Analysing the consequences of a future implementation of a new logistics concept

A case study at Volvo Trucks

Master's thesis in Supply Chain Management

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Abstract

The automotive industry and vehicle manufacturers are constantly tackling new logistics challenges and changes on the market. Increased demand for customised vehicles forces the actors to switch from mass production to mass adaptation, which leads to increased variety and number of components. The changes in the industry and future launches of new models and electric trucks puts pressure on Volvo's logistics management, and the requirements for flexibility and quality has become increasingly evident. To tackle the challenges, and to be able to introduce additional material in the plant, Volvo has established a new logistics concept: Material to Man, where the material is delivered to the operators, instead of vice versa. A central part of Material to Man is to increase the use of kitting, which is an activity that prepare the material for the operators in pre-organised kits, to facilitate the assembly and save time on the main assembly line.

Interviews with logistics engineers and managers, followed by a literature review and observations in the plant, have been conducted to establish an understanding of Material to Man and the conditions and possibilities at Volvo's plant in Tuve. For Volvo to evaluate the possibilities of the Material to Man, the consequences of a future implementation of the concept have to be analysed. This has been achieved by analysing the consequences in terms of transports, operators, and space, through seven different potential scenarios, based on the fundamentals of Material to Man. Internal data, measurements, and calculations has provided an overview of the potential consequences of the concept as a whole and of the different scenarios.

The results indicated that no single scenario would provide all benefits of Material to Man simultaneously, but that Volvo needs to prioritise and decide what is most important for a future implementation, given the current constraints and conditions in the plant. Finally, further research regarding simulation of the logistics flow, feasibility of the scenarios, and establishment of a business case would be valuable for a deeper insight in the advantages and disadvantages of Material to Man.

Keywords: M2M, Kitting, Flexibility, Quality, Logistics, Operator, Transport, Assembly line

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Hanna Norlander & Vituong Thai, Gothenburg, June, 2021

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Chapter 1

Introduction

1.1 Background

The background of the study will be presented in this section, by first introducing the automobile industry and a company description, followed by the logistics challenges that Volvo is facing. Further, this section also includes a presentation of the identified need for change within Volvo's logistics, and what factors are prioritised in the implementation of these changes. Lastly, an introduction to the logistics concept Material to Man will be presented.

1.1.1 The automobile industry

The automobile industry is changing and the competition and customer demands are increasing. Therefore, to obtain market advantages, manufacturers have to adapt their strategy from mass production to a more customised production strategy(Limère et al. 2012). However, the process is complicated, since the variety of parts will increase, which in turn will lead to a more complex material flow in the plants. As a result of this, the logistics have to comprehend the new requirements in order to gain an advantage over competitors (Limère et al. 2012).

Another area that has influenced the automotive industry, by improving productivity and eliminating waste, is Lean production (Nieuwenhuis and Wells 2015). The lean philosophy has also influenced Volvo, which has lead to the implementation of Volvo production system (VPS). This phenomenon, i.e. that companies develop internal production system, arise from companies trying to establish competitive advantages on the market, by understanding the market requirements and adapting their strategies to achieve competitive advantage (Bennett 2014).

Moreover, the implementation of automated equipment has emerged in the automobile industry throughout the years, which has been a positive contribution to improved product quality and process efficiency (Tortorella and Fettermann 2018). Smart manufacturing, including for example automated processes, has been implemented in order to deal with the customer demands in a more sufficient way (Schumacher et al. 2019).

1.1.2 Company description

One of the world's leading vehicle manufacturers is Volvo Group AB, where products such as passenger cars, trucks, and construction equipment are produced. The headquarters for Volvo Group is located in Gothenburg, and the company has around 100 000 employees in 18 countries around the world, and sales in more than 190 markets worldwide. There are 12 brands within Volvo Group, including e.g., Volvo, Volvo Penta, Volvo Trucks Aktiebolag, etc. (Volvo Group AB 2020) Volvo Trucks is a part of Volvo Trucks Aktiebolag and is one of the leading companies within the final assembly of heavy-duty trucks in Europe. The company has plants worldwide and is one of Europe's leading truck manufacturers. Volvo Trucks in Tuve opened in 1982 and the site has an area of 117 500 m^2. The plant can be divided into four segments: customer adaptation, cab, and vehicle assembly, completely knocked down (CKD), and a pilot plant (Volvo Group AB 2019).

1.1.3 Logistics challenges for Volvo

The development within the automotive industry leads to logistic challenges for Volvo. As mentioned, both Volvo and the overall market is changing from mass production to increased customisation, which leads to an increased variety of components and trucks assembled as well as an increased amount of material. Having said that, Volvo and other companies have to find ways to manage a customised production set-up to stay competitive (Limère et al. 2012). Already today, Volvo offers a variety of customisation for their customers and the range of choices is wide. Customers can request almost anything for their truck, e.g. microwaves, fridges and several kinds of beds, but also as simple changes as colour. The customisation is mainly handled by a separate department at Volvo Trucks, called customer adaptation, which focuses on the customised requests from customers. As a result of the many options for customisation, a huge amount of weight is put on the logistics department to fulfil these demands. With the high amount of customised trucks produced at Volvo Truck, the company has identified a possible correlation between high levels of product variations and deteriorated quality. Hence, the quality might be affected by the new models and variations that will be presented to the assembly line (Granero 2019). In addition to the quality challenges, another result of the increased variation is the need to switch between different truck models and components and to handle an increased number of components in the logistics activities, which can be summarised as flexibility challenges. The combination of increased variety and an increased amount of materials also results in a need to manage both the current and the new part numbers at the same space. However, since the available space in the assembly plant is limited and an expansion of the plant is not an option, due to the land being owned by a third-party and it would require high investment costs, Volvo has to consider other options in order to fit additional part numbers in the plant in the future.

For Volvo, the challenges above have become increasingly apparent and the need to find potential solutions is increasingly urgent, as the company's new model releases are approaching and the competition is tightening. Volvo has identified three objectives that need to be improved in order to successfully deal with the challenges presented above. The first objective is to increase, or at least maintain, the quality of the trucks assembled at Volvo, which can be affected when new material variants are incoming. Second, as an affect of the increased variation and new material being introduced, flexibility has to improve to enable efficient shifts between different truck models on the assembly line. The third and final objective for Volvo is to manage to cope with the increased amount of material in the plant, which is limited regarding shop-floor space.

1.1.3.1 Quality challenges

To fully understand what quality measures imply in this study, it is vital to define how quality is defined and measured in this specific context. Since no universal definition of quality exists, due to the varieties of contexts in which the term is used, e.g., organisation, product, service, process, etc., quality can be perceived differently by different people. As a result of this, Dale et al. (2016) emphasise the importance of agreeing on a definition of quality within an organisation, to assure that all employees are focused on the same vision and goals. At Volvo, the main aspect of quality is to ensure that as many trucks as possible are delivered on time, with all components correctly assembled. Dan Edblom, Manufacturing Technology Manager at Volvo, describes quality as first time through (FTT), which means that the assembled truck has not been adjusted or changed along the way until the end of the line. With this background, Volvo needs to ensure that they can retain the quality, despite the increased variety of trucks and part numbers, which in practice means that the level of FTT not should decrease. One key aspect that Volvo believes could achieve this is to improve the operators' conditions on the assembly line. The conditions for the operators include deliveries on time, deliveries of the right materials and presentation of the material in a logical and user friendly set-up. When improving these conditions further, the intention would be to reduce decision points, i.e. number of decisions, and walking distance and to improve the presentation of the material at the assembly line.

1.1.3.2 Increased variation require improvements in flexibility

In order to achieve the quality objective, the logistics activities need to able to handle an increased number of components and switch between different truck variants. Volvo suggests that one important factor when it comes to managing increased variety of part numbers is to increase the flexibility in the logistics flow. According to Zhang et al. (2005), logistic flexibility is one of the most important parts of a supply chain, who describes it as the capability to quickly respond to changes of customer demands in delivery, support, and services in an efficient manner. In the context of Volvo, the company suggests that increasing the capacity of the storage, to manage more part numbers, would increase the flexibility of the logistics flow as it would be able to better handle new models, customer requirements, and more part numbers. Moreover, Volvo suggests that flexibility also refers to the time required for readjustment between different set-ups, e.g. related to switching between set-ups when different variations arrive, and implementations of new layouts and systems. This latter view of flexibility is in line with Barad and Sipper (1988), who consider that flexibility can be measured in time, referring to the capacity to quickly move between different states. Since the new models, e.g. electric trucks, will be assembled at the same assembly line as previous models, the time required to readjust is essential for the operators.

1.1.3.3 Limited space at the plant

Improved quality and flexibility of the logistics flow could theoretically be facilitated through expansion of the plant, to fit more components and activities. However, as expansion is not currently an option for Volvo, it is instead necessary to find other solutions that would enable the increased variety and number of components to fit into the same space as is available today.

1.1.4 Material to Man

As a result of the identified need to increase flexibility, while maintaining the quality and use less space in the plant, Volvo further identified the need to structure these improvement areas and communicate needed actions to the whole company. Hence, Volvo has established a theoretical concept that they believe is a potential solution for these challenges, and they intend to implement this concept in their production plants. The concept is called Material to Man (M2M), and is so far only a theoretical concept that has not been implemented in any physical plant. The time horizon for the implementation of this concept is yet to be determined, and the planning, development, and adaptation of the concept is still in an early phase.

From the previously presented challenges that arise for Volvo, it can be concluded that M2M has been developed with the aim to improve conditions for the operators on the assembly line, reduce required space for the logistics activities before the assembly line, and increase flexibility and quality. As is indicated in the name of the concept, i.e. Material to Man, the main aspect is to make sure that material is delivered to the operators who use the material, in contrast to the current situations where operators at the assembly line and within different activities often need to collect the material themselves through manual picking of parts. Volvo believes that when the material is delivered to the operators, instead of the operators collecting the material, the quality can be improved, as the walking distance and decision points for the operators will be reduced. Further, if an operator is located in one place, and the material is delivered to that specific place, the flexibility of the activities performed is believed to increase. This is both due to the fact that material could be delivered to a different operator if needed, and that the operator can receive any type of material to their location.

1.1.4.1 Kitting within Material to Man

In combination with the changes in how the material is delivered to the operators, the concept also suggests that a high amount of components should be included in an activity called *kitting*. The reason for this suggestion is presented more in detail in the next section. When using kitting, the material is delivered to the operator on the assembly line in pre-organised kits that are adapted to the assembly operations that the operator performs (Bozer and McGinnis 1992). This means that all parts that are delivered in the kit are to be used by the operator on the assembly line, in contrast to regular continuous material supply, also referred to as line stocking, where the material is delivered to the assembly line in packages with the same type of material. Kitting can have advantages when, for example, the space around the assembly line is limited, but it could also contribute to higher labour costs from the additional material handling step (Limère et al. 2012). Limère et al. (2012) emphasise the importance of careful consideration of what parts are desirable to kit, and what parts would be more efficient to handle by line stocking, considering total cost and space efficiency.

Within the kitting concept, several different methods can be used for the parts picking that constitutes the kitting process. Some examples are pick-by-paper, pick-by-display and pick-by-light, which all give the needed information to the operator in different formats (Bächler et al. 2016). At Volvo, mainly the method pick-by-light (PBL) is used. When using PBL, the picker receives the first instruction of the kit set-up on a screen. This is followed by the lightning of a lamp that indicates where the needed material is located and how many components should be picked. All needed material is then identified with lamps above the specific location, and the kitting process ends with the picker pushing a button at the end of the aisle, to confirm that the process is complete. Bächler et al. (2016) has identified how PBL offers advantages such as transparency of changes in inventory, parallel order processing, and visual identification of the position of the material, which facilitate the kitting process for the picker. However, some disadvantages can be identified, such as high initial investment costs and the need for a high-performing management system supporting the process (Bächler et al. 2016).

1.1.4.2 Increase the number of components that are kitted

The decision to increase the number of kitted material, compared to the current situation, is based on the overall goals with M2M: to increase quality and flexibility. The quality aspect of increased kitting can be derived from Volvo's belief that presenting the material in prepared kits contributes to better conditions for the operator, which in turn leads to higher quality of the end product. When the operator receives the material in kits, instead of material-wise, the decision points will reduce for the operator, as all the material in the kit should be used in the assembly of one specific truck. The kitting also contributes to reduce the walking distance, as the operator does not need to walk to each of the components, but receives everything gathered at one place.

In previous studies, Volvo has altered the number of kits and the articles in the kits, with the intention to find a suitable distribution between kitted components and components that are delivered directly to the pre-assembly stations or the final assembly stations material-wise. Volvo's conclusion, so far, is that it is impossible to kit 100% of the components, due to the heavily increased number of transports and kitting operators required, even though the company believes that it would maximise the quality of the assembly. Also, the part numbers that are delivered in cardboard boxes should preferable not be kitted, due to three main reasons: the boxes are small and take up little space by the line, they are used very frequently and the transportation need would heavily increase, and the material flow for these material differs from the other material. With that in mind, the current suitable distribution between kitted and non-material material would be to kit approximately

80% of the components. This would mean that cardboard box material is not kitted, but that all other material potentially could be included in a kit. Although, special components or constraints on the different assembly stations could imply a slightly different distribution on certain assembly stations. Previous studies indicates that a 80/20 distribution also would provide a balance between the positive impact, i.e. improved quality, and the negative impact, i.e. the increased need for transports and operators. The 80% distribution of kitted material, and the exclusion of cardboard box material, has acted as a base also for this study, but an analysis of the different materials' suitability has been done to ensure that the 80/20 distribution is suitable in this study as well. The flexibility aspect of increased kitting is based on the fact that the material that is currently stored on the assembly line will be moved to the kitting areas. When releasing space on the assembly line it is possible to use that space for different types of material, depending on the truck that is assembled, instead of storing specific types of components on fixed positions.

The above mentioned suggestion to increase the number of components that are being kitted does, however, imply that Volvo needs to change and adapt their logistics flow and processes for it to work efficiently. Suggestions on how to achieve this is presented in the next section.

1.1.4.3 Changes that need to be made to the kitting process and layout of the kit stations

To make it possible to include a higher amount of components in the kitting activity, Volvo believes that changes are needed in the kitting process and the layout of the kit stations. Volvo has therefore identified what changes that they believe need to be initiated. First, Volvo believes that the fundamental idea of M2M, i.e. that the material is delivered to the operators who uses the material, which in the context of kitting would be the kitting operator, would be the first step towards a more efficient kitting process, since elements such as walking to the material and moving the kit cart around would be eliminated. Second, both to support the new type of kitting process and to fit all the additional kitting material, the layout of the kitting station needs to be changed, as they are currently using all available floor space on the kit stations, for the material that is being kitted today. For this new layout, Volvo has identified a solution that they believe would be the most space efficient and that also would increase the flexibility and quality of the kitting process. In this solution, the material would not be located on a fixed location in the kitting station, but so called *dynamic kit slots* would be introduced instead. Since a certain amount of material would be transported to the dynamic slot, the decision point for the operator to would decreased compared to the current scenario where there are several amount of fixed slots to pick from. The chances of picking the wrong component with the dynamic kit slots layout will decrease compared to the current layout.

An additional aspect of the changes that need to be made in the kitting process, to handle the increased number of kitted material, is the potential ergonomic benefits that could derive from these solutions. For example, if all material is presented to the kit operator on a dynamic kit slot, and a transport operator and/or vehicle transport the material to that kit slot, it is possible to adapt the height and position of the material when it is presented to the kit operator. This could eliminate the need to perform certain picks on floor-level, as the vehicle that transport the material could lift the material to a more ergonomic level. Further, as the solutions intend to reduce walking distance for the operators, heavy tasks, such as walking with a cit cart in the kit aisles, can be reduced.

Further, Volvo is convinced that for the above mentioned solutions to be successfully implemented and work efficiently, the material used in kitting should be stored in close proximity to the kitting areas. This can be achieved through different logistics and storing solutions, but Volvo has identified the potential use of storing areas designated for frequently used material, which are located in close proximity to the kitting stations. These storing areas are referred to as *Range area*, and differ from the currently used local storage in two ways. First, the intention is to place these areas closer to the kitting stations than the local storage, in order to reduce the transport distance for the frequently used material. Second, the material in the range area should not be stored vertically in shelves, but on the floor, in order to reduce the handling time for the material, with the elimination of vertical transports. The range areas could be designated for either blue boxes or pallet material, but Volvo believes that the two types of packages should be divided into two different range areas, to ensure efficient logistics where all the material in the same range area could be handled with the same type of vehicles and processes.

In summary, the M2M concept that Volvo has introduced suggest that an increased number of material should be included in kitting, and preferably around 80% of the part numbers. To manage this increase, changes in the kitting process and the layout of the kitting stations need to be made. One suggested solution is to perform the kitting with dynamic kit slots, instead of fixed kit slots, and to introduce range areas for the frequently used material. Also, the kitting would be performed in one designated kit area, compared to the current set-up where kitting is performed at several different locations at the assembly line and in kitting aisles. With this background, this study will evaluate the concept and consequences of introducing the concept, with these suggestions as a starting point. Further, while the use of dynamic kit slots is a preferred solution, to maximise flexibility and quality and to minimise the required space, it is also possible to introduce combinations of the currently used layout, with fixed kit slots, and Volvo's vision of dynamic kit slots. Therefore, this study will also included such potential combination, to broaden the analysis and find different view points and variations of the concept.

1.2 Aim of the study

This study will use the increased use of kitting within the M2M concept, as a basis and starting point. Based on this, the study will analyse how the transports, operators, and space requirements are affected by increased kitting, by evaluating negative and positive aspects of different set-ups on the kit stations. This will be achieved by evaluating different scenarios, where the set-up and conditions for the kitting stations, material flow, and the operators will be altered. Through the evaluation of the mentioned scenarios above, the study aims to provide a deeper understanding of the consequences from increased kitting, which is a vital part of the future implementation of M2M at Volvo.

1.3 Delimitation

This study will be limited to handle activities and logistics flow that are located in the factory, and specifically the activities and logistics that handle material from the local storage, until the material is delivered the final assembly stations or to a pre-assembly station. The activities and logistic flows that take place before the material is stored in the local storage will not be included in the analysis.

Further, this means that the material that is stored in other areas of the factory, and delivered directly to the assembly line or to pre-assembly stations, is not included in this study. The reason for this is that the logistics flow for these components are assumed to be handled in the same way as they are handled today, which means that no analysis of those logistics flow will add value to this study. Also, the material that currently is delivered directly to the assembly line will, based on M2M, be delivered to a different location in the plant. This means that the number of transports needed for the material to be delivered to either the assembly line or to another location will be the same as before, as it include the same amount of material. Although, since the delivery location differs the transport distance might also differ. However, Volvo does not consider an analysis of this factor to be prioritised in this study. Therefore, potential increases in transport distances will not be analysed in this study.

Also, as the number of transports required for material delivered directly to the assembly stations today are the same, no matter where the delivery point is located, those transports does not need to be included in the comparison of number of transports between the current state and other possible solutions analysed in this study.

The material flow and activities that are included in the study are highlighted in red in Figure 1.1.

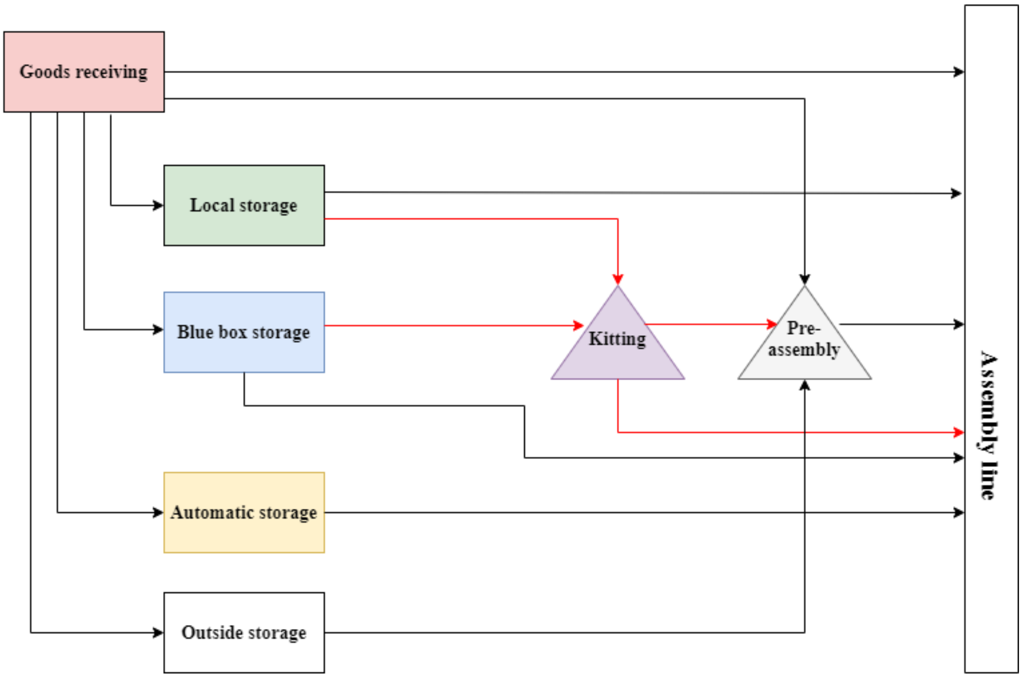

Figure 1.1: *The material flow and activities that are included in the study*

1.4 Research questions

As a central part of M2M is to increase the number of part numbers being kitted, it was necessary to establish what part numbers that should be prioritised for kitting. Therefore, the part numbers used at assembly stations 16 to 24 has to be prioritised and analysed, based on how suitable they are to kit. Therefore, the first research question is:

> **RQ1:** How many, and which, part numbers should be included in kitting on the stations 16 to 24?

Once the distribution between kitted and non-kitted material has been established, this distribution was used as a base in the succeeding analysis. With this distribution, in combination with Volvo's vision to use one dynamic kitting slot per kitting station as a starting point, the consequences of the increased kitting in different set-ups could be evaluated. To analyse the consequences in this set-ups, the following three research questions has been analysed. While RQ4 is partly based on the results in RQ3, all three RQs have been analysed in parallel.

> **RQ2:** How does the space requirements vary between solutions with, or without range areas and between solutions with our without fixed kitting slots?

> **RQ3:** How does the transportation requirements vary between solutions with, or without range areas and between solutions with or without fixed kitting slots?

> **RQ4:** How many operators and vehicles are needed to handle the increased kitting and increased number of transports?

Chapter 2

Literature review

As a theoretical basis for the analysis in this report, several frameworks and concepts have been used. This theoretical basis include theory related to inventory, activities, and material handling. In this section, these theoretical frameworks are presented and explained.

2.1 Material handling

Material handling can simply be defined as movement of material (Stephens 2019; Green et al. 2010). However, it includes more than just moving material, activities such as order-picking, storage, and transportation of material are also included as different parts of material handling (Green et al. 2010). Green et al. 2010 emphasise that for a large number of manufacturers, material handling accounts for more than half of the total cost of manufacturing. The material handling is strongly intertwined with several manufacturing processes in the company and require lots of resources, including both equipment and labour (Stephens 2019). Material handling is usually considered a non-value-added activity since it does not bring any direct value or benefits to the customer, but it is still a necessary completion for the manufacturing process. When integrating other elements into the material handling activities, the material handling can generating indirect value for the customer. Manufacturers like Volvo has found a way to bring value to these activities, by optimisation of the whole logistics flow, where the material handling is an important part, which in turn can bring value and quality to the end product. An example of this can be seen in kitting and sequencing, where material is pre-organised and picked especially for the operator before being delivered to the use point (Andersson and Roso 2016). The pre-organisation enables a more efficient assembly once the material arrive to the assembly operator, and the structure and presentation of the material can contribute to higher quality of the products, with fewer mistakes in the assembly process. Also, since the assembly on the assembly line operate under time constraints, the possibility to remove certain activities, i.e. kitting and sequencing in this case, from the assembly line makes it possible for the company to produce a higher number of trucks during one day than if they would be placed under the same time constraints, which in turn can enable shorter production time for customer orders. In contrast, other activities within the material handling, such as order-picking and transportation, do usually not add any values to the end-product, and are therefore usually consider as non-value-added activities (Green et al. 2010). With that said, the difference between a value-added and a non-value-added material handling activity is that the activity adds value to the end-product, i.e. the final assembly of the truck in this case.

Material handling has a great impact on the manufacturing processes and the overall material flow, especially for vehicle manufacturers, since most vehicle manufacturers have assembly lines and the material is required to be delivered to the line and from a storage point to the right place and at the correct time. The material handling activities, especially in the warehouses, need to be working in an efficient way in order to be able to provide to different needs and to ensure the supply of material to the assembly line. The material supply to the assembly line is performed through several warehouse activities, such as storage, order picking, receiving, and transport, which are all part of material handling, and performed in the warehouse (Moshref-Javadi and Lehto 2016). All these warehouse activities are performed at Volvo today. However, this study focuses mainly on the kitting, transport, and storage, which are all described more in detail in the next sections.

2.1.1 Inventory

Inventory can be a monumental part and one of the most expensive assets of a company (Bose 2006). Manufacturing companies tend to have a greater inventory compared to service firms; however, inventory management is still as important for both manufacturers and service companies since the goal is to satisfy the customers (Wild 2017). In this case, the customer is the assembly line. Inventory can either be an asset for a company or a liability which depends on the management. For some organisations, the inventory can account for more than 10% of the total revenue (Wisner et al. 2014). In Volvo's case, all material should be stored in the plant as long as there is space for it.

According to Wisner et al. (2014) all the materials and goods purchased, partially completed parts and components, and finished goods produced are included in an inventory, which is no exception for Volvo. The main functions of an inventory are to buffer for uncertainty in the market and remove the dependencies between different actors in the supply chain (Bose 2006). This mean that for a vehicle manufacturer such as Volvo, the inventory works as a buffer between different internal activities, which enable the company to operate without interruptions and to have the right amount of inventory at each workstation (Wisner et al. 2014).

The inventory is a storage of material, which is usually stored in a warehouse. There are different kind of activities performed in the warehouse in order to have a functional manufacturing process. In the next section, the activities used to handle the warehouse processes are introduced.

2.1.2 Warehouse activities

As mentioned previously, the traditional operations included in warehouse activities are receiving, storing, order-picking and shipping (Van den Berg and Zijm 1999). The order picking process occurs whenever a request for a part is made by assembly workstation from the inventory and retrieved from the storage area (Van den Berg and Zijm 1999). Order picking is one of the most important non-value-adding activities for companies with warehouses, due to the intensive labour and cost requirements to perform the activity (Van den Berg and Zijm 1999). Order picking is usually performed by operators, either manually or assisted by technical equipment, such as forklifts, conveyors and overhead cranes (Calzavara et al. 2019) (Van den Berg and Zijm 1999). However, in Volvo's case, order-picking has been optimised in order to add value to the end-product. Instead of picking and delivering the material directly from the warehouse to the assembly line, the material is rather picked and pre-organised to specific station in so called kits, before being delivered to the line. This will then eliminate unnecessary steps for the operator at the line, which then will increase the efficiency of the work, and therefore is a value-added activity compared to order-picking.

The typical warehouse consists of several parallel aisles with material stored at shelves (Van den Berg and Zijm 1999). Larger items, e.g. pallets, are usually stored in pallet racks on the shelves. The warehouse can be either set-up as manual or automated systems. In a manual warehouse, the order-picking task is performed by an operator, either by walking or assisted by a vehicle, e.g. a forklift, (Van den Berg and Zijm 1999). In an automated warehouse, the order picking is performed by a robot and the products are placed at conveyor belts that are transporting the material for pick-up (Van den Berg and Zijm 1999). The warehouses in the Tuve plant at Volvo consist of both manual and automated warehouses. However, the scope of this study has not included performance or logistics activities in the automated warehouses.

2.1.3 Activities performed on material in a production company with an assembly line

The material in the inventory will at some point be used in activities and processes. What activities and processes are suitable highly depends on the context in which the company operates, and what the purpose of the organisation is. A manufacturing company with an assembly line can either perform activities directly on the main assembly line or beforehand, to reduce the number of activities in the final assembly. In this section, four commonly performed activities that are highly related to Volvo's main assembly line are presented: kitting, sequencing, pre-assembly, and transport. On the contrary to transport, kitting and sequencing combined with pre-assembly are considered as value-added activities in Volvo, since these activities add value to the end-product. Further, the workload and tasks that are assigned to each operator affect the performance of the activities and the result of the products, which can be controlled through the use of time balancing. This concept is also presented in this section.

2.1.3.1 Kitting and Sequencing

In addition to the kitting activity, another commonly used value-added activity within manufacturing is sequencing. When using sequencing, the material is delivered to the operator in the same exact order as the material should be used in the assembly. This means that the sequence of the products that should be assembled must be known in advance. Sequencing can be performed either before delivery to the factory, i.e. by the supplier, or internally at the factory. Potential benefits of using the sequencing concept are reduced need of storing space and inventory, as well as easier material handling for the operators on the assembly line. Ding and Sun (2004) describe how sequencing differs from kitting by including only one particular type of material while kitting usually includes several different materials.

2.1.3.2 Pre-assembly

A third value-adding activity that can be performed on the material in a manufacturing company is pre-assembly. Pre-assembly means that material is assembled to a module, that later can be assembled at the truck in one piece. The material used in the pre-assembly can either be arranged in a kit beforehand or placed directly at the pre-assembly station. Pre-assembly offers several potential advantages, such as increased flexibility and capacity of the assembly line. Kern et al. (2015) describe how pre-assembly can reduce the impact of variations in the products, as the pre-assembly stations can work in a different frequency than the main assembly line. For example, if some variations require longer assembly time than what is possible to use at one station on the mainline, pre-assembly stations can prepare modules beforehand, which can be assembled on the product quicker than if each material would be assembled at the mainline.

2.1.3.3 Transport

Transport system or transportation in general is the most important activity within logistics from an economic perspective. Since transportation connects and converts different resources into goods, it is essential to plan all of these activities in order to minimise the cost and maximise the services (Tseng et al. 2005). One of the main tasks performed by logistics operators is to transport the correct amount of material and products to the correct location, all the way from storage to production workstations (Sulirova et al. 2017). Well functioning transportation systems are vital in order for logistics to fully attain the advantages the systems possess. Additionally, having a good transport system in logistics activities can improve logistics efficiency, reduce operation cost, and promote service quality (Tseng et al. 2005).

2.1.3.4 Balancing for activities and operators

When assigning certain work tasks to operators on the assembly line and in the different activities performed before the final assembly, it is vital to ensure that the operators have enough time to perform the tasks. At Volvo, this is ensured through the use of assembly line balancing. This means that each operator has a certain amount of time, which at Tuve plant has been established to be 474 work minutes in one day, and that all tasks that the operator need to perform during one day has been properly timed and should fit into those 474 work minutes. Assembly line balancing is commonly used in producing companies, to ensure that the operators have enough time to perform their tasks and to optimise the operators work time (Boysen et al. 2008). At Volvo, balancing of the operators work time and the tasks they are expected to performed is also used within the different activities before the main assembly line, i.e. kitting, pre-assembly and sequencing.

2.2 Fish bone strategy

Most warehouses have a similar layout, called traditional layout. The traditional layout is easy to identify due to the arrangement of parallel aisles (Cardona et al. 2015). One unorthodox layout is called fish bone layout, which is a layout designed to optimise the walking distance for picking products, by having the products with higher demand closer to the usage point in a warehouse and limit the errors in order picking. Since order-picking is the largest cost of all material handling in a warehouse (Venkitasubramony and Adil 2016; Van den Berg and Zijm 1999), it is highly valuable to optimise the warehouse and make the order-picking activity as efficient as possible. According to Venkitasubramony and Adil (2016), one way to reduce the picking cost is to reduce the walking distances to the products in the warehouse, by rearranging the storage and place, for example, products with high turnover rate closer to the use point.

The concept of the fish bone strategy can advantageously be used in plants with an assembly line. The strategy is the same as in a fish bone warehouse, where materials and activities such as kitting and pre-assembly are located in close proximity to the usage point, which in this case is the assembly line. Figure 2.1 demonstrates a fish bone layout, where the rectangular boxes represent kitting and pre-assembly stations and the circles represent the stations at the assembly line (Ranstrand and Ziaeenia 2013).

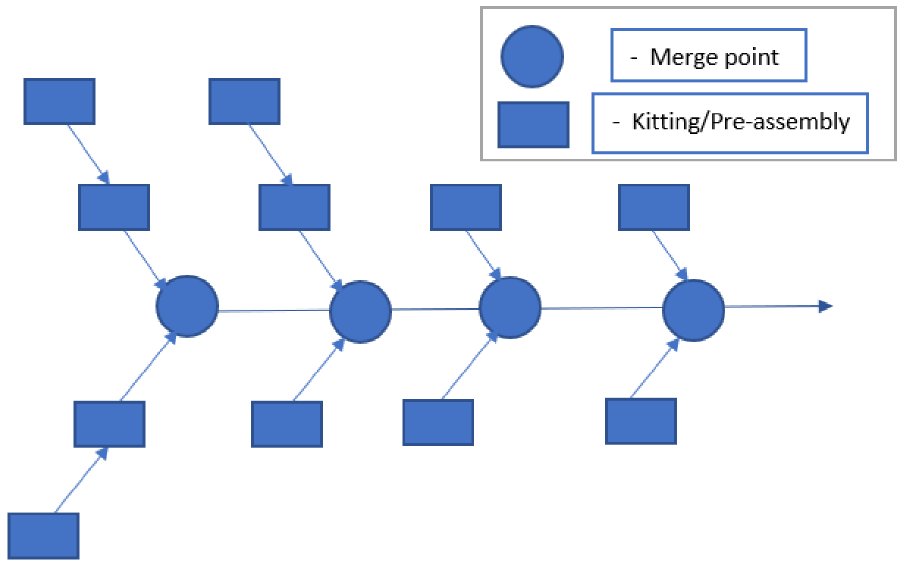

Figure 2.1: *Fishbone layout*

Chapter 3

Method

This study has been conducted through the use of several different methods aimed to create an understanding of the conditions at Volvo and the Tuve plant, collect relevant data, and to analyse the collected data and information. The study has used a case study approach, where certain areas of the Tuve plant has been used as a case for the study. The scope of the case study will be presented more in detail in this section. Further, the different steps of the data collection and the analysis in the study will also be presented in this section. Initially, an overall understanding of the conditions at Volvo and the Tuve plant has been created. This has been achieved through interviews and discussions with relevant people at Volvo, as well as an introduction to relevant company related concepts and conclusions from previous projects at Volvo.

Once the overall understanding had been established, the conduction of the study was structured in three phases, which were all interdependent. The first phase included Data collection, which formed the basis of the analysis in the consecutive phases. The second phase addressed the first research question, i.e. to find a suitable distribution between kitted and non-kitted material. The third phase focused on research question two, three, and four, i.e. analysing the consequences of the increased kitting in different situations. These three research questions that were addresses in the third phase are all interdependent, which made it preferable to analyse all three of them in parallel. However, within the three research questions, several different variables could be altered and the outcome of the analysis differed depending on the values on the variables and the chosen set-up for the kit stations. Therefore, seven different scenarios were established, which formed a base for the analysis of the research questions. The seven scenarios and the variables used in the scenarios are presented later in this section.

The three phases has been conducted in a cyclic manner, where the result in the consecutive phases have resulted in new cycles where the three phases have been conducted again. In practice, this means that additional data collection was done also once the analysis had begun, and that the second phase, where the establishment of kitted material was made, was updated so that the result was in line with the new data. The cyclic phases are presented in Figure 3.1, and the implication of each of the phases is described more in detail later in this section.

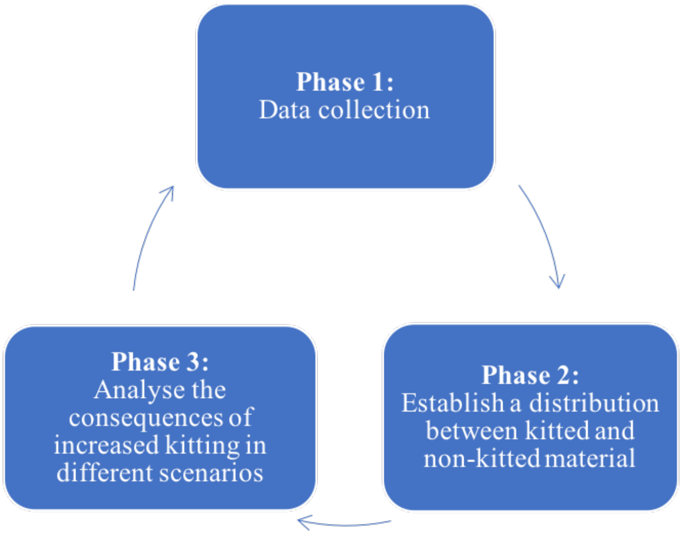

Figure 3.1: *The three, cyclic phases conducted in the analysis*

3.1 Research strategy: Case study

This study has used the scientific method abductive reasoning, which is a combination of inductive and deductive reasoning. This means that empiricism and theory will be used in parallel during the study, and that an understanding of the study is created successively along with the new insights and knowledge that is created. In order for this to be possible, the gathered information has to be appropriately revised and analysed Dalen (2007).

This study will be performed through a case study approach, where a limited number of assembly stations in the Tuve plant will be the focus. A case study is a flexible approach for research, as it both offers the opportunity to obtain a holistic view of a phenomenon, and insights of real life events and data in certain situations (Schell 1992). Gerring (2004) describe this type of approach to a research topic as a study on a single unit, with the aim to generalise the conclusions to a larger set of units. In this study, the conclusions drawn from the case study on the specific assembly stations aim to be applicable also on other stations in the Tuve factory, and to some extent also to other factories within Volvo. This means that the conclusions are not focused on characteristics that are unique for these assembly stations, but on characteristics that can be found in other parts of the factory and in other factories as well.

3.2 Initial understanding of the overall situation at Volvo and establishment of the scope

To fully understand the conditions and possibilities for this study, it was necessary to establish a better understanding of the concept M2M, as this study is mainly focused on that concept, as well as the conditions at Volvo and the Tuve plant and the challenges that Volvo previously has identified. To retrieve the necessary information and insights within these areas, several interviews and discussions has been conducted. In combination with the interviews and discussions, continuous observations of the plant and the overall logistics flow has been conducted.

3.2.1 Interviews and discussions focused on the overall situation at Volvo

Since M2M has been a central part of this study, it was necessary to get a proper introduction to the concept early in the study. This introduction to the concept was made through several interviews with relevant employees at Volvo. All employees that have been interviewed are presented in Table 3.1, where their name and title is specified. From now on, they will be referred to as their titles.

Table 3.1: Name and title of the interviewees

Name	Title
Dan Edblom	Manufacturing Technology Manager 1
Magnus Höglin	Logistics Manager 1
Johan Elfvenfrost	Logistics Engineer 1
Tommy He	Logistics Engineer 2
Alfred Hedblad	Logistics Engineer 3
Erik Bergstrand	Global Logistics Specialist 1
David Almén	Production Technician 1
Gerarld Martin	Logistics Project Manager 1

Interviews and discussions regarding the concept and its context was initially conducted with Logistics Engineers, who explained the fundamentals of the concepts and their visions for the future. Manufacturing Technology Manager 1 has been involved in previous studies conducted on the topic M2M and he possesses important information and knowledge of the subject. Therefore, interviews has been conducted with Manufacturing Technology Manager 1, where the focus laid on previous studies related to M2M and what conclusions that have been drawn from those. These interviews can be described as semi-structured interviews, which means that the interviews had low levels of standardisation and structure (Patel and Davidson 2003). Manufacturing Technology Manager 1 was allowed to steer the interviews and the focus of the topics, which gave an indication of what areas of the topic were relevant and prioritised from his point of view.

In addition to the interviews with Manufacturing Technology Manager 1, semi-structured interviews and discussions were also conducted with Logistics Manager 1, Logistics Engineer 1, and Global Logistics Specialist 1 in order to get a more detailed view of the business and how this study could benefit the company. These three Logistics Engineers work daily at the plant and could provide more detailed knowledge of the current situation in the Tuve plant, and present their view of how the concept could be applicable in the plant. From the information provided from the Logistics engineers, regarding M2M, it became clear that kitting was a central part of the M2M concept and this study. Therefore, several additional , semi-structured interviews with Logistics Engineer 3 were conducted, in order to get a better understanding and detailed information of the activity kitting. Since Logistics Engineer 3 works with tasks related to kitting on a daily basis, the information gathered from his work and the knowledge he provided was valuable for the kitting focused part of this study. Once a basic understanding of the concept M2M had been established, a walking tour in the Tuve plant was conducted. This provided an overview of the logistics activities in the plant as a whole, the material flows, and the different parts of the assembly line. Also, it offered a possibility to ask questions to Global Logistics Specialist 1 , to clarify limitations, challenges, and possibilities in the Tuve plant.

The above conducted interviews and discussion created a basic understanding and overview of the conditions for this study, and confirmed that the study should focus of M2M in the Tuve plant, and specifically on a limited number of assembly stations. Further, what assembly stations that were suitable to base the case study on had to be established. This establishment is described more in detail in the next section.

3.2.2 Definition of the case study scope

When deciding what assembly stations were suitable to focus on in this study, mainly three criteria had to be met: the stations should handle material of many different types, to capture the complexity of variety, the stations should not have been the focus of a previous study, and the stations should be located in an area of the plant were a future implementation of M2M would be possible. To establish which stations could meet these criteria, consulting and discussions were held with the Logistics Engineers at the plant. The conclusion from these discussions was that the assembly stations 16 to 24 were suitable for the study, as they met the criteria. Also, the material for these nine assembly stations are stored in the same local storage, which offers a natural boundary of the analysed area.

3.3 Analysis in three phases

Once a basic understanding and overview of the conditions, challenges, and the concept M2M had been established, the three phases of analysis could be initiated, which together have addressed the four research questions in this study. The three phases, i.e. Data Collection, Establish a distribution between kitted and non-kitted material, and Analyse the consequences of the increased kitting in different scenarios, are presented more in detail in the following sections.

3.3.1 Phase one: Data collection

Phase one, i.e. Data collection, has focused on collecting information regarding the components used on the assembly stations 16 to 24, the activities that are performed on these components, and the limitations and constraints of the logistics flow. Data collection can be divided into primary data and secondary data. Primary data includes data collected through interviews, observations, data systems, and quantitative study, while secondary data is data previously collected by individuals unrelated to the report (Eliasson 2018). In this study, both primary and secondary data has been used to establish a basis for the study and to analyse the results of the study, and the majority of the data has been retrieved from Volvo Trucks. The secondary data has consisted of information regarding part numbers and activities connected to the assembly stations 16 to 24, as well as needed time to perform kitting, sequencing, and pre-assembly connected to the studied assembly stations.

The data collection has been performed through four different types of data retrieval: a literature study, interviews with relevant people at Volvo, observations of the relevant areas of the plant, and data retrieval from Volvo's internal systems. The literature study mainly provided theory concerning activities in assembly plants, the automobile industry, and logistics related concepts, which contributed to the overall understanding in the data collection and the analysis as a whole. Also, more specific information of activities that are performed in the Tuve plant has been retrieved through the literature study, which provided insights that were useful in the analysis. The interviews and the observations has focused on the activities and material flows related to the assembly stations 16 to 24. That, in combination with the data retrieval from internal systems, has provided a full picture of the current conditions at the area around the assembly station 16 to 24. Finally, the collected data has been visualised through MFM and shown to the Logistics Engineers, which has ensured that this study's perception of the current situation is correct and shared with Volvo.

3.3.1.1 Literature study

As a first basic data collection, a literature study has been performed to increase the understanding of the topic of the study, and to get a deeper knowledge of the different processes in the plant. By compiling available information in scientific publications (Bryman and Nilsson 2011). The information gathered in the literature study focused on the automobile industry and different logistics activities that are performed at assembly plants. Further, a more detailed literature study were conducted, where information related to relevant activities was retrieved. These activities are the ones that are performed in the Tuve plant, including activities related to inventory, logistics flow, and material handling activities such as kitting, sequencing, pre-assembly and transport.

The main part of the literature study included information retrieval from the internet, and certain keywords were used to gather and search for literature. Keywords used in the literature research were, for example: kitting, material handling, sequencing, transportation and logistic flow. The literature retrieval has been collected from data bases such as Chalmers Library and Google Scholar, Volvo Group AB's website, and books e.g. Principles of Supply Chain Management by Wisner, Tan and Leong from 2014.

3.3.1.2 Interviews and observations related to the assembly stations 16 to 24

To fully understand the conditions at the specific assembly stations included in this case study, i.e. assembly stations 16 to 24, observations of the logistics flow, the ongoing activities, and the daily work flow in the area has been observed. The initial observations were conducted with support from Production technician 1, who was interviewed through a semi-structured interview during a tour around the assembly stations 16 to 24. Since he previously has worked as a team leader at these assembly stations, he was able to answer questions related to the performance and activities around the stations. Furthermore, Production technician 1 was given the opportunity to speak freely about his thoughts and suggestions that could be considered in this study. This was later followed up by a second tour with Production technician 1, which focused more in detail on the activities kitting, pre-assembly, and sequencing. The information expected to be retrieved from the observations was not established beforehand, and they were conducted in an unstructured way. Therefore, the focus on the different tours depended on the interests of the participants and the natural development of the conversations. An unstructured observation approach is useful when the knowledge regarding the topic is low and in complex environment(Mcilfatrick 2008). Furthermore, a third tour was conducted with Logistics Engineer 2. Since he works within the logistics department, these observations, and the semi-structured interview that was held during the tour, provided a better understanding of the logistics flow around the relevant assembly stations. Finally, to get more detailed information regarding kitting activities, a combination of a semi-structured and unstructured interview was conducted with Logistics Project Manager 1. Since Logistics Project Manager 1 possesses a great knowledge within kitting, the semi- and unstructured interview were suitable, to allow him to openly answer questions and bring his own ideas and thoughts during the interview. The questions asked and discussed were ways to manage smaller parts, in form of bolts, nuts, screws etc. and blue boxes in a future state. All interviews conducted during this phase is presented in the table in Table 3.1, including the titles of the interviewees.

As mentioned earlier, the data collection has been conducted in cycles. In the second cycle, interviews related to handling of blue boxes has been conducted with Logistics Project Manager 1. He possesses long experience in analysing and developing the concept of kitting, and has been involved in several previous studies related to kitting and handling of blue boxes. Therefore, his insights in these areas were valuable for the analysis of blue box material in future kitting set-ups.

When this overview of the stations had been established, more detailed data regarding the material used on the stations and in the different activities was needed. The data collection that included this detailed information about the material is explained in the next section.

3.3.1.3 Data retrieval from internal systems

Once an overview of the activities and the logistics flow on the assembly stations 16 to 24 had been established, data about the material was retrieved. The data collection conducted in this step is focused on secondary data, where the data has been collected from internal logistics system. The basis of the data collection laid in the identification of what part numbers that are currently used on the assembly stations 16 to 24. This has been done through assistance of Logistics Engineer 2, who has provided a compiled list of all material that is currently used on the assembly stations 16 to 24 and the packaging of different materials, as well as the time required to handle pallets with a forklift in the local warehouse. All material in the list is identified with a unique part number and a part description. Further, more information about each of the part numbers could be added to the same list, to provide a solid base for the future analysis. The information that has been documented about each part number is: weight, type of packaging, number of units in each package, and the activities in which the part number is included.

Further, information regarding how frequently the different part numbers are used is relevant for the documentation of the current situation. This data is needed to later categorise and prioritise what material should be included in kitting. To retrieve this data, demand forecast have been used. The forecast consists of planned and expected demand for one year ahead, which in this case is from 8th of April 2020 until 7th of April 2021. However, additional manual data collection has been conducted for a limited amount of components, since it was necessary to manually split the demand between different stations in the plant. This is because these components are delivered to several stations, while the demand is grouped per component in the forecast.

As mentioned earlier, the data collection has been conducted in cycles. In the second cycle, additional data regarding balanced times for kitting and pre-assembly has been retrieved from the internal logistics systems. This data is based on previously conducted studies, where all activities in the plant has been timed and given a specific time frame in which the activity should be performed. This data has later been used in the comparison of the current situation and future scenarios.

3.3.1.4 Visualisation of the current state

Based on the observations on the assembly stations, a visualisation of the logistics flow has been created, to establish a visualised overview of how the different activities are connected to each other. The included elements in the visualisation are transports, storing of material, and the activities kitting, pre-assembly and sequencing. This visualisation was created to ensure that the relevant people at Volvo agreed on the information that was documented, which in turn could ensure that this study was based on the correct information and conclusions. The visualisation also helped guide a common view of suitable boundaries and delimitation of this study. For example, it was possible to easily identify what different parts of the material flow that were prioritised in the analysis, and what material flows that did not affect the result in this study, which could then be confirmed by Volvo.

3.3.2 Phase two: Establish a distribution between kitted and non-kitted material

The data collection from internal systems, performed in the first phase, resulted in a compiled list of all material used on the assembly stations, which acted as a basis for the analysis in this phase. When distributing what type of articles that was suitable to include in kitting, mainly three factors were taken into account: frequency of the material, size of the material, and the type of package that is used for that type of material. Based on the data concerning frequency, size, and packaging, in combination with Volvo's insights from earlier studies, a first distribution could be established. Further descriptions of the factors are presented in section 5.1. Additionally, all articles that are currently located on the assembly line and on the pre-assembly stations have been visually observed by walking around in the plant and looking at the different material, which helped to identify if any specific part numbers were inconvenient to include in kitting, due to its size or any other characteristics that had not been identified in the collected data.

As mentioned, all three phases in the analysis has been performed in a cyclic process. This means that every time new data has been retrieved, this phase has been performed again. In practice, this has mainly meant that the established distribution of kitted and non-kitted material has been verified in every cycle, to ensure that the additional data did not imply any different distribution. For example, one type of data that was not retrieved in the first cycle was the classification of awkward material. This was added later, once a first distribution was established and additional factors that could be applicable had been identified.

3.3.3 Phase three: Analyse the consequences of increased kitting in different scenarios

The data collection in phase one provided a decision basis for phase two, and the compiled data from phase two, including a distribution between kitted and non-kitted material, could then act as a basis for the analysis in phase three. The analysis in phase three has been conducted through the use of seven different scenarios. The analysis of the seven scenarios are presented further in section 5.2. The seven scenarios has included several independent variables, where some variables have been collected from internally available data and some variables have been altered to identify potential improvements in the negative consequences that the increased kitting would imply. Independent variables that has been collected from internal data, and that have had the same value in all scenarios, are: distances between different locations in the plant, the required space for different parts of the logistics flow, the maximum speed for vehicles performing the transports, picking times for different material, the time it takes to switch between materials on the dynamic kit slot, and the handling time for material in the storage. The calculations where these variables have been used are further described in section 3.3.3.1. Further, the number of kit stations has been set to two in all scenarios, since the analysis of scenario one early indicated that one kit stations was too little, and that at least two stations was necessary to manage the increased kitting. Also, since the main point of the analysis was to compare the different scenarios, the most important factor was that all scenarios had the same basic conditions, which is why all scenarios have been analysed with two kit stations.

All the seven scenarios has the same starting point, which is two kit stations that consist of one dynamic kitting slot each, and no fixed kit slots. Through these two kit stations, material will be supplied to all the nine assembly station included in this study. This starting point forms scenario one. The succeeding scenarios, i.e. scenario two to seven, are all extensions of scenario one. In scenario two, three, and four, the kit station consists of one dynamic slot and one, two, or three fixed kit slots, respectively, which are designated for pallet material. In scenario five, six, and seven, the kit station consists of one dynamic slot and one, two, or three fixed kit slots, respectively, which are designated for blue box material. The seven scenarios are presented in Table 3.2. Since the blue box material is stored in racks that contains six part numbers, the fixed slots designated for blue boxes also fit one rack with six part numbers in each rack. This means that one fixed kit slot for blue boxes will fit six different part numbers, while the kit slots for pallet material only fit one part number. Since the number of fixed kit slots on the kit stations has been altered between the scenarios, the variable describing the fixed slots are also an independent variable in the analysis, with different value in all the scenarios.

Table 3.2: The four scenarios analysed in phase three

		Fixed pallet slots			
		0	**1**	**2**	**3**
Fixed Blue box slots	**0**	Scenario 1	Scenario 2	Scenario 3	Scenario 4
	1	Scenario 5			
	2	Scenario 6			
	3	Scenario 7			

An overview of the differences between the scenarios, including the definitions and the abbreviations of each scenario, is presented in Table 3.3. Each scenario has an abbreviation containing a D, for Dynamic, a P, for Pallet slots, or a B, for Blue box slots. The number before these letters represent the number of dynamic kit slots, fixed pallet slots, or fixed blue box slots. For example, scenario two, three, and four consist of one, two, or three fixed pallet slots, which is abbreviated to 1P, 2P, and 3P. Notice that there are two variants of each scenario: one without a range area for pallets and one with a range area for pallets, which is described with the abbreviation R. The storing solution for blue boxes has remained the same through all the seven scenarios. That is, a designated storing area where the blue boxes are stored in racks with six part numbers in each rack. How each of the scenarios have been structured and how they have been compared and analysed, as well a visualisation of the different scenarios and the measurements, is described more in detail in each of the scenario sections below.

3.3.3.1 Calculations made to calculate the result variables

The independent variables presented above have been included in calculations to obtain the values of dependent result variables. The dependent result variables are: total numbers of transports needed to kit all the material established in phase 2, the number of needed transport operators, the number of needed kit operators, the required space for the kitting activity and the range area, the released space in the storage when pallets are relocated, and the total space required for the scenarios, if taking the released space into account. An overview of all variables, including both independent and dependent variables, is presented in Table 3.4.

Table 3.3: Abbreviations and definitions of the scenarios

Scenario	Abbreviations of the scenarios	Definition of the scenarios
1	1D	1 Dynamic slot without range area
	1DR	1 Dynamic slot with range area
2	1P	1 Fixed pallet slot without range area
	1PR	1 Fixed pallet slot with range area
3	2P	2 Fixed pallet slots without range area
	2PR	2 Fixed pallets slot with range area
4	3P	3 Fixed pallet slots without range area
	3PR	3 Fixed pallet slots with range area
5	1B	1 Fixed blue box slot without range area
	1BR	1 Fixed blue box slot with range area
6	2B	2 Fixed blue box slots without range area
	2BR	2 Fixed blue box slots with range area
7	3B	3 Fixed blue box slots without range area
	3BR	3 Fixed blue box slots with range area

Table 3.4: All variables used in the analysis in phase three

Independent variables		Dependent variables
Variables that are not altered	Variables that are altered	Result variables
Distances between locations in the plant	Number of fixed pallet kit slots	Number of transports
Required space for different parts of the logistics flow	Number of fixed blue box kit slots	Number of logistics operators
Maximum speed for vehicles	Pallets in the range area	Number of kit operators
Picking times for the material		Required space for the kitting activities and the range areas
Time for switching between materials on the dynamic slot		Released space in the local warehouse
Handling time for material in the storage		Required space with consideration to released space
Number of kit stations		

The calculations made to obtain a value on the result variables have been similar in all the scenarios. First, the total number of transports has been calculated from the demand for the different part numbers, for one day. In the first scenario, all material had to pass through the same dynamic kit slot, which means that the material had to be replaced every time the kit operator had performed the pick. Therefore, every pick of every material required one transport from the storage, to the kit station, and back to the storage. However, the part numbers that has a demand higher than the total number of trucks assembled in one day, only need to be transported to the kit station once per truck, since the kit operator can pick several pieces of the part number once it arrives to the kit station. In the succeeding scenarios, i.e. scenario two to seven, the number of transports are reduced, since one or several part numbers are located on the kit stations and no additional transports are needed to provide this material to the kit operator. Although it is still necessary to switch the pallet or the blue boxes on the fixed slot once they run out of material, the transports for these particular part numbers do not increase compared to the current situation in the plant, since those transports used to be necessary also when switching pallets or blue boxes on the line or in the kit aisles.

The number of needed transport operators was calculated from the number of needed transports, and the resulting time needed for those transports. This means that the number of transport operators is directly dependent on the time it takes to perform the transports, and therefore how many operators that are needed to perform them. The time needed for the transports was calculated by dividing the total transport distance for the transports with the speed of the vehicles, and adding the handling time for the material in the storage, and the time it takes to switch the material on the dynamic kit slot. The calculations have been presented to logistics engineers at Volvo in order to validate the results and evaluate if they were reasonable. Once the total time needed to transport and handle the material was established, the total time could be divided by the balanced time that one transport operator works during one working day. This gives the total amount of needed transport operators, per day. Based on the same data, the number of needed vehicles could also be calculated. Here, the number of transport operators does not equal the number of vehicles needed to perform the transports, since the number of transport operators needed is the total number for a full working day, including both the day and the evening shift. This means that transport operators working during the evening shift can use the same vehicles as the operators use during the day shift. Currently, the plant assembles approximately 68 trucks during the day shift, and 34 trucks during the night shift. Hence, the number of needed vehicles for the different scenarios can be calculated by multiplying the total amount with 0,69, i.e. the percentage of trucks that are being assembled during the busiest shift of the day. The total time required from kit operators to manage the kitting activities was calculated by adding the picking time, the potential waiting time during material switches, and the walking time in the scenarios which include more than one fixed kit slot. The total kitting time could then be divided by the balanced time that one transport operator works during one working day. This gives the total amount of needed kit operators, per day.

Further, the three interrelated result variables related to space was calculated. The total required space for kitting and the range areas between the different scenarios, i.e. the first space variable, was calculated by using the length and width for the different storage areas, including the range area when applicable, the length and width for different types of packaging, which forms the fixed kit slots, and the different parts of the kit station, i.e. the fixed kit slots, the dynamic kit slot, the kit cart, the lifting tool, the garbage container, and space for the operator. The length and width of the packaging also provided information about how many extra pallets that could be stored in the local pallet storage in each of the scenarios, since material have been moved from the local storage and placed in the range area or at the kit station in some of the scenarios. The released space in the warehouse, i.e. the second space variable, was calculated by multiplying the size of a pallet with the number of pallets being relocated. Further, the results regarding the required space for the scenarios, with consideration to the released space, i.e. the third space variable, has been calculated by subtracting the released space in the warehouse from the total required space for kitting activities and the range areas. This calculation step was made to give a combined view of the two first space variables, since the released space in the warehouse is a positive effect, i.e. extra space that can be used for additional storage, while the required space is a negative effect, i.e. the required space for the scenarios. In the scenarios including one or more fixed pallet slots, the number of pallets in the range area differs between the scenarios. The number of pallets differ because the number of pallets in the range area is based on how frequently the material is used. The first criteria for the material that should be located in the range area is that is should be frequently used. As there is no exact definition of what counts as frequently used, the suitable limit for this has been discussed and confirmed with Volvo, and material that is used on more than 50% of the trucks could be considered to be relatively frequently used in this case. Further, the range area used in the scenarios in this study should be able to fit into the designated area for the logistics activities of the assembly stations within the scope. In this study, the range area should preferably not exceed the leftmost storage rack used for material at the assembly stations 16 to 24. With these two considerations in mind, the pallets that are located in the range area are the ones that are demanded on more than 50% of the trucks, but not more than 12 pallets, to fit into the designated area, which creates a range area that is not exceeding the leftmost storage rack. However, this limit could potentially differ depending on the assembly stations as well as personal opinions. The most important aspect in this study is not the exact number of pallets in the range area, but rather that frequently used material is defined the same across the scenarios, so that comparison and analysis of the differences are possible. When using this definition of which material that should be included in the range area it also means that when additional pallet material should be located at fixed kit slots at the kit station, they are moved from the range area, and since the limit for frequency used material remains, no other material will be added to the range area.

Finally, when the kitting aisles are removed from the local storage, which is the case for all the seven scenarios, more space would open up for storage, which in turn would mean that more pallets could be stored in the local storage. This is possible since the kitting aisles require a height of three meters, for the kitting activities to be performed safe and efficient, while storage of pallets do not require that height. Instead, one extra row of pallets could be used for storage in each warehouse rack. The current layout, with extra space above the kitting aisles, is shown in Figure 3.2.

The observations at the local warehouse showed that 6 pallets can be stored vertically in the warehouse, which requires the the same floor space as for one pallet stored in the range area or at the kit station, since there is no possibility to store the pallets vertically at these locations. However, these calculations is not used in any of the dependent variables, as it is more of a reasoning of how the space could be utilised in the most efficient way. Still, the reasoning regarding value of the space, depending on where it is located, is included in the analysis of the different scenarios.

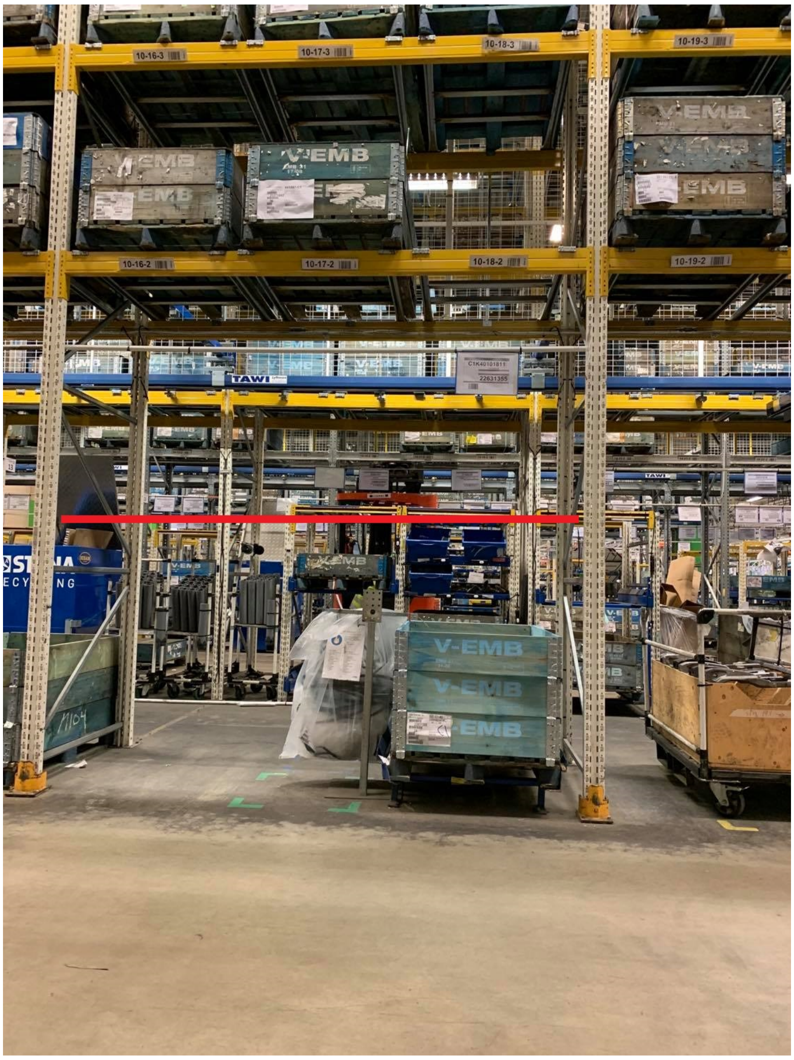

Figure 3.2: *The red line shows where an extra shelf could be added if the kitting aisles where removed*

3.3.3.2 Scenario one: One dynamic kit slot

In the first scenario, which was the starting point for the analysis in phase three, the kit station contained one dynamic kit slot where material passes by and the kit operator picks the material and no fixed kit slots. This set-up implies that all the material that had been prioritised for kitting in phase two had to pass through the same kit slot, i.e. the dynamic kit slot. As stated, two different variants of storing solutions have been analysed: With and without a range area, see Table 3.3. Scenario 1D is visualised in Figure 3.3, and Figure 3.4 shows scenario 1DR.

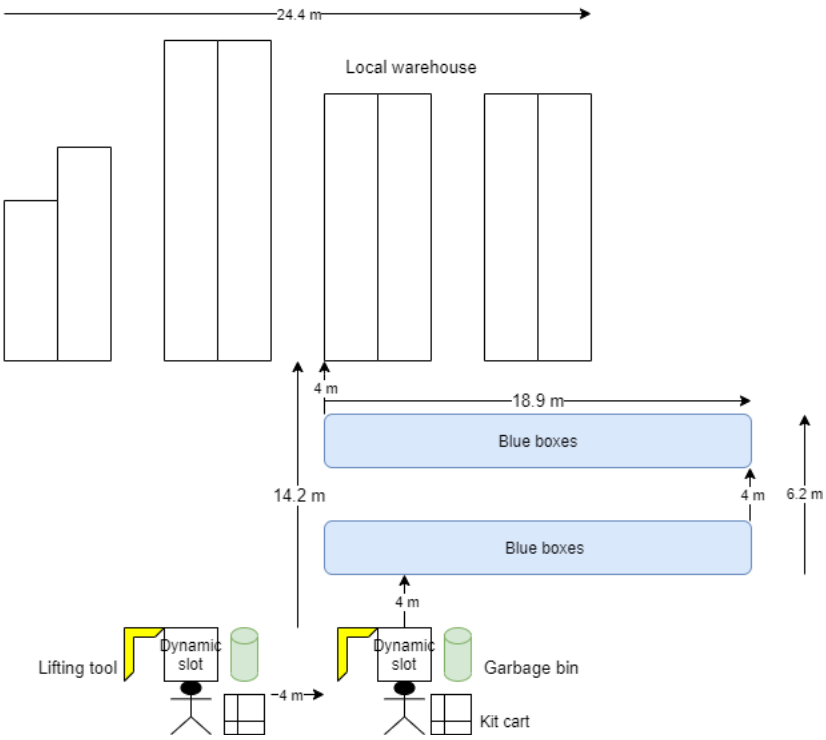

Figure 3.3: *1D: One dynamic slot with no range area for pallets*

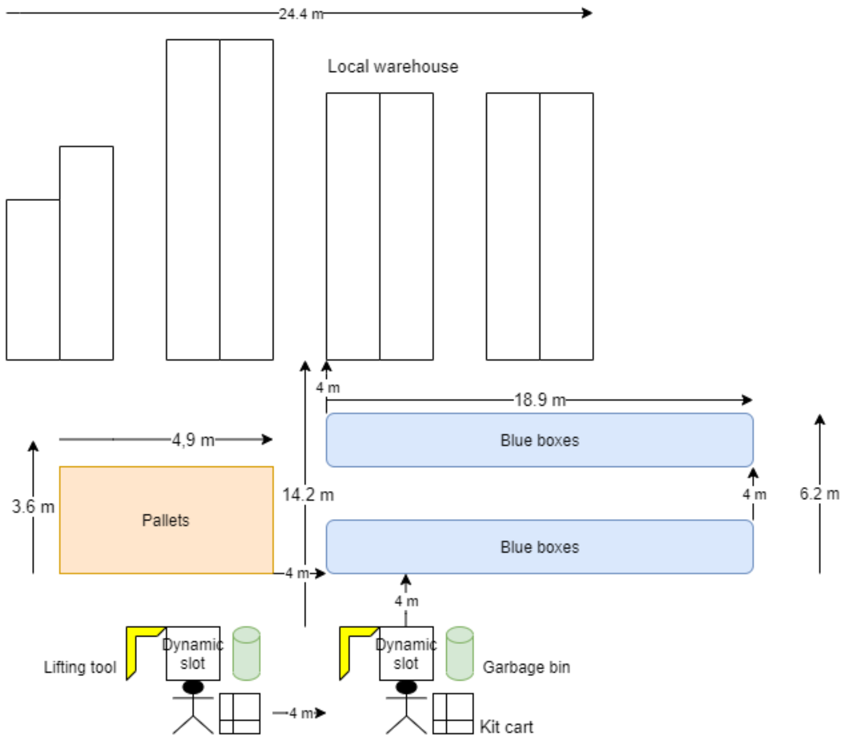

Figure 3.4: *1DR: One dynamic slot with range area for pallets*

3.3.3.3 Scenario two, three, and four: fixed kit slot(s) for pallet material

In scenario two, three, and four, the set-up of the kit stations was different than in scenario one. In addition to the dynamic kit slot, one, two, or three fixed kit slot was located at the kit station, where only one part number could be located. This means that the majority of the material still passed through the same kit slot as in scenario one, i.e. the dynamic kit slot, but that one part number remained at the kit station and did not pass through the dynamic kit slot. Just like in scenario one, the two different variants of storing arrangements have been used: with or without a range area. What this implies for the space requirements is slightly different than from scenario one, since the material on the fixed kit slot was removed from the range area when placed on the kit station.

Since scenario two, three, and four are extensions of the same condition, i.e. fixed kit slots designated for pallet material, all three scenarios, 1P, 2P and 3P are visualised Figure 3.5, and 1PR, 2PR, 3PR in 3.6.

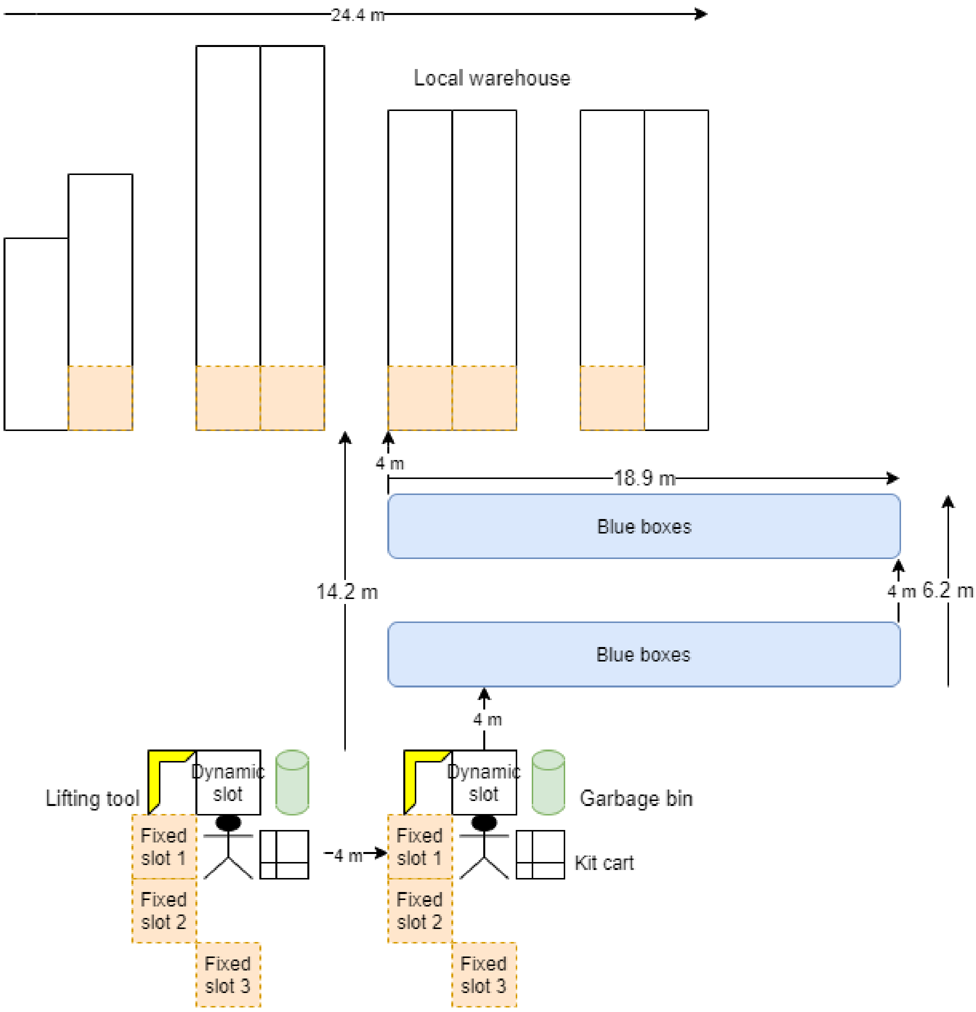

Figure 3.5: *One dynamic slot with 1-3 fixed pallet slot(s) with no range area for pallets*

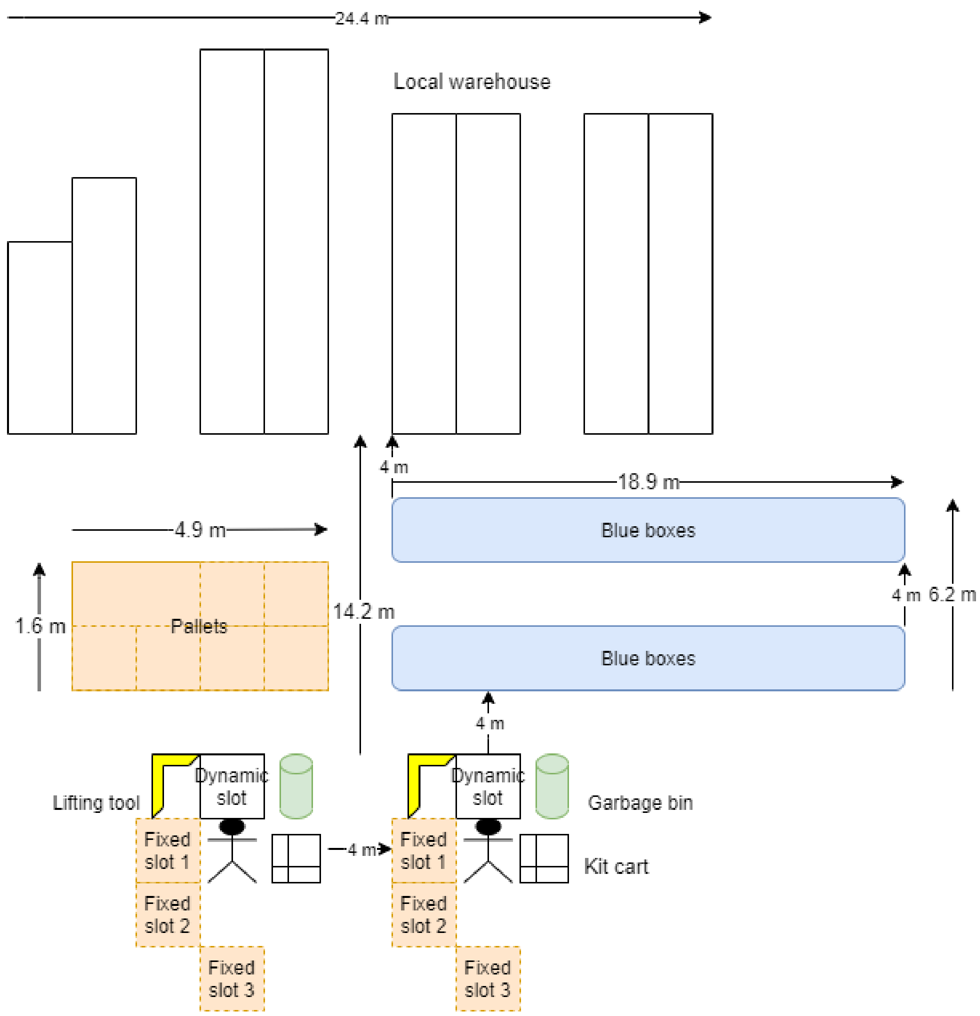

Figure 3.6: *One dynamic slot with 1-3 fixed pallet slot(s) with range area for pallets*

3.3.3.4 Scenario five, six, and seven: Fixed kit slot(s) for blue box material

In scenario five, six, and seven, the set-up of the kit stations was similar to the one in scenario two, three, and four, but racks for blue boxes was located in the fixed kit slots instead of pallets. One, two, or three fixed kit slot with blue box racks, were located at the kit station, where six part numbers could be stored in each rack. Just like in previous scenarios, the two different variants of storing arrangements have been used: with or without a range area.

Since scenario five, six, and seven are extensions of the same condition, i.e. fixed kit slots designated for blue box material, all three scenarios 1B, 2B and 3B are visualised in Figure 3.7, and 1BR, 2BR and 3BR in Figure 3.8.

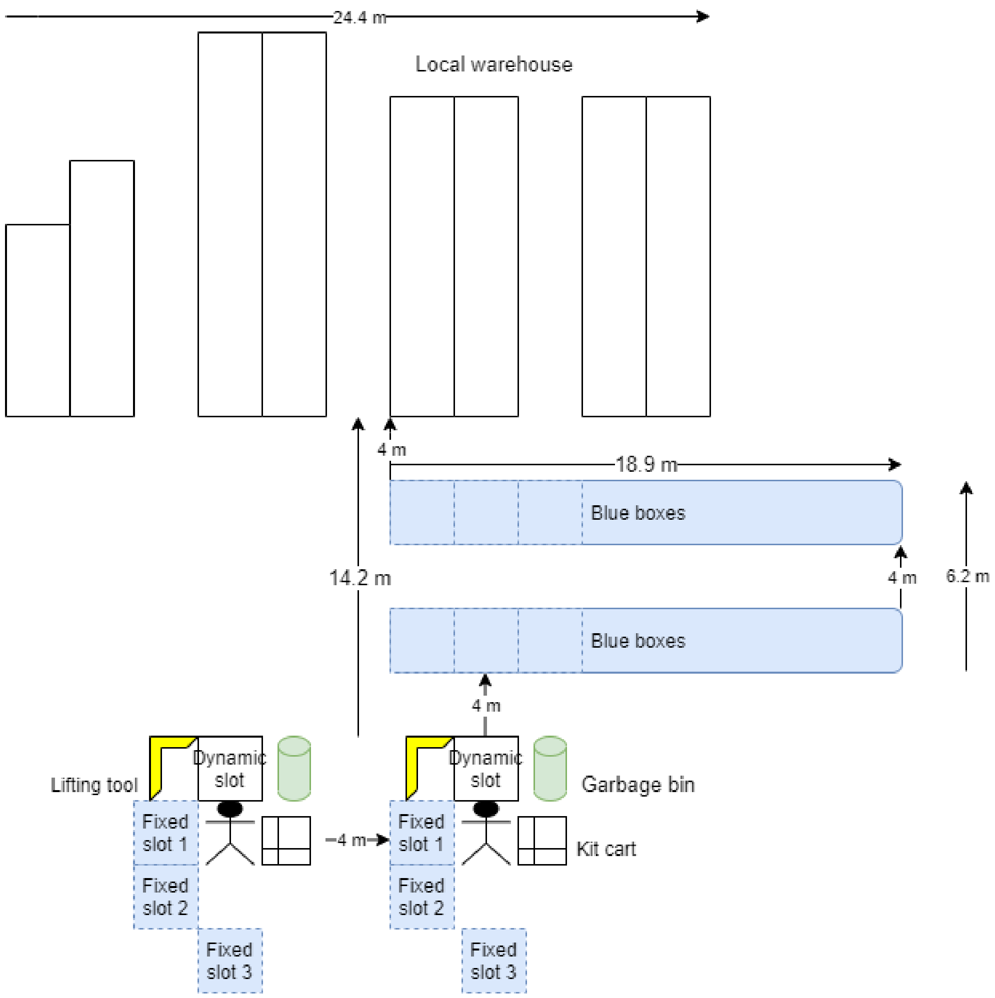

Figure 3.7: *One dynamic slot with 1-3 fixed blue box slot(s) with no range area for pallets*

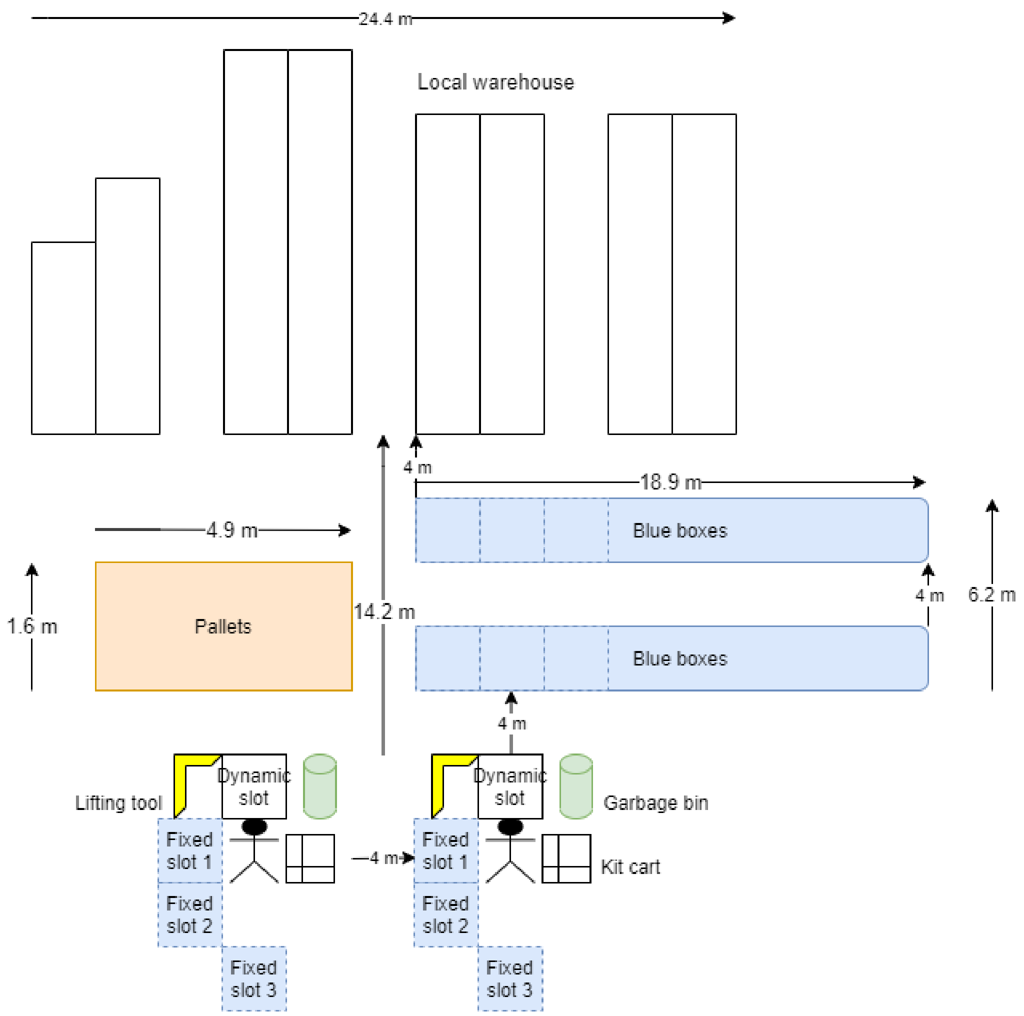

Figure 3.8: *One dynamic slot with 1-3 fixed blue box slot(s) with range area for pallets*

3.3.3.5 Comparison between the scenarios

The seven scenarios presented above provided information on how the different dependent variables varied when the independent variables were altered. Once the value on the dependent variables had been established, a comparison between the values in the different scenarios were conducted. The differences were visualised through the use of plotted graphs, where the values for the result variables in each of the scenarios were plotted and presented in a table with the values of all the variables, in each scenario.

3.4 Validity and reliability

Two prominent criteria for research of high quality are *validity* and *reliability* (Bell et al. 2018; Eliasson 2018; Waller et al. 2015). Validity is concerned with relevance of the collected data and that the methods used to interpret the data should be well connected to the aim of the study(Waller et al. 2015). Further, Bell et al. 2018 describe how validity is concerned with if the conclusions drawn from a research holds. This includes, among other things, if conclusions regarding causal relationship between independent and dependent variables are valid (Bell et al. 2018). To achieve validity in this study, all gathered data have been revised consciously, with several relevant employees at Volvo. This has been applied both on the data collected from internal systems, where different sources of information has been compared and evaluated, and during the construction of the different scenarios, which has been made in consultation with Logistics Engineers and Logistics Manager, to ensure that the methods used to calculate and evaluate the scenarios are valid and suitable for the aim of the study. Potential causal relationships between the independent variables and the dependent result variables in the scenarios have been evaluated through repeated calculations and close analysis of how they correlate. However, in the context of this study, it is predicted that other factors also would influence the success of a future implementation of M2M, but that this study is limited to the evaluation of a few variables and how they affect each other.

The second criteria, reliability, has also been considered in this study. Bell et al. 2018 describe how reliability is concerned with whether the results of a study or research is repeatable, and whether the measurements used in the study are consistent. This means that the same results should be obtained if repeating the same methods, but also that the result is independent of the researcher and other participants in the study (Waller et al. 2015). According to Eliasson (2018), reliability can be increased by measuring the most influential variables in various way, creating routines, controlling the data collection and be well prepared for the study. Validity of this study as been ensured by repeating the calculation steps of the scenario analysis, and also by consulting with Volvo to ensure that the calculations are valid and that they agree on the procedure that has led to calculations of the result variables.

Chapter 4

Current state

In the following sections in this chapter, Volvo Trucks departments are presented, followed by a more detailed description of the assembly line and its material flows. Thereafter, the relevant part of the assembly line, i.e. where the case study has been conducted, is presented together with the related transports and activities.

4.1 Four departments at Volvo Trucks

The Volvo Trucks plant in Tuve has four different departments: customer adaptation, final assembly of the trucks, completely knocked down (CKD) and a pilot plant. The customer adaptation department is handling the special customised request from customer, while CKD is a part in the factory where components are packed and delivered to other Volvo factories and customers. The Tuve plant has a pilot plant that is connected to the factory for testing of new materials and innovations. However, Volvo has two assembly lines called the main line for final assembly of the trucks and cab trim, where the cabins are assembled. The main line is the primary occupation of the plant and one of the most important part of the factory. According to Volvo, the main line is the most expensive part of the factory and should be prioritised. Therefore, any possible improvements and savings that could be made, should start from the main line.

4.1.1 The assembly line at Volvo Trucks

As stated by Volvo, the main line is a central part of the factory. It can be divided into three segments: base module, final assembly one (FA1), and final assembly two (FA2). The entire line is shaped as the letter L, see figure 4.1. The main assembly line consists of 43 stations that are grouped into the three segments: The station 1 to 15 are located in the segment *Base module*, the stations 16 to 29 are located in the segment *FA1*, and the stations 30 to 43 are located in the segment *FA2*. All the material, regardless of which segment they will be delivered to, first go through goods receiving, where the parts are registered in the internal system. In this paper, the case study had focused on FA1, and more specifically on the assembly stations 16 to 24. On these stations, the types of material vary, and therefore also the type of packaging of the materials. Due to the great variation in material and packaging, the transportation processes and steps differs, as well as the activities that are performed on the material. Eventually, all the material end up on the main assembly, but a large amount of the material are stored in warehouses and/or used in different activities before being delivered to the main assembly line. These different transports and activities will be further explained in the next section.

At the Tuve factory, the trucks are assembled during two separate working shifts: the day shift and the evening shift, which are both eight hours long. While the same activities are performed and the shifts are the same length, more trucks are assembled during the day shift. This means that an operator during the evening shift is responsible for and works at two assembly stations, compared to an operator that works in the day shift who only works at one single station. Therefore, fewer operators are needed during the evening shift than during the day shift.

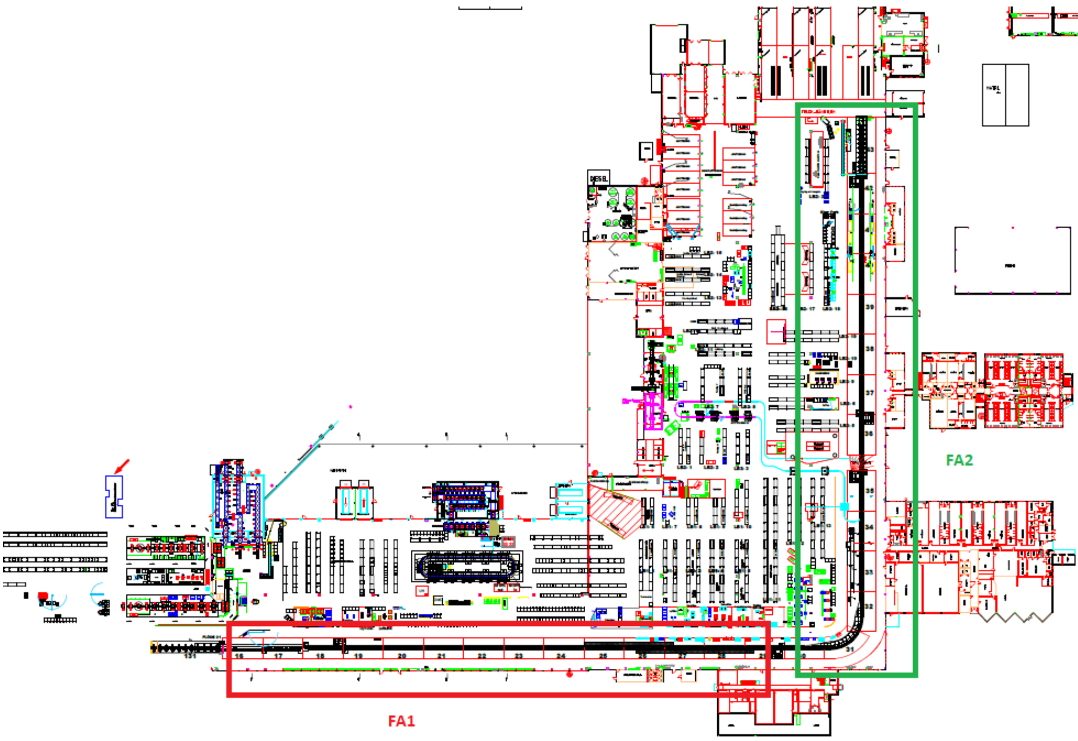

Figure 4.1: *The stations included in FA1 and FA2*

4.2 The material flow in the Tuve factory

The material used at FA1 arrive from several locations around the plant. As explained in the previous section, after the materials have passed goods receiving, the materials for FA1 are transported to their designated locations. The materials are either transported to one of the storage locations, i.e. the local warehouse that are located nearby FA1, one of the automated warehouses, an outside storage area, the local blue box warehouse called SUMA or directly to the main assembly line. The materials stored at the local warehouse or SUMA have a higher demand compared to the materials stored in the automated warehouses, and the material that is delivered directly to the assembly line are also used frequently and stored close to the usage points. An overview of the material flows in the Tuve factory is presented in figure 4.2.

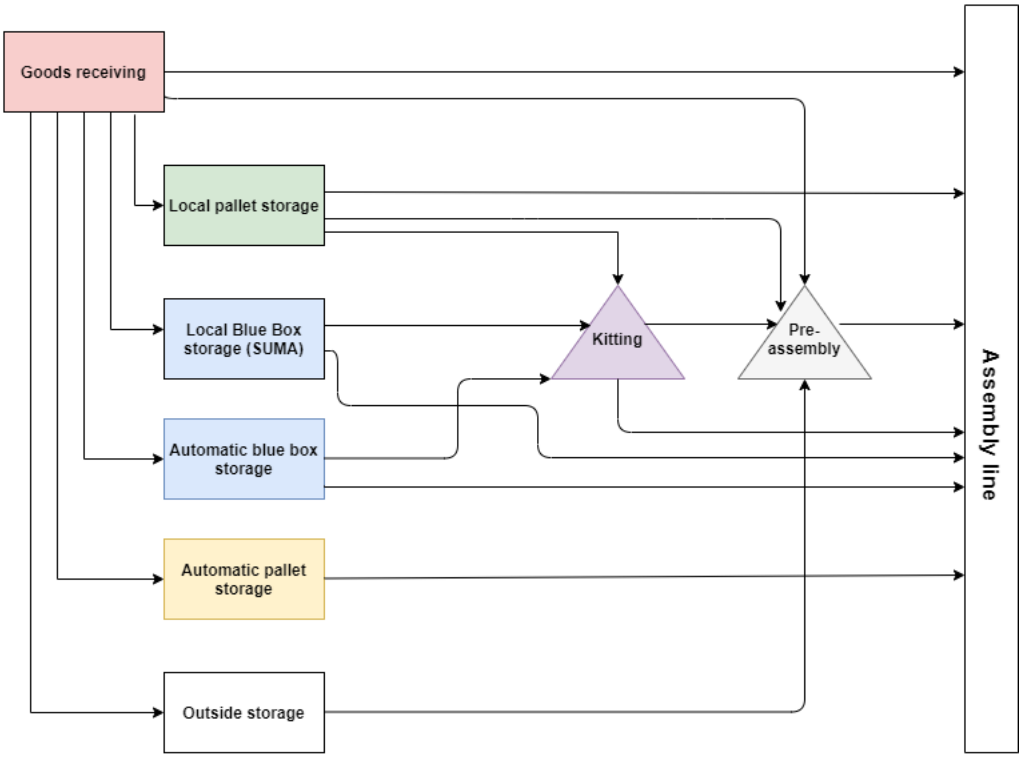

Figure 4.2: *Material flow in the Tuve factory*

4.2.1 Material flow to the station 16 to 24

The focus of this case study, i.e. the assembly stations 16 to 24, have the same types of material flows as the rest of the factory. Currently, around 1146 part numbers are active at the stations 16 to 24 and different types of materials have separate material flows, which is presented in figure 4.2. In this study, some of the material flow in the analysed scenarios differ from the ones presented in this section, while some remain the same. In order to fully understand the possibilities of the scenarios, as well as the difference between the scenarios and the current state, a description of the current material flows is useful.

As shown in figure 4.2 and explained in previous sections, the material flows to the line originate from the local warehouse, the automatic warehouse for pallets, the automatic warehouse for blue boxes, SUMA, the outdoor warehouse, directly from goods receiving, or from one of the activities: kitting, pre-assembly, and sequencing.

The majority of the material that is stored at the local warehouse supply the kitting aisles underneath the racks and are stored in pallets. The pallets are handled and transported by a forklift, see figure 4.3. However, there are also part numbers that are delivered from the local warehouse to pre-assembly stations or to the main assembly line. The parts that are particularly large and heavy, e.g. a type of part that is called *Link rod*, are being sequenced by suppliers, which is further explained in section 4.2.2. These sequenced parts are either being delivered directly to the main line from goods receiving, or via the outdoor storage and then to pre-assembly.

The material presented above are all stored in wooden pallets, and the remaining materials active around station 16 to 24 are stored either in blue boxes or in cardboard boxes. There are different sizes of blue boxes depending on what component it contains. The blue boxes can be find at the main line, the pre-assembly stations, and the kitting stations and are transported from two different warehouses in the plant that only handle and store blue boxes, i.e. the automated blue box warehouse for components that are large and low in demand and SUMA, for components that are smaller and have a higher demand. The part numbers delivered in cardboard boxes are mainly screws, nuts and bolts. The cardboard boxes can be find both at the pre-assembly stations and at the main assembly line, and are delivered directly from goods receiving. There is no inventory for cardboard boxes in the factory, so when the materials that are delivered in these boxes are low in stock, the operators make new orders for the material directly from the supplier. It arrives to the plant one or two days later and is then delivered directly to the usage point.

4.2.1.1 Transportation of materials to station 16 to 24

In order for all the different types of materials to be delivered to the various locations at the plant, different types of transportation is required. The transport equipment and processes used in the plant are affecting both the possibilities in terms of layout in future scenarios as well as factors such as transportation speed, handling time, and space requirements. The transportation begin when the materials arrive outside goods receiving, and continue between all the different activities and storing locations around the plant. All the materials delivered to the factory arrive in pallets, but the material stored in blue boxes and cardboard boxes are separated from the pallets once it has been registered. The most common transport equipment used to handle and transport pallets are forklifts, which is also the most common vehicle in the factory as a whole. The forklifts that Volvo currently uses for transportation and material handling are called counterbalanced lift trucks or fork trucks (see Figure 4.3). This type of forklifts require a minimum aisle width between three and a half to four meters and can lift heights more than four meters (Kay 2012).

Although, forklifts are not the only transport equipment used at the plant. The transportation equipment between different storage areas and activities differ depending on what kind of material that is transported, and the type packaging. The pallets that are stored at the local warehouse are delivered to the storage area by a Tugger train, which is a type of carrier that has several trailers connected to it. The carrier can carry several pallets on each trailer (see figure 4.4).

In addition to the transportation equipment used to transport pallets, blue box material require different types of transport. Since blue boxes are smaller than pallets, they are usually transported in smaller forklifts. There are two different types of forklifts used for transportation of blue boxes. The first forklift, shown to the left in Figure 4.5, is used when transporting smaller blue boxes from SUMA, while the second forklift, shown to the right in Figure 4.5, is used with larger blue boxes that is stored in the automated blue box warehouse.

Figure 4.3: *The forklifts used to handle pallets at Volvo*

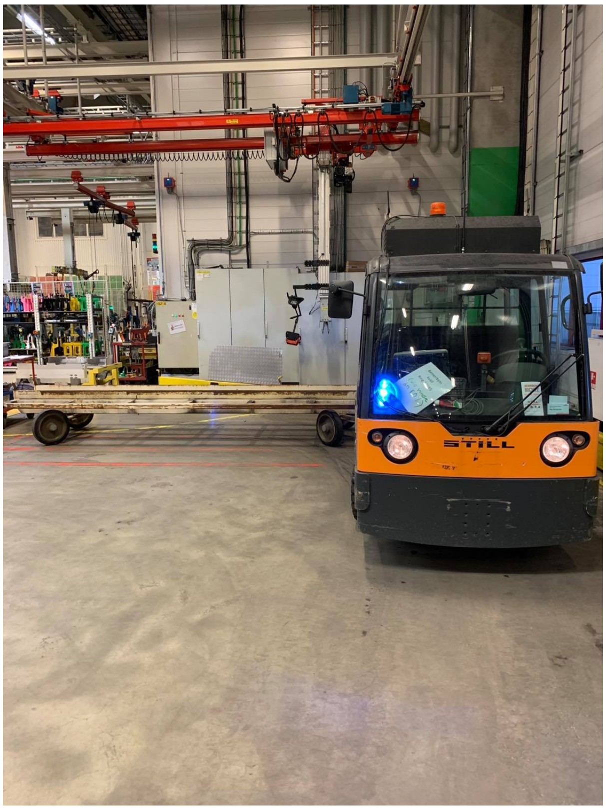

Figure 4.4: *A tugger train, including a carrier with trailers connected to it*

Figure 4.5: *Two types of forklifts that are used for delivering blue boxes*

4.2.2 Activities performed on the material before the assembly on the main line

Apart from the transportation, there are three activities that are performed on material in the plant, and they are located in close relation to the main line. These activities are kitting, pre-assembly, and internal sequencing. These activities have a great impact on the performance on the main assembly line and play an important role in order for the line to function efficiently. The purpose of performing these activities, and the reason why they are considered to increase value for the company and efficiency on the assembly line, are mainly based on two factors. First, they intend to increase quality, by reducing the decision points for the operators on the mainline, which in turn reduces mistakes and delays. Second, they are performed to save time on the main assembly line, which is where the foremost time constraints lay.

4.2.2.1 Kitting to station 16 to 24

The kitting is a central part of the M2M concept, and the analysis in this study also focus heavily on potential changes in this activity, both regarding number of kitted components and regarding how the kitting activity can be performed. At the Tuve plant today, kitting is performed manually by an operator, and the majority of the kitting is performed with support from a pick by light system (PBL). The parts picked from kitting are placed in a kitting cart, see Figure 4.6, then transported manually by the operator to either pre-assembly or directly to the main line. Moreover, there are different variants of carts used in kitting, depending on the size and weight, e.g. part number called leaf spring requires a semi-automated cart, due to the weight of the component. However, the majority of the carts are handled manually.

Figure 4.6: *Kitting cart at Volvo*

The kitting stations around station 16 to 24 are based on the fish bone layout, which means that they are located as close as possible to the usage point at the assembly line, to minimise the time for transports. As presented in Figure 4.7, the kitting areas around station 16 to 24 are currently located in the local warehouse, on some pre-assembly stations, along the main line and on the main line. There are currently 206 part numbers being kitted. Most of the materials that are heavy and require a lifting device are located in the kitting aisles (see the red area in Figure 4.7) and are stored in pallets, while smaller and lighter parts that do not require a lifting device are located at kit stations next to the main line (see the yellow area in Figure 4.7) and on some pre-assembly stations (see the green area in Figure 4.7). The parts that are kitted on the pre-assembly stations are mainly stored in different types of blue boxes. There are currently five operators that are performing kitting tasks. However, these five operators are also performing the tasks at the pre-assembly stations, which means that the operators mainly kit to themselves before performing the pre-assembly on the kitted material. Figure 4.1 presents the average picking time on each kit, location and the names of the kit stations that are currently active, which has been withdrawn from Volvo's PBL system. Worth noting is that the amount of parts being picked in the current kitting activities vary combined with the distances for each kit station. When dividing the total kitting time on the kit stations with the total amount of picks in each of the kits, to find the average time for one pick, the result is 27.1 seconds. An explanation to the high picking time for one pick is due to the walking distance and the time required to swap between different lifting tools. These kits includes, in total, 206 part numbers, which equivalent to 2968 picks during one day. In the scenarios analysed in this study, the number of part numbers being kitted, and therefore the total number of picks, will increase. However, it is not necessary that the average picking time would increase due to the new set-up of the kit stations.

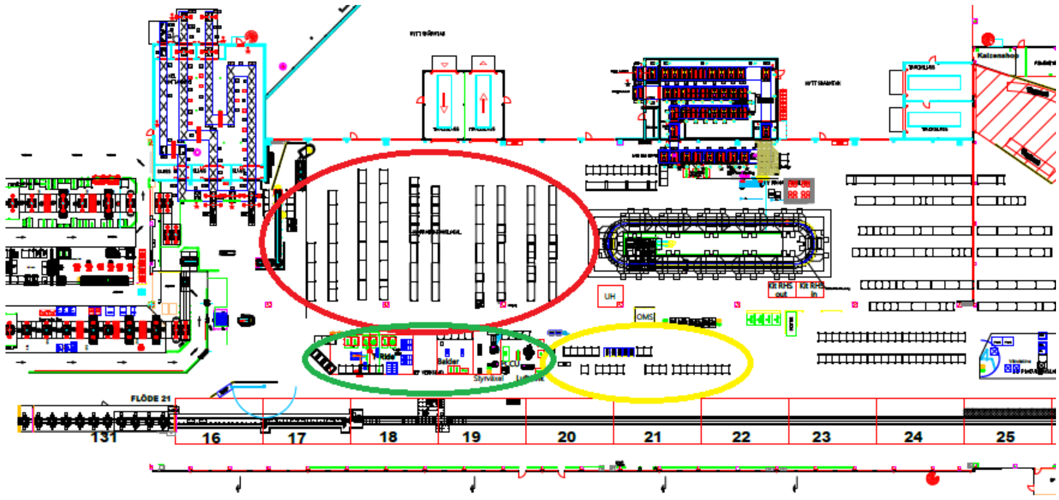

Figure 4.7: *Red: Kitting aisles, Green: Kitting in Pre-assembly and Yellow: Kitting stations*

Table 4.1: Location and names of the kitting activities around station 16 to 24

Location	Kitting station	Average kitting time (sec)
Kitting aisle 6-8	LBCylinder	11,31
	Stodlager11600	34,64
Kitting aisle 10-12	LB Faste	11,14
	Luftbalg	26,76
	Bakrefaste	7,87
Kitting aisle 14-16	Styrvaxel	79,2
Kitting aisle 18-20	Airtank	139,89
At pre-assembly	LB Tridelh	151,83
	LB Tridelh	143,83
Kit stations	BLABOXKIT3	46,25
	LANKSTANGVFL21	20,75
	ACSLANG	7,53
At Spring pre-assembly	Self kitting	107,09

4.2.2.2 Sequencing to station 16 to 24

When performing sequencing, the material is ordered in the same order as they will be assembled on the trucks, so that the operator in the assembly line can take one part a time in the same order as it is delivered, and it will fit to the specific truck that they are assembling. There are two types of sequencing used at the Tuve plant: internal and external sequencing. The internal sequencing is performed at the plant after the material has been registered at goods receiving. The external sequencing is performed by suppliers and delivered directly from goods receiving to either pre-assembly or the main line, which is the case for, for example, the link rods.

The difference between sequencing and kitting in this context is that sequencing is performed on one single type of material, while kitting include several different types of material in the same kit. Sequencing, as well as kitting, remove decision points from the operator, which intend to increase quality of the product and conditions for the operator. Sequencing is mainly used for bulky and heavy parts. Because of the rather big packaging for these parts, it is advantageous to perform the sequencing as close as possible to the goods receiving according to Volvo, and then transfer the sequenced parts by a tugger train to the point of use.

There is currently one type of material that is being sequenced to station 16 to 24, which is performed by suppliers before being delivered to the plant and later on to both pre-assembly stations and to the main line. The material is called link rod and there are approximately 600 part numbers of link rods. Moreover, the range size of the link rods vary depending on the truck model and are used on several stations throughout 16 to 24. However, all the link rods are heavy and large and require a lifting tool. The internal sequencing on these stations is performed on one type of material, i.e. relay rod. In the internal sequencing, kitting operators prepare the material in the correct order for the assembly line after being registered at goods receiving.

4.2.2.3 Pre-assembly at station 16 to 24

As previously presented, pre-assembly means that material is assembled to a module that later can be assembled at the truck in one piece. At Volvo, pre-assembly is used on several stations and on a big variety of material. The majority of the pre-assembly stations are located in close proximity to the assembly stations on which they are assembled to the truck, based on the fish bone layout, but some pre-assembly is performed in a different part of the factory and then transported to the correct assembly station. There are currently four pre-assembly stations that handle components that are to be assembled on the stations 16 to 24. These pre-assembly stations are called: Air Tank, Balder, Steering Gear, and Spring. On these stations, there are also a couple of pre-assembly stations that are combined with kitting, i.e. at the pre-assembly stations Spring and LB Tridelh. While pre-assembly is intended to be used in future scenarios of M2M, the focus on this study has not laid on the performance of pre-assembly or the number of part numbers that should be included in the activity. However, since the kitting currently is being performed in combination with, or in close relation to, the pre-assembly, it is still valuable to understand the conditions for the operators on the pre-assembly stations.

Chapter 5

Analysis and Results

5.1 Distribution between kitted and not kitted material

Since the basis of kitting distribution lies in Volvo's previously established conclusion that approximately 80% of the material in the plant should be included in kitting, this was also the starting point for the analysis of which part numbers to include in kitting in the scenarios. In this analysis, the sequenced material has been considered to be included in those 80%, since the sequenced material is presented to the operators in the correct order, adapted to the truck that they assemble, which creates the same benefits for the operator as a kit would do. The difference between the sequenced and the kitted material is, how ever, the logistics flow. The sequences material does not pass through the kitting station, but is transported directly to the assembly line. Therefore, even though the sequenced material is included in those 80%, that material is not included in the kitting activities that has been exemplified in the scenarios that are analysed later in the analysis. However, no additional material has been included in sequencing, but only the material that is currently sequenced.

When deciding which of the material in the compiled list of all currently active material at the assembly stations 16 to 24, i.e. 1146 part numbers, several considerations have been taken into account. First, all material stored in cardboard boxes, i.e. 167 part numbers, were eliminated. There are several arguments behind this elimination. The majority of these material are frequently used, and with their small sized packaging, those material are the most space efficient material to store on the assembly line. Also, the small size of the material in the boxes increases the risk of losing them in the kitting process, which is another reason to remove them from the kitting process. The risk of losing material is, in turn, a quality risk, which is believed to out weight the potential quality improvements that kitting would contribute to. Finally, the cardboard boxes are handled in a separate logistics flow, which would increase the complexity and reduce the possibilities to alter between different material, i.e. decrease the flexibility. Therefore, when eliminating all the boxes, the logistics flow for the kitting will be less complex and potentially more flexible. The elimination of the cardboard boxes resulted in a distribution of 85% for the kitted material. Further, considerations were taken to certain especially awkward or large material, i.e. 13 part numbers, which were also eliminated from the kitting. This was mainly based on the extra space that would be required on the kit station if those were included, as well as a preferred minimisation of unnecessary extra handling of these material. This resulted in a final distribution of 84% for the kitted material, which is divided into 356 part numbers included in kitting and 610 part numbers included in sequencing. This corresponds to a total of 966 number of part numbers that are included in the new distribution, which is an increase with 18% part numbers, from the previous 816 part numbers. If only counting the part numbers included in kitting, the number of kitted material increased from 206 part numbers to 356 part numbers, which corresponds to an increase of 72% .The full list of all part numbers and the distribution of kitted material is presented in Appendix A. The number of material that will pass through the kitting process, i.e. 356 part numbers, has been consistent over the whole scenario analysis, which is presented in the section below.

5.2 Scenario analysis

When analysing the different scenarios in this study, the starting point for the analysis is based on the previously established parts of the M2M concept that is believed to provide flexibility, quality, and space efficiency. This includes, as mentioned, an increased number of parts that are kitted, which has been presented in the previous chapter, and the introduction of a new kitting process with dynamic kit slots. Flexibility, in this case, refers to efficiency when switching between different set-ups and the capacity to handle an increased number of components. The scenario that would result in the highest flexibility, according to Volvo's definition, is a scenario where kit stations contains only one dynamic slot on each station, which is summarised in scenario one see Figure 3.4 and Figure 3.3. The flexibility in this scenario mainly comes from the possibility to kit any kit on any kit station, as no material is tied to a location. Also, Volvo believes that elimination of fixed slots for the material would result in less space needed, which in turn would enable storage of more part numbers. However, the actual space requirement for this scenario will be analysed later in this section, and compared to other scenarios. In addition to scenario one, which can be seen as the starting point of the scenario analysis, six other scenarios has been analysed, where all the scenarios has a different number of fixed kit slots and/or types of fixed kit slots. Below, a presentation of the result variables in each of the scenarios is provided, divided by variables related to transport and operators and space.

The abbreviations of the scenarios have been presented in the methodology section. However, in order to recall the scenarios, the same table is presented to give a better overview of the analysis, see Table 5.1.

5.2.1 Required space for the different scenarios

The space required in each scenario has been calculated by first using the space required to store one large pallet and the space required to store racks containing 6 blue boxes each. This enabled the calculations of the space for the kitting stations in each scenarios, the range area for either pallets or racks, and the space that is required to store one pallet in the local storage. Since the space required to store and

Table 5.1: Abbreviations and definitions of the scenarios

Scenario	Abbreviations of the scenarios	Definition of the scenarios
1	1D	1 Dynamic slot without range area
	1DR	1 Dynamic slot with range area
2	1P	1 Fixed pallet slot without range area
	1PR	1 Fixed pallet slot with range area
3	2P	2 Fixed pallet slots without range area
	2PR	2 Fixed pallets slot with range area
4	3P	3 Fixed pallet slots without range area
	3PR	3 Fixed pallet slots with range area
5	1B	1 Fixed blue box slot without range area
	1BR	1 Fixed blue box slot with range area
6	2B	2 Fixed blue box slots without range area
	2BR	2 Fixed blue box slots with range area
7	3B	3 Fixed blue box slots without range area
	3BR	3 Fixed blue box slots with range area

handle the largest sized pallet exceeds the space required for one rack, the dynamic kit slots in the scenarios are equal to the size of a pallet, which ensures that all types of material would be able to pass through the dynamic kit slot. All these calculation steps further enabled calculations of the space requirements for the whole scenarios, which is presented in Table 5.2 and Figure 5.1. Figure 5.1 include three different variables: First, the required space for the kitting activity and the range areas. Second, the space that is released in the local warehouse when pallets are removed from the local storage and located on a kit station or in a range area. Third, a combination of the other variables, where the released space in the local warehouse has been deducted from the total space requirements for the kitting activity and the range area. This third variable represent the resulting space requirement, if taken the released space into account. This variable has been used to show how the released space in the local warehouse is valuable to include in the result, since the released space potentially could be used for additional material, which is also valuable in the bigger picture. One area that is not included in any of these calculation is the required space for the driving routes, and a deeper explanation of why these have been excluded from the calculations is presented in Section 1.3.

5.2.1.1 Differences depending on the number and type of fixed kit slots

As presented in the graph in Figure 5.1, and in Table 5.2, the required space vary between all the scenarios, but there is no clear pattern over the seven scenarios. However, the graph shows that when moving from scenario one, with only a dynamic kit slot, to scenario two, three, and four, with fixed pallet slots, the required

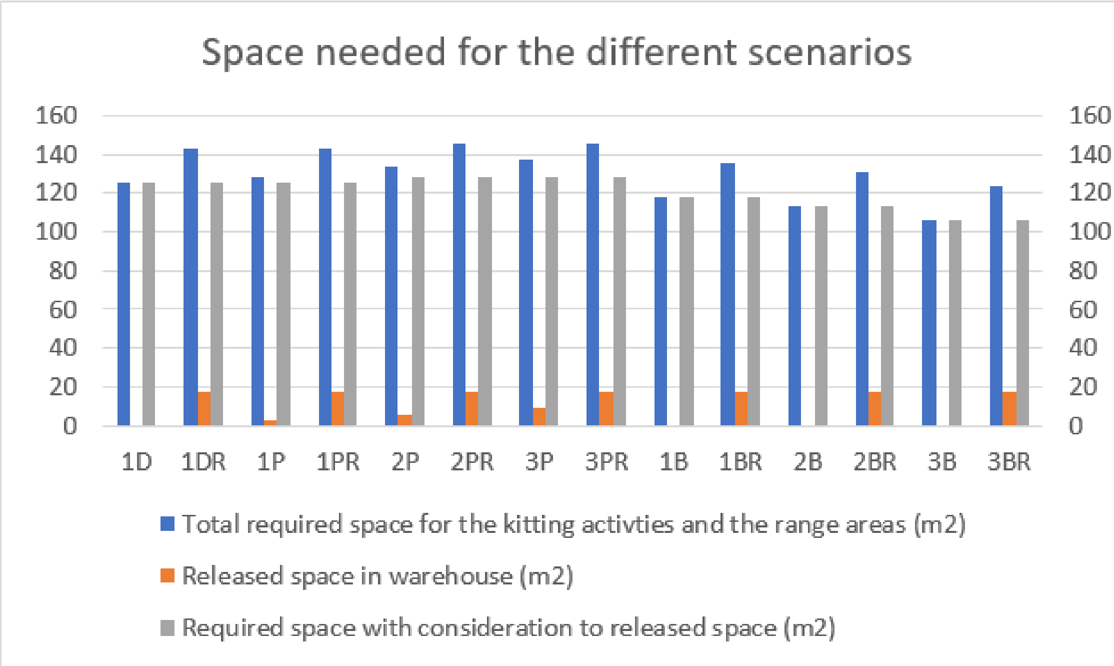

Figure 5.1: *Required space for the different scenarios and the extra pallet space available*

Table 5.2: Required space for the different scenarios and the extra pallet space available

Scenario	Total required space for the kitting activities and the range areas (m2)	Released space in warehouse (m2)	Required space with consideration to released space (m2)
1D	125	0	125
1DR	143	18	125
1P	128	3	125
1PR	143	18	125
2P	134	6	128
2PR	146	18	128
3P	137	9	128
3PR	146	18	128
1B	118	0	118
1BR	136	18	118
2B	113	0	113
2BR	131	18	113
3B	106	0	106
3BR	124	18	106

space for the kitting activity and the range areas increases. This can be explained by the fact that the pallets that are stored in the local storage or the range area in scenario one are moved to the kit station, where space for the pallet is required in all the scenarios, and extra walking space is required if the number of fixed slots exceeds one. Further, when moving to scenario five, six, and seven, which include fixed blue box slots, the required space for the kitting activity and the range areas decreases. This can be explained by the fact that the racks for blue boxes are moved from the blue box range area to the kit station, and while the space for one rack is equal, the walking space required next to the racks on the kit station is smaller than the required space for forklifts next to the racks in the range area.

Further, Figure 5.1 and Table 5.2 show that the released space in the warehouse also differ between the scenarios, and that the introduction of fixed kit slots affect this variable. Since the variable is based on how many pallets that are relocated from the warehouse, the introduction of fixed kit slots directly contributes to this relocation, which increases the released space in the local warehouse. The released space in the local warehouse directly affects the result of the third result variable, i.e. space requirements with consideration to the local warehouse. Here, the difference between the scenarios is smaller. This is explained by the fact that considerations of the released space evens out the difference in space requirements, since the space required for the fixed kit slots partly are compensated by the released space in the warehouse, which can be used for storing of other material. However, one important aspect of this result variable is that it is based on the assumption that all space is valued the same. In this case, the released space in the warehouse would be able to compensate for the increased space in the range area. In reality, the material is stored vertically in shelves in the local storage, while the pallets are stored on floor-level in the range area, without any vertical storing. This means that if the floor space needed for one pallet in the range area would be used for a shelf in the local storage, it could store up to six times as many pallets, assuming that the height of the shelves equal the height that is used in Tuve today. With this in mind, the space is not necessary as valuable in all situations, which is why the main point of the comparison between the scenarios still should be applied to the required space for the kitting activity and the range areas.

The scenario with the lowest space requirements for the kitting activity and the range areas is scenario seven, with a total space of 106 m^2 for 3B, which is the lowest variant within scenario seven, and 124 m^2 for 3BR. These scenarios included 3 fixed blue box slots with and without the range area. In contrast, the scenario with the highest space requirement for the kitting activity and the range areas is scenario four, with a total space of 137 m^2 for 3P, which is the lowest variant within scenario seven, and 146 m^2 for 3PR.

5.2.1.2 Differences depending on the range area for pallets

All the scenarios require less space for the kitting activity and the range area if there is no range area for pallets included. Naturally, this is because the range areas are included in the calculation, and if there is no range area for pallets, the required space will automatically decrease. The opposite correlation can be identified for the released space in the warehouse, where all scenarios have more released space in the warehouse if a range area is introduced. This is because the released space in the warehouse is the space required to store the pallets that are removed form the warehouse, and placed in the range area. Further, as presented in Figure 5.1 and Table 5.2, the released space in the warehouse is the same for all of the scenarios when a range area for pallets is included. This is because the pallets are relocated from the warehouse to the range area in all of the scenarios. In the scenarios where the range area is smaller, the number of fixed pallet kit slots is higher, which means that the pallets are still removed from the warehouse, but instead placed at the kit station. With this logic, the total space for the scenarios, if taking the released space into account, is independent of the range area. This would mean that all scenarios have the same total required space regardless if they have a range area or not. However, as pointed out in the previous section, the value and efficiency of the space differ depending on where the pallets are located, due to the differences in vertical and horizontal storing solutions.

5.2.2 Required transports and operators for the different scenarios

The transport need for each of the scenarios has been calculated both regarding the number of required transports and regarding the total time needed to perform these transports. The transport time depends on the transport distances, which has been calculated from the visualised scenarios presented in Section 3.3.3. The measurements for the driving routes between the different areas in the scenarios are based on the minimum required space for a driving route, but is not adapted to potential situations with extensive traffic or if several parallell lines would be needed. These calculations have, in turn, enabled calculations regarding the number of transporters, i.e. transport operators, needed to perform the transports. Further, the picking, walking, and waiting time for the kitting operators has enabled calculations regarding the number of kitting operators needed to perform the kitting.

However, two important facts about these calculations has to be emphasised here, to fully understand the reliability and usability of the variables. First, the transports that have been calculated for every scenario are the *additional* transports. This means that the transports that are performed today, which will also be performed in the future, have not been calculated. A deeper explanation of why these are excluded from the calculations is presented in Section 1.3

Second, the number of required kitting operators are based on the actual time that the operators spend on picking material and walking, and the waiting time that occurs during the material shifts on the dynamic spot. What is not included in this is any potential waiting time that would occur if the vehicles that transport the material to the kitting station would not be waiting in line, ready to supply the kitting station. This means that if the transport time for a certain number of vehicles would be longer than it takes for the same number of vehicles to go through the kitting process, waiting time would occur. On the other hand, if the vehicles would stand in line and be ready to supply the kitting station, waiting time would instead occur for the transport operators and/or vehicles. None of this potential waiting times has been accounted for in the calculations in this analysis. The reason for this is that the waiting time for the operators depends on the number of active vehicles, while the number of vehicles in this analysis depends on the total required transport and handling time, which in turn depends on the waiting time for the transport operators. With these cyclic relationships, one variable would have to be established beforehand in order to avoid cyclic dependencies, if the waiting time should be included. Instead, this analysis has focused on the actual time used for the kitting activity for the kit operators, and the actual transportation and handling time for the vehicles. This implies that further research would be necessary to achieve a result with better precision, which would require a deeper analysis of potential efficient vehicles, route planning, and efficiency in the handling of material in storage. With this clarification in mind, the number of kitting operators and transport operators has been calculated in the same in all of the scenarios, which still enables a comparison between the different scenarios.

The transport need and the number of needed operators and vehicles for the different scenarios are visualised in Figure 5.2, and the values of each variable in the graph is presented in Table 5.3. Since the different scenarios differ when it comes to the number of fixed kit slots and the type of material on the fixed kit slots, and that each scenario contains both a variant with a range area for pallets and one variant without, the following sections analyse the scenarios from these different perspectives.

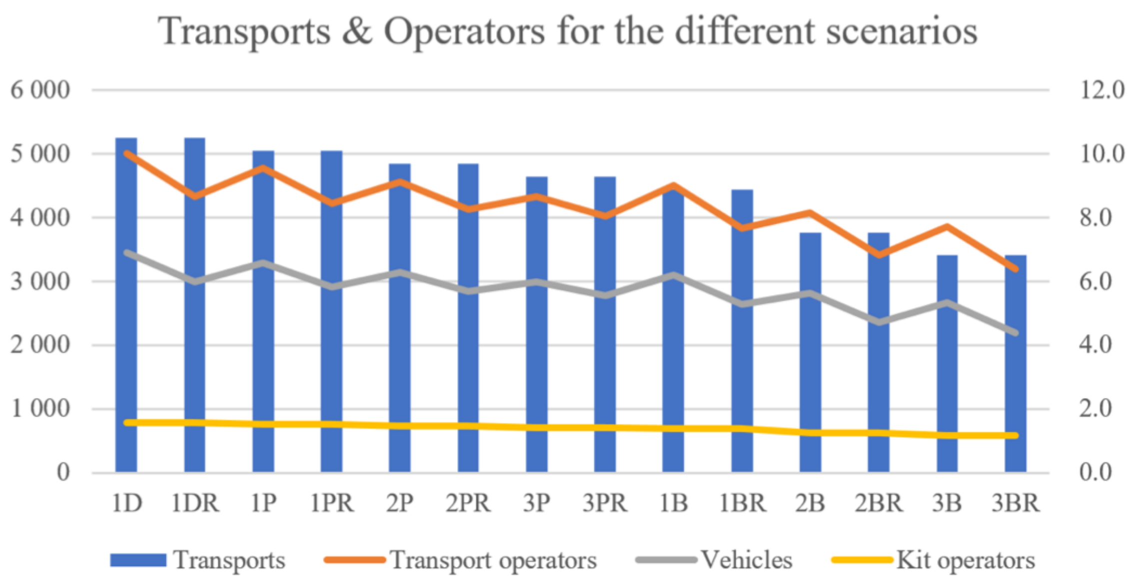

Figure 5.2: *Transports and operators that are required in the different scenarios*

5.2.2.1 Differences depending on the number and type of fixed kit slots

The number of transports vary over the scenarios, and a negative relation can be identified between the number of fixed kit slots and the number of transports needed. That is, that when the number of fixed kit slots increases, the number of transports decreases. Further, all the scenarios that involve fixed kit slots for blue boxes stored on racks result in a lower number of transports than both the scenario with only one dynamic kit slot and the scenarios that involves fixed kit slots for pallets. The reason behind this is that there are six blue boxes in each rack, which means that there are six different part numbers on one slot, compared to pallets, where there is only one part number on each fixed slot. The highest number of needed transports is for scenario one, which results in 5346 daily transports, and the lowest number of

Table 5.3: Transports and operators that are required in the different scenarios

Scenario	Transports	Transport operators	Vehicles	Kit operators
1D	5 256	10.0	6.9	1.6
1DR	5 256	8.7	6.0	1.6
1P	5 052	9.5	6.6	1.5
1PR	5 052	8.4	5.8	1.5
2P	4 848	9.1	6.3	1.5
2PR	4 848	8.2	5.7	1.5
3P	4 644	8.7	6.0	1.4
3PR	4 644	8.0	5.5	1.4
1B	4 440	9.0	6.2	1.4
1BR	4 440	7.7	5.3	1.4
2B	3 762	8.2	5.6	1.2
2BR	3 762	6.8	4.7	1.2
3B	3 411	7.7	5.3	1.2
3BR	3 411	6.4	4.4	1.2

needed transports is for scenario seven, which results in 3501 daily transports. This decrease in transports, from scenario one to seven, amounts to 35%.

A similar relationship can be identified between the number of fixed kit slots and the number of needed kitting operators. However, this relationship is not as strong, since the difference between the first and the seventh scenario is small. The number of needed kitting operators differ between 1,2 and 1,6 operators, which is a decrease of 25%, while the decrease of transports needed between the same scenarios amounts to 35%.

Regarding the transport operators, Figure 5.2 does show an overall negative relationship between the number of fixed kit slot and the number of needed transport operators, but the relationship is not perfect. This means that the pattern is not consistent over the scenarios, and that the number of needed transport operators not necessarily decrease when introducing more fixed kit slots. The explanation here is that there is a difference between having a range area for pallets and not having a range area for pallets. This difference is explained further in the next section.

5.2.2.2 Differences depending on the range area for pallets

The difference between having a range area for pallets and not having a range area for pallets can be identified in Figure 5.2. Between the two variants of each scenario, there is a consistent pattern that the variant including a range area for pallets require fewer transport operators. This pattern is due to the reduced transport distances since the material with higher demand is stored closer to the kit stations compared to local warehouse. This leads to a shorter handling time since the time required to handle a pallet on floor-level take lesser time than to handle a pallet that is stored on a shelf. However, this does not apply for the number of transports needed, since the difference between having a range area and not having one is the length of the transports and the handling time of pallets, which makes the total time for transportation shorter, but it does not affect the number of transports. The transports that goes between the local storage and the kit station in the variant without a range area, instead goes between the range area and the kit station for some of the frequently used material.

Finally, the required number of kit operators are equal for the variants with a range area for pallets and the variants without one. This can be explained by the fact that the kitting process and the time for the kitting activity is independent of the range area, which only affects the transportation and storing.

5.2.3 Comparison of the scenarios with consideration to all variables

When the scenarios are compared only with regards to transports, operators, and vehicles, the solution which would be the most beneficial is scenario seven with a pallet range area. When the scenarios are compared with regards to required space for the kitting activities and the range areas, the most beneficial scenario would be scenario seven without a range area. However, for Volvo's implementation of M2M, all factors, both transport related and space related, are important and need to be taken into consideration. Figure 5.3 and Figure 5.4 present a combination of the space, transport, and operator variables for all the different scenarios, which has been created with the purpose to visually clarify where the different variables differ, and which solutions that give the best possible combination of the required space, transports, and operators. The analysis here is basically a summary of the previously analysed variables, but with a better representation of the data, which facilitates an understanding of the different views. Figure 5.3 indicates what could also be concluded from the separate graphs: that the most beneficial solution, both regarding space and number of transports, coincides in scenario seven without a range area. When combining consideration of space and operators, the beneficial solution differs between the space analysis and the operators analysis, which is visible in Figure 5.4. The space requirements is the lowest in scenario seven without a pallet range area, while the same scenario with a range area result in the lowest number of required operators. However, the overall analysis, with a combination of all variables, indicates that scenario seven, and mainly the variant without a range area, would the most beneficial solution for Volvo. This is due to the fact that scenario 3B has the lowest value in two out of the three variables, i.e. both the required space and the number of transports.

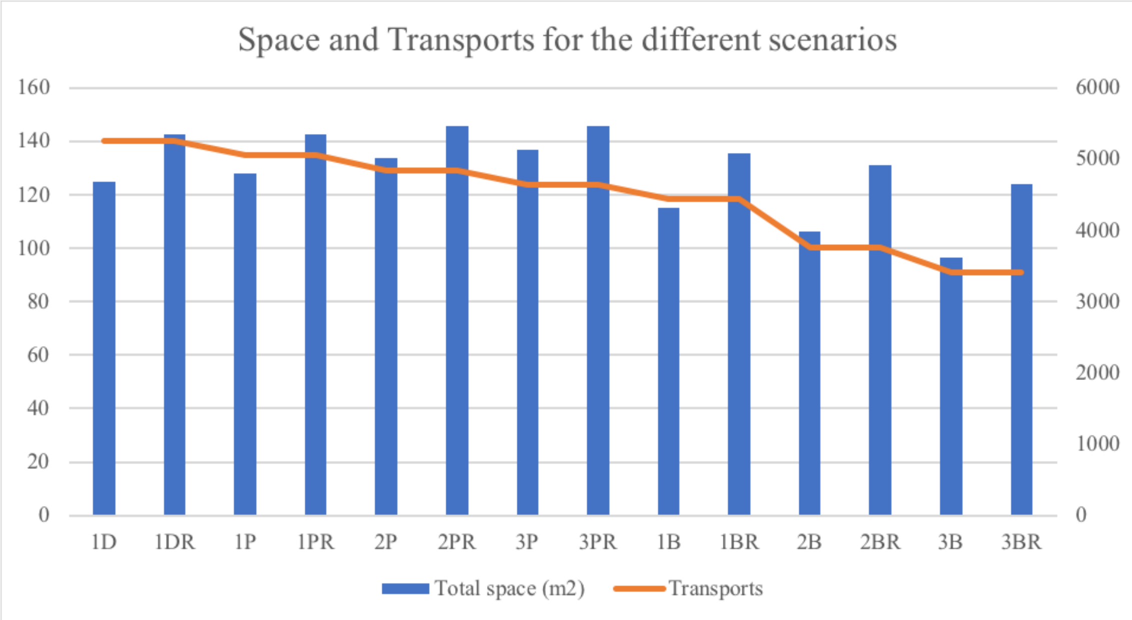

Figure 5.3: *Combination of space and transportation requirements in the different scenarios*

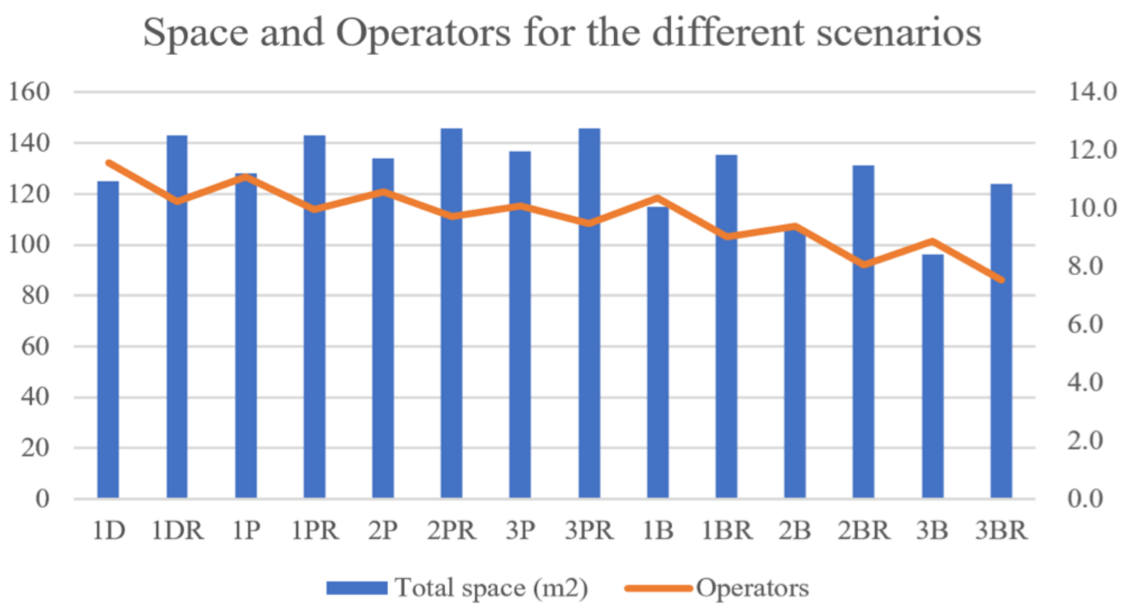

Figure 5.4: *Combination of space and operators requirements in the different scenarios*

5.3 Answers to the four research questions

The analysis in this study has presented transport and operators need and space requirements for seven different scenarios, where the number of fixed kit slots and the use of a pallet range area have been altered. This analysis is summarised in this section, where every section corresponds to one of the research questions presented in Section 1.4, in ascending order.

5.3.1 Types of material that should be included in kitting

All material should be included in kitting, with two exceptions: material that are stored in cardboard boxes and material that are particularly awkward to handle. This results in 356 part numbers that are included in kitting. Since sequencing offers the same advantages as kitting, for the operators, the sequenced part number is also included in the final distribution. The number of sequenced part numbers is 610, and the kitted and sequenced material together consists of 966 part numbers. 966 part numbers corresponds to 84% of all part numbers that are active on the assembly stations 16 to 24.

5.3.2 The total required space for the different scenarios

The total required space when introducing fixed slots, compared to the scenario with only dynamic slots, varies and the fixed kit slots have both a negative and a positive impact on the space requirements, depending on the type of fixed kit slots. In scenario two, three and four where fixed pallet slots are introduced, a negative impact on the required space can be identified, and the required space increases with up to $12m^2$ in the seven scenarios. However, in scenario five, six, and seven, where fixed blue boxes slots are introduced, a positive impact on the required space can be identified, and the required space decreased with between 7-$29m^2$. With this said, the least required space can be identified in when using three fixed blue box slots, i.e. scenario seven, with a total space of 106 m^2 for 3B, which is the lowest variant within scenario seven, and 124 m^2 for 3BR.

The total required space for the kitting activity and the range areas increases when a pallet range area is introduced, which is consistent over all seven scenarios. Scenario two, three and four with fixed pallet slots still require the most space, with up to $146m^2$, followed by the first scenario with only the dynamic kit slot that requires $143m^2$ and finally scenario five, six and seven with fixed blue boxes require the least space, with down to $106m^2$. This shows that the implementation of a pallet range area will increase the total required space in every scenario with between 11-$28m^2$.

When taking the released space in the warehouse, enabled by the relocation of pallets, into consideration, the space requirements are similar across all scenarios. Also, the result of this variable is independent on the range area, since all scenarios have the same value regardless if they have a range area or not.

5.3.3 The total required number of transport for the different scenarios

The scenarios with only one dynamic kit slot and no fixed kit slots require the highest number of transports. The scenarios with fixed pallet slots require the second highest number of transports, and the scenarios with fixed blue box slots require the lowest number of transports. The number of transports vary between 5256 transports, for 1D in scenario one, and 3411 transports, for 3BR in scenario seven. The more material that is located on the kit station, i.e. on the fixed kit slots, the fewer transports are required, which is why the scenarios with blue box slots require the lowest number of transports.

The number of transports is independent on the pallet range area, meaning that the scenarios differ only depending on the number of fixed kit slots, and not dependent on the range area within each scenario.

5.3.4 The number of operators and vehicles required to handle the increased kitting and transport need

The number of kit operators required to handle the increased material are two and is the same in every scenarios. However, the transport operators and vehicles required varies between the scenarios with, and without a range area. The number of transport operators required vary between 7 to 10 and the number of vehicles needed vary between 5 to 7. The least number of transport operators and vehicles needed can be found in scenario seven, 3BR, with 7 transport operators and 5 vehicles. The scenario with the highest number of transport operators and vehicles needed is scenario one, 1D, with 10 operators and 7 vehicles needed.

Chapter 6

Discussion

From the presentation and analysis of data in the previous section, the four research questions in this study have been answered. However, there are several factors of the analysis that could elaborated beyond the research questions, to better fulfil the long-term aim of the study, i.e. to provide a deeper understanding of the consequences from increased kitting, which is a vital part of the future implementation of M2M at Volvo. Therefore, this section will further discuss the implication of the analysis and the answers to the research questions. The discussion will focus on weighting the different result variables, presented in the analysis, against each other, analyse the feasibility of the scenarios, and present areas where further research could be useful, to provide a more detailed view and analysis of the possibilities that M2M could bring to Volvo.

6.1 The flexibility and quality outcome of the different scenarios

While transports, space, and operators are central in this study, the main purpose and focus when Volvo developed the concept M2M was to increase flexibility and increase, or at least maintain, quality when the variation and volume of material would increase. Thus, it is valuable to discuss whether the analysed scenarios can live up to the expected flexibility and quality outcome.

6.1.1 Flexibility outcome of the different scenarios

According to Volvo's previous discussions and studies, the ultimate scenario for maximised flexibility would be to kit all articles on dynamic kit slots, and not have any fixed kit slots or kit aisles. This corresponds to scenario one in the analysis of this study. Therefore, if only looking at the flexibility aspect, scenario one would be the preferred solution when implementing M2M. However, as was emphasised in the analysis, several other factors could also have an impact on the logistics system, and flexibility is not the only factor to take into consideration. When looking at the other scenarios, which are not considered to be as flexible as scenario one but might have other advantages, the potential flexibility and quality outcome of those scenarios can also be analysed. For example, the scenarios which include fixed blue box slots are the three scenarios that require the least number of transports and operators, as well as the least space. The flexibility in these cases can be considered to be lower than in the other scenarios, if looking only at the fact that the number of part numbers that are located on fixed slots are the highest in these scenarios. With more part numbers located on fixed locations on the kit stations, the possibility to kits between the kit stations decreases. This means that it could be less efficient to switch between different set-ups, in cases when, for example, a certain kit would need to be kitted on several stations at once, or if one kit station would be overloaded for some reason. This reasoning applies also to scenarios with fixed pallet slots, but since they include fewer material on each fixed slot, the number of material that is tied to one specific kit station is lower. With the above reasoning, the flexibility decreases steady from scenario one to scenario seven.

On the other hand, flexibility could also be defined as the capacity to store more types of material in the plant, which is connected to the space that would be released in the storage area for the different scenarios. From this perspective, it is a bit more complex to analyse how many additional material that would be possible to store in each of the scenarios. This is especially complex for the solutions including fixed blue box slots, since they are currently stored in the automated blue box storage or in the SUMA storage, which means that the space that would be released depends on how they were previously stored and efficiency of that storage, compared to the space it requires to store the blue boxes in the blue box range area in the different scenarios. Since the details of the automated blue box storage and the SUMA has not been analysed in this study, a well-grounded analysis could not be conducted in this specific area.

6.1.2 Quality outcome of the different scenarios

When it comes to quality, the main aspect of possible quality increase is that the decision points will reduce for the kitting operator, which in turn can reduce the mistakes made within kitting. Without testing the different scenarios physically, with people performing the kitting activity, it is difficult to determine which scenario that would be able to reduce the mistakes the most. However, what can be said is that when the kitting is performed on one dynamic kit slot only, there are no decisions regarding which part number to pick, as there is only one part number presented to the operator at a time. In the other scenarios, with one or more fixed kit slots, there will be decisions to take for the operator, regarding which part number to pick. The possibility to make the wrong decision in these situations could, however, be minimised through use of different picking methods, such as the currently used Pick By Light (PBL). Despite the minimising of wrong decisions and mistakes, the scenarios with fixed kit slots could potentially decrease the quality, and the quality would then decrease continuously between scenario one and seven as well, even though the difference might be insignificant. On the other hand, the increased use of kitting and the use of dynamic kit slots also contributes to a heavy increase in number of transports. Each of the transports does include at least one decision point for the transport operator, when picking up the material that should be delivered to the kit station, and one more decision point when returning the material. Here, supporting technology, such as the PBL for the kit operator, is not as natural to introduce. This means that while the decision points decreases for the kit operators, the decision points increases for the transport operators. What this implies for the final quality output is difficult to anticipate, but this study indicates that the quality potentially could be affected, either positively or negatively.

Based on the above discussed factors, the scenario that would result in the least transports, operators, and space, would potentially result in the lowest degree of flexibility and, potentially, affect the quality. Therefore, it is of high relevance to discuss which factors that are the most important when implementing M2M, as well as if there is a compromise that would provide a middle-way, where none of the factors are maximised, but still could be good enough. This is discussed further in the next section.

6.2 The most important variables and potential compromises

As mentioned, the foundation of the concept M2M is to ensure flexibility and quality when the variety and volume increases. This indicates that these factors are of high priority, but not if they are the utter most important ones. One other factor that plays a significant role in the implementation of this new logistics concept is the required space. The space limitations in the Tuve factory is, within this case study, an obstacle that is difficult to overcome. Since Volvo is not able to expand the plant, while additional truck models and part numbers will be introduced, the necessity to decrease the space requirements for the currently used part numbers is approaching. From that perspective, the scenarios with the least required space could potentially be the best solutions for Volvo, when implementing M2M. What also argue for a prioritisation of space saving scenarios is that space saving also contributes to flexibility, when defining flexibility as the ability to store more part numbers in the plant. If space can be saved around the kitting station, that space could be used for storing of more material. Since vertical storing is more space efficient than horizontal storing, this space saving at the kitting station could enable up to six times more space for storing of material, which means that five additional part numbers could be stored. Hence, when only using this definition of flexibility, the scenarios including fixed blue box slots would be the best option both regarding transports, operators, and space, but also because of the increased flexibility that the space saving would enable.

Another aspect of the scenarios where fixed kit slots are used, is that the more fixed slots that are introduced, the further away the solution gets from the main thought of delivering the material to the operator. If adding even more fixed slots than is included in the scenarios, i.e. maximum three pallets or three racks, the kitting station would eventually become a kitting aisle again, where the operator would walk and collect the material. This means, that the more fixed slots that is added, the further away from M2M the solution will be, and the closer it gets to today's set-up with kit-aisles. This could indicate that fixed slots is a negative addition to the concept, as it steps away from the original solution, but it could also indicate that it could be beneficial to find a compromise between today's set-up and a fully implemented M2M concept. Since the addition of one to three fixed slots on the kit station could decrease the number of transports with 35%, it could be worth the loss of flexibility, depending on how you define flexibility, to achieve the several benefits that derives from fixed kit slots.

6.3 Feasibility of the scenarios

One key aspect of all the scenarios and the M2M concept as a whole is the feasibility of the implementation. While this is a complex analysis, considering the many factors that affect an implementation of a whole new logistics system, several parts of the concept can be discussed on an abstract level, to get an understanding of which parts that would need further research and, if possible, trial implementations or pilot projects.

In this study, all the results regarding the transport times, number of operators and vehicles required have been calculated through use of the daily demand for each of the part numbers. However, since the daily demand is based on forecasts, the results might vary compared to the actual demand. Furthermore, as explained in 5.2.2, two factors that have not been considered are the potential waiting time that would occurs if the kit operator would have to wait for delivery of material and the potential queue time that would occur if the forklift operators would have to wait in line to supply material to the kit station. In order to completely avoid waiting time both for the kitting operator and the transport operators, the transports would need to be perfectly timed and one vehicle would have to arrive to the kitting station right after the previous vehicles leaves the station. In reality, this would be a complex logistics system, which would be very sensitive to disturbances. Also, additional automated solutions would probably be necessary to achieve this, and even with the use of automated solutions the full system would have to run smoothly without failures and disturbances, which naturally is difficult to achieve. With that said, the scenarios analysed in this study, with the use of one single dynamic kit slots on each of the stations, where most of the material would pass through, would most probably cause either waiting time for the kitting operators or the transport operators. Also, with uneven transport distances and handling times, some transports would be quicker than others, which in reality would create an uneven logistics flow with waiting times both for the logistics and the kitting operators, at different times. With that said, potential waiting times and the possibilities of route planning can have a great impact on the reality of an implementation and need to be analysed further in order to make decisions more reality-based. Additionally, the increased number of vehicles and the potential queuing for the transport operators would require an expansion of the driving routes in this area. The expanded, or additional, driving routes would require plenty of space and space is, as mentioned, a limited resource at the Tuve plant. Therefore, this area would also be beneficial to look further into, to get a full picture of the consequences of a future implementation of M2M. How these consequences, caused by increased transportation, can be further analysed and tested is discussed more in detail in section 6.6.4.

6.4 Comparison between the current state and the scenarios

The new layout for the scenarios differ compared to the current state at Volvo in general, and the Tuve factory in particular. In the new scenarios, all the kitting activities are performed at a designated location with at least one dynamic kit slot included, compared to the current state where kitting is performed in various location such as in kitting aisles, kit stations, pre-assembly and at the assembly line. One of the main differences with the new scenarios is that the walking distance is either eliminated or very short compared to the current situation. For example, average time to pick one part is 27.1 seconds currently and the time required for walking has a great impact on that time. In comparison, in the new scenarios the material is transported to the operators and the kitting activity is performed without walking or with very short walking distances. The average time to pick one part can therefore be reduced significantly, to 5.9 s for the scenarios with non-fixed slots, 5.5 s for scenarios with fixed pallet slots and finally, 4.6 s for scenarios with fixed blue box slots. Additionally, the space required to perform the kitting at the kit station is more space efficient, due to the fixed kit slots in combination with the reduced walking distance. However, if implementing the pallet range area, which Volvo consider to be a desirable part of the implementation of M2M, not all scenarios would necessary result in space savings. As presented in the scenarios with the pallet range area, the total space for the kitting activities and the range area in these scenarios is bigger than for the scenarios without the range area. On the other hand, the introduction of a pallet range area, resulted in reduced handling time of the material and the transport time, since the high demanded material was stored at floor-level and closer to the kit station. With that said, the more space required at the range area, in terms of pallet slots, the more time can be reduced in transports and handling. However, from Volvo's point of view, the space in the plant is limited and the arrival of new material is a reality, which makes the space requirements an important factor when comparing potential future implementations of M2M and the current situation in the plant.

One area that has not been analysed in this study, but that would differ significant between the current state and the scenarios, is the available space on the assembly line. Since material that is currently stored on the assembly line would be removed and stored in the local storage or a range area instead, space would be released on the assembly line. However, with the heavy increase in kitted material, the number of kit carts providing material to the assembly line would increase. Those additional kitting carts would need space on the assembly line, which could eat up the released space from the moved material. If Volvo would manage to release some space on the assembly line that would not be completely taken up by the kit carts, that space could be used to present additional material to the operators on the assembly line when new truck models are introduced in the future. The material that would then be located on the assembly line would preferably follow the same criteria as in this study, where only material stored in cardboard boxes, sequenced material, and particularly awkward material have been considered for a location at the assembly line.

6.5 Possibilities for generalisation of the study

While this study has been conducted on one specific case company, and on nine assembly station at a specific plant of this company, it is still desirable to find areas that can be generalised for other plants within the factory and for other companies. First, the increased use of kitting in M2M is based on the increased variation that Volvo expect, as well as the need to assemble qualitative products on their assembly line. These aspects could be present in other companies within the automotive industry, but also in other industries, where companies use assembly lines or other types of assembly of products, and the variation is high or is expected to increase. Second, the distribution between kitted and not kitted material that was established in this study is based on the part numbers that are used on the assembly stations 16 to 24, but the characteristics for the kitted material is transferable to other areas and companies as well. For example, the elimination of cardboard box material is independent of the exact part number, but is concerned with the complexity that would occur if small, frequently used components with separate logistics flow would be kitted. These difficulties could be identified also in another company, where material is prepared in kits for operators that perform the assembly of a product and certain material is small and less suitable to kit.

6.6 Areas that call for further research

The analysis and discussions presented in this paper has provided insights in consequences of the implementation of M2M, through different scenarios, weighing of different variables, potential feasibility of the scenarios, as well as potential areas where the results can be generalised and used in a different context or in a different company. However, there are still several areas that would benefit from further research and deeper analysis. These areas are identified both through the assumptions that has been used in this study, as well as areas that has not been included in the scope of this study but that would be valuable to analyse before an implementation in a Volvo plant. The identified areas where further research would be valuable is presented in this section.

6.6.1 Design and layout of the storage areas

A key factor for the scenarios to work is to redesign the storage solutions. However, in this study, the design of the storage has not been analysed or evaluated thoroughly. There has been several assumptions regarding the space, the distance, and the handling time for the different storage areas in this study. Therefore, in order to get a better reliability of the scenarios, evaluating and analysing storage solutions is highly relevant and will give a more accurate number of the space requirements for each scenario. Moreover, the results regarding transports could be calculated more precise with further research on storage solutions and distances and handling time between the storage areas.

6.6.2 New times for tasks in the kitting process

The calculations regarding the new kit times for the scenarios is based on Volvo's balanced times, which are the times that Volvo believes it takes to perform different tasks, such as manual picking, walking, and usage of tools. Since the kitting process in M2M is new, and differs from the currently used processes, the balanced times are not adapted to the new conditions. This means that certain times could be misleading, in case certain elements would take longer or shorter time in the new settings. In order to achieve a reliable and reality based calculation of the kitting times, new studies and timings of the different tasks in the kitting process would be necessary. This should, preferably, be made before a future implementation of M2M in a Volvo factory.

6.6.3 Conditions for the operators

Tests regarding the time consumption for each of the tasks included in kitting can also contribute to a deeper understanding of the conditions for the operators. While ergonomic factors continuously are analysed and developed at Volvo, the new kitting process and the presentation both for the kitting operators and the operators on the assembly line could potentially have ergonomic consequences as well. When analysing the elements of the solutions suggested in the concept of M2M, and analysed in the scenarios in this study, it can be identified that the ergonomics could be improved by the introduction of M2M. This is both through the possibility of altering the height of the material when it is presented to the kit operator, and the reduction of decision points for the operators, which in turn can reduce potential stress or worry of making mistakes. However, to see how these different factors play out in a real life situation, with real people performing the tasks, additional tests should be performed and analysed with the operators condition in mind, in addition to the timing of the performed tasks.

6.6.4 Simulation of the traffic situation and analysis of the potential of automated equipment

The scenario where the highest flexibility and quality could be attained, i.e. scenario one, also resulted in the highest number of required transports. This means that the achievement of great flexibility and quality comes with the cost of increased number of vehicles and traffic in the plant. This increased transportation does, in turn, leads to potential queuing and the need for complex route planning for the logistics system to work in reality, as presented in section 6.3. To fully understand the consequences of this increased transport need, with regards to potential traffic jams, queuing time and space need to support this traffic, and to obtain more accurate results of the transportation variables, it would be beneficial to perform both simulations and physical tests. By establishing a comprehensive simulation model, the traffic caused by the increased transport need be analysed both regarding feasibility of the scenarios, the concept of M2M as a whole, and what vehicles that would be suitable to use in a future implementation. In this study, the calculations related to transportation are based on data on forklifts, which includes, for example, vehicle speed, space requirements in the storage, and material handling times. However, forklifts might not the most sustainable option in a production plant. The emission and/or electricity consumption caused by forklift traffic and potential safety risks affects both the environmental aspect of sustainability, and the socially sustainable issues. By studying the possibilities to implement automated solutions, both for the sake of sustainability and to eliminated non-value-added activities, potential risks and negative environmental aspects could be decreased. However, automated solutions also require electricity or other types of fuel, which means that emission and electricity consumption could be on the same levels as the manual vehicles, and might depend more on the specific type and model that is used. Having said that, one limitation of automated vehicles is that the transport routes have to be synchronised for the vehicles to work efficiently simultaneously, and they could be less flexible in case of sudden changes in the plant, since they lack the judgement of a human being. In order for this to function, the vehicles have to be programmed and integrated with the logistics system at Volvo. This is an area where Volvo might find limitations and obstacles, which calls for further investigations and studies before introduction of automated vehicles. Additionally, previous research conducted by Volvo indicates that automated vehicles generally have a lower maximum speed than a forklifts, which would have an affect on the result on the number of required vehicles. This will probably result in an increased number of transports and vehicles needed to handle the demand, compared to the use of forklifts.

6.6.5 Business case for the implementation of M2M

Another factor that is relevant for any company, but not included in this study, is the investment costs for the different scenarios. For example, the increase in required vehicles for these solutions would imply an initial investment cost for purchasing additional vehicles, as well as preparation for potential additional maintenance and other equipment. While it can be argued that the more vehicles Volvo would need to invest in, the higher the cost, a business case for the complete implementation and differences between the scenarios would include many different factors, in addition to the vehicle investment. Therefore, an implementation of the scenarios discussed in this study would require an extensive analysis of the investments costs, maintenance costs, and the value that the implementation would bring.

Chapter 7

Conclusion

This study has, through the use of a case study at Volvo Trucks, examined potential consequences of a future implementation of the concept M2M. This new logistics concept has been analysed regarding the transport requirements to supply material to the new and increased processes, the number of operators that would be needed to perform the activities, and the space requirements in the plant. Through alteration of independent variables in different potential scenarios, certain elements of the concept have been analysed and compared, to identify advantages and disadvantages that arise from these alterations.

From a flexibility and quality point of view, the fixed kit slots might have a negative impact, both due to the decreased possibilities to alter between kit stations and locations in the plant, and through the increased number of decision points. The analysis has provided deeper insights in how the use of fixed kit slots at the kit stations can decrease the number of transports as well as the required operators to perform the kitting and transportation. The space requirements, however, is dependent on the type of fixed kit slots that are used, where the use of fixed blue box slots is more space efficient than the use of fixed pallet slots. The space requirements is also highly dependent on the use of a pallet range area, where the space requirements consistently increase in all scenarios, when a pallet range area is used. The range area also contributes to a decreased need for operators to perform the transport activity, while the number of transports remain regardless of a range area is used or not.

For Volvo, in a future situation when a physical implementation of the concept is to be initiated, it will be necessary to decide what factors can be compromised, and where their priorities lay, since no single solution possibly could provide all advantages of M2M at once. To establish which solutions that would provide the best combination of benefits, and be both feasible and financially justified, further research will need to be conducted. The main areas where Volvo should focus their research are simulation models of the traffic situation and the logistics flow, as well as a detailed business case that takes investment costs into account, in combination with the value that the solutions can bring to Volvo.

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Appendix A

The appendix in this section presents the material list used in the establishment of kitted and not kitted material, including all material that are used on the assembly stations 16 to 24. The material in this list has also been used in the analysis.

Part	Part description	Demand per day	Material changes	Type of packaging	Awkward	To be kitted	Total picking time (min)
####	CAP PLUG	457	68.0	Bluebox	No	Yes	10.0
####	CAP	279	68.0	Bluebox	No	Yes	6.1
####	RETAINER	190	68.0	Bluebox	No	Yes	4.2
####	SHACKLE	183	102.0	Pallet	No	Yes	4.0
####	SHACKLE	183	102.0	Pallet	No	Yes	4.0
####	RETAINER	176	68.0	Bluebox	No	Yes	3.9
####	MOUNTING STRAP	163	102.0	Pallet	No	Yes	3.6
####	LATCH	147	68.0	Bluebox	No	Yes	3.2
####	FLANGE NUT	57 113	0.0	Cardboard b	No	No	0.0
####	CAP	144	68.0	Bluebox	No	Yes	3.2
####	FLANGE SCREW	133	68.0	Bluebox	No	Yes	2.9
####	FLANGE LOCK NU	16 264	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	10 401	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	10 118	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	8 633	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	8 258	0.0	Cardboard b	No	No	0.0
####	FLANGE NUT	6 166	0.0	Cardboard b	No	No	0.0
####	WASHER	5 485	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	4 710	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	3 359	0.0	Cardboard b	No	No	0.0
####	SPACER WASHER	2 690	0.0	Cardboard b	No	No	0.0
####	FLANGE LOCK NU	2 676	0.0	Cardboard b	No	No	0.0
####	FLANGE LOCK NU	2 646	0.0	Cardboard b	No	No	0.0
####	SPRING CLIP	131	68.0	Bluebox	No	Yes	2.9
####	MOUNTING STRAP	131	102.0	Pallet	No	Yes	2.9
####	CABLE TIE	130	68.0	Bluebox	No	Yes	2.9
####	FLANGE SCREW	123	68.0	Bluebox	No	Yes	2.7
####	HEXAGON SCREW	120	68.0	Bluebox	No	Yes	2.6
####	MANIFOLD	108	68.0	Bluebox	No	Yes	2.4
####	HEAT SHIELD	108	68.0	Bluebox	No	Yes	2.4
####	BRACKET	108	102.0	Pallet	No	Yes	2.4
####	MANIFOLD	107	68.0	Bluebox	No	Yes	2.4
####	COOLING COIL	107	102.0	Pallet	No	Yes	2.4
####	COMPRESSED-AIR	107	102.0	Pallet	No	Yes	2.4
####	RETAINER	107	102.0	Pallet	No	Yes	2.4
####	RETAINER	107	68.0	Bluebox	No	Yes	2.3
####	BRACKET	106	68.0	Bluebox	No	Yes	2.3
####	FLANGE SCREW	100	67.0	Bluebox	No	Yes	2.2
####	MOUNTING STRAP	91	90.6	Pallet	No	Yes	2.0
####	TUBE	89	59.5	Bluebox	No	Yes	2.0
####	TUBE	89	89.2	Pallet	No	Yes	2.0
####	SPACER	85	56.9	Bluebox	No	Yes	1.9
####	FLANGE SCREW	75	50.2	Bluebox	No	Yes	1.7
####	ANCHORAGE	75	74.8	Pallet	No	Yes	3.7
####	PLATE	73	73.3	Pallet	No	Yes	1.6
####	SQUARE WASHER	72	47.7	Bluebox	No	Yes	1.6

####	FLANGE LOCK NU	2 126	0.0	Cardboard b	No	No	0.0
####	RUBBER BEARING	69	68.9	Pallet	No	Yes	3.4
####	WASHER	2 065	0.0	Cardboard b	No	No	0.0
####	NIPPLE	2 039	0.0	Cardboard b	No	No	0.0
####	RETAINER	68	45.0	Bluebox	No	Yes	1.5
####	BRACKET	66	65.8	Pallet	No	Yes	1.4
####	COMPRESSED-AIR	64	63.8	Pallet	No	Yes	7.0
####	LINK ROD	62	62.0	Pallet	No	Yes	3.0
####	BRACKET	61	60.7	Pallet	No	Yes	1.3
####	PIVOT PIN	61	40.4	Bluebox	No	Yes	1.3
####	HOSE ASSEMBLY	60	60.4	Pallet	No	Yes	1.3
####	HOSE ASSEMBLY	59	39.5	Bluebox	No	Yes	1.3
####	HOSE ASSEMBLY	53	35.1	Bluebox	No	Yes	1.2
####	HOSE ASSEMBLY	53	35.1	Bluebox	No	Yes	1.2
####	ANCHORAGE	50	50.2	Pallet	No	Yes	2.5
####	BRACKET	50	49.7	Pallet	No	Yes	1.1
####	COMPRESSED-AIR	49	49.0	Pallet	No	Yes	2.4
####	BRACKET	48	32.1	Bluebox	No	Yes	1.1
####	FLANGE SCREW	2 017	0.0	Cardboard b	No	No	0.0
####	COVER	48	31.8	Bluebox	No	Yes	1.0
####	PIVOT PIN	47	31.2	Bluebox	No	Yes	1.0
####	HOSE	47	0.0	Pallet	Yes	No	0.0
####	TILT CYLINDER	47	46.8	Pallet	No	Yes	2.3
####	STRAP	45	30.0	Bluebox	No	Yes	1.0
####	STRAP	45	29.9	Bluebox	No	Yes	1.0
####	HOSE ASSEMBLY	40	26.4	Bluebox	No	Yes	0.9
####	HOSE ASSEMBLY	40	26.4	Bluebox	No	Yes	0.9
####	BRACKET	40	39.6	Pallet	No	Yes	0.9
####	PITMAN ARM	39	38.7	Pallet	No	Yes	1.9
####	STEERING GEAR	37	36.9	Pallet	No	Yes	4.8
####	CAP PLUG	37	24.5	Bluebox	No	Yes	0.8
####	PLATE	37	24.4	Bluebox	No	Yes	0.8
####	FLANGE SCREW	1 859	0.0	Cardboard b	No	No	0.0
####	ATTACHING CLAM	36	23.9	Bluebox	No	Yes	0.8
####	NIPPLE	1 820	0.0	Cardboard b	No	No	0.0
####	HEXAGON SCREW	34	23.0	Bluebox	No	Yes	0.8
####	COMPRESSION FIT	34	34.4	Pallet	No	Yes	0.8
####	OVERFLOW VALVI	34	22.5	Bluebox	No	Yes	0.7
####	PROTECTING HOSI	33	32.6	Pallet	No	Yes	0.7
####	FLANGE NUT	1 683	0.0	Cardboard b	No	No	0.0
####	HOSE	32	32.2	Pallet	No	Yes	0.7
####	FLANGE SCREW	32	21.4	Bluebox	No	Yes	0.7
####	COMPRESSED-AIR	32	31.6	Pallet	No	Yes	1.5
####	SWIVEL	1 678	0.0	Cardboard b	No	No	0.0
####	FLANGE LOCK NU	1 564	0.0	Cardboard b	No	No	0.0
####	BRACKET	31	31.1	Pallet	No	Yes	0.7
####	HEXAGON NUT	1 371	0.0	Cardboard b	No	No	0.0
####	HEXAGON SCREW	1 371	0.0	Cardboard b	No	No	0.0
####	BRACKET	31	31.1	Pallet	No	Yes	0.7
####	BRACKET	31	20.7	Bluebox	No	Yes	0.7

####	FLANGE NUT	1 281	0.0	Cardboard b	No	No	0.0
####	NIPPLE	1 264	0.0	Cardboard b	No	No	0.0
####	ANCHORAGE	31	30.9	Pallet	No	Yes	3.4
####	BRACKET	30	30.1	Pallet	No	Yes	1.5
####	ANCHORAGE	30	29.5	Pallet	No	Yes	1.4
####	COMPRESSED-AIR	29	28.9	Pallet	No	Yes	1.4
####	NIPPLE	1 161	0.0	Cardboard b	No	No	0.0
####	SWIVEL	1 146	0.0	Cardboard b	No	No	0.0
####	WASHER	28	18.8	Bluebox	No	Yes	0.6
####	LINK ROD	28	27.8	Pallet	No	Yes	1.4
####	SUPPORT	27	17.8	Bluebox	No	Yes	0.6
####	FLANGE NUT	1 125	0.0	Cardboard b	No	No	0.0
####	HOSE ASSEMBLY	26	17.4	Bluebox	No	Yes	0.6
####	STEERING GEAR	24	24.1	Pallet	No	Yes	3.2
####	FLANGE SCREW	1 087	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	1 057	0.0	Cardboard b	No	No	0.0
####	U-BOLT	23	23.2	Pallet	No	Yes	0.5
####	ELBOW NIPPLE	978	0.0	Cardboard b	No	No	0.0
####	BRACKET	23	15.4	Bluebox	No	Yes	0.5
####	ELBOW NIPPLE	963	0.0	Cardboard b	No	No	0.0
####	RETAINER	958	0.0	Cardboard b	No	No	0.0
####	SENSOR	23	15.3	Bluebox	No	Yes	0.5
####	SWIVEL	889	0.0	Cardboard b	No	No	0.0
####	BEARING SUPPORT	23	22.7	Pallet	No	Yes	0.5
####	STUB	866	0.0	Cardboard b	No	No	0.0
####	STUB	866	0.0	Cardboard b	No	No	0.0
####	BRACKET	23	0.0	Pallet	Yes	No	0.0
####	BRACKET	23	0.0	Pallet	Yes	No	0.0
####	HEX. SOCKET SCRI	857	0.0	Cardboard b	No	No	0.0
####	NIPPLE	772	0.0	Cardboard b	No	No	0.0
####	HEXAGON SCREW	22	14.6	Bluebox	No	Yes	0.5
####	COMPRESSED-AIR	21	20.9	Pallet	No	Yes	1.0
####	HOSE ASSEMBLY	21	13.8	Bluebox	No	Yes	0.5
####	COLLAR	769	0.0	Cardboard b	No	No	0.0
####	HOSE ASSEMBLY	21	13.8	Bluebox	No	Yes	0.5
####	WASHER	732	0.0	Cardboard b	No	No	0.0
####	AIR SPRING	20	20.5	Pallet	No	Yes	1.0
####	FLANGE SCREW	695	0.0	Cardboard b	No	No	0.0
####	PITMAN ARM	20	20.4	Pallet	No	Yes	1.0
####	COVER	20	13.5	Bluebox	No	Yes	0.4
####	ANGLE RING	656	0.0	Cardboard b	No	No	0.0
####	BOLT	632	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	585	0.0	Cardboard b	No	No	0.0
####	AIR SPRING	20	20.1	Pallet	No	Yes	1.0
####	LOCK NUT	581	0.0	Cardboard b	No	No	0.0
####	CONNECTOR	19	19.3	Pallet	No	Yes	0.4
####	PLUG	563	0.0	Cardboard b	No	No	0.0
####	CONNECTING BAR	18	18.3	Pallet	No	Yes	0.4
####	TEST NIPPLE	561	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	18	12.2	Bluebox	No	Yes	0.4

####	LOCK NUT	555	0.0	Cardboard b	No	No	0.0
####	COMPRESSED-AIR	17	17.4	Pallet	No	Yes	0.9
####	TESTING NIPPLE	510	0.0	Cardboard b	No	No	0.0
####	BRACKET	17	11.5	Bluebox	No	Yes	0.4
####	FLANGE SCREW	466	0.0	Cardboard b	No	No	0.0
####	SPACER SLEEVE	17	16.9	Pallet	No	Yes	0.4
####	U-BOLT	17	16.9	Pallet	No	Yes	0.4
####	ANCHORAGE	17	16.8	Pallet	No	Yes	0.8
####	SPRING WASHER	430	0.0	Cardboard b	No	No	0.0
####	LOCK NUT	417	0.0	Cardboard b	No	No	0.0
####	U-BOLT	16	10.9	Bluebox	No	Yes	0.4
####	NIPPLE	405	0.0	Cardboard b	No	No	0.0
####	BRACKET	16	16.3	Pallet	No	Yes	0.8
####	SERVO PIPE	16	10.6	Bluebox	No	Yes	0.3
####	T-NIPPLE	402	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	402	0.0	Cardboard b	No	No	0.0
####	SERVO PIPE	16	10.4	Bluebox	No	Yes	0.3
####	HEXAGON SCREW	393	0.0	Cardboard b	No	No	0.0
####	BRACKET	16	10.4	Bluebox	No	Yes	0.3
####	SWIVEL	381	0.0	Cardboard b	No	No	0.0
####	DRAIN VALVE	378	0.0	Cardboard b	No	No	0.0
####	ANCHORAGE	15	14.6	Pallet	No	Yes	0.7
####	LINK ROD	14	14.4	Pallet	No	Yes	0.7
####	FLANGE SCREW	376	0.0	Cardboard b	No	No	0.0
####	NIPPLE	362	0.0	Cardboard b	No	No	0.0
####	T-NIPPLE	361	0.0	Cardboard b	No	No	0.0
####	NIPPLE	352	0.0	Cardboard b	No	No	0.0
####	BRACKET	14	9.6	Bluebox	No	Yes	0.3
####	LINK ROD	14	14.0	Pallet	No	Yes	0.7
####	NIPPLE	340	0.0	Cardboard b	No	No	0.0
####	HEXAGON SCREW	324	0.0	Cardboard b	No	No	0.0
####	TESTING NIPPLE	320	0.0	Cardboard b	No	No	0.0
####	HEXAGON NUT	310	0.0	Cardboard b	No	No	0.0
####	COMPRESSED-AIR	14	13.7	Pallet	No	Yes	0.7
####	FLANGE SCREW	13	8.6	Bluebox	No	Yes	0.3
####	FLANGE SCREW	307	0.0	Cardboard b	No	No	0.0
####	NIPPLE	301	0.0	Cardboard b	No	No	0.0
####	CRADLE	13	12.8	Pallet	No	Yes	1.4
####	NIPPLE	300	0.0	Cardboard b	No	No	0.0
####	BRACKET	12	8.3	Bluebox	No	Yes	0.3
####	HEX. SOCKET SCRI	293	0.0	Cardboard b	No	No	0.0
####	ANGLE RING	289	0.0	Cardboard b	No	No	0.0
####	LOCK NUT	289	0.0	Cardboard b	No	No	0.0
####	LINK ROD	12	0.0	Pallet	Yes	No	0.0
####	BRACKET	12	11.8	Pallet	No	Yes	0.6
####	AIR SPRING	12	11.8	Pallet	No	Yes	0.6
####	FLANGE SCREW	262	0.0	Cardboard b	No	No	0.0
####	PITMAN ARM	12	11.7	Pallet	No	Yes	0.6
####	FLANGE SCREW	256	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	248	0.0	Cardboard b	No	No	0.0

####	BRACKET	12	7.8	Bluebox	No	Yes	0.3
####	TOP PLATE	12	11.6	Pallet	No	Yes	0.6
####	FLANGE NUT	243	0.0	Cardboard b	No	No	0.0
####	CRADLE	12	11.6	Pallet	No	Yes	1.3
####	BRACKET	11	11.4	Pallet	No	Yes	0.3
####	NIPPLE	239	0.0	Cardboard b	No	No	0.0
####	SERVO PIPE	11	7.3	Bluebox	No	Yes	0.2
####	ELBOW NIPPLE	235	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	231	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	225	0.0	Cardboard b	No	No	0.0
####	CLAMP	215	0.0	Cardboard b	No	No	0.0
####	SUPPORT	11	7.2	Bluebox	No	Yes	0.2
####	BRACKET	11	7.0	Bluebox	No	Yes	0.2
####	FLOW INDICATOR	10	7.0	Bluebox	No	Yes	0.2
####	FLANGE SCREW	210	0.0	Cardboard b	No	No	0.0
####	NIPPLE	209	0.0	Cardboard b	No	No	0.0
####	SERVO PIPE	10	7.0	Bluebox	No	Yes	0.2
####	DECAL	201	0.0	Cardboard b	No	No	0.0
####	NIPPLE	191	0.0	Cardboard b	No	No	0.0
####	GASKET	190	0.0	Cardboard b	No	No	0.0
####	CRADLE	10	10.0	Pallet	No	Yes	1.1
####	FLANGE SCREW	184	0.0	Cardboard b	No	No	0.0
####	HOSE	9	6.2	Bluebox	No	Yes	0.2
####	U-BOLT	9	9.2	Pallet	No	Yes	0.4
####	FLANGE SCREW	9	6.1	Bluebox	No	Yes	0.2
####	HOSE	9	6.0	Bluebox	No	Yes	0.2
####	PITMAN ARM	9	9.0	Pallet	No	Yes	0.4
####	SERVO PIPE	9	6.0	Bluebox	No	Yes	0.2
####	SPACER SLEEVE	162	0.0	Cardboard b	No	No	0.0
####	SERVO PIPE	9	6.0	Bluebox	No	Yes	0.2
####	ANGLE RING	156	0.0	Cardboard b	No	No	0.0
####	BRACKET	9	5.9	Bluebox	No	Yes	0.2
####	DOUBLE NIPPLE	156	0.0	Cardboard b	No	No	0.0
####	SHACKLE	9	5.9	Bluebox	No	Yes	0.2
####	SHACKLE	9	5.9	Bluebox	No	Yes	0.2
####	FLOW INDICATOR	9	5.7	Bluebox	No	Yes	0.2
####	WASHER	145	0.0	Cardboard b	No	No	0.0
####	F-NIPPLE	145	0.0	Cardboard b	No	No	0.0
####	STEERING GEAR	9	8.5	Pallet	No	Yes	1.1
####	STEERING GEAR	8	8.5	Pallet	No	Yes	1.1
####	DECAL	135	0.0	Cardboard b	No	No	0.0
####	HOSE	8	5.7	Bluebox	No	Yes	0.2
####	HEXAGON SCREW	134	0.0	Cardboard b	No	No	0.0
####	SERVO PIPE	8	5.7	Bluebox	No	Yes	0.2
####	SERVO PIPE	8	5.7	Bluebox	No	Yes	0.2
####	HEXAGON SCREW	132	0.0	Cardboard b	No	No	0.0
####	REINFORCEMENT	8	0.0	Pallet	Yes	No	0.0
####	ELECTRIC MOTOR	8	8.2	Pallet	No	Yes	0.4
####	SPACER SLEEVE	131	0.0	Cardboard b	No	No	0.0
####	BRACKET	8	8.0	Pallet	No	Yes	0.4

####	HOSE ASSEMBLY	8	5.3	Bluebox	No	Yes	0.2
####	HOSE ASSEMBLY	8	5.3	Bluebox	No	Yes	0.2
####	AIR SPRING	7	7.5	Pallet	No	Yes	0.4
####	SUPPORT	7	4.9	Bluebox	No	Yes	0.2
####	NIPPLE	108	0.0	Cardboard b	No	No	0.0
####	STEERING GEAR	7	7.4	Pallet	No	Yes	1.0
####	HOSE	7	7.4	Pallet	No	Yes	0.2
####	BRACKET	7	7.3	Pallet	No	Yes	0.2
####	HOSE ASSEMBLY	7	4.9	Bluebox	No	Yes	0.2
####	HOSE ASSEMBLY	7	4.9	Bluebox	No	Yes	0.2
####	HOSE CLAMP	108	0.0	Cardboard b	No	No	0.0
####	BRACKET	7	7.2	Pallet	No	Yes	0.2
####	SERVO PIPE	7	4.8	Bluebox	No	Yes	0.2
####	COMPRESSED-AIR	7	6.9	Pallet	No	Yes	0.3
####	U-BOLT	7	6.8	Pallet	No	Yes	0.3
####	PITMAN ARM	6	6.4	Pallet	No	Yes	0.3
####	SERVO PIPE	6	4.3	Bluebox	No	Yes	0.1
####	STEERING GEAR	6	6.4	Pallet	No	Yes	0.8
####	PITMAN ARM	6	6.2	Pallet	No	Yes	0.3
####	PITMAN ARM	6	6.2	Pallet	No	Yes	0.3
####	SERVO PIPE	6	4.0	Bluebox	No	Yes	0.1
####	SERVO PIPE	6	4.0	Bluebox	No	Yes	0.1
####	ATTACHING CLAM	6	4.0	Bluebox	No	Yes	0.1
####	SERVO PIPE	6	4.0	Bluebox	No	Yes	0.1
####	SERVO PIPE	6	4.0	Bluebox	No	Yes	0.1
####	SERVO PIPE	6	4.0	Bluebox	No	Yes	0.1
####	HOOK	6	4.0	Bluebox	No	Yes	0.1
####	WASHER	6	3.7	Bluebox	No	Yes	0.1
####	ANCHORAGE	6	5.6	Pallet	No	Yes	0.3
####	BRACKET	6	3.7	Bluebox	No	Yes	0.1
####	SPRING WASHER	100	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	97	0.0	Cardboard b	No	No	0.0
####	SUPPORT	6	3.7	Bluebox	No	Yes	0.1
####	BRACKET	6	5.5	Pallet	No	Yes	0.1
####	ELECTRIC MOTOR	5	5.1	Pallet	No	Yes	0.2
####	HOSE	5	4.7	Pallet	No	Yes	0.1
####	ATTACHING CLAM	92	0.0	Cardboard b	No	No	0.0
####	ELBOW NIPPLE	91	0.0	Cardboard b	No	No	0.0
####	AIR TANK	4	4.3	Pallet	No	Yes	0.5
####	TOP PLATE	4	4.1	Pallet	No	Yes	0.2
####	STEERING GEAR	4	3.9	Pallet	No	Yes	0.5
####	BRACKET	4	3.7	Pallet	No	Yes	0.2
####	BRACKET	4	3.7	Pallet	No	Yes	0.2
####	SENSOR	91	0.0	Cardboard b	No	No	0.0
####	HOSE	4	2.5	Bluebox	No	Yes	0.1
####	BRACKET	4	2.5	Bluebox	No	Yes	0.1
####	BRACKET	4	2.5	Bluebox	No	Yes	0.1
####	HOSE	4	2.5	Bluebox	No	Yes	0.1
####	BRACKET	4	2.5	Bluebox	No	Yes	0.1
####	PIPE	4	2.5	Bluebox	No	Yes	0.1

####	BRACKET	4	2.4	Bluebox	No	Yes	0.1
####	BRACE	3	2.3	Bluebox	No	Yes	0.1
####	HOSE	3	2.2	Bluebox	No	Yes	0.1
####	FLANGE NUT	89	0.0	Cardboard b	No	No	0.0
####	HOSE	3	2.2	Bluebox	No	Yes	0.1
####	FITTING	88	0.0	Cardboard b	No	No	0.0
####	ANGLE RING	88	0.0	Cardboard b	No	No	0.0
####	HOSE	3	2.2	Bluebox	No	Yes	0.1
####	HOSE	3	2.2	Bluebox	No	Yes	0.1
####	WASHER	75	0.0	Cardboard b	No	No	0.0
####	SERVO PIPE	3	2.1	Bluebox	No	Yes	0.1
####	SERVO PIPE	3	2.1	Bluebox	No	Yes	0.1
####	COMPRESSION SPR	73	0.0	Cardboard b	No	No	0.0
####	SERVO PIPE	3	2.1	Bluebox	No	Yes	0.1
####	SWIVEL	71	0.0	Cardboard b	No	No	0.0
####	AIR SPRING	3	3.2	Pallet	No	Yes	0.2
####	FLANGE SCREW	68	0.0	Cardboard b	No	No	0.0
####	T-NIPPLE	68	0.0	Cardboard b	No	No	0.0
####	F-NIPPLE	68	0.0	Cardboard b	No	No	0.0
####	STEERING GEAR	3	3.1	Pallet	No	Yes	0.4
####	CAP	3	2.1	Bluebox	No	Yes	0.1
####	BRACKET	65	0.0	Cardboard b	No	No	0.0
####	PITMAN ARM	3	3.0	Pallet	No	Yes	0.1
####	FLANGE LOCK NU	62	0.0	Cardboard b	No	No	0.0
####	STRAP	3	1.9	Bluebox	No	Yes	0.1
####	ANCHORAGE	3	1.8	Bluebox	No	Yes	0.1
####	HOSE	3	2.7	Pallet	No	Yes	0.1
####	BRACKET	3	2.6	Pallet	No	Yes	0.1
####	FLANGE SCREW	60	0.0	Cardboard b	No	No	0.0
####	ANGLE RING	60	0.0	Cardboard b	No	No	0.0
####	HOSE	3	2.6	Pallet	No	Yes	0.1
####	FLANGE NUT	57	0.0	Cardboard b	No	No	0.0
####	NIPPLE	56	0.0	Cardboard b	No	No	0.0
####	HOSE	3	1.7	Bluebox	No	Yes	0.1
####	HOSE	3	1.7	Bluebox	No	Yes	0.1
####	NIPPLE	53	0.0	Cardboard b	No	No	0.0
####	LOCK NUT	51	0.0	Cardboard b	No	No	0.0
####	STEERING GEAR	3	2.5	Pallet	No	Yes	0.3
####	BRACKET	3	1.7	Bluebox	No	Yes	0.1
####	WASHER	49	0.0	Cardboard b	No	No	0.0
####	STEERING GEAR	3	2.5	Pallet	No	Yes	0.3
####	ATTACHING CLAM	48	0.0	Cardboard b	No	No	0.0
####	PIPE	2	1.7	Bluebox	No	Yes	0.1
####	LINK ROD	2	2.5	Pallet	No	Yes	0.1
####	AIR SPRING	2	2.3	Pallet	No	Yes	0.1
####	PITMAN ARM	2	2.3	Pallet	No	Yes	0.1
####	LEAF SPRING	2	2.2	Pallet	No	Yes	0.3
####	WASHER	46	0.0	Cardboard b	No	No	0.0
####	CRADLE	2	2.2	Pallet	No	Yes	0.3
####	ANCHORAGE	2	1.5	Bluebox	No	Yes	0.1

####	DECAL	45	0.0	Cardboard b	No	No	0.0
####	QUICK COUPLING	43	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	42	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	40	0.0	Cardboard b	No	No	0.0
####	BRACKET	40	0.0	Cardboard b	No	No	0.0
####	AIR SPRING	2	2.2	Pallet	No	Yes	0.1
####	SERVO PIPE	2	1.4	Bluebox	No	Yes	0.0
####	LINK ROD	2	2.0	Pallet	No	Yes	0.1
####	VALVE	2	1.4	Bluebox	No	Yes	0.0
####	SCREW	38	0.0	Cardboard b	No	No	0.0
####	PITMAN ARM	2	2.0	Pallet	No	Yes	0.1
####	PIPE	2	1.9	Pallet	No	Yes	0.0
####	SPACER SLEEVE	37	0.0	Cardboard b	No	No	0.0
####	BRACKET	2	1.2	Bluebox	No	Yes	0.1
####	SOCKET	36	0.0	Cardboard b	No	No	0.0
####	LINK ROD	2	1.8	Pallet	No	Yes	0.1
####	PLAIN WASHER	34	0.0	Cardboard b	No	No	0.0
####	BRACKET	2	1.2	Bluebox	No	Yes	0.0
####	FLANGE SCREW	2	1.1	Bluebox	No	Yes	0.0
####	CAP PLUG	2	1.1	Bluebox	No	Yes	0.0
####	SHACKLE	2	1.7	Pallet	No	Yes	0.1
####	BRACKET	2	1.6	Pallet	No	Yes	0.1
####	PROTECTING PLAT	2	0.0	Bluebox	Yes	No	0.0
####	STEERING GEAR	1	1.5	Pallet	No	Yes	0.2
####	STRAP	1	0.9	Bluebox	No	Yes	0.0
####	BRACKET	1	0.9	Bluebox	No	Yes	0.0
####	BRACKET	1	0.9	Bluebox	No	Yes	0.0
####	HOSE	1	1.3	Pallet	No	Yes	0.0
####	PIPE	1	1.2	Pallet	No	Yes	0.0
####	NIPPLE	30	0.0	Cardboard b	No	No	0.0
####	PIPE	1	1.2	Pallet	No	Yes	0.0
####	SHIELD	1	0.0	Bluebox	Yes	No	0.0
####	HEXAGON NUT	29	0.0	Cardboard b	No	No	0.0
####	BRACKET	1	1.2	Pallet	No	Yes	0.1
####	BRACKET	1	0.7	Bluebox	No	Yes	0.0
####	SPACER SLEEVE	27	0.0	Cardboard b	No	No	0.0
####	HEXAGON SCREW	27	0.0	Cardboard b	No	No	0.0
####	LOCK NUT	27	0.0	Cardboard b	No	No	0.0
####	BRACKET	1	0.7	Bluebox	No	Yes	0.0
####	NIPPLE	27	0.0	Cardboard b	No	No	0.0
####	3-WAY NIPPLE	27	0.0	Cardboard b	No	No	0.0
####	COVER	26	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	1	0.7	Bluebox	No	Yes	0.0
####	RETAINER	1	0.7	Bluebox	No	Yes	0.0
####	COMPRESSED-AIR	1	0.9	Pallet	No	Yes	0.0
####	U-BOLT	1	0.9	Pallet	No	Yes	0.0
####	BRACKET	1	0.5	Bluebox	No	Yes	0.0
####	BRACKET	1	0.7	Pallet	No	Yes	0.0
####	VALVE	23	0.0	Cardboard b	No	No	0.0
####	SERVO PIPE	1	0.5	Bluebox	No	Yes	0.0

####	SERVO PIPE	1	0.5	Bluebox	No	Yes	0.0
####	SERVO PIPE	1	0.4	Bluebox	No	Yes	0.0
####	LINK ROD	1	0.7	Pallet	No	Yes	0.0
####	PUMP	1	0.4	Bluebox	No	Yes	0.0
####	PIPE	1	0.6	Pallet	No	Yes	0.0
####	LINK ROD	1	0.6	Pallet	No	Yes	0.0
####	SERVO PIPE	0	0.3	Bluebox	No	Yes	0.0
####	SERVO PIPE	0	0.3	Bluebox	No	Yes	0.0
####	SERVO PIPE	0	0.5	Pallet	No	Yes	0.0
####	PITMAN ARM	0	0.5	Pallet	No	Yes	0.0
####	FLANGE SCREW	20	0.0	Cardboard b	No	No	0.0
####	FLANGE SCREW	19	0.0	Cardboard b	No	No	0.0
####	PITMAN ARM	0	0.5	Pallet	No	Yes	0.0
####	TENSION LOCK	19	0.0	Cardboard b	No	No	0.0
####	BRACKET	0	0.4	Pallet	No	Yes	0.0
####	STEERING GEAR	0	0.4	Pallet	No	Yes	0.1
####	SHACKLE	0	0.3	Bluebox	No	Yes	0.0
####	SHACKLE	0	0.3	Bluebox	No	Yes	0.0
####	SHACKLE	0	0.3	Bluebox	No	Yes	0.0
####	CONNECTOR	17	0.0	Cardboard b	No	No	0.0
####	HEXAGON SCREW	17	0.0	Cardboard b	No	No	0.0
####	SHACKLE	0	0.3	Bluebox	No	Yes	0.0
####	STEERING GEAR	0	0.4	Pallet	No	Yes	0.1
####	BRACKET	0	0.0	Pallet	Yes	No	0.0
####	ANCHORAGE	0	0.2	Bluebox	No	Yes	0.0
####	BRACKET	0	0.2	Bluebox	No	Yes	0.0
####	ANCHORAGE	0	0.3	Pallet	No	Yes	0.0
####	STEERING GEAR	0	0.3	Pallet	No	Yes	0.0
####	PITMAN ARM	0	0.3	Pallet	No	Yes	0.0
####	ELBOW NIPPLE	15	0.0	Cardboard b	No	No	0.0
####	HOSE CLAMP	15	0.0	Cardboard b	No	No	0.0
####	STEERING GEAR	0	0.3	Pallet	No	Yes	0.0
####	BRACKET	0	0.2	Bluebox	No	Yes	0.0
####	HOSE ASSEMBLY	0	0.2	Bluebox	No	Yes	0.0
####	HOSE	0	0.2	Bluebox	No	Yes	0.0
####	REDUCTION NIPPL	14	0.0	Cardboard b	No	No	0.0
####	LINK ROD	0	0.2	Pallet	No	Yes	0.0
####	HOSE	0	0.2	Pallet	No	Yes	0.0
####	STEERING GEAR	0	0.2	Pallet	No	Yes	0.0
####	SERVO PIPE	0	0.2	Pallet	No	Yes	0.0
####	SERVO PIPE	0	0.2	Pallet	No	Yes	0.0
####	OIL RESERVOIR	0	0.2	Pallet	No	Yes	0.0
####	STRAP	0	0.1	Bluebox	No	Yes	0.0
####	BRACKET	0	0.2	Pallet	No	Yes	0.0
####	PITMAN ARM	0	0.2	Pallet	No	Yes	0.0
####	STEERING GEAR	0	0.1	Pallet	No	Yes	0.0
####	AIR SPRING	0	0.1	Pallet	No	Yes	0.0
####	BRACKET	0	0.1	Bluebox	No	Yes	0.0
####	STEERING GEAR	0	0.1	Pallet	No	Yes	0.0
####	BRACKET	0	0.1	Pallet	No	Yes	0.0

####	AIR SPRING	0	0.1	Pallet	No	Yes	0.0
####	RETAINER	0	0.0	Pallet	No	Yes	0.0
####	HOSE ASSEMBLY	0	0.0	Pallet	No	Yes	0.0
####	HOSE ASSEMBLY	0	0.0	Bluebox	No	Yes	0.0
####	NIPPLE	10	0.0	Cardboard b	No	No	0.0
####	HOSE	0	0.0	Pallet	No	Yes	0.0
####	AIR SPRING	0	0.0	Pallet	No	Yes	0.0
####	STEERING GEAR	0	0.0	Pallet	No	Yes	0.0
####	STEERING GEAR	0	0.0	Pallet	No	Yes	0.0
####	HOSE ASSEMBLY	0	0.0	Bluebox	No	Yes	0.0
####	BRACKET	0	0.0	Bluebox	No	Yes	0.0
####	BRACKET	0	0.0	Pallet	No	Yes	0.0
####	STEERING GEAR	0	0.0	Pallet	No	Yes	0.0
####	BRACKET	0	0.0	Bluebox	No	Yes	0.0
####	HOSE	0	0.0	Pallet	No	Yes	0.0
####	SERVO PIPE	0	0.0	Bluebox	No	Yes	0.0
####	SPACER SLEEVE	9	0.0	Cardboard b	No	No	0.0
####	SERVO PIPE	0	0.0	Bluebox	No	Yes	0.0
####	BRACKET	0	0.0	Bluebox	No	Yes	0.0
####	HOSE	0	0.0	Bluebox	No	Yes	0.0
####	HOSE	0	0.0	Bluebox	No	Yes	0.0
####	HOSE	0	0.0	Bluebox	No	Yes	0.0
####	HOSE	0	0.0	Bluebox	No	Yes	0.0
####	BRACKET	0	0.0	Bluebox	No	Yes	0.0
####	BRACKET	0	0.0	Bluebox	No	Yes	0.0
####	HEX. SOCKET SCRI	8	0.0	Cardboard b	No	No	0.0
####	RETAINER	8	0.0	Cardboard b	No	No	0.0
####	NUT RETAINER	8	0.0	Cardboard b	No	No	0.0
####	PITMAN ARM	0	0.0	Pallet	No	Yes	0.0
####	HOSE	0	0.0	Pallet	No	Yes	0.0
####	AIR SPRING	0	0.0	Pallet	No	Yes	0.0
####	STEERING GEAR	0	0.0	Pallet	No	Yes	0.0
####	BRACKET	0	0.0	Pallet	No	Yes	0.0
####	BRACKET	0	0.0	Pallet	No	Yes	0.0
####	PIPE	0	0.0	Bluebox	No	Yes	0.0
####	PITMAN ARM	0	0.0	Pallet	No	Yes	0.0
####	SERVO PIPE	0	0.0	Pallet	No	Yes	0.0
####	STEERING GEAR	0	0.0	Pallet	No	Yes	0.0
####	REDUCTION NIPPL	7	0.0	Cardboard b	No	No	0.0
####	SERVO PIPE	0	0.0	Bluebox	No	Yes	0.0
####	BRACKET	7	0.0	Cardboard b	No	No	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	VALVE	7	0.0	Cardboard b	No	No	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0

####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	CONNECTOR	5	0.0	Cardboard b	No	No	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	13	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	CONNECTOR	3	0.0	Cardboard b	No	No	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0

####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	ELBOW NIPPLE	2	0.0	Cardboard b	No	No	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	SPACER SLEEVE	2	0.0	Cardboard b	No	No	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	17	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	3-WAY NIPPLE	1	0.0	Cardboard b	No	No	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0

####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	12	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	4	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	4	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	16	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	PROPELLER SHAFT	1	0.0	Pallet	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0

####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	4	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	PROPELLER SHAFT	1	0.0	Pallet	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	PARKING HEATER	23	0.0	Pallet	Yes	No	0.0
####	CROSS MEMBER	18	0.0	Pallet	Yes	No	0.0
####	PARKING HEATER	9	0.0	Pallet	Yes	No	0.0
####	TILT CYLINDER	4	4.2	Pallet	No	Yes	0.5
####	#N/A	5	#N/A	#N/A	No	Sequen	0.0
####	ATTACHING CLAM	0	0.0	Cardboard b	No	No	0.0
####	RELAY ROD	2	0.0	Pallet	No	Interna	0.0
####	RELAY ROD	2	0.0	Pallet	No	Interna	0.0
####	#N/A	3	#N/A	#N/A	No	Sequen	0.0
####	#N/A	6	#N/A	#N/A	No	Sequen	0.0
####	BRACKET	0	0.0	Cardboard b	No	No	0.0
####	#N/A	2	#N/A	#N/A	No	Sequen	0.0
####	#N/A	2	#N/A	#N/A	No	Sequen	0.0
####	#N/A	2	#N/A	#N/A	No	Sequen	0.0
####	RELAY ROD	1	0.0	Pallet	No	Interna	0.0
####	PROPELLER SHAFT	0	0.0	Pallet	No	Sequen	0.0
####	#N/A	2	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	2	#N/A	#N/A	No	Sequen	0.0
####	#N/A	2	#N/A	#N/A	No	Sequen	0.0
####	#N/A	2	#N/A	#N/A	No	Sequen	0.0
####	RELAY ROD	1	0.0	Pallet	No	Interna	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	BRACKET	0	0.0	Cardboard b	No	No	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0

####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	RELAY ROD	0	0.0	Pallet	No	Interna	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	PROPELLER SHAFT	0	0.0	Pallet	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	PROPELLER SHAFT	0	0.0	Pallet	No	Sequen	0.0
####	PROPELLER SHAFT	0	0.0	Pallet	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	BRACKET	0	0.0	Pallet	Yes	No	0.0
####	BRACKET	0	0.0	Pallet	Yes	No	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	PROPELLER SHAFT	0	0.0	Pallet	No	Sequen	0.0
####	PROPELLER SHAFT	0	0.0	Pallet	No	Sequen	0.0

####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	4	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	3	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	5	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	PROPELLER SHAFT	0	0.0	Pallet	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	2	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0

####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	3	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	PROPELLER SHAFT	0	0.0	Pallet	No	Sequen	0.0
####	DRAIN VALVE	0	0.0	Cardboard b	No	No	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0

####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	PROPELLER SHAFT	0	0.0	Pallet	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	4	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0

####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	PROPELLER SHAFT	0	0.0	Pallet	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	LEAF SPRING	0	0.0	Pallet	No	Yes	0.0
####	AIR SPRING	0	0.0	Pallet	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	STEERING GEAR	0	0.0	Pallet	No	Yes	0.0
####	STEERING GEAR	0	0.0	Pallet	No	Yes	0.0
####	AIR TANK	0	0.0	Pallet	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	SERVO PIPE	0	0.0	Pallet	No	Yes	0.0
####	U-BOLT	0	0.0	Bluebox	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	SERVO PIPE	0	0.0	Bluebox	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	SERVO PIPE	0	0.0	Bluebox	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	SERVO PIPE	0	0.0	Bluebox	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0

####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	SERVO PIPE	0	0.0	Bluebox	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	SERVO PIPE	0	0.0	Bluebox	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	RELAY ROD	0	0.0	Pallet	No	Interna	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	LINK ROD	0	0.0	Pallet	No	Interna	0.0
####	RELAY ROD	0	0.0	Pallet	No	Interna	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	RELAY ROD	0	0.0	Pallet	No	Interna	0.0
####	CLAMP	0	0.0	Bluebox	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	NIPPLE	0	0.0	Bluebox	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0

####	NIPPLE	0	0.0	Bluebox	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	PROTECTIVE CAP	0	0.0	Bluebox	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	TUBE	0	0.0	Pallet	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	FLANGE NUT	0	0.0	Bluebox	No	Yes	0.0
####	TUBE	0	0.0	Pallet	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	TUBE	0	0.0	Pallet	No	Yes	0.0
####	TUBE	0	0.0	Pallet	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0

####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	1	#N/A	#N/A	No	Sequen	0.0
####	RETAINER	0	0.0	Bluebox	No	Yes	0.0
####	FLANGE SCREW	0	0.0	Bluebox	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	CABLE TIE	0	0.0	Bluebox	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	CABLE TIE	0	0.0	Bluebox	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0

####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	PROPELLER SHAFT	0	0.0	Pallet	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	PROPELLER SHAFT	1	0.0	Pallet	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	CABLE TIE	0	0.0	Bluebox	No	Yes	0.0
####	CABLE TIE	0	0.0	Pallet	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	CABLE TIE	0	0.0	Pallet	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	STEERING GEAR	0	0.0	Pallet	No	Yes	0.0
####	COMPRESSED-AIR	0	0.0	Pallet	No	Yes	0.0
####	PROPELLER SHAFT	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0
####	COMPRESSED-AIR	0	0.0	Pallet	No	Yes	0.0
####	SERVO PIPE	0	0.0	Bluebox	No	Yes	0.0
####	SERVO PIPE	0	0.0	Bluebox	No	Yes	0.0
####	#N/A	0	#N/A	#N/A	No	Sequen	0.0

Total	**203 878**	**217.7**

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