JÖNKÖPING UNIVERSITY
School of Engineering

Integrating digital marketing strategies and efficiency when designing an assembly line with high product variations

A case study performed at Habo Plast AB

PAPER WITHIN *Production systems*
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Abstract

The volatile nature of the current market situation forces companies to improve their competitiveness in different ways. An important but unexplored research area is the integration between production marketing and production efficiency. This research area is important as it can assist companies to improve their competitiveness. The integration between digital marketing and production was examined in this study, and to which extent this integration affects the ability to design an effective and flexible assembly line at a case company. An abductive research approach formed the methodology during this research project, which was a case study where literature review, interviews and observations was used to gather data. The deductive approach facilitated the ability to analyze existing theories and form guidelines to follow when designing an efficient and flexible assembly line. The abductive approach facilitated the integration of the digital marketing strategies with the design of an efficient and flexible assembly line. The analysis showed that the digital marketing attributes had both positive and negative impacts on the production efficiency. It was also stated that using the production as a marketing tool can in fact result in a positive outcome for both parts. Using the production as a part of the marketing strategy could encourage companies to keep the production space clean and structured, which in turn have a positive effect on the production efficiency. The study results also indicated that it is important to consider possible trade-offs that might occur when using the production as a marketing tool. In the case of Habo Plast, the main trade-offs that was found was that the shape of the assembly line is not aligned with both the efficiency and Habo Plast's marketing purpose. The trade-offs for production marketing are, however, dependent on companies' chosen marketing attributes and can therefore not be generalizable for all companies. As this subject is an unexplored research area, suggestions for further research are also included in this report.

Keywords: Assembly Line Design, Production Efficiency, Digital Marketing Strategies, Production Marketing

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1 Introduction

This chapter will introduce the reader to the subject with the background and the problem description. The chapter continue with the purpose and the research questions of the study. Ending with delimitation on the study and the outline of the report.

1.1 Background

The globalization and rapid changes of the market has complicated the ability to remain competitive for companies. With shortened product life cycles and customers expecting high-quality products that should be delivered in time at the right price adds pressure at companies and their business strategies to maintain a competitive position (Bellgran and Säfsten, 2009). Actors needs to offer several different variations of products and services to manage the dynamic changes in the market (Dotoli, Fay, Miskowicz and Seatzu, 2019). The volatile nature of the market requires manufacturing companies to develop comprehensive and sophisticated manufacturing system (Bellgran and Säfsten, 2009). To improve the well-being and competitiveness for manufacturing companies, it is important to perform well at the core dimensions of quality, flexibility, delivery and cost (Berry and Cooper, 1999; Sarmiento, Byrne, Contreras and Rich, 2007).

To handle the market needs of high variations of the products, it requires a carefully planned system to handle the complex material flow (Hasan, Sarkis and Shankar, 2012). An efficient system takes into consideration the different interactions between the material handling in both the processes and the facility. Efficiency is in this context defined as how well the resources of the transformation processes are utilized (Tangen, 2005). Every process must have an efficient product flow, simultaneously as the processes needs to be well integrated in the holistic product flow of the facility (Shayan and Chittilappilly, 2004). Redesigning the system and improving the arrangement of different workstations can have a heavy impact on the total cost (Tompkins, 1996).

Today, the trend shows that companies are moving more towards flexible manufacturing systems to handle the tough market requirements. Flexibility is defined by Olhager (2013) as the ability to adapt to changing or new requirements quickly and cost efficiently. Fisel, Exner, Stricker and Lanza (2019) argues that in an assembly system with high flexibility and product variation, the material handling must be carefully planned to create an efficient flow of the material and the products. The assembly system must be able to handle the variations of the customized products, which makes it important to adjust the production according to the fluctuations in the market.

For the customers to understand the large variety of products that they are offered, marketing can play an important role in reaching out to customers. Digital marketing is a marketing strategy that have become more influential on the possibility to gain and interact with more customers. Digital marketing can be done in many ways, and it differs between products and company strategies of what is interesting to market (Sajid, 2016).

Information about marketing the production is not mentioned in literatures related to this subject. This leads to the questions of how the design and marketing of an assembly line can be combined to create both an efficient and attractive assembly line. How does an attractive design of an assembly line design affect the efficiency of it? Is it possible to integrate an efficient assembly line with a design that is attractive for customers through digital marketing?

1.2 Problem description

The importance of high flexibility has increased over time due to the volatile nature of the market and constant changes regarding the customer requirements (Bellgran and Säfsten, 2009). Habo Plast is a company that produces high quality and customized floorball sticks, and they are planning for a new venture with several new product variants. The current production steps that take place in Habo is the assembly of the floorball sticks. All assembly operations are currently not placed in an assembly line, they are dispersed throughout the production plant, which means that the material flow of the products is complex. The current assembly system is not efficient enough to produce the number of products that they plan to produce after the new venture. Since the case company of the study will be offering several product variants, a well-structured and flexible assembly line is crucial for their production strategy and their competitiveness in the market.

Since Habo Plast reach out to their customers mostly through digital marketing, they also wish for the assembly line to be useful as a marketing tool. This means that the assembly line will not only have to be efficient, but it must be planned and designed from a marketing perspective to make it attractive. The challenge will therefore be to find the balance between efficiency and attractiveness, and to find the link between them that works for both purposes.

1.3 Purpose

The purpose of this study is to provide guidelines for integrating digital marketing strategies with the design of an assembly line to fulfil the purpose of both having a useful marketing tool and an efficient assembly line. The design of the assembly line must also take high product variation into consideration.

1.4 Research questions

To fulfil the purpose of this project, the purpose has been broken down into three research questions. The first question concerns the efficiency of the assembly line and will be managed by answering the following research question:

> [1] What aspects are important for designing an efficient assembly line with high product variations?

The digital marketing aspects of this study will be answered through the following question:

> [2] What aspects of an assembly line can be affected by the digital marketing strategies?

The last research question concerns the connection between the first and the second research question:

> [3] What potential trade-offs exists when integrating digital marketing strategies with the design of an assembly line?

1.5 Delimitations

This project will delimit other activities that are being performed in other areas within the facility. This will include activities such as the material flow of components to and from the assembly system design of this project or any other production activity within Habo Plast AB facility. Additionally, the project will not take into consideration of marketing aspects and tools other than digital marketing. Since marketing is a wide subject, we have chosen to only focus on the digital marketing of the production since this is the main topic that the case company wishes to explore.

1.6 Outline

In chapter two, the reader will be introduced to the theoretical foundation of the project, where design of assembly lines will be a main part. The chapter will also provide information about digital marketing and how this could be connected to the production. Chapter three explores the different methods that have been used to carry out the project, and how the gathered data was analysed. The chapter also includes a discussion regarding the validity and reliability of the project, as well as ethics and morale. The fourth chapter includes the findings of the data collection that was gathered at the case company. The analysis of this study takes both the theory of the subjects and the findings into consideration. There are three main subheadings of this chapter: Assembly system, digital marketing, and the integration of production marketing and production efficiency. In the sixth chapter is the methods and the results of the study discussed from different perspectives. The last chapter summarizes the report in the conclusions. The chapter ends with implications and further research for the study.

2 Theoretical background

This chapter will include the theories that are necessary and will contribute to the study of this project. There are three main chapters that are fundamental for the project: Assembly systems, Assembly line balancing, and Digital marketing.

2.1 Assembly systems

An assembly line is a manufacturing process where the different components of products are attached together. The attachment of the components is often put together in series of assembly operations, to create an efficient flow of the material and the products (Thomopoulos, 2014). Assembly systems are flow-oriented and can often customize the products through the flexibility of the assembly line in order to respond to the customer needs (Boysen, Fliedner and Scholl, 2008). The efficiency of an assembly system is also an important aspect of responding quickly to the customer needs. The efficiency is often described as "doing the things right" and it can be defined as how well the resources of the transformation processes are utilized (Tangen, 2005).

2.1.1 Performance objectives

The performance objectives of a production system is a common evaluation method that companies use to determine the success of a production system according to Bellgran and Säfsten (2009). Tangen (2005) argues that the term performance objectives includes more aspects than just the economical and operational, but instead it should include any objective of competitive nature. Slack (2007) provided five leading performance objectives which companies usually aim to achieve: *cost*, *speed*, *quality*, *flexibility* and *dependability*. Bellgran and Säfsten (2009) offers a clear description of each performance objectives, including examples of different performance measurements (see table 1).

Table 1 - Performance measurements of the performance objectives.

Performance objectives	**Explanation**	**Performance measurements**
Cost	The cost of producing a product (e.g., material and labor costs)	Unit production cost Inventory cost Direct labor cost
Quality	The manufacturing of product with high performance and conformance.	Scrap percentage Scrap costs Rework costs Complaints Warranty returns
Speed	Delivery speed	Lead time Response time Cycle time
Dependability	Reliability of delivery	Percentage on time delivery
Flexibility	The ability to react to changes in volume or product mix etc.	Set-up time Range of products Number of options Time to change schedule

2.1.2 Factory layouts

There are three basic factory layouts that are commonly known. These three layouts are functional, cellular, and line layout (Miltenburg, 2005). *Functional layouts* are commonly used where equipment that are performing similar operations are placed in the same area. The advantage of this layout is to utilize the high flexibility, which is necessary to handle the large variety of products (Stevenson, 2009). In *cellular layouts* are different equipment and processes instead grouped up and located in the same area. The grouping of processes is determined by the need of operation to fulfill the production requirements of any product within a large product family (Miltenburg, 2005). Cellular layouts increase the flexibility of the company to produce a fairly large variety of products, with reduced transportations cost and idle time (Stevenson, 2009). *Line layouts* includes all the equipment that is needed to produce one or a small product family and the layout is arranged as a line (Miltenburg, 2005). This layout is advantageous when companies produce large volumes of standardized products at a rapid and smooth pace. This layout is typically referred to as assembly lines, as the work usually is divided into standardized processes which facilitates the rapid flow (Stevenson, 2009).

Miltenburg (2005) developed a framework for analyzing and developing manufacturing strategies, which included the product/volume-layout/flow (PV-LF) matrix. The PV-LF matrix includes four dimensions: number of products produced, volume of each product, layout of equipment for production and material flow and illustrates seven different production systems. It is a useful matrix that visualizes the similarities and differences between the seven commonly used production systems and how these systems perform within these dimensions.

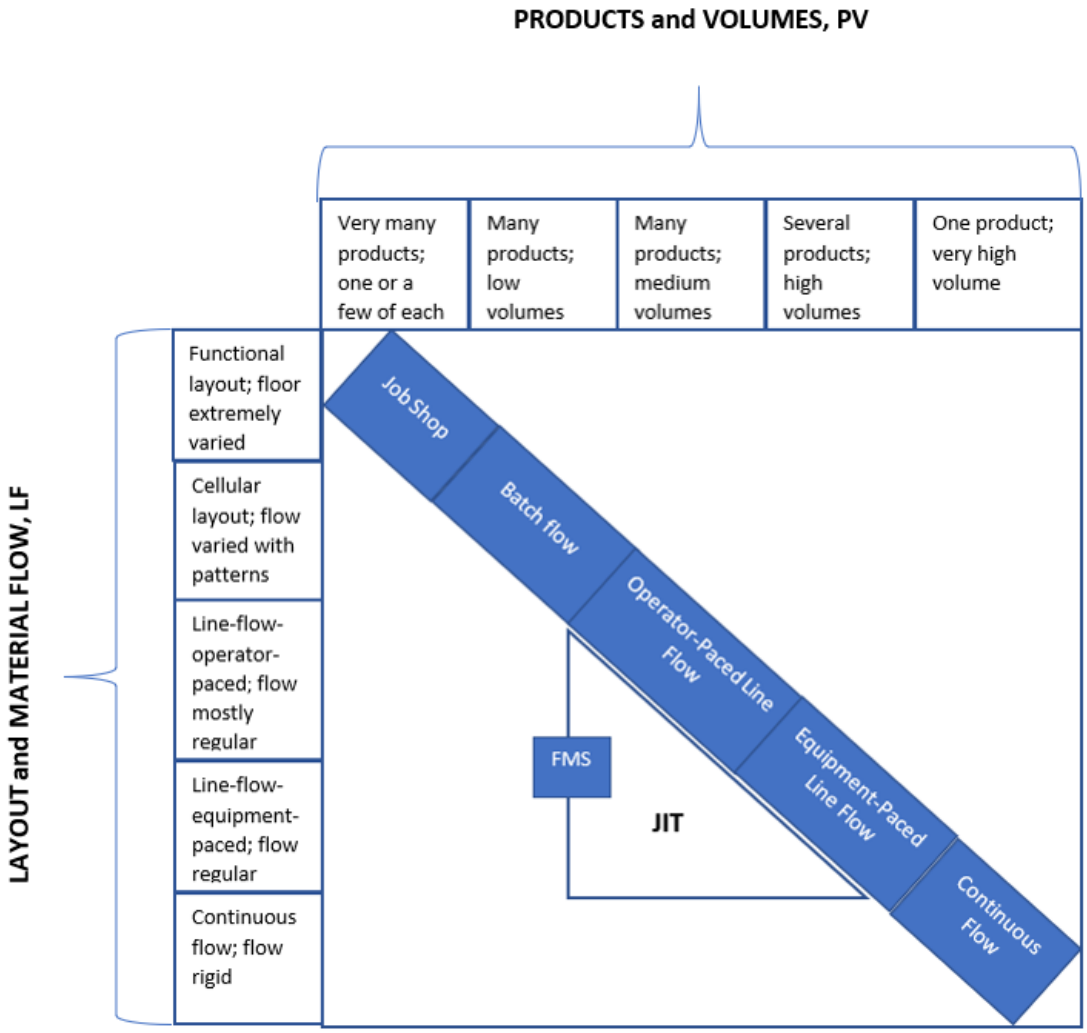

Figure 1 - Adapted PV-LF matrix from Miltenburg (2005).

The following segment originates from the work of Miltenburg (2005). According to him, job shop system has the ability to produce a large number of variants of products, in small volumes. This system has a functional layout and high flexibility, with an extensive material flow that varies depending on the customer order. This leads to high work-in-progress (WIP) in inventory and long delivery times. *Batch flow system* is using a combination of functional and cellular layout, while producing higher volumes than job shop systems but have smaller variety of products. The material flow differs from order to order since products are produced and transported in batches. An *operator-paced line flow system* is advantageous when the variety of products are high, and the forecast of the volume is fluctuating. This system is more flexible than the equipment-paced line and the pace of the system depends on the complexity of the product and the operator's ability to work as a team. *Equipment-paced line flow system* is useful when there is a small difference in products and the product volume is high. The advantage is to produce products in a cost-effective way with high quality and the products are standardized, while the operator's task is simple. *Continuous flow* is quite similar to the equipment-paced line flow system. The main difference is that continuous flow is more automated and can be active the whole time. The system produces one product or

one product family at extremely high volumes compared to the other systems. The products are highly standardized and the system itself have limited flexibility. A *just-in-time (JIT) system* should not necessarily be mixed with other JIT tools, such as kaizen, pull production and multiskilled workers. These techniques can be implemented in all systems and is not only applicable in a JIT system. This system resembles a line flow with two important components: it can produce several different products in low and medium volumes, and it involves continuous improvement, with a focus to identify and eliminate wastes. The competitive advantage with JIT is cost, quality and delivery, as the system itself forces the identification of wastes and allows companies to remove them. In a *flexible manufacturing system (FMS)*, the system is built on computer-controlled machines that also include some level of automated material flow. The flexibility is high, due to the high level of integration of the equipment in the system. This allows companies to produce large numbers of different products in low volumes.

2.1.3 Assembly system

There are several different assembly systems that exist. The traditional systems are *single model, batch, mixed model, postponement* and *one station assembly system*. Each system is more applicable in a certain situation than others, due to their ability to meet the production specifications that are set (Boysen, Fliedner and Scholl, 2008), as the volume-variety aspect specifically affects the layout of the assembly system remarkably (Algeddawy and Elmaraghy, 2010). *Single model assembly system* is useful when the assembly system is focusing at one model. As an example, companies may offer a certain number of models, but each model have its own dedicated assembly line. *Batch assembly system* involves pre-assigned sizes of the models that are assembled. Model X will be assembled until a predetermined level is reached and then Model Y will be assembled. The batch sizes are determined and optimized based on two major factors: the inventory level and customer demands. *Mixed model assembly system* is used when there is more than one product that are assigned to the same assembly line simultaneously. To integrate several of models into the same line raises several of challenges, such as line balancing and sequencing. In mixed model assembly systems, there are usually two orientations: make-to-stock and make-to-order. In make-to-stock, the assembly plan is based on forecast of the customer demands, which allows assemble lines to assemble the products in a more structured way. Make-to-order will instead trigger an action in the assembly system when the customer make an order. In these systems, each order will be unique and the product variation quite high and the sequencing and line balancing are quickly becoming more complex with this kind of system. *Postponement assembly* occur when the assembly line does not fully complete the product, but instead postpone the complete assembly which is carried out close to the decided delivery date. This approach usually is decided by the supply chain strategy where the assembly line is used. *One station assembly* is when the assembly line instead resembles a workstation, and the task is carried out by one person at one station. All the material is being transported to the station.

2.1.4 Assembly line design

Stevenson (2009) defines layout as a "configuration of departments, work centres, and equipment, with particular emphasis on movement of work through the system." He continues to mention that layout design decision involves three important aspects to bear in mind:

(1) Involves high resource investment of money and effort
(2) Long-term commitments
(3) Layout decisions have a significant impact on the cost and efficiency of operations

These aspects are important to consider when preparing for designing a new layout or redesigning an existing layout. Stevenson (2009) continues to explain that the objectives of layouts are to simplify the flow of the work, material handling and information flow throughout the system. To support these objectives, the following segments of the assembly system needs to be considered:

(1) Facilitate attainment of product or service quality
(2) Use workers and space efficiently.
(3) Avoid bottlenecks
(4) Minimize material handling costs.
(5) Eliminate unnecessary movements of workers or materials
(6) Minimize production time or customer service time
(7) Design for safety

(1) Facilitate attainment of product or service quality.

The ultimate purpose of the design is to meet the customer requirements. This is the very ambition of the layout, to facilitate the making of products which meets the customer requirements. Undoubtedly, the first segment that Stevenson (2009) presents are broad, although it is later broken down into more specific and measurable segments. All these segments will affect the layout's ability to meet the customer requirements in a smooth and efficient way. Another aspect that should be considered in space efficiency is the shape of the actual assembly system, which may include the U-shape. According to Miltenburg (2005), U-shape is proven to be advantageous as is uses less floor space than a straight line, while it also increases the flexibility of assembly system as the operators can work at adjacent stations and stations on opposite side. Another interesting aspect that Stevenson (2009) points out is that if materials enter at the same point as the finished products leaves, a U-shaped layout will minimize the material handling costs.

(2) Use workers and space efficient.

To decrease the waste that can occur in a production facility it is important to create a design that is efficient for both the workers and the space according to Chiarini (2013). If the design of the production system does not take this into account, waste will be

created in terms of unnecessary motion in the production, where workers must perform activities that do not add value to the products.

(3) Avoid bottlenecks.

The bottleneck of an assembly system affects the productivity of the manufacturing process and decreases the capacity of the system. The bottleneck limits the other operations as the capacity of the bottleneck operation is fully utilized, while the capacity of other operations still has available capacity (Pourbabai, 1994). The bottleneck of an assembly system can vary between the different operations depending on the product. Since there can be variations in the assembly time for different products in the different operations, the bottleneck in an assembly system for one product is necessarily not the same for another product (Dewa and Chidzuu, 2013). The bottlenecks can be managed by analyzing the bottleneck through line balancing, creating a higher utilization and a better throughput in the assembly line (Masood, 2006).

(4) Minimize material handling costs.

Material handling process is important to consider when designing a new system, due to the material handling costs (MHC). MHC is measurable and closely related to the performance of the assembly system. According to Emami and S. Nookabadi (2013), MHC is a significant indicator of the efficiency of the newly designed system. Additionally, Tompkins (1996) suggests that companies have the potential to reduce manufacturing costs up to 10-30% by redesigning a system, whereupon MHC is a major contributing factor to this cost. Therefore, it is important to consider the integration of the assembly system and the material handling process in the early stages in the design phase of assembly systems to minimize the MHC (Wänström and Medbo, 2009).

(5) Eliminate unnecessary movements of workers or materials.

Unnecessary movements of workers and materials are elements that are waste within the lean philosophy, as they are considered as being non-value adding activities within the system (Panwar, Nepal, Jain, Rathore and Lyons, 2017). When designing a new assembly system, these aspects can be minimized by placing assembly units in a way that facilitates the utilization of the value-adding movement by considering the space availability and material flow (Drira, Pierreval and Hajri-Gabouj, 2007).

(6) Minimize production time or customer service time.

The layout of the assembly system will have significant affect at the lead time of the system (Drira, Pierreval and Hajri-Gabouj, 2007). The production time can be reduced by designing the layout in a way that supports the equipment and facilitates the work of the operators. This also includes a reduction in bottlenecks rate, MHC and improves the productivity as the idle time is being minimized (Kulkarni, Talib and Jahagirdar, 2013).

(7) Design for safety.
The design of manufacturing systems has a significant impact of the safety and health of the workers. Designing ergonomic workstations reduces work related injuries, as well as improving the overall performance of the system. This means that ergonomics is an important aspect to consider when creating a productive and reliable assembly system (Dul and Neumann, 2009).

2.1.5 Wastes in assembly systems

Lean Production is a philosophy that aims towards increasing the value-added activities in the value chain and decrease the wastes that occurs. This means that every activity that does not add value to the products are wastes and should be removed (Bellgran and Säfsten, 2009).

There are originally seven different wastes that Lean Production strives towards eliminating according to Chiarini (2013), these are: *Overproduction, Inventory, Motion, Defects, Transportation, Overprocessing,* and *Waiting*. *Overproduction* occurs when more products are being manufactured than there are customer orders. There are a lot of negative outcomes from overproducing, such as increased inventory, personnel, and transportation costs. *Inventory* is the waste that occurs when too much inventory is stored and there are unnecessary too many products in the inventory that is waiting to be processed. Some reasons for having too much inventory can for instance be early production, or bottlenecks in the production that limits the production efficiency. *Motion* refers to unnecessary movement of the workers. This waste occurs when there is for instance a poor layout design, inexperienced workers, and lack of structure of the production equipment. To decrease the motion of the workers, it is therefore an important aspect to consider when designing the production layout. *Defects* is the waste when products do not fulfil the customer requirements. This can lead to that product must be reworked, which in turn will result in workers must spend their time with activities that do not add any value. Some of the reasons why defectiveness occurs can be unclear work instructions and working methods, inexperienced workers, poor production equipment, or problem with the material or the products. *Transportation* is the activity that occurs when products must be moved between the processes. Since this activity do not add any value to the products, it is important that this waste is being eliminated as much as possible. The waste in transportation is also affected by poor layout design and inexperienced workers. *Overprocessing* is the activities around the production processes that is unnecessary and does not add value to the customer. These activities process the products more than the customer requires and is therefore not adding value to the product since the customers do not pay for these activities. *Waiting* time refers to both waiting time for the workers as well as for the machines. Some of the reasons why this occurs is that there is a lack of balance between the activities and that the maintenance work is poor, which in turn can create downtimes in the machines. These seven wastes that have been described is considered as the traditional wastes in in lean production. Although, a fairly new waste has been identified and should be considered as the eighth

waste in lean production: *skills*. This includes the potential waste of employee skills and competence and companies should realize that the most important resources are the employees (Compton, 2017).

2.1.6 Flexibility in assembly systems

Flexibility can be described as the ability to adapt to changing or new requirements quickly and cost efficient. Flexibility is often divided into product mix flexibility and volume flexibility (Olhager, 2013). By having a flexible production system, the uncertainties and the volatile nature of the customer requirements can easier be faced, which will result in a higher customer satisfaction (Iravani, Kolfal and Van Oyen, 2014). There is an increasing interest for companies to sell customized products. Both because the customers are demanding more customized products, but also because it is a possibility for companies to reinforce the company in the market and thereby improve their competitive position. Customization focuses on offering individual customers products that are specialized for their own needs and requirements. The degree of customization can vary from uniquely customized products to different variations of a standard model. One key aspect to deal with customization is the modularity of the products. This allows for a large product variety by giving the customers the opportunity to choose between a variety of features within individual modules of the products. At the same time can the main structure of the product and the relations between the components be standardized, which is beneficial for the manufacturing of the products (Fredriksson and Gadde, 2005).

Having a high product variability and flexibility increases the chances for companies to satisfy the customer requirements. It will, however, also increase the complexity of the assembly system. According to Busogi and Kim (2017), human involvements are still considered key factor in maintaining high flexibility and adaptability in assembly systems. But in terms of high variations, the many variations create a higher demand on the operator's choice-making, as the operator in their work must make the right choice from several different alternatives. The complexity of an assembly system can therefore result in human errors and in turn also affect the production performance negatively (Hu, Zhu, Wang and Koren, 2008). When customers get the opportunity to select options for each component of the products, the many variations create unique products. In such cases it is advantageous to use Make-To-Order assembly, where the assembly processes start after the customer has made their order. Starting the assembly processes after the customer order makes it easier to handle the flexibility and variations of the products. It can however increase the lead time of the products (Thomopoulos, 2014).

How many product variations that the customers can be offered are depending on the flexibility of the different components in the product. Figure 2 shows the product combinations that can be made from 3 components from Supplier A and 2 components from Supplier B. If these components are independent form each other and all components

can be assembled together, the component can in this case be combined into 3x2=6 different products (Hu *et al.*, 2008).

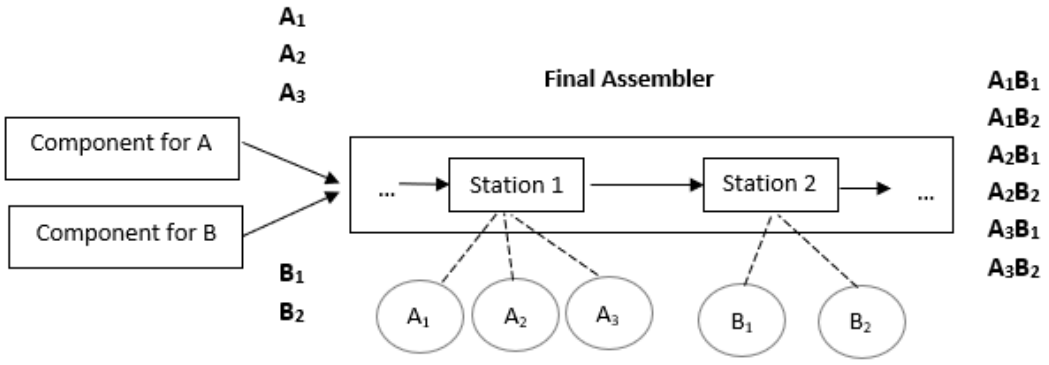

Figure 2 - Adapted illustration of product combinations in assemble system from Hu *et* al. (2008).

2.2 Assembly line balancing

Line balancing is often used when designing and planning an assembly line to create an efficient layout. Line balancing allows companies to divide the assembly activities between the workstations as equally as possible, without disregarding the precedence relations in the assembly sequence (Khan and Day, 2002).

2.2.1 Line Balancing

Line balancing is an activity where the objective is to distribute the work content even across the system (Bellgran and Säfsten, 2009). Using line balancing will reduce the idle time and increase the utilization of the equipment being used within the system. Reducing the idle time usually facilitates the distribution of tasks over the equipment, increasing the throughput and reducing the work in progress (WIP) in the inventory (Dessouky, Adiga and Park, 1995). The primary obstacle of achieving a completely balanced line with a balance delay equal to zero, is the difficulties of clustering tasks together that will have equal cycle time and (Stevenson, 2009).

When designing a single-product assembly line, it is crucial to set an appropriate cycle time since it affects the potential flexibility of the assembly system design (Dessouky, Adiga and Park, 1995). According to Moodie (1981), there are four general steps to follow when designing an assembly line that is supported by line balancing:

(1) Determine and set an appropriate cycle time.
(2) Determine the number of operators that is needed to support the set cycle time.
(3) Form a precedence diagram among the tasks within the assembly system.

(4) Assign tasks to operators considering the restrictions on labour assignment.

It is quite customary that one assembly system produces several product types. A common approach for companies to manage this situation is to develop and implement one assembly line for each product type. The disadvantage of this procedure is that it is highly likely that there is low level of utilization of the operators. Instead, an alternative assembly system design is to include several of product types within the same assembly line (Dessouky, Adiga and Park, 1995). A common approach when several product types are being processed in the same assembly system is aggregate task balancing method. The different products will usually have different processing time for the same task in the assembly system. In this case, Milas (1990) pointed out that it is common to design the system based on either the average task time or the task with the largest processing time. According to Ren, Barlotti, Cohen, Frangipane, Garofalo, Cozzari and Metz (2015), U-shaped layouts are proven to increase the work efficiency of manual labour.

When calculating line balancing, it is important to start with the precedence diagram, where the purpose is to identify the required sequence of the processes. Stevenson (2009) says that the precedence diagram is quite effortless, and it is optimal to start with the tasks that has no predecessors. This will facilitate the pairing of tasks into workstations that is later calculated and limited by the cycle time. The calculation of line balancing is according to Olhager (2013) based on the market requirements of the customer demand rate. The demand rate is transformed into a production rate, where the cycle time of the stations must be able to keep this rate. The cycle time of the production rate can be calculated by using following equation (Stevenson, 2009).

$$C = \frac{T}{D} \tag{1}$$

Where:

$C = Cycle\ time$

$T = Operating\ time\ per\ day$

$D = Desired\ output\ rate$

The number of workstations is dependent on both the production rate and the ability to combine the different operation into workstations. The theoretical number for the workstations that are necessary can be calculated by using equation (2):

$$N_{min} = \frac{\sum t}{C} \tag{2}$$

Where:

$N_{min} = Theoretical\ number\ of\ stations$

$$\sum t = Sum\ of\ task\ times$$

$$C = Cycle\ time$$

When the theoretical number of stations have been calculated and the actual number of stations have been determined, the tasks need to be paired into workstations. This is where the precedence diagram is useful to see the which tasks can be paired. The calculated cycle time set the limit of the time where the stations are paired. Idle time will usually be generated since it is difficult to find one definite solution where there is no idle time. The percentage of the idle time in the system is then calculated by:

$$Percentage\ of\ idle\ time = \frac{Idle\ time\ per\ cycle}{N_{actual} \times C} \times 100 \quad (3)$$

Where:

$$N_{actual} = Actual\ number\ of\ stations$$

The efficiency of the assembly system can then be calculated:

$$Efficiency = 100\% - Percentage\ of\ idle\ time \quad (4)$$

This line balancing concept is a heuristic approach, and according to Stevenson (2009) it is important to realize that it will not always result in the most optimal solution but instead provide several practical solutions to the problem. He continues to mention that it is extremely rare for an assembly line, in practice, to be perfectly balanced. Furthermore, additional research has examined the assembly line problem and concluded that the assembly line problem is more complicated and exposed to more factors than just the predetermined cycle time due to customer demands. Xu and Xiao (2009) pointed out that in reality, assembly lines tasks which includes human resources are subjected to social, physical, and psychological factors. These factors are important to take into consideration, as they will ultimately affect the variation of the processing time.

2.2.2 Precedence diagram

Precedence diagram is a practical tool according to Stevenson (2009), that is used in line balancing that allows the visualization of the sequential order in which the tasks must be performed. It also visualizes and represents the direct relations between the different assignment tasks that is carried out. Pintzos, Triantafyllou, Papakostas, Mourtzis and Chryssolouris (2016) suggests that the advantage of developing a precedence diagram is that companies can get several solutions of the assembly sequences. Pintzos *et al.*, (2016) continues that the challenge is to select the most appropriate sequence solutions, without violating the predetermined sequence relations. Using precedence diagram in a system where there are several of tasks that are being performed will facilitate the complexity in the system as Figure 3 shows.

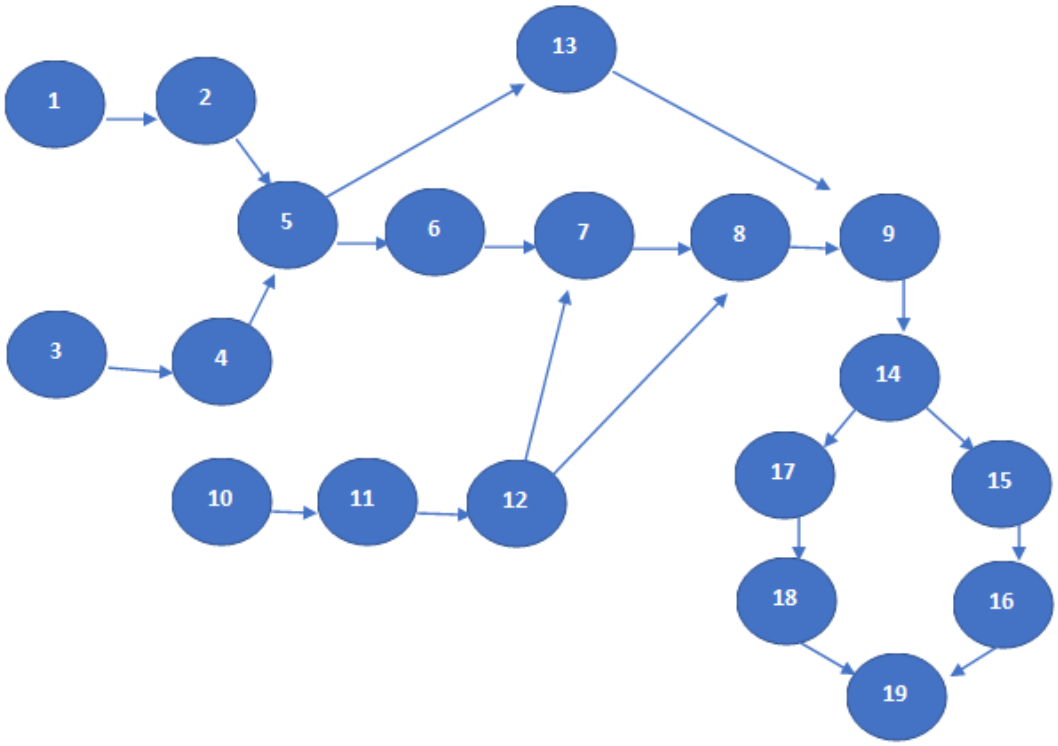

Figure 3 - Precedence diagram adapted from Zaman, Paul and Azeem (2012).

2.3 Digital marketing

The purpose of digital marketing is not only to reach out to the customers by marketing products through digital channels. It has become a marketing strategy where digital channels can be used to communicate with customers, creating customer relationships and promote the brand (Kannan and Li, 2017). Kannan and Li (2017) defines digital marketing as "an adaptive, technology-enabled process by which firms collaborate with customers and partners to jointly create, communicate, deliver, and sustain value for all stakeholders". The adaptive nature of the digital marketing approach has significantly increased the number of touchpoints, up to 20% annually due to previous offline customers using more digital technologies according to Bughin (2014).

The key touchpoints in this paradigm shift have been developed in the framework of Kannan and Li (2017) that illustrates the interaction between digital technologies and the marketing strategies of companies (see Figure 4). The theories and concepts brought up in this section originates from the work of Kannan and Li (2017). In the left box, there is the conventional five C's: *customers*, *collaborators*, *competitors*, *context* and *company*. All these elements together create the *environment* that firms operate in. The main element here is the *customers*, as they are the essential segment in the current online-offline shift and increasing the number of touchpoints. The interesting aspect here, is the interaction between *digital technologies* and the interface of the *costumers*. Especially the concepts that occurs from the following interactions: *search engines*,

social media & UGC, two-sided markets and platforms, contextual interactions and *consumer behaviour*.

The result of the interaction between digital technologies and the costumer forms information which will require a decision from the company. This information will also include the analytics from the *marketing research* and all the aspects in the marketing mix: *product and service, price, promotion* and *place*. Together, all this comprehensive information that flows between these segments informs the *marketing strategy* of the firm and this framework will illuminate how digital technologies and marketing shapes affects these interactions. This leads to the final part of the framework, where an analysis is conducted at the impact of digital technologies may have in the value creation.

The outcomes are the result from the actions that the company perform using digital technologies in the environment that they are active in. In this framework, the outcomes have been classified into three different value dimensions: *value for customers*, *customer value* and *firm value*.

Value for customers consist of four different elements: value equity, brand equity, relationship equity and customer satisfaction. While customer satisfaction is self-explanatory, the other elements are not. For instance, value equity in this context is defined as the objective value that the customer will receive when interacting with the company. Brand equity involves the perception and experience customers have while engaging with the products or the company itself and what the company prefers to be identified as. Relationship equity refers to building relationships, meaning if the company want a close relationship with the customers and how they are pursuing it with the usage of digital technologies.

Customer value in this framework involves how digital technologies facilitate companies' ability to acquire and maintain their customers, while simultaneously improve their profitability from these actions. *Firm value* covers the financial aspects of the outcomes, which are more tangible aspects compared to the previous dimensions of the outcome. Sales, profits and growth rate are aspects that are related to the digital technologies in this framework.

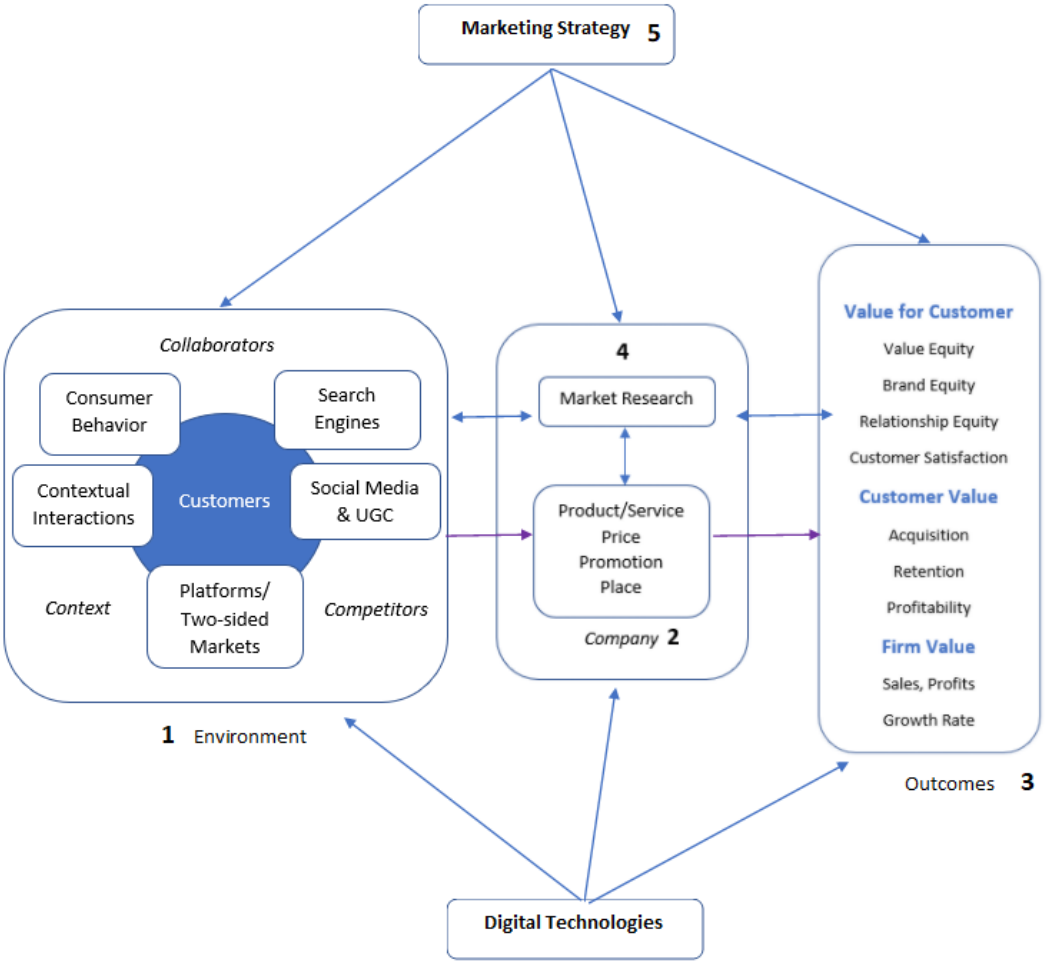

Figure 4 - Digital marketing framework adapted from Kannan and Li (2017).

2.3.1 Digital marketing strategies

There are according to Asma, Mary and Prestin (2020) four dimensions of digital marketing: *Personalized Marketing*, *Push Notifications*, *Social Media Marketing*, and *Content Marketing*. *Personalized Marketing* strategy is when companies deliver tailorized marketing content to their customer based on data collection and automated technology. The purpose of personalized marketing is to personalize the products and services to every individual's need and communicate with each customer as individuals, and thereby also create a closer relationship with the customers (Tong, Luo and Xu, 2020). *Push Notifications* are used when there is a need to notify the target audience about new updates and offers about products and services. The challenge in this case is to not overdo the marketing and annoy the customers, where it is important that the notifications are informative, and the information is useful for the customers. *Social Media Marketing* is used to promote the brand, products, or services via social media channels. This marketing strategy is especially useful to build brand awareness to the customers and the target audience. Social media has the ability to reach out to many potential customers, which makes it a powerful marketing tool. Social media is not only a marketing tool for marketing products and services, but also an opportunity for social

networking. It has therefore become a powerful tool for Customer Relationship Management (CRM) according to Li, Larimo and Leonidou (2021), as it can contribute to a collaborative interaction with the customers. This can be advantageous for companies as it is an opportunity to learn more about the customers and the product requirements they set. *Content marketing* focuses according to Asma, Mary and Prestin (2020) on providing valuable and insightful information to build a relationship with the customers. The purpose of content marketing is to have a clear communication with the customers and to create a demand from the customers for the business. In content marketing it is important to understand the expectations of the customers before presenting the content in order to offer them the best possible experience. Ho, Pang and Choy (2020) argues that it is significant for companies to align their content marketing with their brand values to create and share a convincing content for the customers.

3 Method and implementation

This chapter will inform the reader of the approach of the study. The nature of the study will be explained in Research Design. A thorough description of the literature review, the case study approach of this study, and the data gathering techniques will be explained. The chapter Data analysis informs the reader of how the gathered data has been interpreted and analyzed in this project. And the last chapter Research quality refers to the role that validity and reliability, and ethics and morale plays in this research.

3.1 Research design

The nature of this research had a qualitative approach. The choice between quantitative and qualitative research affects how the researchers collect, processes and analyses the data of the study. Quantitative research is a research where the data are collected through measurements and the data are analyzed statistically. The qualitative research primarily emphasizes words rather than quantity of the data collection. This approach focuses more on the "soft" data, where data is mostly gathered from qualitative and interpretative analysis (Bell and Bryman, 2019; Patel and Davidson, 2019).

Deduction, induction, and abduction are three different approaches to relate theory and research (Patel and Davidson, 2019). Deduction is the most common approach and is based on already existing theories, where conclusions can be made in specific cases or events. Induction is on the other hand an approach where researchers focus on formulating a theory based on the gathered data in the research. The purpose here is to make generalizable theories that is based on the observation and findings of the study (Bell and Bryman, 2019). Abduction is a combination of induction and deduction. The research in an abductive approach usually starts with an inductive approach. The theory is then tested with a deductive approach, where the theory later on can be developed to become more generalizable (Patel and Davidson, 2019).

This study has mainly followed the qualitative approach, where it has been used when gathering data from the case company. Qualitative interviews have therefore been an important data gathering technique in this study, as it has been the main source for the findings. The relation between the theory and research has in this study been based on both a deductive and an inductive approach. To answer Research Question 1, the study has had a deductive approach. This have been chosen since there already exists a lot of theories and research about this area. The design of the assembly line has been based in already existing theories and have been implemented and adjusted to the specific case study. Research Question 2 and 3 have on the other hand had an abductive approach as there is a gap in the literature regarding marketing strategies of the production. A framework from Kannan and Li (2017) have been used as a base for Research Question 2. The data that have been gathered from the case company have been analyzed and

adapted into this framework to create new theories that are adaptable in this specific case.

3.2 Literature review

The literature review has an important role for researchers when formulating the theoretical background (Williamson, 2002). Williamson (2002) continues to point out that literature review allows researchers to identify the current knowledge gaps, which may justify the research work that should be carried out. Additionally, literature review can guide researchers to choose similar methods that may be suitable in the research project, and thereby decide which approach that might be suitable for the study (Patel and Davidson, 2019).

An initial literature review was conducted in this project to gain knowledge about the fundamentals of the subject. Initial literature reviews are conducted through a literature review that focuses on an overview of the existing knowledge and literature within the specific area (Patel and Davidson, 2019). The purpose of the initial review is to investigate the theories and concepts that already exists in the research area. It is from this initial literature review that the research questions should be based and formulated from according to Bell and Bryman (2019). The initial literature review was helpful for defining the purpose and the research questions of this study. There was a lot of information that could be found in the literature regarding the design and line balancing of the assembly line. It was, however, more difficult to find information about marketing of the production. This led to a different approach of this research, with a more inductive approach. The initial review can also according to Patel and Davidson (2019) be helpful for identifying relevant keywords for the specific topics of the study. A mind-map was therefore created from the initial review in order to easier create a structured literature review. The main topics of the study was identified and organized into smaller sub-categories. This was helpful to use when writing the theoretical framework, to make sure that there was no important category that was missing. The mind-map was divided into two different maps (see Appendix 1 and 2), one for each research question.

For the basic literature review, educational textbooks and scientific papers were mainly used. This allowed us to gather basic information to inform the reader about the fundamentals of each specific research area and it serves an important part of the theoretical framework. To increase the reliability, the next step of the literature review was to conduct a structured review of peer-reviewed journals. According to Saunders, Lewis and Thornhill (2016), peer-reviewed academic journals are considered to be the most useful source, since the article will undergo a rigorous process of verification before the publication. This should not neglect the fact which Bell and Bryman (2019) points out, that the reliability may increase when information is compared from multiple sources and the research process achieve triangulation.

The first step of the review was to decide which database that will be used. During the initial literature review, several databases were used, such as Primo, Scopus, Emerald, and Science Direct, as the purpose was to gather information about the existing theories. When the main literature review was conducted, we chose to use Scopus only as a data base. Scopus offers peer-reviewed research literature in the scientific, technical, medical, and social sciences areas, and was therefore chosen as a suitable database for the study. The next step of this review was to decide on the search terms that will be used to find suitable articles for the study. According to Patel and Davidson (2019), it is important that the search terms are central of the field and that they lead towards the right direction of the study. The search terms of the literature study were based on the mind-maps that were developed from the initial review. This was useful for identifying important areas of the literature review, where three main areas were chosen. These areas were: Assembly systems, Designing flexible assembly lines, and Digital marketing. Table 2 shows the results of the structured literature review that was conducted. This review gave in-dept knowledge about the important research areas of the study. The hits of the literature search were narrowed down in three steps to clarify if the studied articles are relevant for the theoretical framework. The first selection was based on the title and the abstract of the article. The second selection was based on a quick overview and the conclusion of the articles. The final selection was based on a thorough reading of the articles. The articles that were chosen have contributed to a more thorough knowledge of the theoretical framework.

Table 2 *– Literature review.*

Theoretical topic	Kewords	Filters used	Hits	1st selection	2nd selection	Papers used
Assembly system	"Assembly system" AND Layout	Language: English Document type: Article Subject area: Engineering	85	39	13	3
Designing flexible assembly lines	“Assembly line” AND Flexib* AND Design	Language: English Document type: Article Subject area: Engineering	154	73	20	6
Digital marketing	"Digital marketing" AND Strategy	Language: English Document type: Article Subject area: Business, Management and Accounting Year: 2017-	139	52	16	3

3.3 Case study

To answer the research questions, a case study has been performed in this study. According to Yin (2018), a case study is a contemporary phenomenon research method where the “case” is investigated in its real-world context. Yin (2018) continues to point out that the strength of case study is that it allows researchers to acquire in-depth insights, where these insights are characterized as empirical descriptions to facilitate the understanding of the phenomenon. Furthermore, to achieve these insights, the case study needs to rely on data collected from multiple sources (Yin, 2018). In case studies, it is common to use both observation, interviews and questionnaires as data collecting techniques (Saunders, Lewis and Thornhill, 2016). The negative aspects of case study

are that it is time consuming to gather and analyse the extensive data (Saunders, Lewis and Thornhill, 2016), since the collected data originates from several of different sources. There can also be a lack of ability to procure knowledge that are generalizable and reliable, which hinders the possibility to applicate the theories in other contexts (Saunders, Lewis and Thornhill, 2016).

The case company in this project is Habo Plast AB, which means that this project was carried out as a single case study. The project was carried out in their facility in Habo, where their assembly processes was studied. This helped us when trying to adapt the theory of designing an efficient and flexible assembly line. Yin (2018) states that case studies should rely on data collected from multiple sources, therefore, the data to answer this research questions has been gathered through both observations and interviews that took place at the case company. To answer the second research question, Habo Plats was instead used to gather information about their marketing strategies, in order find ways to adapt their strategy with their assembly line. This was also carried out as a single case study design and it was an appropriate research design to investigate the theoretical gap regarding the integration between assembly system and marketing.

3.3.1 Observations

Observations is a data gathering technique that is common in exploratory studies (Saunders, Lewis and Thornhill, 2016). There are different observation approaches that can be used depending on the purpose of the study. According to Patel and Davidson (2019), the two main approaches are structured and unstructured observation. A structured observation is used when gathering quantitative data and the main function is to gain information about "what is happening" (Saunders, Lewis and Thornhill, 2016). In this study, we have used unstructured observations as a method to collect information about the current assembly system. Unstructured observations are often used to collect as much information as possible in a certain knowledge area. Instead of having an observation schedule, the purpose is to register and collect as much information as possible in the observation. It is important to prepare for the unstructured observations. Since it is impossible to register everything, we need to know the main areas that are most important to observe, to gain as much important and useful information as possible (Patel and Davidson, 2019). Observations have been used as a complementary method to gather data, as most of the data has been collected through the interviews in this study. Observations has, however, been an important part of understanding the assembly processes. This gave us a more thorough understanding of the processes and fundamentals of the assembly line. Observation was also used to collect information about the cycle times of the assembly operations.

3.3.2 Interviews

One of the most common and useful data collection methods that are used in a case study is interviews (Yin, 2018). Interviews allows researchers to obtain explanatory

information about certain events and especially in case studies, where the interviews preferably “resemble guided conversations rather than structured queries” (Yin, 2018). Interviews can be categorized as structured, unstructured, or semi-structured interviews (Williamson, 2002).

Structured interviews will have well prepared closed questions and developed a standardized format where the respondents are asked the identical questions in the same predetermined sequence (Saunders, Lewis and Thornhill, 2016). This type of interview is useful when performing a comparison of the answers that have been acquired from several of different sources, for instance across different departments within a company. Semi-structured interviews will instead have a standardized list of key questions which are more open and allows interviewees to elaborate their answers. This interview type is characterized by an explanatory approach, where the interviewer is given the opportunity to ask supplementary questions directly (Saunders, Lewis and Thornhill, 2016). This allows further explanation and in-depth understanding of the topic. Unstructured interviews are a common interview type used in case studies. It is characterized by its low level of standardization, with a focus at the exploratory and the in-depth aspects of the topic (Williamson, 2002). The interviewees can speak freely about the different aspects related to the topic and there are no restrictions regarding the format of the interviews (Saunders, Lewis and Thornhill, 2016).

In this project, there have been interviews that are unstructured and semi-structured. In the early stages of the project, the first interviews where completely unstructured, which allowed the interviewers to gain more understanding and in-depth knowledge about the purpose of the project. The information regarding the operation times has also been collected through unstructured interviews. To find out information about Habo Plast’s marketing strategy, semi-structured interviews were used (see appendix 3). A semi-structured interview was used in this case since there was a need for standardized questions to make sure all information gaps were covered, while there at the same time was a possibility to ask supplementary questions directly. The interviewee for the interviews was the CEO of Habo Plast.

3.4 Data analysis

It is important to manage and analyze the qualitative data in case studies in a structured way (Bell and Bryman, 2019). Commonly used techniques to maintain a structured approach is to categorize and tabulate the gathered information, to achieve a transparent displaying of the qualitative data (Bell and Bryman, 2019). Based on this premises, Miles, Huberman and Saldaña (2014) have further developed three general stages, which have been followed throughout the duration of this research project. The first stage by Miles, Huberman and Saldaña (2014) is the data condensation, where the focus is at selecting and simplifying the data which ultimately will result in that the qualitative data becomes more clearer and easier to analyze. Data display is the second stage, which allows researchers to decompress complicated qualitative information and display it in

a structured manner, with the usage of categorizing, tabulation or other visualization techniques (Miles, Huberman and Saldaña, 2014). By achieving the previous stages in a structured way, facilitates the possibility to achieve the third and final step, conclusion drawing (Miles, Huberman and Saldaña, 2014).

In this research project, all the three stages presented by Miles, Huberman and Saldaña (2014) have been followed. The qualitative data used for the analysis in this project have been decompressed and summarized using categorization, tabulation, and figures. In combination with the abductive research approach, these three stages have facilitated the ability to draw conclusions in a structured way as advocated by Bell and Bryman (2019).

3.5 Research quality

This chapter includes a description of how validity and reliability, as well as ethics and morale was followed throughout the project.

3.5.1 Validity and reliability

Validity and reliability are criteria that are important when gathering data in a scientific work (Bell and Bryman, 2019; Patel and Davidson, 2019). The reliability describes how accurate a measure is and a result with high reliability should easily be replicable (Bell and Bryman, 2019). A high validity means that the study is measuring what is supposed to be measured. It is therefore important to consider what it is in the study that must be measured to get valid information that will contribute to the study (Patel and Davidson, 2019). According to Williamson (2002), validity also consist of two aspects which are the internal and the external validity. Internal validity includes the degree of trustworthiness in a cause-and-effect relationship and in what degree the outcome has been affected by unknown factors (Williamson, 2002). External validity refers to the generalizability of the research if the result can be generalized to other context of population or settings (Williamson, 2002).

Considering that this research project includes both qualitative and quantitively data, there are different approaches to determine the validity and reliability. In a qualitative research design, validity and reliability is considered to be so intertwined that the term reliability is rarely used according to Patel and Davidson (2019). Additionally, it is rare to determine the validity of the research by relating the outcome to external objects or positions Patel and Davidson (2019). Patel and Davidson (2019) suggest that instead the validity can be determined by the logical reasoning of the analysis and how the different parts of the research can be connected to the entirety of the research.

Interviews is a method that is commonly used in qualitative research and have been used in this project as well. To achieve higher validity, the interviews was also recorded as recommended by Patel and Davidson (2019). Furthermore, observation was also

used in this project. Structured observation was used to gather the quantitative data that provided information what is happening in the different assembly activities, as recommended by Saunders, Lewis and Thornhill (2016). As parts of these structured observations also was recorded, it increases the reliability regarding the quantitative research approach that is included in this research project.

3.5.2 Ethics and morale

Ethics and morale are an important part of a research project, as it considers the rights of those who are affected by the research (Saunders, Lewis and Thornhill, 2016). Patel and Davidson (2019) have formed four general ethical rules to guide researchers when conducting their research project.

The first ethical rule according to Patel and Davidson (2019), is that researchers need to inform those who are involved in the research project about the purpose of the research that is being conducted. This rule was followed without any issue throughout the project. The second rule concerns the rights of the participants, where they have the right to decide regarding their participation in the research project. Considering that interviews and observations were conducted in this project, the question if they wanted to participate was asked in advance to confirm their willingness to participate. Third rule includes that all participants should be offered confidentiality and that personal information of those involved should not be accessible by unauthorized persons. In this project, the case company is investing a lot of resources into this new venture and detailed confidential information have been shared with the authors, which will not be included in any means in this project. Fourth and last rule considers the data collection on individuals, where this type of data may only be used for research purposes and nothing else. This rule is not applicable in this situation since such data have not been collected.

4 Findings

This chapter covers the data that has been collected from the case company. The chapter is divided into three different sub-headings: product information, assembly system, and marketing strategy.

4.1 Habo Plast

Habo Plast AB was founded in 1970 and has since then been active in injection moulding, where floorball sticks have been their main income. Habo Plast is now planning for a new venture with their newly developed floorball stick.

4.1.1 Product information

The new products that Habo Plast plans to produce is a part of the new venture. The focus on these products will be cleanliness, high-technology, and locally produced products. The product exists of five different modules that are attached with two different screws. Each module is customized and changeable from the customer perspective to have a high customization of the products. This means that there is a high variation among the modules and the products. The floorball sticks that will be offered comes in four different colors, but the colors cannot be changed for the different modules, which means that the floorball sticks will be one-colored. The product variations that are offered are:

Blade:

There will be three different models of the floorball blades that the customer can choose between. These will also come in two different materials and two different blade hooking (left or right). There will be four different colors to choose between, where the rest of the modules will have the same color.

Interface:

The interface is the part that attaches the blade with the shaft. The interfaces will be in the same color as the blade. There will therefore only be four different variants for this module. The interface is assembled on the blade in Habo Plast's plant.

Shaft:

There will be three different types of flex for the shaft. The shaft will also be cut to the desired length that the customers have ordered. The standard length of the shafts will be 104 cm, which can be cut to any full centimeter between 90-104cm. There will also be four different color for the shafts.

Grips:

The grips comes in two different variants, with four different colors. The grips will be attached to the stick by a special winding machine.

Knob:

A knob will be attached to the floorball stick but will only come in one variant and one color.

There will also be two different screws that will be attached to the stick. Six screws will be attached to the interface on the stick, while one screw will be sent to the customers, for the customers to attach the blade themselves. Habo Plast will also put a lot of effort on the packaging of the products, with the purpose that the package should look exclusive.

4.1.2 Assembly system

In the current situation, the different assembly operations are dispersed throughout the plant, which has resulted in a complex material flow for the assembly system. The current assembly system is however not adjusted for the new products Habo Plast plans to assemble. For the new products, there are seven different assembly operations to conduct, which also includes the preparations for transport. Table 3 presents the different operations the operators conduct and the cycle time for those operations.

Table 3 – Assembly operations

Operation #	Operation	Execution	Cycle time (s)
1	Cutting	Cut the shaft to the correct length, using a cutting machine.	10
2	Assemble of knob on the shaft	The knob must be heated before it is assembled.	25
3	Wrap the shaft with grip	This step includes opening the package of the grips, remove paper from the grips, and use the winding machine.	35
4	Put on tape on the grip	Done directly after the wrapping.	15
5	Assemble the interface	Fastening the interface to the blade, using 6 screws.	30
6	Packaging of the product	Package the product together with the blade and an associated screw. This also includes color marking of the package to ease the handling of finished products.	45
7	Preparation for transport	Labelling the package and order shipping.	15
			Total time: 175

The assembly line should be able to handle a product volume in the range between 20 000 to 40 000 sticks per year with a staff of two operators at the assembly line. 30 000 sticks per year was chosen in this research project, as it is the middle volume in the range of 20 000 to 40 000 sticks per year. The operators are working 226 days per year and 7,33 hours per day in the assembly line, and their main goal is to deliver the

products to their customers within 1-2 days. The plan for Habo Plast is to move all assembly operations into one of the rooms in their plant to create a better flow of the material. The incoming material will arrive in the same area as the outgoing finished products (see figure 5). Habo Plast will have a warehouse located in their facility, where the operators in the assembly line can place orders and the material will be transported to the assembly line. The operators will be able to see all the material that is needed for each day and it is their responsibility for ordering more material. The transportation from the warehouse to the assembly line is carried out by other employees and not by the operators in the assembly line.

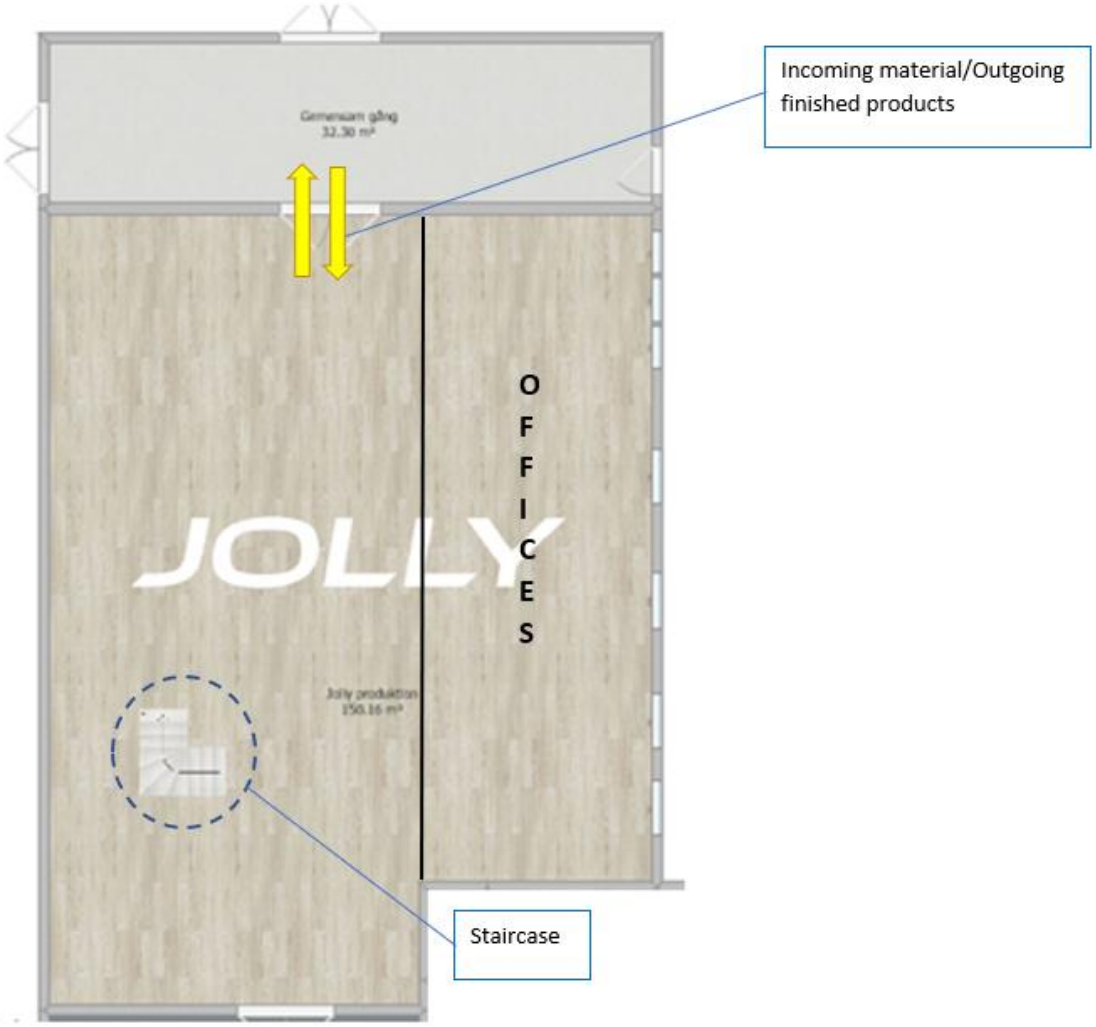

Figure 5 – Overview of Habo Plast's facility for the assembly line.

4.1.3 Marketing strategy

According to Habo Plast, they have a clear marketing strategy of how they want to present the brand and their products to the customers. Habo Plast intend to fully invest in digital marketing, where they think they have the possibility to reach out to their main customer segments. The purpose of the digital marketing is to communicate the advantages of the products and the values that the brand represents to the customers. They want to create a "hype" around their products, where the core values for Habo

Plast will be quality, swedishness and sustainability. Swedishness represents that the product will mainly be produced in Sweden, which in turn reinforces both the high quality and the sustainability aspects that Habo Plast represents. The quality that Habo Plast represents focuses on deliver high product quality to the customers. This is one of their main marketing attributes in their marketing strategy. The sustainability aspects of their marketing strategy are two-fold. One of the sustainability aspects is the product sustainability, which is directly connected to the product quality where they want their products to be durable. The other sustainability aspect focuses on the brand of Habo Plast and how they want to represent sustainability. They want to produce environmentally friendly products throughout their supply chain, as well as including the social aspect of sustainability. This aspect is related to the marketing attribute swedishness, where Habo Plast consider the sustainability to be one of their core values in their products and is therefore important for their marketing strategy.

Habo Plast will mainly focus on digital marketing since they believe it is currently the fastest and the most powerful marketing method. This gives the opportunity for Habo Plast to market on the same terms as their competitors. They also believe that it is on social media that they will find the customer segments that they are searching for. Another reason for digital marketing is the rapidity that can be displayed. New products and prototypes will be presented and communicated through digital marketing to the customers fast.

Most of the marketing strategy will focus on building a content and a network, mainly on social media such as Instagram, TikTok, YouTube, and Facebook. Habo Plast intend to work thoroughly with identifying search terms, movements of their key customers as well as focusing on keyword optimization, to generate network traffic. There will be a webpage with both a Swedish and an English approach, as well as one page for floorball clubs and one page for their end customers. Another approach they will use to reach out to their customers is by creating a Jolly-community where sponsored floorball player will use content marketing to create an even bigger network.

The main focus of the marketing content will be on the products. Habo Plast will focus on techniques, details, and facts around the products to create a demand from the customers. The content will be focusing on the choice of material, the structure, and the different features of the sticks. With this strategy, the aim is to present the products as high technology products, and to highlight their knowledge of designing and creating high quality floorball sticks. Simultaneously, Habo Plast wants their brand to be marketed and presented in a way that represent the company’s long history in floorball. It is also important for Habo Plast to build a high level of trust to their customers. They want their brand to be marketed as a company that stands for what they do, and they will attach a great importance in their values and reliability, which also will be transparent in their marketing of the products. Craftmanship will therefore be a key word for

their brand marketing. The plan for Habo Plast is not to market themselves to as many customers as possible, instead they want to find the floorball players that want sustainable and high-quality products. The focus is therefore not mainly on elite players, but rather on all players that are aware of using products with high quality.

Structure is a term that is used within Habo Plast and it is characterized as the ability of the company to maintain systematic order. High structure also means the opportunity to facilitate the work for the operators, were the material and operations are easily accessible, and easy to understand and perform.

5 Analysis

The analysis will include three main chapters: Assembly system, Digital marketing strategies, and Integration of digital marketing and production efficiency. The first chapter analysis how the assembly line can be designed from an efficiency perspective and which factors that are important to consider when dealing with high product variations. Digital marketing includes which factors of Habo Plast's marketing strategy that the marketing of the production can affect. The last chapter presents the connection between the production marketing and the production efficiency.

5.1 Assembly system

The new assembly system of Habo Plast will rely heavily at the resources provided by the operators. The characteristics of the assembly system can be aligned with the PV-LF matrix developed by Miltenburg (2005), where Habo Plast will have a system that resembles a JIT-system. JIT-system is an appropriate system due to the need of having a flexible system to handle the amount of product variants and the dynamic changes in the volume, triggered by the changes by the amount of customer orders. The volume is estimated to be between 20 000 to 40 000 products during the first year, where a volume of 30 000 have been set for this research project. The products should be delivered to the customers within 1-2 days, which further suggests that JIT is a suitable system as the delivery factor is a competitive advantage as pointed out by Miltenburg (2005).

The assembly layout that is suitable for this situation is the single model assembly system, as described by Thomopoulos (2014). Considering that Habo Plast will have one dedicated assembly system to produce one product with several different variations. There operations within the assembly line will be unchanged, no matter of the customer order. The only operation that will be affected is to what length the stick should be cut to in the cutting station. Even if there are several of product variations, there will essentially only be one product that is produced from the functional perspective.

5.1.1 Flexibility

Habo Plast will be offering their customers customized products that can be adapted to their own needs. Each floorball stick will be unique according to the customer order. One way of dealing with high product flexibility is according to Fredriksson and Gadde (2005) to use modularity. This gives the customers the opportunity to choose between a variety of features within each component of the products. Habo Plast are using modularity to create a variety of products to offer to the customers, while Habo Plast at the same time can have some standard features which will decrease the flexibility for them. The structure of the products can therefore be standardized, which according to Fredriksson and Gadde (2005) can increase the efficiency of the assembly system.

Habo Plast's assembly system must be able to handle a large variety of product variations and must therefore have a flexible system. The number of variations can according

to Hu *et al.* (2008) be calculated by multiplying the different variations of the different components (see table 4).

Table 4 – Compilation of the different component variants.

Component	**Variations**	**Number of variations (approximately)**
Blade	Colours Models Materials Blade hooking	50
Interface	Colours	5
Shaft	Colours Types of flex	15
Grip	Colours Variants	10

The total number of product variants are calculated by not including the different colours more than once, since the floorball sticks will only be sold to customers as one-coloured. The total number of component combinations that will be offered to the customers are approximately 200-300 variants of the floorball sticks. Since there are 200-300 different product variants that the customers can order, it is difficult to forecast the assembly of the products. Thomopoulos (2014) argues that it is advantageous to use Make-To-Order assembly when dealing with a high flexibility and large product variations, which will therefore be adapted into Habo Plast's assembly system. Another key factor for maintaining flexibility and adaptability in assembly systems are according to Busogi and Kim (2017) human involvements, which also will be a key factor for the assembly system in Habo Plast. By using the operators in their assembly system, the flexibility can be maintained at a lower price than using high-technology automation. Hu *et al.* (2008) argues however, that a complex assembly system can result in human errors and affect the production performance negatively. The high product flexibility that Habo Plast will offer requires a high demand on the operators' choice-making. Since there will be almost 100 different variants among the components to choose between, it will require a structured system that can facilitate the operators' decision making which is preferable (Hu *et al.*, 2008). The structured system must therefore include several checkpoints for the customized products. It must also include a logical and organized location of the components in order to reduce the time for searching for components.

5.1.2 Line balancing

To make sure that the customer demand can be fulfilled with 30 000 floorball sticks per year, a calculation of the production rate has been performed. The line balancing of Habo Plast has followed the four steps that Moodie (1981) suggests. The first step is to calculate the cycle time, according to equation (1).

$$C = \frac{T}{D} = \frac{7{,}33}{30\,000/226} = 0{,}0552h = 199\,sec$$

Equation (2) calculated the number of needed assembly stations in relation to the determined cycle time in equation (1).

$$N_{min} = \frac{\sum t}{C} = \frac{175}{199} = 0{,}8794$$

Considering that the estimated cycle time is 199 seconds and the total cycle time for the assembly operations is only 175 seconds. This results in 0,8794 needed operators for the assembly line, which means that only one station and one operator is required to fulfil the customer demand. In the case of Habo Plast, this means that the second operator is not necessarily required, and that the arrangement of the assembly operations can be based solely on the precedence diagram.

The third step is to develop a precedence diagram (Moodie, 1981). According to Stevenson (2009), a precedence diagram is useful for visualizing the sequential orders in an assembly line. Since there only is a need for one assembly station, the precedence diagram is helpful for designing the workflow and the working areas of the assembly line. The precedence diagram in figure 6 is based on the empirical findings from Habo Plast (see table 3).

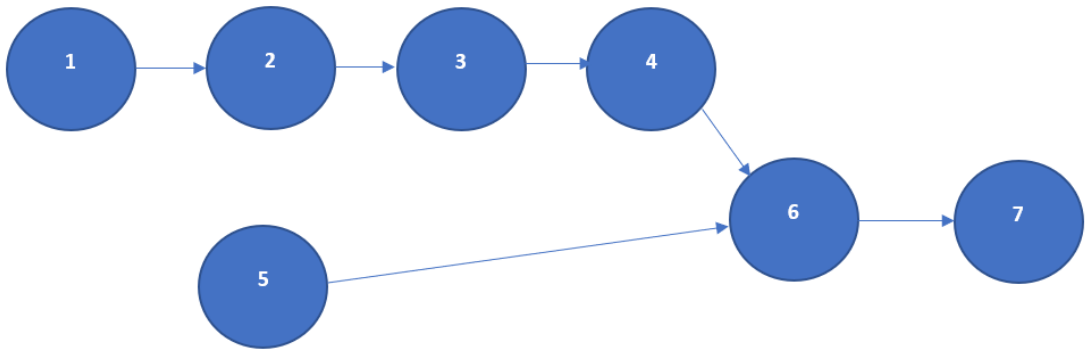

Figure 6 – Precedence diagram of Habo Plast's assembly operations

5.1.3 Assembly line design

There are many dimensions that must be considered when designing the assembly line for Habo Plast. According to Stevenson (2009), the layout decisions have a significant impact on the costs and efficiency of the operations, which means that the assembly line design must be carefully planned. In order to simplify the material handling and the information flow throughout the system, Stevenson (2009) further explains that there are seven different segments that must be considered in order to support these objectives. To make sure that all dimensions are covered for the design of the assembly system in Habo Plast, Stevensons (2009) list has been used as a guideline for designing an assembly layout.

(1) Facilitate attainment of product or service quality

The ambition of the assembly system is to facilitate the making of products which meets the customer requirements according to Stevenson (2009). The assembly system must be designed with the purpose of fulfilling the customer requirements. According to Bellgran and Säfsten (2009) performance objectives are vital for customer requirement evaluations. The customer requirements that will be most important for Habo Plast are mainly quality, but also flexibility and speed. These are three of the performance objectives and is therefore important for Habo Plast to take into consideration when designing their assembly line.

In order for Habo Plast to satisfy their customers, the quality is the most important production performance that the design of the assembly system must focus on. Habo Plast will market their products as high-quality products, which means that the assembly system must support this requirement. Defects is one of the wastes in Lean Philosophy that is directly associated with the customer requirements. Chiarini (2013) suggests that defects often occur due to unclear work instructions and working methods, inexperienced workers, poor production equipment, or problem with the material or the products. This implies that the work instructions and working methods is vital for Habo Plast considering their many product variations. There must be a clear structure for the operator to choose between the different components, and clear work instructions and quality checks, that reassures that the products are correctly assembled. The speed refers to the lead time of the products, which preferably would be 1-2 days. This would require for Habo Plast to have an efficient assembly line, with a make-to-order assembly to reach this customer requirement.

(2) Use workers and space efficiently.

The new assembly line will facilitate the overall utilization of workers and space. Holistically, by allocating all the processes within the same area will increase the efficiency by reducing the overall wastes that occur by unnecessary motion in the current assembly operations, which is pointed out by Chiarini (2013). Furthermore, the utilization of the space is also hampered by staircase that is positioned in the center of the room (see Figure 5). The staircase may affect the space utilization by increasing the distances between the different stations in the assembly line. This may also affect the material flow within the line and from where the operators may collect components during operation time, which ultimately will affect the utilization of the workers.

(3) Avoid bottlenecks

Bottlenecks have a high impact on the efficiency and utilization of an assembly line, where the bottleneck limits the utilization of other operations (Pourbabai, 1994). Line balancing is one efficient method when dealing with bottlenecks in order to create a better throughput in the assembly line (Masood, 2006). Dewa and Chidzuu (2013) argues that the bottleneck can vary between different products if the operation cycle time

differs between the products. In the case of Habo Plast, the cycle time will not vary considering there are only one product that will be assembled but in many variations.

(4) Minimize material handling costs.

The delivery area for materials will arrive in the same entrance as the finished products will leave when they are prepared for transportation. Operators will have material transported to the assembly line when demanded. The operators will have the responsibility of the material flow within the assembly line itself. Considering that the material flow will not change because of the product variations, the flow itself is consistent for all products in the assembly line. This allows Habo Plast to identify potential wastes that will emerge once the line is active and have conditions to eliminate them to minimize the material handling costs (Wänström and Medbo, 2009).

(5) Eliminate unnecessary movements of workers or materials

Unnecessary movements of the workers are directly related to the waste motion. This waste often occurs then there is a poor layout design, inexperienced workers or lack of structure of the production equipment (Chiarini, 2013). This waste is important to consider in order to eliminate the non-value-added work of the operators. Since Habo Plast will have many variations of the components, there are many items that must be placed strategically. To decrease the motion for the operators, all components must be placed in adjacent to the assembly line. It can, however, difficult to optimize the efficiency of the assembly line before the production of the products have started. The assembly line can be even more structured after some usage, where data can be collected from actual assembly operations instead of only using presumptions. It will therefore be important for the operators to work with continuous improvement and develop the assembly line from real life scenarios.

(6) Minimize production time or customer service time

The assembly line will be characterized as a JIT system, with an aim to reduce the customer service time by identifying and removing wastes within the assembly line as Miltenburg (2005) described. Using JIT in combination with the new assembly layout will facilitate Habo Plast ability to manage the inventory and minimizing the risk of causing another waste, which is overproduction. This is further enhanced with the usage of make-to-order assembly. Additionally, the production time will be even further reduced with the new assembly line, considering that all the processes will be located close to each other, compared to the current assembly operations.

(7) Design for safety

The layout design should support both the ergonomic and safety aspects that must be considered. The design for safety is an important aspect to consider for the assembly line since ergonomic workstations reduces work related injuries and can even improve

the overall performance, according to Dul and Neumann (2009). This will especially be important for purchasing the production equipment in the assembly line.

5.2 Digital marketing strategies

Habo Plast digital marketing strategy revolves around the development of a social media network, which is integrated by identifying search terms and optimizing keywords to facilitate the identification of the value for the customers. Using the framework developed by Kannan and Li (2017), it is possible to identify which marketing aspects that can be integrated with the production, in this case the assembly line.

The box *outcome* (see figure 4) in Kannan and Lis framework, includes *value for customers, customer value* and *firm value*. In this analysis, the focus will be upon the *value for customers.* The reason why customer value and firm value are neglected are because they have no direct connection to the marketing of production. Value for customers has potentially several links to the company's marketing strategy and the possibility of integrating this into the assembly line. This was identified partly by the results of findings, as well as the definition of the subcategories within value for customer, which are: *Value equity, Brand equity, Relationship equity and Customer satisfaction*. *Value equity* represents how Habo Plast want their customers to perceive them as a company. Habo Plast has stated that it is important for them to present their core values of the company to the customer, and that their values should be represented to the customers in both their products and in their marketing. *Brand equity* represents how Habo Plast wants to market their brand. Habo Plast want their company to be presented in a different way compared to the products. The brand should be presented as a high-quality brand that has been established in the market for a long time, where the key words for the brand marketing will be quality and craftmanship. *Relationship equity* refers to Habo Plast's communication with their customers, where they wish to have a close relationship with a high level of trust. *Customer satisfaction* represents how Habo Plast wants the customers to perceive the company based on the products and services that are offered. The quality and the flexibility play an important role in this category, which will be an important aspect for Habo Plast to market.

Based on the interviews with Habo Plast, Habo Plast's marketing strategy has been broken down into different marketing attributes and placed into the four different categories (see table 5).

Table 5 – The marketing attributes that are included in the different values for customer.

Value for customer	**Marketing attributes**
Value equity	- Quality - Swedishness - Sustainability - Reliability
Brand equity	- Quality - Rustic - Craftmanship
Relationship equity	- Invitation to facility - Fast communication & close relationship - Jolly community - High level of trust - Find the right customer segments
Customer satisfaction	- Quality - High-technology products - Flexibility, product variants - Reliability

The 4P's in the marketing mix, *product and service*, *price*, *promotion* and *place* have been more or less neglected as they are not providing clear connection towards the production and the purpose of this project. Instead, the marketing mix was replaced with *production* as this term offer a transparent connection with the purpose of this project. *Production* will include some of the marketing mix as provided in the framework by Kannan and Li (2017), but *price* will not be included in this analysis because the decision made by Habo Plast that they are willing to be placed in higher price class. Additionally, this project does not involve an investigation regarding the affects that price may have at the possibility of using the assembly line in the context of this project. But the *promotion* aspect will still be included in a certain degree, as the production (e.g., the assembly line) will be used as a marketing tool to promote the equity aspects represented in table 5.

In the box *environment*, only the *social media & user generated content* and the *contextual interaction* perspective will be involved. These perspectives are included as they are within the scope of this project, while *customer behavior*, *search engines* and *platforms/two-sided market* does not. Social media will be the main marketing channel in the new marketing strategy of Habo Plast, which also will be complemented with the ambition of building a digital network where the different stakeholders contribute and form the *user generated content.* There are two different interactions considering the *contextual interaction*. The first interaction is the digital interaction that will occur between the customers and Habo Plast. This interaction will happen in the social media network, which will allow Habo Plast reach many potential customers as pointed out by Asma, Mary and Prestin (2020). The second interaction involves a more physical interaction, which is the invitation to the facility, where Habo Plast ambition is to enhance their relationship with the customer. The assembly line will be vital in this

interaction and a useful marketing tool to achieve the intended close relationship and trust with the customers.

The framework (see figure 7) shows in which of the values for the customer that the marketing of the production can reinforce the customers perception. In *Value equity*, marketing the production can affect how the customers perceive the quality, swedishness and the sustainability. Habo Plast wants to emphasize that the products are locally produced and that they are proud of the swedishness of their products. This can be marketed by presenting the assembly line to be located in Sweden. The swedishness will also represent their values for high quality and sustainability.

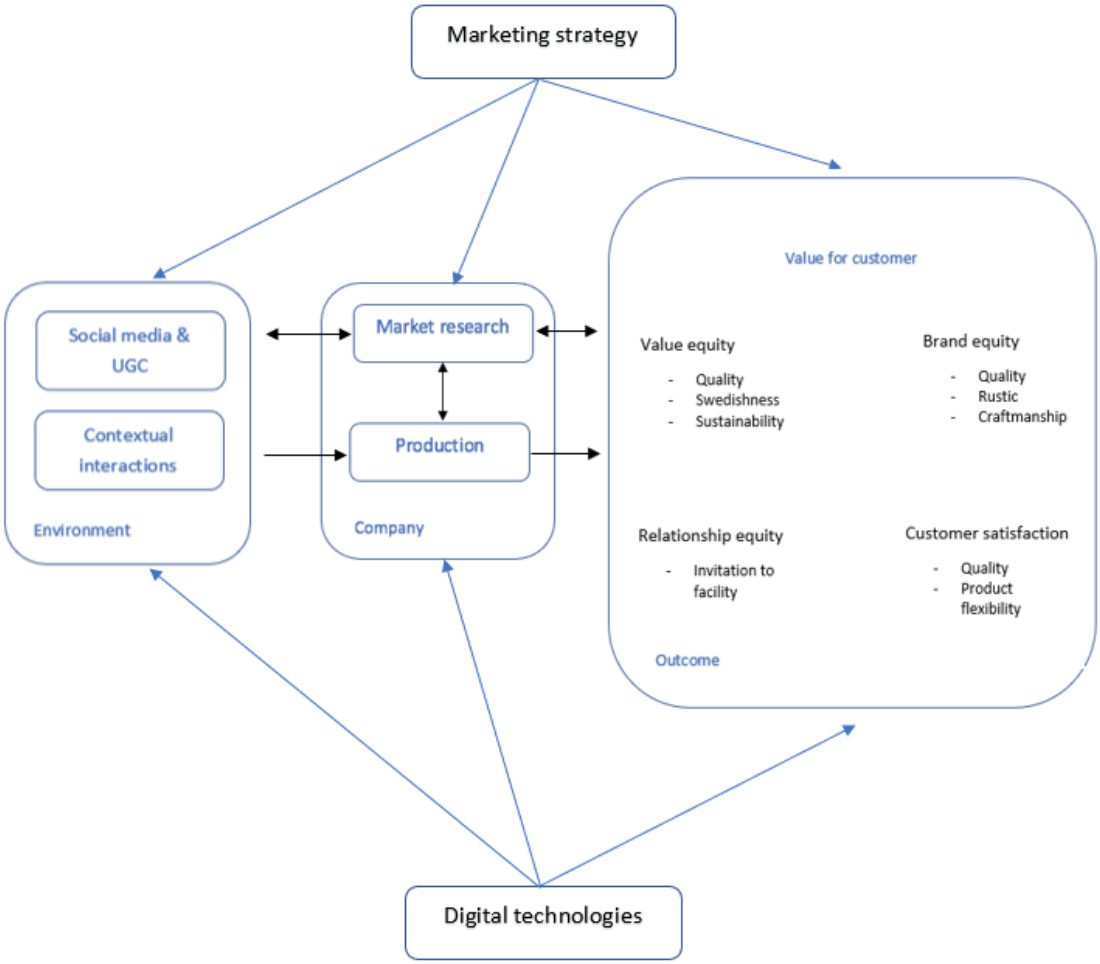

Figure 7 – Digital marketing strategy adapted from Kannan and Li (2017) to Habo Plast's production marketing.

Marketing of the production can affect the Brand equity for Habo Plast. The assembly line can in this case be used as a marketing tool to enhance the feeling of a brand that represents high quality, rustic, and craftmanship. The rustic of the brand can be marketed by having a production with rustic colours that reminds of an old industry. Habo Plast wants this to be marketed, especially since their facility is located in an old

industrial building. The quality and the craftmanship can be marketed through showing the assembly operations of the products, and how all operations of the assembly process are done by the operators only using their hands.

The customer satisfaction can be affected through the quality, high-tech products, and the flexibility of the products. The flexibility of the products and the many product variants can be marketed through showing the many components in the production. It will in this case be important that the components are visually structured in the assembly line, creating an environment that also is representative for the quality. The high-tech products can be marketed through close ups on the assembly operations and information regarding the features of the floorball sticks.

Relationship equity involves how Habo Plast plans to communicate with the customers. It is important for Habo Plast to maintain a close relationship with their customers. Habo Plast plan to invite their customers to their facilities and show how their products are being produced. They want their customers to be involved in the activities of the company. In order to build a close relationship with their customers, Habo Plast will be using content marketing. When using content marketing it is, according to Asma, Mary and Prestin (2020) important to understand the expectations of the customers before presenting the content to give them the best possible experience. Ho, Pang and Choy (2020) further explains that the content marketing must be aligned with the brand values to create convincing content for the customers. This means that it will be important for Habo Plast that the assembly line of the floorball stick will represent the core values of Habo Plast: Quality, Swedishness, and Sustainability.

5.3 Integration of digital marketing strategies and production efficiency

The integration of designing an efficient assembly line and the production marketing is affecting each other in different ways. The marketing attribute quality might have both a positive and a negative impact on the assembly line when marketing quality through the production. In order to mediate high quality to the customers, it is important that there is a cleanliness, which requires a high level of structure in the assembly line. It will also be important that the operators give the impression of being knowledgeable to increase the impression of quality. It will therefore be advantageous to have a well-defined working structure and work instructions to ensure the operators' working competence. Both of these connections are affecting the assembly line in Habo Plast positively since it will minimize the potential errors caused by humans, as pointed out by Busogi and Kim (2017). The high level of structure might visually be less perceived with a U-line. The assembly line is visually more structured when having a straight line. There is therefore a negative connection between the marketing attribute Quality and the assembly line in Habo Plast, as Miltenburg (2005) states that a U-line is easier balanced and is easier to reach higher efficiency than a straight line.

Swedishness and Rustic are attributes that can be marketed through the production but does not affect the efficiency of the assembly line. Both of the attributes mainly affects the visual aspects that concerns the assembly line.

The marketing attribute sustainability can be divided into two different categories: product sustainability and Habo Plast's values of sustainability. The product sustainability is considered to have a positive impact on the assembly line. Product sustainability is connected to quality where a high level of structure plays an important role to mediate the values of sustainability through order and cleanliness. This would affect the assembly line for the same reason as for quality. Secondly, the sustainability also involves the values of Habo Plast were they consider the environmental and social sustainability aspects. This could therefore reinforce the impressions of sustainability through having an assembly line that is concerning the ergonomical aspects. This will also have a positive impact on Habo Plast's assembly line since Dul and Neumann (2009) argues that ergonomic work stations will have an impact on the overall performance in a company.

Habo Plast wants their products to be marketed as crafts. This delimits the opportunity for Habo Plast to choose automation for their assembly line. It is, however, not necessarily negative that they are not using automation in their assembly line. Considering their many product variants it might be advantageous to handle the complexity through the operators, which Busogi and Kim (2017) point out being a key factor when dealing with high complexity in assembly lines. It could, however, be unfavorable to not have the opportunity to use automated assembly operations, in case of increased volumes where automation is prefered.

Habo Plast also plans to invite customers and retailers to the facility to introduce them to the core values that Habo Plast represents. In order to present the assembly line in the best possible way, it will be important that there is a high level of structure in the assembly line. Structure in this instance refers to the importance of cleaningness and systematic order in the assembly line. This will help to enhance the impression of selling high quality products. Another aspect that must be considered when inviting customers and retailer to the facility will be to make sure that there is space for the guests to observe the assembly operations that are being performed. The best solution in this case would be to use a straight line of the assembly operations, where it is easy to see all operation and follow the product flow. This would also be beneficial for the guests as there would be clear space for them to observe the assembly line. Considering the current space of the facility, having a U-line could be complex when also inviting guests to the facility. This would however, affect the efficiency of the assembly line negatively considering that a U-line is advantageous when dealing with complexity and space utilization, according to Miltenburg (2005). In the case of Habo Plast, having a

straight line will be enough for them to reach their wanted production rate based on the line balancing, which means that it is a trade-off that Habo Plast can afford.

The product flexibility and the many product variations could also be marketed through the assembly stations by showing all components for the products. This could be marketed through social media to inform the customers about their many product variants that Habo Plast are offering. Considering there are 48 different blades for the floorball stick, this would require a high level of structure of the components in the assembly line. Having a well-structured assembly line would also facilitate the work for the operators as it would decrease the complexity and reduce the human errors according to Hu *et al.* (2008).

Table 6 shows how the different marketing attributes of the production marketing might affect Habo Plast's assembly line. The attributes affect the assembly line in different ways and is therefore divided into two categories: positive connection and negative connection.

Table 6 – Compilation of the connection between the production efficiency and the different marketing attributes.

Marketing attributes	**Positive connection to production efficiency**	**Negative connection to production efficiency**
Quality	High level of structure Ensuring operator competence	Less structure with U-line
Swedishness	-	-
Sustainability	High level of structure Ergonomic	-
Rustic	-	-
Craftmanship	-	No automation
Invitation	High level of structure	Space utilization
Product flexibility	High level of structure	-

Based on the integration of Habo Plast's marketing strategy and the assembly line efficiency, a sketched layout has been developed (see figure 8). In this layout, the marketing attributes and their connection to the efficiency of the assembly line has been considered. From the different connections to the production efficiency, it is only the connections that concerns the space utilization that affects the assembly line layout. In the sketched layout, one of the main concerns was therefore to make sure that there is space for visitors to observe the assembly operations. A straight line for the assembly line is therefore necessary, even though Miltenburg (2005) argues that it is less efficient with a straight line compared to a U-line. This will also create a higher level of structure that might also affect other marketing attributes positively. The assembly areas of the suggested assembly line: A, B, C & D (see figure 8) are a combination for the different operations that can be executed on the same working area. They should not be seen as

stations but rather as a placement of the equpment that are needed for the different operations. Another important aspect for the assembly line design is the space utilization for the many component variants that must be placed close to the assembly line. The space for the components are therefore behind the assembly line, placed behind the assembly operation for the specific component attachement. The reason why components are placed behind is to emphasize the visibility of the work conducted by the operators from the walking area. Habo Plast said in the interview that it is necessary for their marketing strategy, although wastes will occur that impacts the utilization of workers and the motion of the assembly line negatively (Chiarini, 2013).

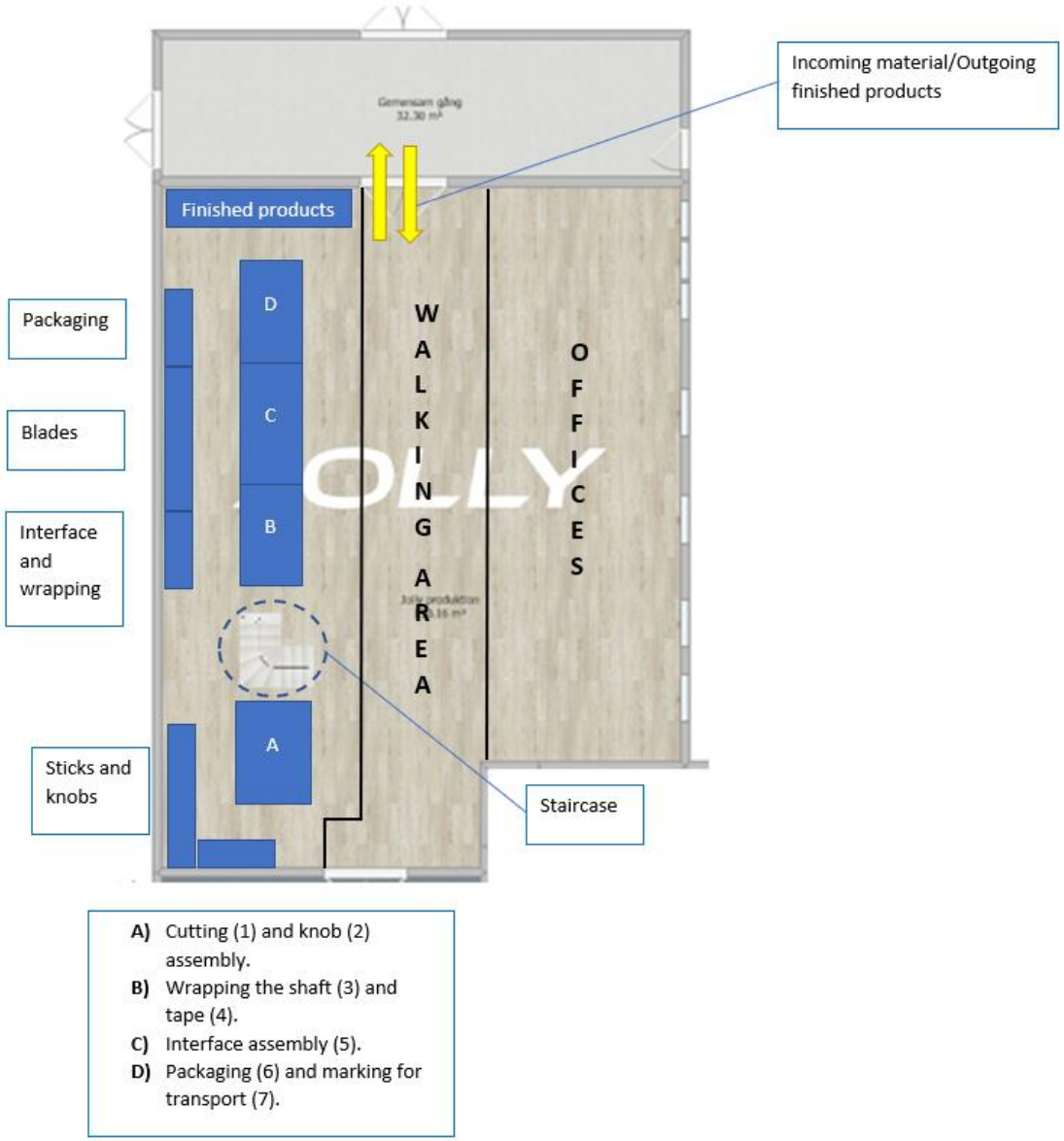

Figure 8- Layout sketch of the assembly line

6 Discussion

In this chapter the analysed findings, as well as the chosen methods will be discussed.

6.1 Discussion of findings

This section further develops the authors' thoughts on the findings.

6.1.1 Assembly system design

The foundation of the layout design of this study is based on Stevensons (2009) list where he describes seven important aspects to consider when designing a production layout. The list was helpful for a general overview over important aspects when designing a layout, which made it appropriate to use in the study. The seven different segments are however broadly described and can only be used as guidelines for such cases. The segments must therefore be supplemented with methods that can be used for fulfilling the segments of the list. By using line balancing as a layout designing method, it takes into consideration several of the different segments that are necessary to consider according to Stevenson (2009). The list was further on also supplemented with taking the different wastes in lean into account. The lean aspect was in this case valuable for increasing the knowledge about production efficiency even more and emphasize the important of decreasing the non-value-added activities.

Considering that the calculations for the line balancing showed that there is only need for one operator and one station in the assembly line, there was no need for further calculations as all assembly operations are feasible within the wanted production rate. Since Habo Plast will be able to keep the demanded production rate with one operator, but has planned for using two operators, it means that they have the possibility to handle increased volumes in the future. Using two operators in their production line will also facilitate their digital marketing strategies, as they will have the possibility to make trade-offs in favor for the marketing aspects.

6.1.2 Production marketing

The major changes to the framework by Kannan and Li (2017), was to neglect and adjust different aspects and make it more suitable for the purpose of this research project. In the *environment*, only *social media & UGC* and *contextual interactions* was included. *Social media & UGC* is directly related to the marketing strategy approach of the company and the purpose of this research and was therefore included in the framework. Additionally, the *contextual interactions* were included due to the different interactions the customers will have with the production. The interactions will either be through digital technologies, such as social media, or it will be through physical interactions where the customers are invited to the facilities. The remaining aspects in the *environment* were excluded, due to their lack of connection with the marketing of the assembly line and their potential implications to the functionality of the line.

Another change of the framework was to neglect the marketing mix and use *production* instead. But it is also important to remember that some of the marketing mix was still included in the *production* as explained in the analysis chapter. It is still considered to be a valid and necessary change, as the *production* will result in a more logical and clearer connection that is aligned with the purpose of this project. It is important to emphasize how the framework has affected the project in a positive way, especially the facilitation of the opportunity to identify which aspects affects the assembly line and how.

The *value for customer* outcome from the framework was included in the analysis, while the other two outcomes were neglected due to their lack of connection towards the marketing of production. While these outcomes may not have been suitable for this study, they still have valuable attributes in other situations and are recommended to use for a more comprehensive study. Considering that this study was conducted in an early stage of the company's marketing strategy and their development of their new assembly line, it is justified to only focus on the *value for customer*. Nevertheless, in a later stage of the marketing strategy and the assembly line, it would be interesting to investigate how the assembly line may be integrated and used for an extended purpose. This purpose may then be connected to the *customer value* and *firm value*, and these outcomes may provide additional interesting financial results. Thus, including the financial aspect can further justify if the integration is economical beneficial, and consequently providing a more solid and complete end result.

6.1.3 Integrating production marketing and production efficiency

The result from this study shows the connection between Habo Plast's different marketing attributes and its affection on the production layout and efficiency. It is vital to emphasize that these results are only based on Habo Plast's marketing strategy. Habo Plast's marketing strategy is very specific and might therefore not applicable for other companies' marketing strategies. What can be generalizable to other studies is that the study shows that there is a connection between the production and the marketing strategies when using the production as a marketing tool. An important aspect to consider for companies, which marketing strategy is to market their production, is to be aware of that some trade-offs might be necessary to consider. The result from this study shows that the marketing attributes is not necessarily positively aligned with the production efficiency. It is therefore important for companies to thoroughly evaluate the marketing strategy and attributes that are relevant for their own situation and investigate if they have any impact on the production efficiency. If there is a negative connection between the production marketing and the production efficiency, a trade-off must be made where the different outcomes must be set against each other. The result does, however, also indicate that there is an important connection concerning the structure of the production that aligns both the marketing strategy of marketing the production and the production efficiency. By showing the production in social media and inviting customers to the

facility, it forces companies to create a cleaner environment in their facility. The integration of marketing and the production might therefore result in a more structured production, and thereby also affect the production efficiency positively.

Structure have been identified to have a positive connection between the marketing strategy and the assembly line. In this context, structure is the company's ability to maintain systematic order. The analysis resulted in that the positive connection was due to the high level of structure and related to several of the marketing attributes. The quality attribute will affect the production positively through structure, as the structure will systemically minimize the human errors that will occur (Hu *et al.,* 2008). Since structure will cause the product components to be placed in a manner that will facilitate the selection of the components for the operators and minimize potential assembling errors. Additionally, space will be required to maintain and manage the structure due to the large volume of different product components. This does not necessarily mean that the floor utilization will be heavily affected, since components can be place in shelves which probably would be a sensible approach to minimize the already limited floor space. The structure of the assembly line is also connected through Habo Plast's plan to market their large variety of products that they will offer. By marketing their many product components to their customers, it will require a high level of structure in the assembly line in order to present the cleanliness that will be a key factor when marketing on social media. As can be seen in table 6, structure is the connection that is mentioned most frequently for the marketing attributes and are only used as a positive connection. It can therefore be stated that when using the production as a marketing tool, it comes with the positive connection of including structure in the production, which in turn has many advantages when it comes to production efficiency.

As mentioned previously, tradeoffs may and have occurred between the production and the marketing strategy. One of the identified tradeoffs was between the marketing attribute of craftmanship and the production aspect automation. Habo Plast wants to market craftmanship, using the manual work conducted by the operators. But if the new venture of Habo Plast becomes successful, it is important to consider the potential actions in the future of the company. For instance, a decision that probably must be made is when the production volumes increase to a point where the manual work is overburden. If this becomes the reality, the company must be prepared for a strategic marketing decision and once again consider the marketing tradeoff between craftmanship and automation. In the current situation of Habo Plast, the manual work of the operators is aligned with Habo Plast's marketing strategy of craftmanship. It does, however, limit their possibilities to use automation in the future, and makes it a trade-off that they might have to consider.

Another tradeoff that was identified occurred between the placement of product components and the visibility of the assembly line. Habo Plast considered it to be a

necessity, from a marketing perspective to minimize any hindrance of the visibility from the walking area. By placing the product components behind the assembly line and aligned against the wall, will cause the operators to have unnecessary movement in their daily operations. If the product components were placed in front of the operators, the waste will be eliminated but the marketing strategy will instead be impacted negatively.

Swedishness and rustic are words that are abstract and difficult to comprehend in this situation. As mentioned earlier, swedishness refers to that the products are locally produced and that the company are unique in the market to offer an all-Swedish floorball stick. But as the term swedishness is abstract, it results in being difficult to interpret, which makes it problematic to convey this to the customers. Due to this reason, it was considered that there was no clear link between swedishness and its impact on production. Rustic is also an abstract term that have been used, which is similar to swedishness makes it difficult to identify its connection towards the production. In Habo Plast's marketing strategy, it is considered that there is value in the fact that the production itself is located in old industrial facilities, as this conveys that the company have been in the industry for a long time and possess experience. The actual functionality of the production is not considered to be affected by the fact that the facility is rustic in this case. Furthermore, it is important to point out that similar abstract marketing attributes may potentially affect the production in other case companies. But in this particular case, it is reasonable to make the assessment that these attributes do not affect the production.

Depending on the marketing strategy of the production marketing, there might be some trade-offs that must be considered. It is however, shown that there is a positive connection between the production marketing and the production efficiency. The result indicates that it actually can be beneficial to market the production in order to create an environment in the production that concerns both a higher level of structure, the operators' competence, and the ergonomic aspects. Simultaneously, it is important to consider the generalizability of this framework and to point out that the result of a similar study using this framework would probably have been different if it had been carried out with another case company.

The results from the integration of the assembly line and the marketing strategies of Habo Plast shows that the assembly line and the marketing attributes affect each other in many different ways. The main connection between them are that marketing of the assembly line requires a high level of structure in order to make it attractive to the customers. Having a structured production will in turn result in many advantages also for the efficiency of the assembly line. There are, however, some trade-offs that must be considered. In this case, an important marketing aspect for Habo Plast will be to use a straight line instead of a U-line in order to persue their marketing strategy. This could

affect both the line balancing, material flow and the efficiency of the assembly line. But in the case for Habo Plast, these aspects are not necessarily affected considering that they only need one operator in the assembly line to satisfy the customer needs.

6.2 Discussion of method

The aim of this study was to investigate the integration of production marketing and production efficiency. Due to the lack of existing literatures within this area, an abductive approach of this study was necessary, where already existing theory was further developed and adapted to the case company. The data gathering for this study has mostly been qualitative, where interviews and observations have been used as data gathering techniques. The qualitative approach gave the authors the possibility to thoroughly understand Habo Plast's marketing strategy and their aim with marketing the production. This was especially useful for understanding how their marketing strategy in the long term could affect the assembly line layout and the efficiency. Considering that this is an abductive approach and no theory have been found regarding this subject, it has been difficult to find similar theories and compare the work with other researchers' results. This have instead resulted on a more thorough theoretical framework, where we instead had to combine these theories together.

The theory that was chosen to base this study upon the digital marketing framework was from Kannan and Li (2017). This framework was appropriate and useful for this study as it provides a holistic perspective of digital technologies are connected with the different business activities and how these activities interact with digital technologies and forms the digital marketing strategy. As this study focuses on the interaction between the production aspect and digital marketing, some parts of the framework were changed for additional suitability. This was helpful for understanding and relating the production aspect with the holistic perspective of digital marketing strategies.

The validity and reliability of this research project has been taken into consideration. To ensure the validity of this research to a certain degree, the semi-structured interviews and observation was recorded as recommended by Patel and Davidson (2019). The reliability of the quantitative data, such as the cycle time, has also been increased due to the recording. Since the cycle time in this research has been estimated, the recorded observations facilitated the estimation of the cycle times. The research design of this project has been abductive, where parts of the marketing and integration analysis originate from the logical reasoning based on the theoretical background. This have impacted the internal validity, as the reasoning of this work may differ from similar work within this area, due to difference in theoretical background. The external validity and generalizability of this work are dependent on digital marketing strategies of other companies. This is because the impacts of marketing strategy at the assembly line may differ, as companies will have different marketing strategy and therefore different marketing attributes that could be integrated in the assembly line.

7 Conclusions

This chapter includes the conclusions that can be drawn from the report. The implications and further research of the study is also described.

7.1 Conclusions

High flexibility and an efficient production are important aspects for companies in order to stay competitive in today's volatile and globalized market. Another important aspect to reach out to customers are to have a suitable marketing strategy. This report presents guidelines for designing an efficient assembly line with a high flexibility, as well as integrating the assembly line with the marketing strategy of the case company Habo Plast.

7.1.1 What aspects are important for designing an efficient assembly line with high product variations?

This question has been answered through the literature review that has been combined with Habo Plast's production, which in turn has led to the follow conclusion:

- The analysis shows how that the seven aspects developed by Stevenson can be combined with the wastes of lean philosophy to create useful guidelines to follow when designing an efficient assembly line with high product variations.
- A practical tool that can be used is line balancing, which is helpful for determining the arrangement of the assembly line.
- High product variations will be one of the main concerns for Habo Plast. For Habo Plast it is advantageous to deal with the high product flexibility with manual assembly operations, create a systematic order for the component variants, and using make-to-order assembly.

7.1.2 What aspects of an assembly line can be affected by the digital marketing strategies?

This question is dependent on the marketing strategies of a company. The aspects that are presented here are therefore based on the marketing strategies of Habo Plast.

- The analysis shows that the marketing attributes quality, sustainability, invitation, and product flexibility can affect the production efficiency (see table 6).
- The aspects of the assembly line that Habo Plast's digital marketing strategy affects are the layout design, the structure of the assembly line, the ergonomic aspects, the space utilization, and ensuring the operators' competence.
- The result of this study shows that it could be beneficial to integrate the marketing strategies with the production, as the cleanliness and structural order that are necessary when marketing the production also has a positive effect on the production efficiency.

7.1.3 What potential trade-offs exists when integrating digital marketing strategies with the design of an assembly line?

The conclusion for this question is based on the second research question and is very specific for the case company in this study,

- In the case of Habo Plast, the bigger trade-off is that there is no possibility for using a U-line in the production, which is proven to be a much more efficient and easier balanced assembly layout than using a straight line.
- Another trade-off that Habo Plast is facing is the placement of their components for the assembly line. As they wish for cleanliness and visible assembly operations, the placement of some of the components must therefore be placed behind the operators, which in turn will increase the waste of the assembly line.
- A future trade-off that Habo Plast might need to consider is the craftmanship of the assembly line. Craftmanship is one of their important marketing attributes, but with highly increased volumes of the products, automation might be favorable.

7.2 Implications and further research

The implication of this study is both theoretical and practical. The outcome of this study suggests that there is an unexamined connection between the production efficiency and marketing the production. The study is also mainly directed at Habo Plast's company and suggested solutions for their desired assembly line. The result of this study is a guideline for an assembly line that is designed with the purpose of both having an efficient production and a useful marketing tool. The results are, however, only based in the initial studies on the products that have been performed at the case company. It will therefore be important for Habo Plast to follow up the assembly operations and continue with improvements to increase the efficiency even more. Another aspect for them to consider is to also use line balancing in their assembly system in order to optimize the assembly line further.

Considering that there is no current research within the production marketing field, there are many parts of this subject that could be further investigated. There is a lot of literature within each subject, but there was no research that could be found regarding the integration of marketing the production. Production marketing seems to be an uninvestigated subject, which means that there are potentially many new possible research areas. The result of this study shows that there are evident connections between the two different subject that brings them together, which should be further investigated for an even more accurate result. This study mainly indicates that there is a connection between the production marketing and the production efficiency. One main research area could be to create a generalizable framework or model that companies, who wishes to use their production as a marketing tool, could use as a guideline for understanding the relationship between the two subjects. A framework could also be useful for companies to easier make decisions regarding the trade-offs that might occur when marketing the production.

8 References

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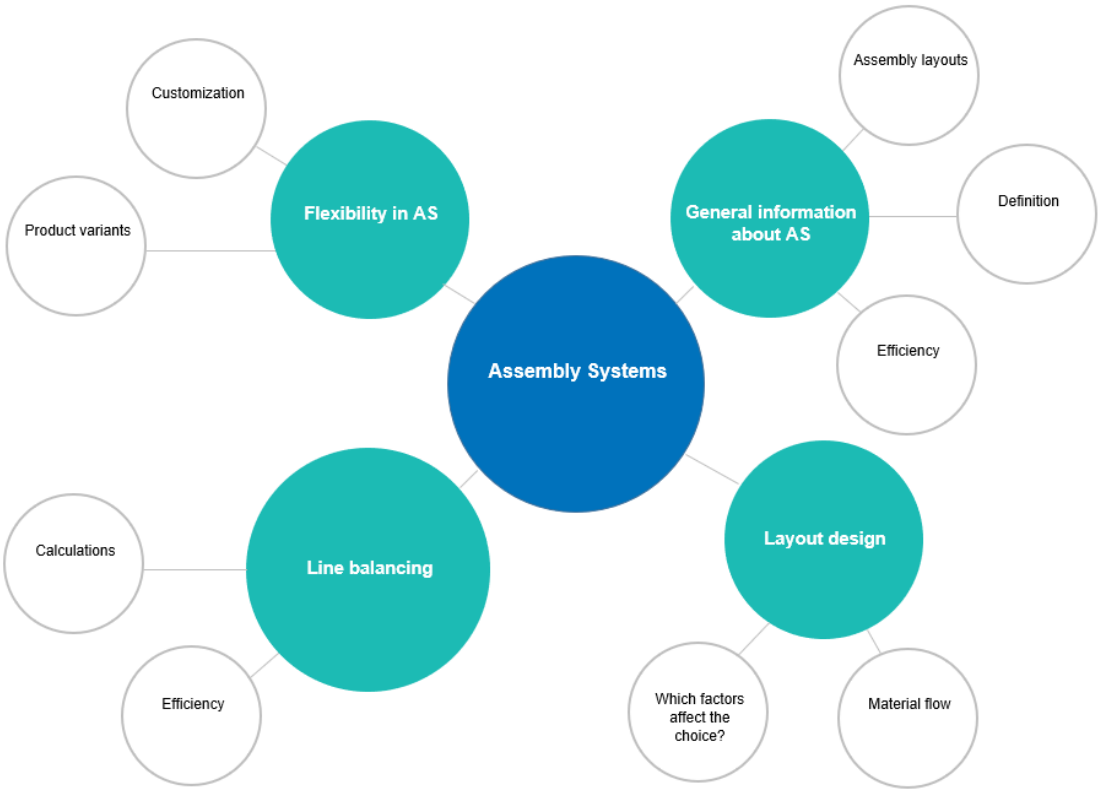
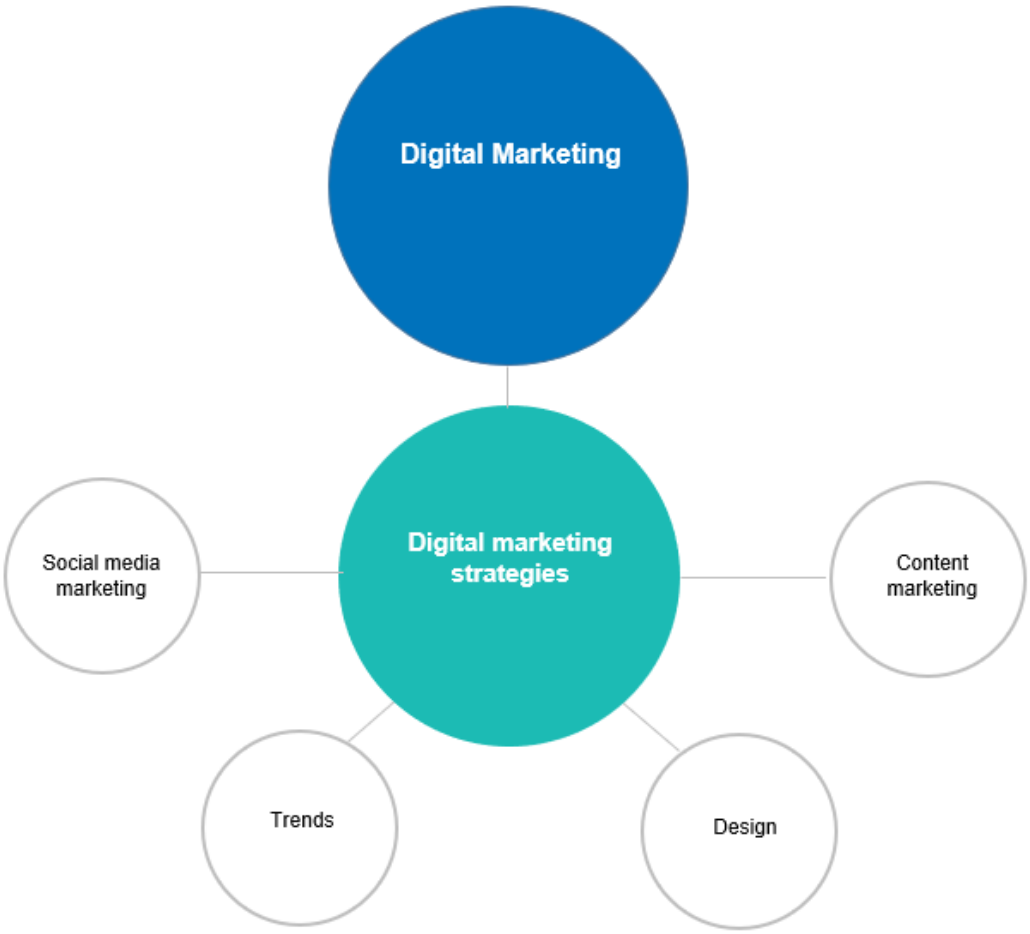
9 Appendices

9.1 Appendix 1 Assembly system mind-map for the literature review



9.2 Appendix 2 Digital marketing mind-map for the literature review



9.3 Appendix 3 Semi-structured interview questions 2021-03-15

General information

- Does Habo Plast have a clear / pronounced marketing strategy?
- What is the ambition with your marketing?
- Which customer do you want to reach?
- How do you want customers to see / perceive you as a company?
- Are you actively working on your marketing strategy?

Marketing of production using digital marketing

- What is the goal of marketing the production?
- What is the goal of digital marketing? Why is social media your main marketing tool?
- How do you think your new concept should be seen in marketing? Is this an important part of marketing the production?
- In what contexts do you think the production will be marketed?
- How do you want customers to perceive the production?