*
- *Support the firm's customer service policies*
- *Meet changing market condition (e.g., seasonality, demand fluctuations, competition).*
- *Overcome the time and space differentials that exist between producers and consumers*
- *Accomplish least total cost logistics commensurate with the desired level of customer service*
- *Support the just-in-time programs of suppliers and customers*
- *Provide customers with a mix of products instead of a single product on each order*
- *Provide temporary storage of materials to be disposed of or recycled (i.e., reverse logistics)*

There has been a change for warehouses and their operations based of several reasons: Such as the movement of Western production to the Far East, the rapid growth of e-commerce (Richards, 2014) and the phenomenon omni-channel retailing. The warehouse managers are faced with the challenge of increasing productivity and accuracy, reduce costs, inventory, and at the same time, improve the customer service (Richards, 2014).

### 3.1.1 Warehouse operations

In a supply chain, the warehouse can have different roles. We will, in this section, focus on a warehouse operation for a retailer utilizing manual labor.

The warehouse operations can be divided into inbound activities (receiving and storing) and outbound activities (order picking, packing, and shipping) (Kim et al., 2018). According to Lambert (1998), there are three basic functions in a warehouse: movement, storage, and information transfer. For this research, we will look further into the movement function. This function can be divided into several activities which can include receiving, repacking, put-away, order picking, cross-docking, and shipping (Tompkins et al., 2010). Also, with the establishment of online stores, warehouses experience a higher rate of returns, which affects the return operations (Bernon et al., 2016).

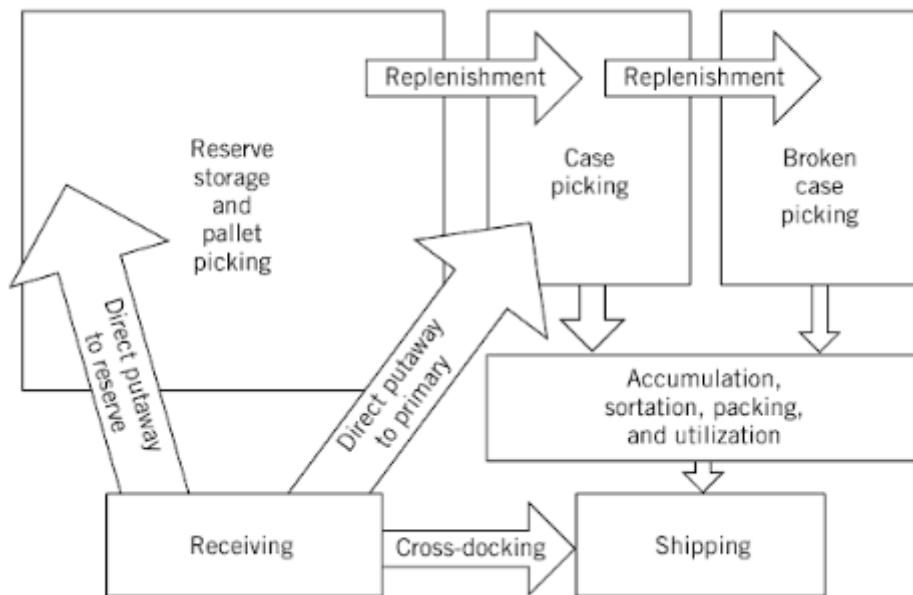


Figure 7 Typical warehouse functions and flow (Tompkins et al., 2010)

The typical warehouse functions start when the products arrive at the warehouse (Figure 7). The receiving activity begins where the products are unloaded, inspected to make sure the goods are as expected, repacked, and placed into storage (Tompkins et al., 2010). The received goods can also be cross-docked, which means it is moved straight to the shipping docks (Gu et al., 2007).

One of the major activities at a warehouse is located at the storage, which is the order picking. When a customer order comes in, the process involves picking the right number of a product. The trends in the market with the establishment of online stores has made the order picking more important and complex. The picking process has a large impact on warehouse design and operations, and therefore, also the supply chain performance (de Koster et al., 2007). According to Gu et al. (2007), order picking methods differ and usually consists of the basic steps: batching, routing and sequencing, and sorting. After the picking, the orders are packed and shipped.

### Order picking

The most researched topic in warehouse literature is order picking. Research done by Drury et al. (1988) concluded that order picking has the highest operating cost and represents 55 percent. Further, shipping stood for 20 percent while receiving stood for 10 percent. The typical distribution of the order picker's time for the different activities is found in Figure 8. Travel, which can be referred to as the time traveling to and from the picking locations, is the most time-consuming activity an order picker does and stands for 50 percent of the time used (Drury et al., 1988). This is confirmed by the statement made by Agatz et al. (2008), saying that order picking accounts for the largest part of the warehouse operational cost and is even higher for e-tail activities.

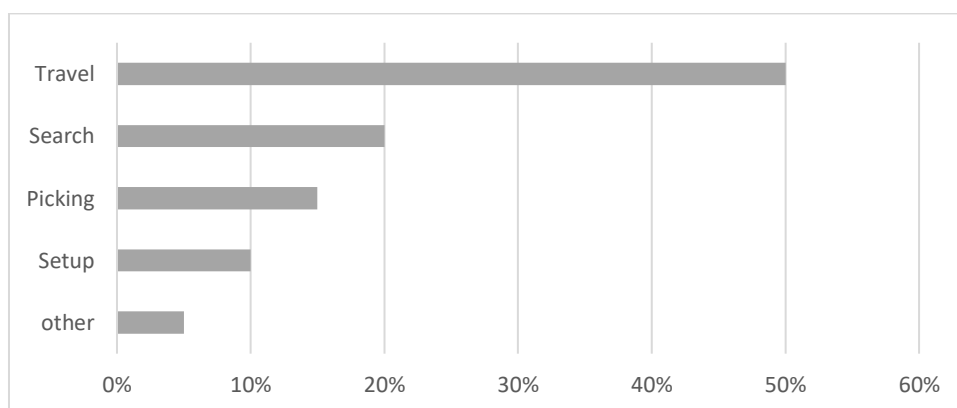


Figure 8 Typical distribution of an order picker's time (Drury et al., 1988)

Goetschalckx and Ashayeri (1989) classify several external and internal factors that can impact the order picking design and operation. External factors can be marketing channels, customer demand pattern, supplier replenishment pattern, and inventory levels. Internal factors can include policy level, command cycle, the dimensionality of the warehouse,

mechanization level, information availability. According to the authors, the factors listed needs to be planned and designed to maximize the service level and reduce order picking costs, which is a common objective of order-picking systems.

The order picking methods differs, and some businesses use automatic systems while others perform it manually. In a warehouse with manual systems, the order picking tends to be very labor-intensive while in an automatic system, the operation is capital intensive (Goetschalckx and Ashayeri, 1989). Despite that the research can be categorized as obsolete, still, 80 percent of all order picking systems is done manually (de Koster et al., 2007) and therefore the research can have some relevance today.

### **3.2 Dual-, multi-, cross- and omni-channel retailing**

When reading through research, multi-, cross- and omni-channel retailing are used interchangeably in the literature. Beck and Rygl (2015) point out this problem where these terms are used interchangeably. In research, the focus has been on multi-channel retailing, and less research has been done on cross- and omni-channel retailing. Also, cross-channel can in some research be referred to as multi-channel. Under a clarification of the terms multi-, cross- and omni-channel will be given.

Multi-channel can be referred to as retailers that sell their products through more than one channel. This can be, for example, through a physical store and an online store. Multi-channel retailing does not provide an interaction across all the channels. In some businesses, the organization is separated for each channel. The reason for this can be that the information systems can differ from physical and online stores (Levy, 2012).

In contrast to the term multi-channel retailing, cross-channel retailing makes it possible for customers to generate channel interaction. Also, the retailer can control parts of or full integration of two or more channels (Beck and Rygl, 2015).

Omni-channel retailing refers to the use of multiple channels to interact with the consumers and fulfill their orders (Chopra, 2018). In omni-channel retail, all paths through the supply chain are connected wherever possible. A positive impact of the use of this channel is that businesses can share facilities and inventories. It may also impact customer satisfaction and



reduce costs. When introducing omni-channel to the business, it is important that all channels are connected and complements each other (Christopher, 2016). In omni-channel retailing, the customer can search for information on a product both online and by visiting the physical store. The customer can thereby get an enhanced insight about the product and may evaluate the alternatives before deciding to purchase (Bernon et al., 2016).

Beck and Rygl (2015) made a categorization tree based on their findings, that illustrates the concept, making it easier to grasp (Figure 9).

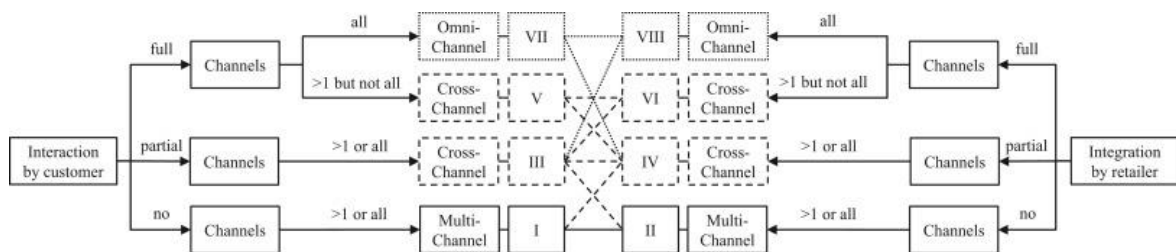


Figure 9 Categorization tree in Multi-, Cross-, and Omni-Channel Retailing for retailers and retailing (Beck and Rygl, 2015).

Dual-channel is also used in research done on traditional and online retail. A dual-channel can be considered as a business that uses several channels to sell a product to the end-customer. This is often done through traditional retail (e.g., physical store, showroom) and online retail (Ryan et al., 2013).

Since the terms are used interchangeably in the literature, research done on multi-, cross- and omni-channel retailing will be used in this study. Also, research done on dual-channel retailing will be relevant.

### 3.3 E-commerce supply chain

In a supply chain, there is a constant flow of information, goods, and capital between the stages involved in fulfilling customer demand. The supply chain for the retailers involves a variety of stages such as, among others, the customer, a website and/or physical store, the warehouse, logistics provider, and all the company's suppliers and their suppliers. The primary goal of the supply chain is to satisfy customer demand and simultaneously generate profit for the company (Chopra, 2018).

Multiple channels, existing of a physical channel and an online channel, is more effective when serving customer needs. The reason for this is that multiple channels can serve a wider variety of customer needs, compared to a single channel (Chopra, 2018). Retailers that expand online are usually building the distribution strategy for the online store on the existing infrastructure, which used to be optimal for serving the physical stores (Richards, 2014). This means that the expansion may affect the whole supply chain, such as suppliers and manufacturer (Kozlenkova et al., 2015). However, in the past several years, transportation and logistics service providers have made considerable investments to support the online retail market and its growth. As a result of the investments, the providers have become dependent on income from online retailers (Lieb, 2018).

### **3.3.1 Interaction between customer and retailer**

As mentioned, the goal of the supply chain is to satisfy customer demand. The primary interaction between customer and retailer is exchanging of information, products, and funds (Chopra, 2018). The retailers provide information such as product description, pricing, and availability to the customer. The customer buys the product, and the product exchange can occur in several different ways such as pickup from the store, click-and-collect service, or through mail deliveries. We will further look into the exchanging of information, product, and funds for traditional and online retail.

#### **Traditional retail**

The interaction between retailer and customer is traditionally done face-to-face. Information, purchase, and product exchange is done in the store. Since the interaction is done face-to-face, retailers usually have several stores within close proximity of large amounts of potential buyers to serve the customer demand. Each of the stores has a high level of overall inventory because the customer expects that products are in stock. In summary, traditional retail has large investments in facilities and high inventories. However, transportation cost is the lowest among the channels (Chopra, 2018).

### **Online retail**

Information and purchase are shared and done online through the online store. The method used to deliver the product is decided by the customer. The product is shipped from the warehouse to either the store of the customers choosing or to the customers home address (Chopra, 2018).

By only having an online channel, the goods are shipped to the customer. This reduces investments in facilities and inventory compared with traditional retail. However, transportation cost are higher (Chopra, 2018).

Retailers with physical and online stores have to a larger degree started to offer the service click-and-collect. This reduces the transportation cost for the retailer, and it can also lead to additional sales for the physical store. The customer comes into the store to pick up their online order and may also buy something extra. Also, in line with the traditional retail, the investments in facilities are high, and the inventories are large (Chopra, 2018).

### **3.3.2 The future trends**

For the future development of e-commerce, it will be important for the companies to focus on the strengths of omni-channel to make the supply chain more effective. For example, Chopra (2018) elaborate on the potential to combine the strengths of both physical stores and online channels. The strength of a physical store is to let the customer experience a high level of information sharing face-to-face. Also, the stores are cost-effective by selling products with predictable demand. In contrast, an online store is cost-effective at selling products with uncertain demand, while online customers experience a lower level of information sharing.

Based on the growing competition in the market, warehouses will strive to be more efficient and cost-effective. An example is the increase in port-centric logistic, which has resulted in companies building large warehouses close to ports (Richards, 2014). Richards (2014) predicts that retailers will reduce stock, which will cause a rise in stockless depots, transshipment and consolidation, and cross-dock operations. The reduction may bring the manufacturer and consumer closer in the supply chain. Also, collaboration, both vertically

and horizontally in the supply chain, is stated to be important, which will lead to an increase in combinations of operations and a reduction in the number of warehouses.

Sustainability has become important for companies, and therefore, the whole supply chain. According to Richards (2014), in the future, it will be important to further develop brownfield land, connections to rail and potential canal and river networks, and energy self-sufficiency. Further, he speculates that the warehouses will be expected, by law, to be carbon neutral and that new warehouses may have their own power generators, such as solar, wind and/or converting waste into power.

### **3.4 The impact of e-commerce**

Laudon and Traver (2010) state that e-commerce technology is different and more powerful than any other technologies we have seen in the past century because it brings out shifts in the foundation of commerce. Retail has become more complicated and more competitive due to e-commerce. Consumers that were trapped by geographical and social boundaries are now able to search widely for the best price and quality of a product (Laudon and Traver, 2018). Also, the internet has become a common channel for consumers to interact with businesses and where traditional companies attempt to increase sales and profitability by creating an online platform for consumers (Bretthauer et al., 2010). During the last two decades, there has been strong growth in the industry, but also massive failures. Many of the failed online retailers misjudged the market, but the firms that survived this early period have become well established, such as Amazon (Lieb, 2018).

Lieb (2018) asks critical questions about the vulnerability of e-commerce and the impact it has on the supply chain management. He states that e-commerce will continue to grow, and there will be a fight for the market shares between online and offline stores. However, research conducted by Hübner et al. (2016) shows that seven out of ten retailers recognized that there is cannibalization among the channels. However, the focus for the companies is on the total revenue. Lieb (2018) state that the cannibalization may also impact other industries such as logistics providers. The author believes that there is a possibility of a wave of online retail failures. This wave can have a larger impact than the dot.com bubble had where many online retailers failed.

The distribution and return processes become more complex with the introduction of multi- and omni-channels (Kembro et al., 2018). A study conducted by Bernon et al. (2016) found that businesses had almost the same criteria for returns for both physical and online stores. Although the similar policies, there was a clear difference in the return levels. From the study, we can see that the businesses that have the highest return rates are the ones that sell clothing (Figure 10). Another interesting result is the return level for online stores where clothing and home products are almost double as high return rates as retail stores. The authors state that customers like to try the product before making a conclusion, therefore, managing the return process is starting to become more important with the increase in online sales.

	Average	Range	Highest	Lowest
<i>Retail store</i>				
Clothing	10.9	14.1	19.0	4.9
Electrical/technical	8.7	7.3	13.3	5.9
Home	5.5	9.4	11.0	1.5
<i>Online</i>				
Clothing	20.0	30.1	38.2	8.1
Electrical/technical	8.0	3.9	10.3	6.4
Home	8.5	7.7	12.7	5.0

Figure 10 Average percentage return rates as a proportion of sales by channel (Bernon et al., 2016)

E-tail orders are typically small, while the assortment of products can be large (Agatz et al., 2008). However, Hübner et al. (2016) state that retailers start their online operations with a smaller assortment than the offline assortment. With experience, the online assortment expands, and over time, the online assortment grows bigger than the offline assortment.

The physical store will have a new role with omni-channel retailing, where it can have more responsibilities within material-handling, such as picking and packing, returns, product availability, delivery options, reverse flows and inventory management (Kembro et al., 2018).

### **3.5 Challenges with having multiple channels**

The trends in the market and technological developments have had a strong impact on warehouse operations. However, there has not been done much research on the challenges and opportunities the retailers are facing. Kembro et al. (2018) state that research done on challenges with transition from multi-channel to omni-channel is mainly conducted by one research group (see, e.g., Hübner et al., 2015, Hübner et al., 2016, Hübner et al., 2018).

The introduction of e-commerce has led to shorter response time with smaller and more frequent deliveries. These services, including others, is something customers are starting to expect from companies. However, they do not want to pay the real cost for the services (Lieb, 2018). Research identifies increasing challenges for retailers that go from a single-channel to multiple-channels. The research focuses on the higher need for efficiency and flexibility in the warehouse by redesigning the warehouse and distribution (Gu et al., 2007, Agatz et al., 2008, Hübner et al., 2015). More specifically, the introduction of omni-channel and a seamless shopping experience for the customer may cause challenges for returns, processes, information systems, inventories, and performance measurement systems (Bernon et al., 2016).

The traditional retailer's warehouse is significantly impacted by seasonal demand fluctuations, where it affects the decision on order quantities, shelf space, and pricing in a store (Agatz et al., 2008). The warehouse manager is faced with the challenge of a variety of staff demand and equipment during the season (Richards, 2014). Further, demand fluctuation tends to have a stronger impact on e-tail and affects, among other things, the delivery capacity utilization (Agatz et al., 2008).

A big challenge for warehouse operations is to combine the handling of small customers online and store deliveries in a way that is time and cost efficient (Hübner et al., 2015, Hübner et al., 2016). The warehouse may have a large assortment of goods stored with different values. Thereby, the low-cost items use the same amount of labor and equipment as high-cost items, which creates a significant difference in margins (Richards, 2014).

Another challenge is addressed by Kozlenkova et al. (2015), where the costs will be different depending on which channel the customer chooses. A supply chain may not be optimal for

both channels. The authors states that the cost of warehouse, merchandising, and transportation processes will differ depending on the channel. The retailers that recently became multi-channel retailers tend to have separated inventories and picking processes based on channel. However, with the experience of having multiple channels, retailers are pursuing an integration of warehouses and inventories, which is predicted to have a positive effect (Hübner et al., 2016). Through the integration of inventories, warehouse operations, organizational units, and IT systems, companies can make benefit of the synergies in sales, organization, and logistics between the channels (Hübner et al., 2015).

### **3.6 Chapter summary**

In this chapter, we have presented aspects of warehouse operations and e-commerce, which forms a theoretical basis for this study. The theoretical framework includes e-commerce supply chain, an overview of terms used in retailing with multiple channels, a description of retail and online retail order, and finally an elaboration of challenges with having multiple channels.

An important part of the supply chain is the warehouse and is its involvement in fulfilling the customers' needs. The e-commerce technology is powerful and brings out shifts in the fundamentals of commerce. E-commerce has changed the supply chain, and warehouse managers are trying to reduce cost and improve customer service (Richards, 2014). Overall, the rapid development has created a lack in literature where current literature analyzes subproblems (Kembro et al., 2018). There has been a gap in the literature, and mainly one research group is addressing the challenges by having several channels (see, e.g., Hübner et al., 2015, Hübner et al., 2016, Hübner et al., 2018).





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## Chapter 4

# Methodology

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## 4.0 Methodology

The following chapter will go through how the research is conducted and how the data is collected. The first section will elaborate on the case method used for this study. Section 4.2 will go through how the data were collected, followed by Section 4.3, where the dataset will be discussed. Section 4.4 provides a description of all the activities, and Section 4.5 contains information about the workload measurement tool. Since the study will be data-driven, the data will be analyzed through statistical testing described in Section 4.6.

### 4.1 Case method

A case study is an empirical method which explores a research topic or phenomenon in depth or within a number of real-life contexts (Saunders, 2012, Yin, 2018). In some cases, the boundaries between the phenomenon and the context may not always be clear (Yin, 2018). To better understand the situation at the warehouses, a multiple case study will be used in this research. A benefit of using a multiple case study is that analysis can be done within each case and across different situations. Thereby, similarities and differences between the cases found (Gustafsson, 2017). An overview of the research design is presented in Table 1.

*Table 1 Overview of the research method*

<b>Overview of research method</b>	
Research design	Multiple case study
Unit of analysis	Time spent on retail and e-tail activities in a warehouse
Research approach	Empirical Quantitative Inductive
Theoretical framework	E-commerce, channels, supply chain, warehouse operations (Chapter 3.0)
Data collection	Empirical data. Recorded by warehouse employees during February/March in 2019 (Section 4.2)

The unit of analysis is the duration of activities at a warehouse given in minutes. There are limitations of how detailed the recording of the different activities can be, but the activities chosen represents the workflow at the warehouse from the receiving of goods, to the packing.

This study is based on quantitative material from observations made by warehouse employees. For data collection, observations are often used as a primary data source. The main advantage of using primary data is that the data collected is gathered specifically for a particular project (Ghuri and Grønhaug, 2010). Further, an inductive approach will be used, where an assumption is made, and a general conclusion will be based on the empirical observations (Saunders, 2012). Ghauri and Grønhaug (2010) points out that this type of research goes from observation → findings → theory. This means that we will explore a subject, where the findings are incorporated back to the theoretical framework.

## **4.2 Data collection**

The analysis is based on observations of activities recorded by employees at two warehouses located in Akershus County in Norway. The warehouse is divided into two categories – retail and e-tail. Retail operations refer to all activities that concern providing the companies physical stores with goods. This category involves inbound and outbound activities. The activities measured in retail operations are “unloading container,” “receiving of goods,” “put-away,” “order picking,” “move goods to conveyor belt,” “packing,” “move goods in racks,” “administration,” and “other activities.” The activities are defined in Table 3 Section 4.4.

E-tail operations refer to all activities at the warehouse that has a direct relation with the operation of the online store. These activities are usually linked to fulfilling end-customer orders, which is placed through the company’s online stores. The activities measured in e-tail are “restock,” “order picking,” “packing,” “processing returns,” “inventory check,” and “other activities.” The activities are defined in Table 3 Section 4.4.

Retail operations can indirectly influence e-tail operations. For example, goods for both retail and e-tail goes through the receiving function and gets repacked. Also, the online store for C1 provides the service “click-and-collect” where the packed orders are sent to the main storage to be wrapped on pallets with the store orders.

The experience with retail and e-tail activities in the companies differs. Both of the companies started with physical stores and has in later years expanded by creating online

stores. Retail operations have thereby been carried out for a longer time than e-tail operations.

### 4.3 Data

At the warehouses, a total of 1 125 observations were recorded. The distribution of the observations was 540 for C1 and 585 for C2. The dataset includes the types of activities, the start and end of the recording for an activity, usernames (not trackable) and category (retail or e-tail).

C1 had a planned project start 04.02.19 and the recording period was four weeks with the end date 01.03.19. C2 had a planned start 18.02.19 and an end date after three weeks, 08.03.19. Daily observations are shown in Figure 11. Due to issues at the warehouse, the project did not start before 19.02.19. The time available at the warehouse was the reason for why one company planned four weeks while the other planned for three weeks.

The participation from the warehouse employees at C1 varied and a decision was made only to use the two first weeks. Both participants and observations were low after the two first weeks. Some activities had an apparent reduction in the last two weeks and can be explained by participation. However, the percentage of change was not significantly high. It can be speculated that after the two weeks, warehouse employees forgot or was unwilling to contribute to the research. By deleting 186 observations (observations done after 15.02), the result can give a more accurate picture of the situation.

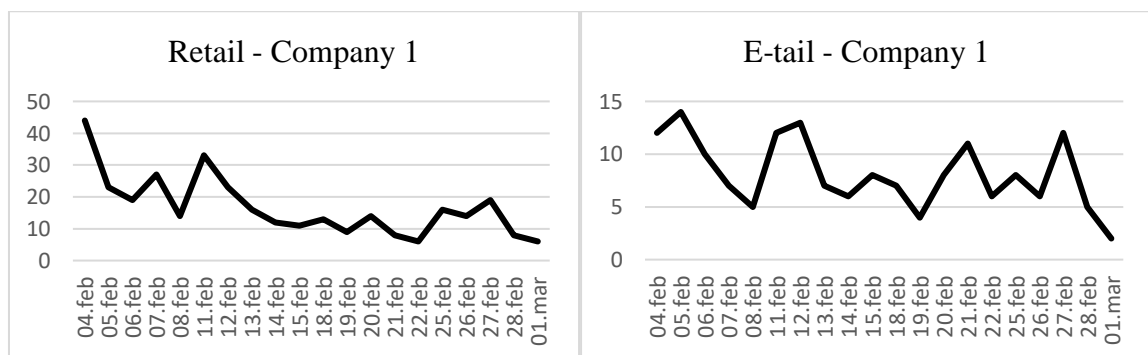


Figure 11 Daily observations for Company 1, separated by category retail and e-tail.

Table 2 shows the percentage of the total number of warehouse employees that contributed to the research for each day. For C1, the average number of warehouse employees

participating per week was around 70 percent while for C2 was around 60 percent. For the planned categories, most of the observations were recorded for retail activities, which was expected since this is the largest category. For both companies, around 80 percent of the employees participating worked under the category retail, and 20 percent under e-tail.

*Table 2 Percentage of total number of warehouse employees that contributed to the research*

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Company 1 (%)	90	75	65	75	55	75	80	65	55	40				
Company 2 (%)	67	50	75	58	58	58	50	58	58	58	58	58	58	50

The datasets contained user errors where warehouse employees have wrongly started the recording for an activity and immediately turned the recording off. Observations under 1 minute were, therefore, deleted. C1 had 38 values under 1 minute, and C2 had 39.

There were also extreme values in the datasets. It was clear that the employees had forgotten to stop the recording before leaving work. This resulted in extreme values for the recordings because of the end of the activity were not indicated. C2 had 29 extreme values. 27 of these values were manually changed to 16:00, which was the end of a typical workday in the company. Two of the values which were registered after 16:00 were deleted. C1 had 48 extreme values. These observations were manually changed:

- Ending 14:00: “administration.”
- Ending 15:00: “order picking,” “receiving of goods,” “move goods in racks,” “move to conveyor belt,” and “other activities.”
- Ending 16:00: “packing” and “unloading container.”

The total number of observations to be analyzed after deleting and changing errors was 860, 316 for C1 and 544 for C2. In Figure 12, the distribution of observations for each day for the study period is shown.

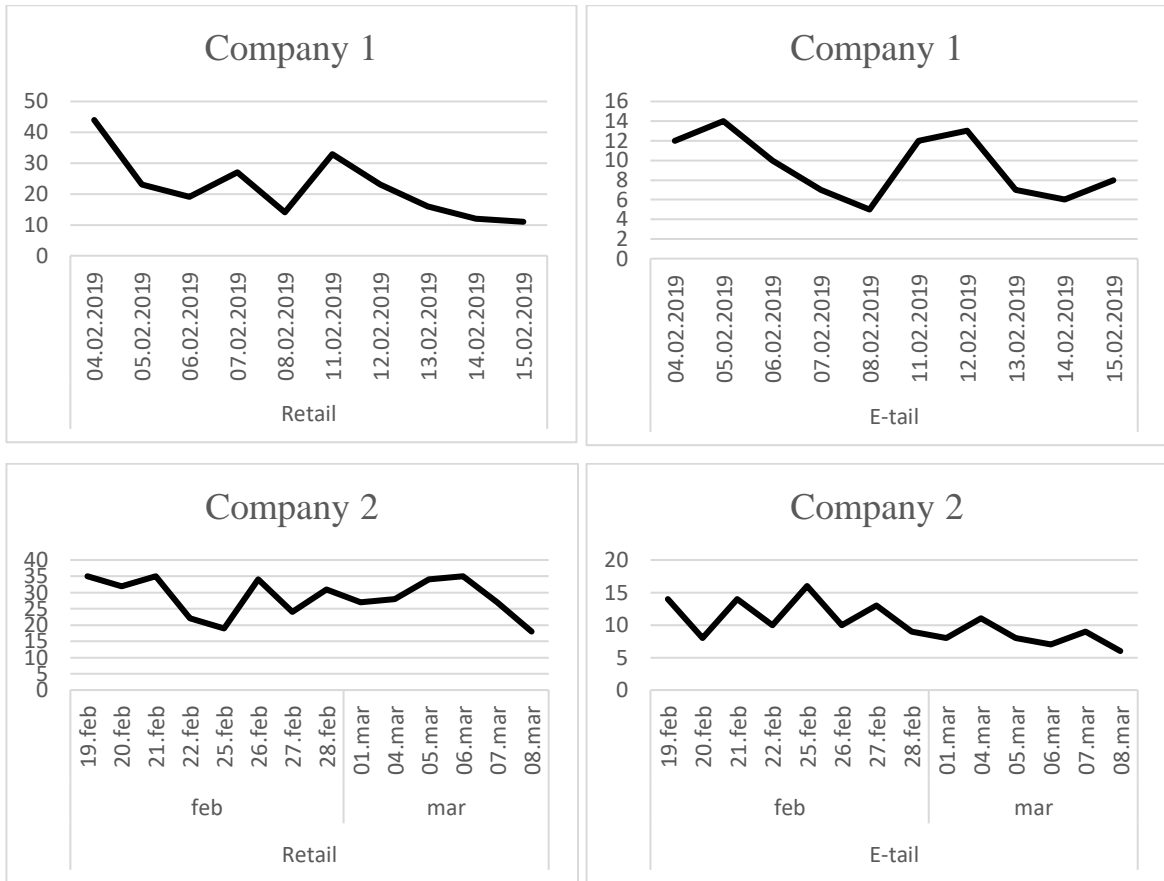


Figure 12 Daily observations for company 1 and 2, separated by category retail and e-tail.

## 4.4 Activities

The activities are representing how the employees work at the warehouse and were chosen after a close dialog with the warehouse manager, supply chain manager, and author. The activities are not the same at both warehouses because the warehouse operation is performed differently. Also, some activities are combined. Definition of the activities is found in Table 3.

Table 3 Definition of the activities in the study

Activity	Definition
Administration	Refers to tasks the administration executes, etc. planning, meetings, and support activities.
Other activities	If an activity that the employees perform is not listed, the process is registered under other activities.

Unloading container	<p>Involves the process where the employees are unloading a shipping container and moving the goods onto pallets.</p> <p>For C2 unloading of the shipping container is combined with the activity “receiving of goods.”</p>
Receiving of goods	<p>The activity includes sorting and assurance that the right quantity and quality are delivered. It can also include cross-docking where inbound packages from the receiving dock are sent directly to the shipping dock.</p>
Put-away	<p>After the goods are received, the pallets with goods are transported and placed in racks in the storage.</p> <p>For C1 “put-away” is combined with activity “receiving of goods.”</p>
Move goods in racks	<p>The warehouses have a low-level order-picking system with high storage racks. The goods placed higher up needs to be moved down by a forklift.</p>
Order picking	<p>The process when an order comes in and the right amount of a specific item is removed from the racks in the storage. The item is placed in a container.</p>
Move to conveyor belt	<p>C1 has a conveyor belt. After order picking, the goods are moved from the container over to a conveyor belt which sorts the goods and sends them to the packing station.</p>
Packing	<p>Packing goods that are going to be delivered to stores or customer. The packing method depends on the channel and the delivery method.</p>
Processing returns	<p>The process of processing a return from an end-customer. Includes put-away the goods received to the e-tail storage.</p>
Inventory check	<p>The process of verifying that the right quantities, condition, and storage placement of an item are correct.</p>
Restock	<p>Restock of the e-tail storage. Includes taking batches from the main storage and splitting them so products can be picked in pieces.</p>

For further analysis, activities are combined into groups. “Total receiving” combines the activities “unloading containers,” “receiving of goods,” and “put-away.” “Total picking and packing” combine the activities “order picking,” “move to conveyor belt,” and “packing.” “Total other activities” combine the activity “other activities,” “administration,” and “move goods in racks.”

## **4.5 The workload measurement tool**

The data used in this research were collected by the warehouse employees. The employees installed a time tracker application (app) called Yast on their smartphones to record the activities. Before the project started, there was a meeting with the manager for each of the companies as well as the inventory managers where we defined the activities which were going to be recorded. The inventory manager was responsible for informing and training the employees to use the app.

Employees logged onto the app using an anonymous user. The first step in the app shows category (retail or e-tail) (Figure 13). By clicking into one of these categories, respective activities for the category appears, see step 2. By selecting an activity (*plukking* selected in Figure 13), the recording starts, a timer appears, and the recording stops when pushing the activity again, see step 3. Under step 3, users can see recent activities recorded and under “History,” the user can check their own recordings and comment on them if they feel it is necessary. The recording is sent to the app providers database. The author logged into this database and transferred the recordings to an excel file.

The users were not informed about the possibility to comment, but some users used this function. The comments contained no relevant information for the analysis.



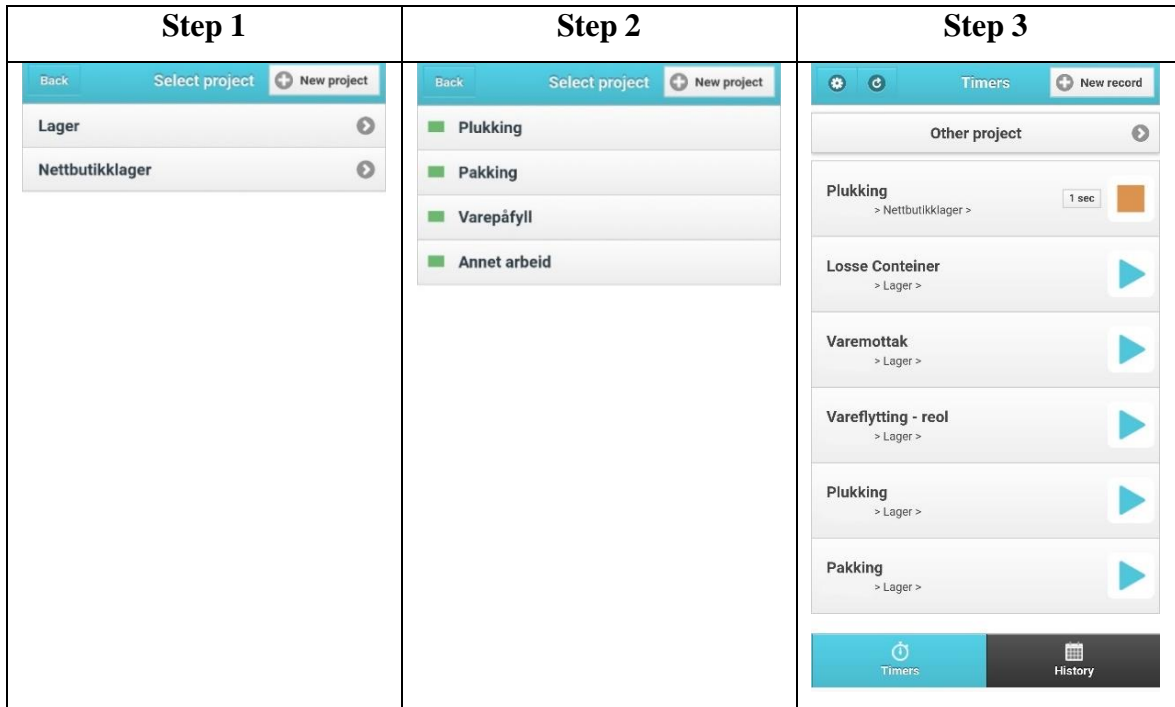


Figure 13 The workload measurement tool. Screenshot from the app Yast (activities written in Norwegian)

## 4.6 Data analysis

The data were analyzed using Excel and IBM SPSS Statistics. When analyzing the data, descriptive statistics were used to describe the information collected with the use of numerical measurements, charts, and tables. The purpose of using descriptive statistic is to organize and create an overview of the data collected (Sullivan, 2011). By using IBM SPSS, a Mann-Whitney test was used to calculate the statistical significance of the observed differences in the duration for e-tail and retail activities for the companies.  $P < 0,05$  was considered to be statistically significant for the statistical analysis.

### 4.6.1 Measures of central tendency

A measure of central tendency gives a numerical description of the average or typical values of a variable. This can be measured by the mean, median, and mode, which are the most used measurements (Sullivan, 2011). In this paper, the mean and the median were used.

The mean formula (Sullivan, 2008):

$$\bar{x} = \frac{\sum x_i}{n}$$

When the data is sorted from lowest to highest, the median of a variable is the value in the center of the data (Sullivan, 2011):

- For an odd-numbered observation, median lies in the position  $\left(\frac{n+1}{2}\right)$ .
- For an even-numbered observation, the median will be the mean of the two observations which lies on either side of the  $\left(\frac{n+1}{2}\right)$  position.

Both median and mean can be used to measure the central tendency, but which is better to use? The median is resistant, which means that it is not affected by extreme values, while the mean will be affected. When the data is skewed, there are extreme values in the tail, and the mean will have a tendency to move towards the direction of the tail. The mean, median, and skewness can be used as guidelines. For symmetric data, the relation between median and mean is close. In a dataset where the data is skewed, the median is the better to use (Sullivan, 2011).

#### **4.6.2 Inferential statistics**

Inferential statistics uses methods to find information about a sample, generalizing it to a population, and measures the reliability of the result. There is uncertainty when extending the results to a population because everything about a population cannot be learned through one sample. When using an inferential statistic method, quantifying the confidence in the results (a measure of reliability) is important and should be reported (Sullivan, 2011).

Nonparametric is a branch of inferential statistics and is appropriate for skewed data. The nonparametric method does work without estimating a parameter, and no assumption about the distribution is required. The Mann-Whitney test is a nonparametric test which can test the structure of the data. The test can be used when the groups differ in size and does not take into consideration the distribution of the data or errors (Sharpe, 2012).

## **4.7 Chapter summary**

The main data source in this study is recorded by warehouse employees in two companies. By using a time tracker app, we have recorded up to twelve activities over two to three weeks. The warehouse operations were divided into two categories – retail and e-tail. Further, the activities measured were combined into groups to give a better overview and to compare the results. The data were analyzed using Excel and IBM SPSS Statistics.



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## Chapter 5

### Research summary

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## **5.0 Research summary**

The retail industry is evolving, and retailers are starting to use online channels to reach their consumers. In the literature, there is limited information on how time is spent in a warehouse with retail and e-tail activities. This may prevent the warehouse manager from utilizing resources and carrying out efficient planning. Overall, the rapid development has left a gap in literature where current literature analyzes e-commerce subproblems (Kembro et al., 2018). The research done on challenges with transition from multi-channel to omni-channel is mainly done by one research group (see, e.g., Hübner et al., 2015, Hübner et al., 2016, Hübner et al., 2018).

The trends in the market and technological developments in retailing have had a substantial impact on warehouse operations. The purpose of this paper is to investigate the time spent on retail and e-tail warehouse activities. This study is based on recorded data by the warehouse employees. By using a time tracker app, we have recorded up to twelve activities over two to three weeks in 2019. The recording was done within two companies, and the results may bring awareness and provide valuable insight for both future research on the area and for the industry itself.

### **5.1 Managerial implications**

The main theoretical contribution of this paper is to highlight the distribution of time on retail and e-tail warehouse activities. This research is one of the first to provide empirical data on warehouse operations that process orders from multiple channels. Even though several companies in the retail industry sell their goods online and offline, this research is delimited to Norway. However, lines can be drawn across borders, and other countries may gain valuable knowledge from this research.

The findings may give an indicator of how the consumption of time is spent on different activities in a warehouse. Also, it can bring awareness to the additional labor hours an online store creates. For retailers that are planning to expand to multiple channels, this may be new knowledge, and the retailers can take the findings into the evaluation. To improve current

performance, retailers can get an idea for areas of improvement and where cost can be reduced in a warehouse.

## **5.2 Limitations of the study**

Like most other studies, this one also has limitations. The companies researched are different in forms of customer base, the number of stores, products they sell, and total revenue. Also, the warehouse operations differ for the companies, and therefore, some activities cannot be analyzed across the warehouses.

Not all warehouse employees participated in the study. Therefore, the researcher does not have a full overview of time spent in the warehouses. However, the proportion of participants based on the average was high, and the companies ensured that each activity had a proper distribution of participants. The total work time may, therefore, be representative of the companies.

The recording was only done for a few weeks in between February and March. The period was said to have a lower demand because of the recent Christmas and New Year sale. By only recording for a few weeks, the fluctuations are not observed.

## **5.3 Suggestions for further research**

This research opens up a plethora of possibilities for further research. This study may serve as a basis to better understand current issues and challenges for retailers with multiple channels. Also, areas of improvement and further development can be identified. For example, how automation and developing IT-systems can change the way the warehouse employees work, and thereby, create opportunities for retailers.

It can be important for retailers to be aware of how expanding online affects the warehouse operations and how time-consuming the different activities are. This awareness can contribute to more effective and efficient planning. For further research, further observation of the activities that are most time-consuming can be recorded and analyzed. Also, a detailed cost analysis can be conducted for all warehouse processes.

This study is limited to only warehouse operations. For further studies, an investigation of other parts of the supply chain can be analyzed, such as the manufacturer, transportation, and/or the store. Although this study has a limitation regarding demographics, future research could validate the results in this study by incorporating more warehouses.



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The research paper  
How much time do companies use on retail  
and e-tail warehouse activities?

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## **6.0 The research paper: How much time do companies use on retail and e-tail warehouse activities?**

### **6.1 Abstract**

**Purpose:** The trends in the market and technological developments in retailing have had a substantial impact on warehouse operations. The purpose of this paper is to investigate the time spent on retail and e-tail warehouse activities. Analyzing how the time is spent can be essential to detect potential areas of improvement and for optimal labor utilization.

**Methods:** Warehouse employees recorded data through a smartphone application. The data for set activities were recorded over 2-3 weeks in 2019. Two companies contributed to the study.

**Results:** The results show that for Company 1, retail activities stand for 84 percent of the time spent in the warehouse, and 81 percent for Company 2. Respectively 16 percent and 19 percent for e-tail activities. The two activities that account for the major share of time under retail was “order picking” and “packing.” The retail activity “order picking” and “packing” stand for 59 percent for Company 1 and 40 percent for Company 2. The most time-consuming activity under e-tail was “packing,” amounting to around 40 percent of the total time spent.

**Conclusions:** The results show that expanding to an online channel gives an additional cost of almost 20 percent in the form of increased consumption of labor resources in the warehouse. “Order picking” was the most time-consuming retail activity while it was “packing” under the e-tail category. For the retail industry, the result may be important for appropriately planning, and efficient utilization of resources in the warehouse.

**Originality/value:** The author contributes by presenting the proportion of time used on different activities in a warehouse, becoming one of the first empirical research papers of its kind in multiple channel retailing research.

**Keyword:** Multi-channel, Omni-channel, e-commerce, e-tail, retail, warehouse operations

## 6.2 Introduction

Integration of physical and online stores is a recent phenomenon which has changed the retail industry. This development had a major impact on retail logistics over the last decade (Hübner et al., 2016). The warehouse is an important part of the supply chain and serves as a link between producers and customers. A warehouse has a major role which includes value-adding activities such as preparing orders, product customization, labeling, and pricing. Also, the warehouse secures supply by acting as a buffer in case of variability in consumption such as product seasonality (Gu et al., 2007).

To create a seamless shopping experience for the end-customers, the retailers are now faced with the challenge of redesigning their warehouse operations (Gu et al., 2007, Agatz et al., 2008, Hübner et al., 2015). The reason for this is usually that traditional retailers that expand online are building the distribution strategy for the online store on the existing infrastructure which has previously been optimized for serving the physical stores (Richards, 2014). Warehouses that before only processed store orders may also be faced with the challenge of serving end-customers through the online store.

In Norway, there has been a significant increase in online shopping, and it grows faster than offline sales. This growth reveals the importance of online sales. Numbers from SSB (2018), show that online stores in Norway sold for over 21 billion NOK in 2017, which is an increase of 13,5 percent compared to the year before. In total, the retail industry in Norway sold for 488 billion NOK in 2017, an increase of 2,5 percent. Although online retail only stands for 4,3 percent of the total retail market, it has had a strong increase due to new shopping patterns in the population. This increase is driven by the rise in sales for existing online channels and the trend where retailers increasingly expand online (Hübner et al., 2015).

Gu et al. (2007) address the gap in warehouse operation literature where there has been a strong focus on storage and order picking, while research on receiving and shipping operations is lacking. Hübner et al. (2015) point out that literature dealing with individual operations planning problems are emerging while there is still a lack of research focusing on warehouse operations and capacity management. The shortage of reviews on warehouse operations and design for retail and e-tail is also elaborated on in the literature overview, written by Kembro et al. (2018).

The literature gap may prevent utilization of resources and efficient planning in the warehouse for retailers. This study is based on recorded data by warehouse employees. By using a time tracker application (app), we have recorded up to twelve activities over two to three weeks in 2019.

The purpose of this paper is to investigate the time spent on retail and e-tail warehouse activities. The recording of data was done within two companies, and the results may serve as an indication of how the consumption of time is distributed on different activities in a warehouse.

### **6.3 The impact of e-commerce**

Laudon and Traver (2010) state that e-commerce technology is different and more powerful than any other technologies we have seen in the past century as it brings out shifts in the foundation of commerce. Retail has become more complicated and more competitive due to e-commerce. Consumers that were trapped by geographical and social boundaries are now able to search widely for the best price and quality of a product (Laudon and Traver, 2018). Also, the internet has become a common channel for consumers to interact with businesses, and where traditional companies attempt to increase sales and profitability by creating an online platform for consumers (Bretthauer et al., 2010). During the last two decades, there has been strong growth in the industry, but also massive failures. Many of the failed online retailers misjudged the market. However the companies that survived this early period have become well established, such as Amazon (Lieb, 2018).

In the literature, many different terms have been used for retail with multiple channels. Beck and Rygl (2015) announced this problem where multi-, cross- and omni-channel retailing are used indistinctly with no clear differentiation. Omni-channel retailing refers to the use of multiple channels to interact with the consumers and fulfill their orders (Chopra, 2018). This term is also associated with a seamless shopping experience for the customer (Beck and Rygl, 2015).

The trends in the market and technological developments such as omni-channel retailing have had a strong impact on warehouse operations. Nonetheless, there has not been many



empirical studies on the combination of retail and e-tail and how to integrate them. Mainly one research group has addressed the challenges with transition from multi-channel to omni-channel (see, e.g., Hübner et al., 2015, Hübner et al., 2016, Hübner et al., 2018).

Research identifies increasing challenges for retailers that go from a single-channel to multiple-channels. The research focuses on the rising need for efficiency and flexibility in the warehouse by redesigning the warehouse and distribution (Gu et al., 2007, Agatz et al., 2008, Hübner et al., 2015). More specifically, the introduction of omni-channel and a seamless shopping experience for the customer may cause challenges for returns, processes, information systems, inventories and performance measurement systems (Bernon et al., 2016)

A severe challenge for warehouse operations is how to combine the handling of small customers online, and store deliveries in a way that is time and cost efficient (Hübner et al., 2015, Hübner et al., 2016). Retailers that recently became multi-channel retailers tend to have separated inventories and picking processes based on channel. However, with the experience of having multiple channels, retailers are pursuing an integration of warehouses and inventories, which is predicted to have a positive effect (Hübner et al., 2016). Further, Hübner et al. (2015) state that through the integration of inventories, warehouse operations, organizational units, and IT systems, the company can draw benefit of the synergies in sales, organization, and logistics between the channels.

Retailers can also face the challenge with seasonal demand fluctuation where it affects the decision on order quantities, shelf space, and pricing in a store. On the other side, demand fluctuation tends to have a stronger impact on e-tail and affects, among other things, the delivery capacity utilization (Agatz et al., 2008). Another challenge is addressed by Kozlenkova et al. (2015), where the costs will be different depending on which channel the customer choose. A supply chain may not be optimal for both channels. The author states that the cost of warehouse, merchandising, and transportation processes will differ depending on the channel.

Multiple channels are more effective when serving customer needs since they can serve a variety of customers compared to a single channel (Chopra, 2018). For the future development of e-commerce, it will be important for the companies to focus on the strengths

of omni-channel to make the supply chain more effective. For example, Chopra (2018) elaborate on the potential to combine the strengths of both physical stores and online channels. The strengths of a physical store are to let the customer experience a high level of information sharing face-to-face. Also, the stores are cost-effective by selling products with predictable demand. In contrast, the online store is cost-effective at selling products with uncertain demand, while online customers may experience a lower level of information sharing.

## **6.4 Methods**

### **6.4.1 Case description**

The analysis was performed on activity data, recorded by warehouse employees in two companies. Both companies are located in Akershus County in Norway. The study was only conducted on retailers with multiple channels. The companies will be given fictive names in this research; Company 1 and Company 2, hereafter referred to as C1 and C2 respectively.

C1 specializes in curtains and other fabrics for the home, having over 60 years of experience in the business. The company has 150 stores spread across the country and expanded online in 2017. They had a revenue of around 879 million NOK in 2017. The company has 1 131 employees, and around 20 of these are employed in the company warehouse.

C2 is one of the leading companies in Norway in the fashion and textile trade segment and has over 30 years of experience. The company has 240 stores distributed on four different brands and a revenue of around 1 718 million NOK in 2017. The company has 1 596 employees, where around 12 of them work at the warehouse. The company expanded online in 2017 with one brand. Online store number two was established in 2018 for another brand.

The companies warehouses are similar in terms of functions and flow. However, the companies have different methods to perform warehouse activities. Also, the warehouse size, the number of employees, and the number of orders handled per day differs.

## **Warehouse activities**

The warehouse was divided into two categories – retail and e-tail. Retail operations refer to all activities that concern providing the companies physical stores with goods. This category involves inbound and outbound activities in the main storage. The activities measured in retail operations are “unloading container,” “receiving of goods,” “put-away,” “order picking,” “move goods to conveyor belt,” “packing,” “move goods in racks,” “administration and other activities,” as listed in Table 3.

E-tail operations refer to all activities at the warehouse that has a direct relation with the operation of the online store. These activities are usually linked to fulfilling end-customer orders, which were placed through the company’s online stores. The activities measured in e-tail are “restock,” “order picking,” “packing,” “processing returns,” “inventory check,” and “other activities,” as listed in Table 4.

Retail operations can indirectly influence e-tail. For example, goods for both retail and e-tail goes through the receiving function and gets repacked here. Restock of the e-tail storage was done by taking goods from the main inventory. Also, the online store for C1 provides the service “click-and-collect” where the packed online orders were sent to the main storage to be wrapped together with store orders.

Activities at the warehouse are mostly done manually by the warehouse employees. An exception was C1, where they have an automatic conveyor belt that sorts the picked orders.

Both companies have job rotation where the warehouse employees rotate between the activities. This means that, for example, an employee can pick orders one day and switch to another activity the next day.

To compare the companies, the activities were combined into groups. “Total receiving” combines the activity “unloading containers,” “receiving of goods,” and “put-away.” “Total picking and packing” combine the activities “order picking,” “move to conveyor belt,” and “packing.” “Total other activities” combine the activities “other activities,” “administration,” and “move goods in racks.” Definitions of the activities can be found in Appendix 1.

To better understand the warehouse operations for the companies, further, a brief description of the warehouse operations will be presented.

### **Warehouse operations**

The warehouse operations start with the receiving activity where a shipping container needs to be unloaded. The goods are sorted based on classification, moved onto pallets, and registered. Some goods get cross-docked, meaning the incoming goods are moved straight to the shipping docks. Further, the pallets are moved into racks in the main storage. Restocking for order picking is done by moving goods from the higher parts of the racks to the lower parts with forklifts. There is a risk associated with the use of forklift in the warehouse. A safety policy for both companies is that no other activities should be done in the immediate vicinity of a forklift in operation. Thus, it may lead to holds in activities that are affected by the safety policy.

One of the major retail activities at a warehouse is located at the storage, and this activity is order picking. When a customer order comes in, the process involves picking the right number of the right product. However, the order picking method differed for the two companies.

For C1, order pickers were assigned racks where they primarily picked from. The order pickers picked several orders simultaneously, where they labeled the products picked and placed them in a container. When the container was full, it was moved close to a conveyor belt where another employer placed the goods from the container onto the belt. The belt will then automatically sort the goods and send them to the packing station. The order pickers for C2 picked one order at a time and moved around the warehouse with scooters. The fulfilled orders were packed continually.

In both companies, the packed store goods were moved onto pallets, wrapped, and then the pallet was then ready for shipment.

Both companies storage locations for the physical stores and retail were separated. It was stated that the main reason for this was that the order picking for the physical stores was often done in batches while online store order picking was pieces. However, C2 shares a common picking zone for single pieces for both online and store orders.

The e-tail activities were a relatively small portion of the total warehouse operations. Restock was done by taking batches from the main storage and splitting it into pieces. As mentioned, C1 order picks in a separate storage while C2 order picks from the online and main storage. Further, online orders were picked and wrapped. C2 has two different online stores where the packing method differed. One packing method was more time-consuming than the other. The first method was wrapping the items in a plastic bag. The second method was more exclusive, where the products were wrapped in tissue paper and placed in a cardboard box.

The shipping method depended on the delivery method chosen by the customer. The package was either shipped to a store for click-and-collect or to the customers local post office.

Both companies offer the possibility of returning products to either one of the company's physical stores or directly to the warehouse. Almost all the product returns for C1 are done through a physical store where the store subsequently adds the product to their inventory. Therefore, the processing for returns was not measured for this company.

For C2, products bought online and returned by the customer is sent to the warehouse for processing from either the customer or the physical store. The reasoning behind this is based on product characteristics, and that the company does not necessarily want to keep the products in the physical store.

## **6.4.2 Data**

The observations were recorded for two-three weeks in February and March 2019. C1 recorded data for two weeks between February 4th to February 15th. C2 recorded data for three weeks between February 19th to March 8th. Table 1 shows the percentage of the total number of warehouse employees that contributed to the research for each day. For C1, the average number of warehouse employees participating per week was around 70 percent while for C2 was around 60 percent. It was voluntary to contribute to the study. For the planned categories, retail accounted for the largest participating employee category.

*Table 1 Percentage of total number of warehouse employees that contributed to the research*

Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Company 1 (%)	90	75	65	75	55	75	80	65	55	40				
Company 2 (%)	67	50	75	58	58	58	50	58	58	58	58	58	58	50

At the warehouses, a total of 939 observations were recorded. The distribution of the observations was 354 for C1 and 585 for C2. The data includes the types of activities, the start and end of the recording for an activity, usernames, and category (retail or e-tail). Extreme values caused by errors were deleted, and some were manually changed. Mainly these errors were caused by users wrongly starting and immediately ending an activity, and activities running over 24 hours because the users had not stopped the activity. Removing the outliers resulted in 860 observations to be analyzed, 316 for C1 and 544 for C2.

For analysis purposes, we have reported the activities for the whole period. However, a detailed distribution per week can be found in Appendix 2.

### **6.4.3 The workload measurement tool**

The data used in this research were collected by the warehouse employees. The employees installed a time tracker app called Yast on their smartphones to record the activities. Before the project started, there was a meeting with the manager for each of the companies as well as the inventory managers where we defined the activities which were going to be recorded. The inventory manager was responsible for informing and training the employees to use the app.

Employees logged onto the app using an anonymous username. The first step in the app is choosing a category (retail or e-tail). By clicking into one of the categories, respective activities for the category appears. By selecting an activity, the recording starts, a timer appears, and the recording stops when pushing the activity again. In the app, users can see recent activities recorded and the history of recordings. The recording was sent to the app providers database.

The data were analyzed using Excel and IBM SPSS Statistics. When analyzing the data, descriptive statistics were used to describe the information collected. By using IBM SPSS,

a Mann-Whitney test was used to calculate the statistical significance of the observed differences in the duration for retail and e-tail activities for the companies.  $P < 0,05$  was considered to be statistically significant for the statistical analysis.

## 6.5 Results

The total hours recorded during the two weeks at C1 were 60 052 minutes from 316 recorded observations (Table 2). The duration of retail activities were 50 230 minutes from 222 observations. For e-tail, the numbers were 9 822 minutes from 94 observations.

For C2, the total hours of work were 40 842 minutes from 544 observations. To be specific, the duration for retail activities were 33 107 minutes from 401 observations, while the duration for e-tail was 7 735 minutes from 143 observations.

The results show that for C1 retail activities stands for 84 percent and 81 percent for C2. Respectively 16 percent and 19 percent for e-tail activities.

*Table 2 Time spent on retail and e-tail activities*

Category	Company 1				Company 2			
	Total (n)	Dur (min)	%	P	Total n	Dur (min)	%	P
Retail	222	50 230	84	0,00	401	33 107	81	0,00
E-tail	94	9 822	16	0,00	143	7 735	19	0,00
<b>Total</b>	<b>316</b>	<b>60 052</b>	<b>100</b>		<b>544</b>	<b>40 842</b>	<b>100</b>	

By looking deeper into the categories, the results show several differences between the activities for the two companies (Table 3). Since the results were mostly skewed, the median, instead of mean, was better to use when comparing the results.

The total median for C1 was higher for most of the retail activities, compared with C2. An exception was the median for the activity “total receiving,” which was approximately the same (C1 median: 96 minutes C2: median: 90 minutes). However, the activity accounted for 14 percent for C1, whereas the percentage for C2 was 30. More specific, C1 uses 9 percent of the time on the activity “unloading container” (median: 113 minutes) and 5 percent on the “receiving of goods” (median: 83 minutes). C2 uses 21 percent on “receiving of goods” (median: 95 minutes) and 9 percent on the activity “put-away” (median: 75 minutes).

The median for the activity “total picking and packing” was 229 minutes for C1 and was over twice as high compared with C2, which was 89 minutes. The respective percentage for the activity was 59 percent for C1 and 40 percent for C2. Since the picking, sorting, and packing-activities were combined for C2, we can only go into details for C1. The activity “order picking” for C1 stands for 33 percent of the retail activities (median: 257 minutes), 19 percent for the activity “packing” (median: 233 minutes) and 7 percent on the activity “moving goods to the conveyor belt” (median: 192 minutes).

The results (Table 3) show that C1 (median: 313 minutes) uses a longer median time on the activity “total other activities” than C2 (median: 50 minutes). On the activity “other activities,” C1 uses over four times longer than C2, with the respective medians 158 minutes and 37 minutes. However, C2 uses twice as much time as C1 in percentage (C1: 6 percent C2: 15 percent). The results for the activity “move goods in racks” also differs. The percentage used was almost equal while the median for C1 was 284 minutes and 89 minutes for C2.

C1 has measured the activity “administration” where the median 471 minutes, which accounted for 8 percent of the total retail activities.



Table 3 Time spent on retail activities

Retail	Company 1					Company 2				
	Minutes					Minutes				
Activity	Dur	Med	Mean	IQR	%	Dur	Med	Mean	IQR	%
Unloading container	4481	113	172	(58-257)	9					
Receiving of goods	2755	83	95	(37-114)	5	6977	95	109	(82-108)	21
Put-away						2963	75	93	(36-103)	9
<b>Total receiving</b>	<b>7236</b>	<b>96</b>	<b>132</b>	<b>(38-179)</b>	<b>14</b>	<b>9940</b>	<b>90</b>	<b>104</b>	<b>(74-106)</b>	<b>30</b>
Picking and packing						13236	89	85	(74-104)	40
Order picking	16535	257	251	(124-386)	33					
Packing	9672	233	255	(170-376)	19					
Move to conveyor belt	3347	192	209	(127-290)	7					
<b>Total picking and packing</b>	<b>29554</b>	<b>229</b>	<b>246</b>	<b>(139-361)</b>	<b>59</b>	<b>13236</b>	<b>89</b>	<b>85</b>	<b>(74-104)</b>	<b>40</b>
Other activities	3195	158	200	(76-328)	6	4891	37	56	(14-93)	15
Administration	3921	471	436	(387-480)	8					
Move goods in racks	6324	284	287	(160-480)	13	5039	89	83	(26-112)	15
<b>Total other activities</b>	<b>13440</b>	<b>313</b>	<b>286</b>	<b>(132-468)</b>	<b>27</b>	<b>9930</b>	<b>50</b>	<b>67</b>	<b>(18-105)</b>	<b>30</b>
<b>Total retail</b>	<b>50230</b>	<b>204</b>	<b>226</b>	<b>(96-349)</b>	<b>100</b>	<b>33107</b>	<b>87</b>	<b>83</b>	<b>(39-105)</b>	<b>100</b>

The total median for e-tail activities was also higher for C1 for most of the activities (Table 4). The total median for C1 under e-tail was 88 minutes and was twice as high as C2, where the median was 42 minutes. We will further go into specific activities.

The results show that the median for the activity “restocking” was higher for C1 (71 minutes) than for C2 (51 minutes). This also implies for the percentage, where C1 uses 16 percent and C2 3 percent. The median for the activity “order picking” for C1 (97 minutes) was almost three times as high compared with C2 (34 minutes). This was also the case for the activity “packing” where the median for C1 was 139 minutes while for C2 was 48 minutes. The percentages for the two activities “order picking” and “packing” was fairly similar (C1: 28 percent and 40 percent, C2: 23 percent and 43 percent).

The percentage used on the activity “other activities” is fairly equal (C1: 16 percent C2: 20 percent). However, the median is over twice as high for C2 (C1: 32 minutes C2: 76 minutes).

C2 has chosen to measure the two activities, “processing returns” and “inventory check.” The median for the activity “processing of returns” was 35 minutes while the activity “inventory check” had a median of 10 minutes. The respective percentages were 9 and 1.

Table 4 Time spent on e-tail activities

E-tail	Company 1					Company 2				
	Minutes					Minutes				
Activity	Dur	Median	Mean	IQR	%	Dur	Median	Mean	IQR	%
Restock	1594	71	80	(42-102)	16	215	51	54	(12-98)	3
Order picking	2733	97	109	(61-164)	28	1803	34	43	(13-60)	23
Packing	3914	139	140	(84-200)	40	3345	48	60	(30-83)	43
Other activities	1581	32	75	(10-81)	16	1546	76	77	(22-116)	20
Processing returns						722	35	52	(27-84)	9
Inventory check						104	10	15	(8-21)	1
<b>Total E-tail</b>	<b>9822</b>	<b>88</b>	<b>104</b>	<b>(45-155)</b>	<b>100</b>	<b>7735</b>	<b>42</b>	<b>54</b>	<b>(22-80)</b>	<b>100</b>

## 6.6 Discussion

This research uses recorded data by warehouse employees to investigate how time is spent in a warehouse where the company has multiple channels (physical and online store). The warehouses have served the physical stores with goods for several years and have in later time started to serve end-costumers from the online store. The results show major differences in the distribution of time spent on different activities in the warehouses for the two companies. This is in line with Kozlenkova et al. (2015) saying that the cost related to the warehouse and transportation will differ depending on the channel of distribution chosen by the customer.

C1 has more experience with e-tail activities than C2 and as Hübner et al. (2016) state that “integration, expansion and operational experience develop over time.” The category e-tail accounted for 16 percent for C1 and 19 percent for C2, which can give an indication that experience has influenced the results. Also, the findings imply that the transition to a multi-channel retailer is labor-intensive, where the empirical findings show that expanding online demands almost 20 percent additional work hours in the warehouse.

Examining the median time spent on specific activities, we can observe significant differences between the companies. Both companies use a manual system for order picking

and packing. The results show that the two activities that consumed the most time were “order picking” and “packing.” The retail activity “total order picking and packing” stand for 59 percent for C1 and 40 percent for C2. This is similar to what previous research has stated that order picking is very labor-intensive and counts for the largest part of the warehouse operational cost (Agatz et al., 2008).

As mentioned, research concludes that picking is labor-intensive. However research also states that the category e-tail has a significantly higher picking cost than store picking (Hübner et al., 2015, Hübner et al., 2016). This is somewhat different from the findings of this study. Under the category e-tail, the activity “packing” was the most time-consuming activity while the “order picking”-activity accounted for significantly less. While research focuses on lower the costs for online picking orders (Hübner et al., 2016, Hübner et al., 2015), labor costs may also be reduced for the e-tail activity “packing.”

One reason for why the activity “order picking” differs between e-tail and retail may be that orders from retail are usually few with many order-lines, while online orders are frequent with few order-lines. However, the findings might imply that the companies can reduce labor cost by integrating a common picking zone for online and store order picking. According to Hübner et al. (2016) will the integration lead to higher picking productivity, which thereby leads to reduced costs and higher overall warehouse efficiency.

The results also show major differences in the retail activity “move goods in racks.” C1 restocks by moving the goods for the entire day in the morning, while C2 restock during the day when needed. The different ways of working have clearly affected the results where the operation for C1 uses almost three times longer on the activity compared to C2. The percentage of time used on the “restock” was relatively equal for the firms, which implies that the total consumed time may be fairly alike percentwise. However, based on safety policy for the companies, the use of forklift sets other activities in the immediate vicinity on hold. The findings might imply that affected warehouse activities for C1 have one longer stay while affected activities for C2 may be set on hold several times during the day because of the safety policy.

An interesting observation was that the activity “total receiving” has a relatively equal median duration for the two companies. However, as a proportion of the total time spent on

retail, “total receiving” accounted for 14 percent for C1, whereas the percentage for C2 was 30. This indicates that C2 uses more time on this activity under the category retail. A proportion of the substantial difference may be explained that C2 was expecting the arrival of a new clothing collection during the recorded period. Also, the organization of the activity might be different, and therefore, the amount of time spent on this activity differs.

The two companies are experiences product returns differently. C1 state that product returns to the warehouse was almost absent while C2 processes returns at the warehouse. This is somewhat similar to Bernon et al. (2016) findings that specify that retailers that sell clothes experience higher degree of return than retailers that sell home products. Based on the saying from C1 and the results from C2. Retailers that sell clothes may use more time on processing returns in the warehouse than retailers that sell home products.

Examining the median on the activity “other activities,” there was a large difference under the category retail while the activity under e-tail was relatively equal. C1 has fewer but extensively longer recordings for the activity, while C2 has a significantly higher amount of observations with a shorter duration. For further research, it may be interesting to investigate the different activities that are combined under the activity “other activities.”

## **6.7 Limitations**

Like all other studies, this study also has limitations. The two companies researched are different in forms of customer base, the number of stores, products they sell, and total revenue. Also, some of the warehouse operations differ for the companies. Despite the differences, this research can serve as an indication of how the time is spent in a warehouse for a retailer with multiple channels.

Not all warehouse employees participated in the study. Therefore, the researcher does not have a full overview of time spent in the warehouses. However, the proportion of participants based on the average was high, and the companies ensured that each activity had a proper distribution of participants. The total work time may, therefore, be representative of the companies.

The recording was only done for a few weeks in between February and March. The period was said to have a lower demand because of the recent Christmas and New Year sale. By only recording for a few weeks, the fluctuations are not observed. Incorporating more warehouses and a longer recording period can be done for further empirical investigation.

## **6.8 Conclusion**

With the use of the internet, retail has evolved to become more complicated and competitive. This affects the warehouses and can be very labor-intensive. The results show that expanding online gives an additional cost of almost 20 percent in the form of labor hours in the warehouse. Also, this research enlightens the amount of time spent on different activities in retail and e-tail operations. “Order picking” was the most time-consuming retail activity while “packing” was the most time-consuming e-tail activity.

Analyzing how the time is spent can be essential when searching for ways to make warehouse operations more efficient, especially if a traditional retailer is planning to expand to an online channel. There is a lack in the literature that may prevent the efficient utilization of resources and efficient planning in the warehouse for retailers, which this research is attempting to fill. This paper is one of the first to provide empirical results on warehouse operations that process orders from multiple channels. Even though we have limited data, our research can serve as an indicator for how the time spent on warehouse activities where you have a combination of retail and e-tail-activities. As well as bringing awareness and valuable insight for both further research and the industry.

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# Appendix

## Appendix 1 Definition of the activities in the study

Activity	Definition
Administration	Refers to tasks the administration executes, etc. planning, meetings, and support activities.
Other activities	If an activity that the employees perform is not listed, the process is registered under other activities.
Unloading container	<p>Involves the process where the employees are unloading a shipping container and moving the goods onto pallets.</p> <p>For Company 2 unloading of the shipping container is combined with the activity receiving of goods.</p>
Receiving of goods	The activity includes sorting and assurance that the right quantity and quality are delivered. It can also include cross-docking where inbound packages from the receiving dock are sent directly to the shipping dock.
Put-away	<p>After the goods are received, the pallets with goods are transported and placed in racks in the storage.</p> <p>For Company 1, put-away is combined with activity receiving of goods.</p>
Move goods in racks	The warehouses have a low-level order-picking system with high storage racks. The goods placed higher up needs to be moved down by a forklift for picking.
Order picking	The process when an order comes in and the right amount of a specific item is removed from the racks in the storage. The item is placed in a container.
Move to conveyor belt	After order picking, the goods are moved from the container over to a conveyor belt which sorts the goods and sends them to packing.
Packing	<p>Packing goods that are going to be delivered to stores or customer.</p> <p>The packing method depends on the delivery method.</p>

Processing returns	The process of processing a return from an end-customer. Includes put-away the goods received.
Inventory check	The process of verifying that the right quantities, condition, and storage placement of an item are correct.
Restock	Restock of the e-tail storage. Includes opening bulk packages which are packaged singly.



Appendix 2 Distribution of time for Company 1 and Company 2

Company 1 Category	Activity	Week 1			Week 2			Total Observations (n)	Total Duration (Min)	Total Percent
		Observ. (n)	Durat. (min)	Percent	Observ. (n)	Durat. (min)	Percent			
		12	918	24 %	13	1815	31 %			
E-tail	Order picking	14	713	18 %	7	868	15 %	21	1581	16 %
	Other activities	13	1636	42 %	15	2279	39 %	28	3914	40 %
	Packing	9	639	16 %	11	955	16 %	20	1594	16 %
	Restock	48	3906	13 %	46	5916	20 %	94	9822	16 %
E-tail Total		5	2207	8 %	4	1714	7 %	9	3921	8 %
Retail	Administration	17	4754	17 %	5	1570	7 %	22	6324	13 %
	Move goods in racks	8	1659	6 %	8	1688	7 %	16	3347	7 %
	Move to conveyor belt	35	8318	30 %	31	8217	36 %	66	16535	33 %
	Order picking	4	938	3 %	12	2257	10 %	16	3195	6 %
	Other activities	21	5494	20 %	17	4179	18 %	38	9672	19 %
	Packing	20	1607	6 %	9	1148	5 %	29	2755	5 %
	Receiving of goods	17	2306	8 %	9	2175	9 %	26	4481	9 %
	Unloading container	127	27282	87 %	95	22947	80 %	222	50230	84 %
Retail Total		175	31189	100 %	141	28863	100 %	316	60052	100 %
Grand Total										

Company 2 Category	Activity	Week 1			Week 2			Week 3			Total Observ. (n)	Total Dur. (Min)	Total Percent
		Observ. (n)	Durat. (min)	Percent	Observ. (n)	Durat. (min)	Percent	Observ. (n)	Durat. (min)	Percent			
		3	47	2 %	4	57	2 %	12	456	20 %			
E-tail	Inventory check	14	529	21 %	16	818	28 %	12	456	20 %	42	1803	23 %
	Order picking	8	661	26 %	6	383	13 %	6	502	22 %	20	1546	20 %
	Other activities	19	1202	48 %	21	1253	43 %	16	890	39 %	56	3345	43 %
	Packing	2	89	4 %	6	277	9 %	6	356	16 %	14	722	9 %
	Processing returns			0 %	3	140	5 %	1	75	3 %	4	215	3 %
	Restock	46	2527	21 %	56	2929	20 %	41	2279	16 %	143	7735	19 %
E-tail Total		13	698	7 %	25	2233	19 %	23	2108	18 %	61	5039	15 %
Retail	Move goods in racks	48	4105	43 %	60	4964	42 %	48	4168	35 %	156	13236	40 %
	Order picking and packing	34	2158	23 %	21	1342	11 %	33	1390	12 %	88	4891	15 %
	Other activities	10	557	6 %	14	1751	15 %	8	655	6 %	32	2963	9 %
	Put-away	19	1947	21 %	15	1524	13 %	30	3506	30 %	64	6977	21 %
	Receiving of goods	124	9464	79 %	135	11814	80 %	142	11828	84 %	401	33107	81 %
Retail Total		170	11992	100 %	191	14743	100 %	183	14107	100 %	544	40842	100 %
Grand Total													