

**THE EVALUATION OF THE FLOW
OF GOODS AT MERUS POWER
DYNAMICS OY**

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Bachelor's/ thesis
December 2018
International Business



ABSTRACT

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The evaluation of flow of goods at Merus Power

Bachelor's thesis 39 pages, appendices 4 pages
December 2018

This thesis has been commissioned by Merus Power Dynamics Oy, Nokia Finland. Merus Power is a company that produces high-technology products to improve power quality. The company was founded in 2008 and at the moment there are about thirty employees working at Merus Power.

In this thesis the material flow of goods has been evaluated. The research has been executed for the reason of the fast-increasing material flow of goods at their facilities. The purpose of the research was to see which improvements could be suggested to improve the material flow of goods at Merus Power. The research used in this thesis was qualitative. The theories that were used in this thesis were the ABC analysis, Lean manufacturing and the just-in-time.

Through conducting this thesis some viable options that could be implemented for improving the flow of goods at Merus Power were discovered. The thesis was divided into three chapters which were each focused on a part of the flow of good.

The first chapter was focused on the incoming goods and brought the following options could were reviewed: small order fees, contract agreements and the receipt of goods. The second chapter was focused on the storage of the goods and the following options were reviewed: stock tracing, Warehouse Management System and a vertical carousel. The third chapter was focused on the outgoing goods and the following forwarding options were reviewed: spot quotes, Freight Forwarding Agreement and online forwarding services.

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GLOSSARY

TAMK	Tampere University of Applied Sciences
Merus Power	Merus Power Dynamics Oy
JIT	Just-In-Time
WMS	Warehouse Management System
ABC	ABC Analysis
RFID	Radio Frequency Identification

1 INTRODUCTION

Having a clear and good overview of your flow of goods is essential in keeping track of your inventory and keep up efficiency. There are multiple aspects that need to be clear and continuously kept up to date to stay on top of your flow of goods. In this thesis the flow of goods of at Merus Power Dynamics Oy will be reviewed through multiple aspects, to check if there are possibilities to improve the flow of goods at Merus Power.

1.1 Thesis purpose

Merus Power is planning to expand their warehouse in the near future, which gives opportunities to look at which options can be implemented to improve the efficiency of the stock locations and the way the materials come to the warehouse and in which fashion they leave the warehouse.

1.2 Merus Power

“Merus Power designs, manufactures and markets a wide range of world leading power quality solutions for dynamic reactive power compensation, active harmonic filtering and power protection. Our solutions portfolio includes active harmonic filters, STATCOMs, SVCs, UPQ and ESS energy storage solutions. Our customers benefit from improved power quality which enables energy savings, increased productivity, guaranteed process reliability and grid code compliance.” (Merus Power Dynamics Oy 2018.)

Merus Power was founded in 2008 in Nokia, Finland and is celebrating it's 10th birthday this year. There are about 30 employees working at Merus Power, who are mainly professionals in the field of electricity and electrical power. About 85 per cent of their products are sold to customers outside Finland.

The product of Merus Power is very versatile and can be used in very different applications such as heavy and light industry, commercial buildings, infrastructure & utilities and renewable energy (Merus Power Dynamics Oy 2018).

All over the world you can find their solutions installed in different applications for example a big cinema complex in Egypt, one of the largest hospitals in the United Kingdom or a big steel mine in Russia. Figure 1 below shows more examples of places where the products of Merus Power have been installed.



FIGURE 1. Merus Power product applications (Merus Power Dynamics Oy 2018)

1.2.1 ERP

Merus Power is using an ERP system called Roima Lean System for all their aspects in the material flow: incoming, storage and outgoing. They use the system also for other departments in the company such as hour-reporting and the finances. The options that will be reviewed in the thesis for Merus Power will be viewed from a perspective that they could use these together with or in addition to their Roima Lean System.

1.3 Research Methods

The research method in this used in this thesis has been Qualitative.

Two definitions of qualitative research are:

- “a type of market research that aims to find out people’s opinions and feelings rather than information that can easily be shown in numbers” (Cambridge Dictionary 2018).
- “It is based on subjective assessment of behaviour, attitude, opinions, behaviour impressions etc..... The generalization of research funding are mainly made on the basis of non-qualitative terms, in otherwards, by adopting group discussion, group interviews, projective techniques, in-depth interviews of the respondents etc.....” (Krishnasawami & Satyaprasad 2010, 7.)

There is also a variety of qualitative methods according to Carson, Gilmore, Perry & Gronhaug (2001, 72-73). These varieties have been applied during the thesis for Merus Power.

- “**Observations** in business context can focus on: what impacts upon behaviour, how managers or staff act and react in certain situations, how behaviour and activities relate to or match what manager and staff say. Observations can be used to delve beyond opinions what managers and staff say they do and focus on their actual behaviour. This will result in the collection of information on behaviour in relation to doing marketing and the participation and involvement of managers and staff.” (Carson, Gilmore, Perry & Gronhaug 2001, 73, according to Gilmore & Carson 1996, 21-26.)
- “**Participation in company meetings** can allow data to be gathered through observation and taking notes on how items on an agenda are discussed. For example, areas of interest might be: the importance and priorities given to some topics and not others, the criteria used to differentiate between important and less important issues, different managers’ positions, opinions and recommendations in relation to each topic, and who has the final say in decision making.” (Carson, Gilmore, Perry & Gronhaug 2001, 73, according to Gilmore & Carson 1996, 21-26.)

- “**Content analysis of company materials** can be useful for determining the history and development of a company or departments within a company; the promotional activity and messages of the company and how they have changed over time; and the development of the product and service range” (Carson, Gilmore, Perry & Gronhaug 2001, 73, according to Gilmore & Carson 1996, 21-26).
- “**Conversational analysis** can be a good technique to use with different levels of staff in a marketing context. For example, conversations with service frontline staff and supervisors regarding the perception of their roles, such as dealing with customers and handling customers’ complaints can help build understanding of the feelings and reactions of staff delivering the service and lead to insights in relation to improving service delivery.” (Carson, Gilmore, Perry & Gronhaug 2001, 73, according to Gilmore & Carson 1996, 21-26.)

These varieties are more focused on the marketing side. However, they are also easily applied to other fields of business. These examples give a good overview of how qualitative research is conducted.

The findings of this thesis have been researched on people’s findings and looking at the options from a point of view that could benefit Merus Power. Theories such as the ABC analysis, Lean manufacturing and just-in-time have influenced the results of these findings. The views/opinions of the employees at Merus Power have played a role in the findings and have influenced the direction of this thesis.

The quantitative method has not been used in this thesis because no statistical or exact research has been conducted. Two examples of a definition for quantitative research are:

- “The use of sampling techniques (such as consumer surveys) whose finding may be expressed numerically and are amendable to mathematical manipulation enabling the researcher to estimate future events or quantities” (Business Dictionary 2018).
- “The analysis will be based on the numerical, percentages and in the monetary terms. The variables used for analysis will be tested with the suitability of holding the relationship to each other.” (Krishnasawami & Satyaprasad 2010, 6.)

2 THEORIES

2.1 ABC Analysis

The ABC analysis looks at each component and sees how much effort should be spent on inventory control on each item (Waters 2003). A general thinking in the inventory management is that 20 per cent of the inventory items need 80 per cent of the attention and the remaining 80 per cent needs only 20 per cent of the attention to keep the stock on a good level. This is due to the value of the goods in inventory. This thinking is called the 80/20 method or the Pareto law (the name of the person who came up with this model). (Slack, Chambers & Johnston 2010.)

The ABC analysis classes the inventory items into three categories:

- A items as expensive and need extra care
- B items as ordinary ones needing standard care
- C items as cheap and needing little care

(Waters 2003, 274.)

Figure 2 below shows a graph of the ABC analysis.

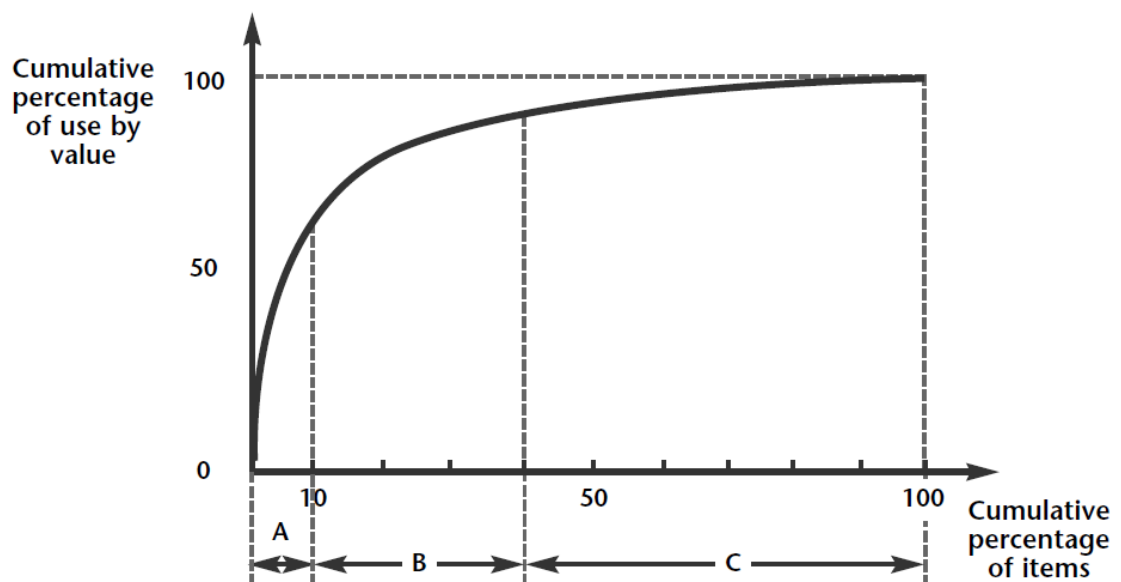


FIGURE 2. ABC analysis (Waters 2003, 274)

Applying this as an example to components that Merus Power has in its warehouse it can be as following:

- A, reactors, igtbs
- B, wiring,
- C, cable markings, relays, bolts, nuts

2.2 Lean manufacturing and just-in-time

To get an idea of where the Lean and just-in-time theory originated we must look back into history. The just-in-time and Lean manufacturing theory all started from the same thinking and originates from 1799 by a man called Eli Whitney who created the idea of the interchangeable parts. He manufactured muskets for the army in such a way that all the parts were identical to each other so that they could be easily manufactured and replaced. Before this manufacturing process everything was made by hand and each piece had its own small differences. (Strategos 2018.)

This way of thinking evolved around 1890 with the industrial engineers. Fredrick W. Taylor began to look at individual workers and work methods. He called all his ideas Scientific Management, however he had little to no eye for the well-being of his workers in these works. Lillian Gilbreth was also one of the people that contributed to this. Her study was on the psychology of how workers are motivated and how this affects the production process. These two people and others started the idea of eliminating waste in the production process, and so the beginning of the just-in-time and lean manufacturing. (Strategos 2018.)

In 1910, Henry Ford started one of the more considerable contribution to the Lean Manufacturing idea by creating an extensive manufacturing process. His ideas were very successful. A lot of other people tried to adapt Ford's methods to their businesses however this did not work so well, because they did not adapt it to their own process and the process of Ford was very specific to building cars in a certain way. However, there were a few problems in the manufacturing process of Ford. The first problem was that Ford's method heavily relied on fully committed workers that would put their own lives and self-esteem aside for their job. There was not a lot of thought put into the well-being of the workers. (Strategos 2018.)

The second problem was that the production process was very specific to one colour and model of a car. The process was not very flexible. However, this process would prove to be very productive during the second world war for building big bomber planes. (Strategos 2018.)

This success was not just known in the USA, but also other businesses around the world noticed that the manufacturing process of Ford was a success. One of these businesses was the Toyota Motor Company from Japan. They introduced Ford's manufacturing process to their own business but also added their own theory to this process: Toyota Production System or also called just-in-time. Toyota noticed though that they had to put more effort into their workforce and not just see them as part of the production. This realization is called the quality circle movement. The second problem that needed to be tackled was the flexibility of the process, they tackled this problem by reducing the time that it took to set up a certain process in the production. By reducing this to minutes and seconds they could easily change the set up of the process and so solve the problem of flexibility in the process. (Strategos 2018.)

As lean thinking is all based on reducing the amount of waste during the manufacturing process, Toyota realized that you first need to identify the waste. They did this through separating the waste into seven 'mudas' which is the Japanese word for waste. The seven 'mudas' are:

- Excess production
- Waiting
- Movement or Transportation
- Unnecessary motion
- Non-essential process
- Inventory
- Defects.

(Basu & Wright 2008, 202.)

The rest of the world got very interested in the process models that Toyota had set up and many people tried to copy. However, they did not study the whole process and did not fully understand the whole reasoning behind the processes from Toyota, so they did not succeed. The first persons that succeeded to get the idea behind the process at Toyota

were Norman Bodek, Robert Hall and Richard Schonberger. They all wrote books on this topic that became popular in the rest of the world. In the period after this, the idea began to have more of a foothold around the world and more people started to understand the theories and consequently teach them. This brought forth many success stories. (Strategos 2018.)

In figure 3 below shows a short timeline of the lean manufacturing.

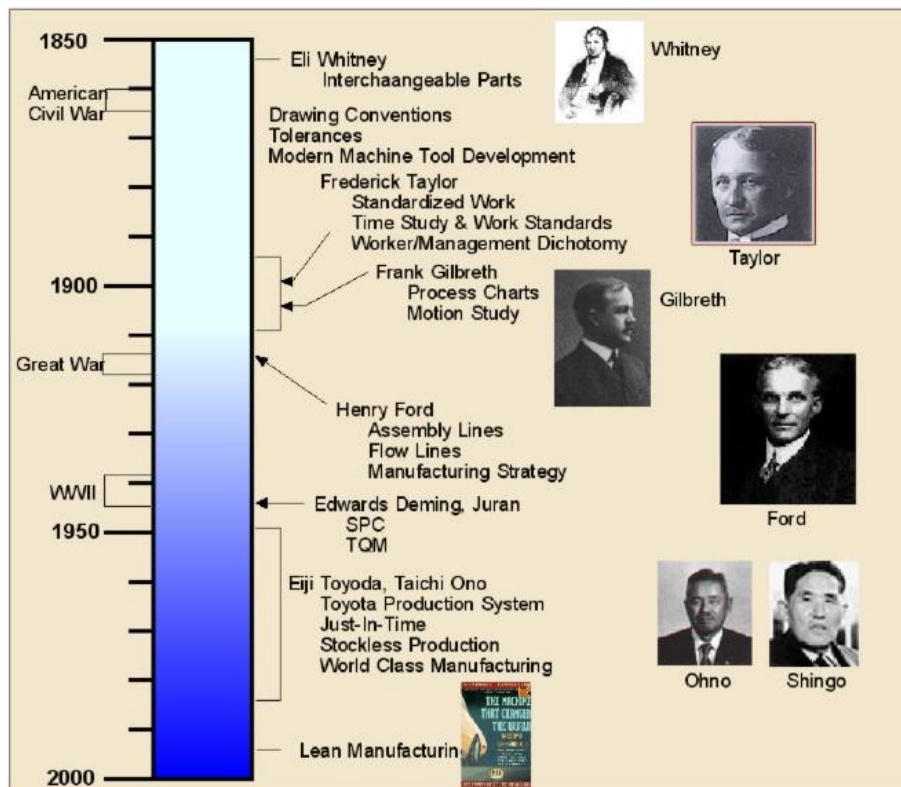


FIGURE 3. Timeline of lean manufacturing (Stratego 2018)

Merus Power tries to produce its products in a lean-production way, the just-in-time principle can be put into practice together with the lean way of thinking. While the lean theory focusses on reducing the waste, the just-in-time principle focusses on the idea of producing items only at the time that they are needed. (Slack, Chambers & Johnston 2010.)

The thought of the just-in-time principle is to get the components at the right time at the right place. The idea is not to have components on the shelf too long that are not being used for any product or project yet. Especially for the compact size of the warehouse at

Merus Power it is crucial not to have too many components in stock, because of the limited space. In figure 4 below, you can see the difference between a normal ordering process and a just-in-time ordering process. (Slack, Chambers & Johnston 2010.)

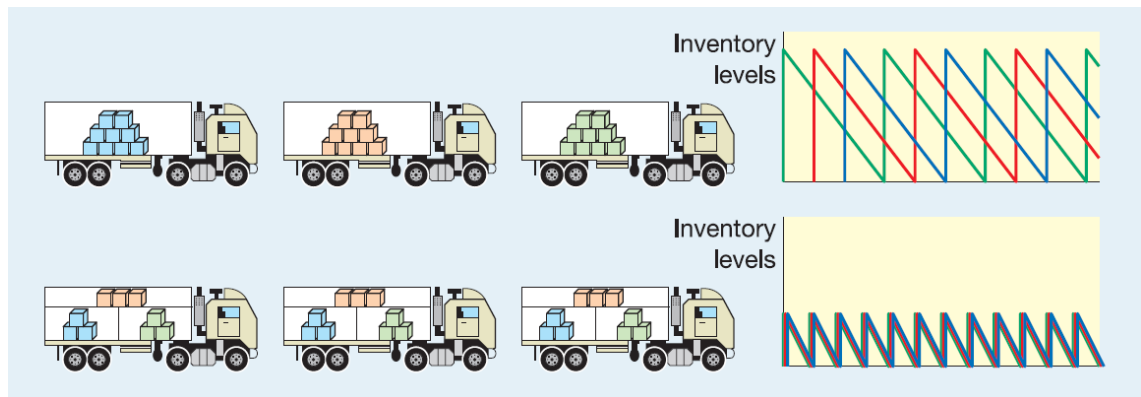


FIGURE 4. Normal vs. just-in-time ordering process (Slack, Chambers & Johnston, 2010, 445)

When you use the just-in-time order process also the total costs will go down, figure 5 below shows the just-in-time cost curves.

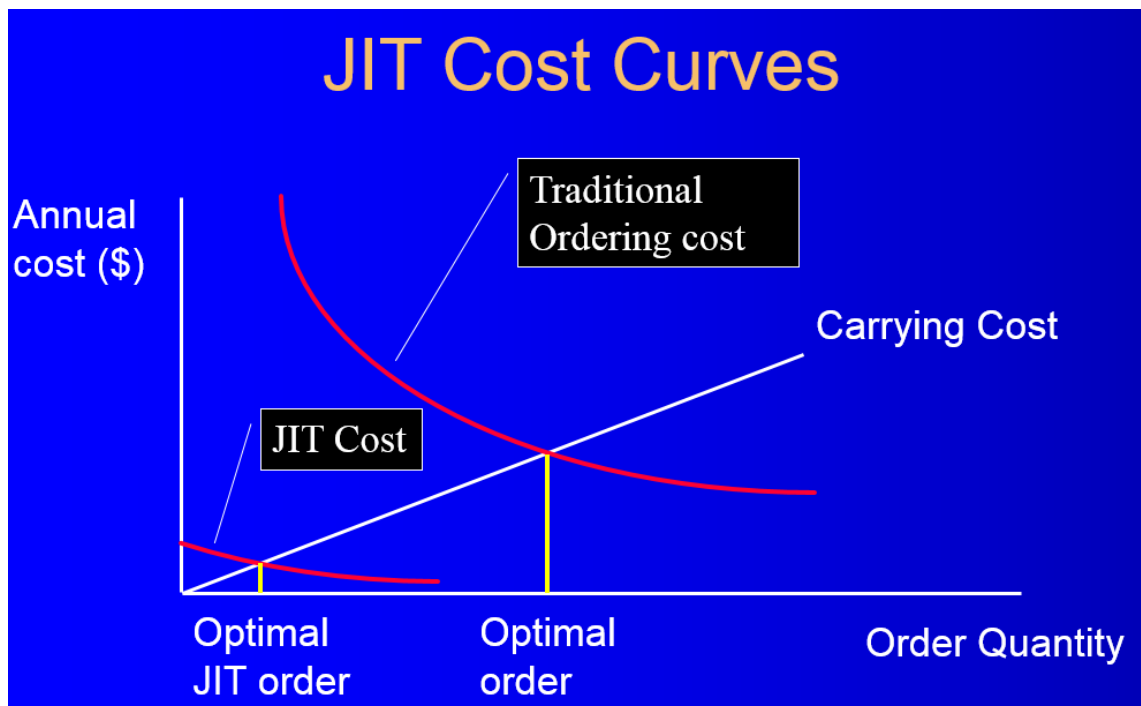


FIGURE 5. JIT Cost Curves (Anasse Bouhlal 2018)

3 INCOMING GOODS

The flow of goods involves the whole supply chain at Merus Power. The whole chain will be looked at in further detail. In this chapter the first step of the supply chain, the incoming goods will be reviewed in detail. After each chapter the different options will be reviewed and applied to the situation at Merus Power to look which option might suit the best for their situation at this moment. Some options might be for the short-term and other options can be for the long-term.

How do you purchase the components that you need for you product? Or how do you do this in the most efficient way? All questions that can be asked when thinking of the best strategies to purchase the products that you need.

3.1 Small order fees

When you order a small amount from some suppliers, they will charge a small order fee and the shipping costs will be also quite high compared to the ordered amount (Merus Power Dynamics Oy 2018).

To avoid these small order fees, there could be made some sort of list/table that collects small amounts that need to be ordered and group them together. After a certain period, weekly or bi-weekly they can be sent to the supplier and so the small order fees can be avoided.

Table 1 below shows an example of how the lists/tables could be set up.

TABLE 1. Example of component order list to avoid small order fees

Supplier A	Date	Item number	Amount	Needed by
1	16.10.18	202144	400 pcs	01.11.18
2	27.10.18	150250	15 pcs	30.10.18
3	01.11.11	M605	21 pcs	08.11.18
4

The table can be set-up per supplier and can be for example put on a shared drive that everyone can add the components themselves and the person responsible for buying the components can easily enter the data into Lean and send the order to the supplier or order them from the online shop if available.

3.2 Contract Agreements

A contract agreement is a contract that can be signed with a supplier where a component is sold according to an agreement. The component is then sold for the same price for amount of time and the delivery dates are agreed beforehand. Merus Power does already have some contract agreements with some suppliers, but this can be increased with more suppliers. (Merus Power Dynamics Oy 2018.)

The advantages of an annual agreement are:

- The assurance that you will get the components
- Easier to know what components are coming at which time

One important point that should be looked at when signing an agreement with a supplier is the length of the agreement. If the goods are quite valuable or difficult to get at some points of time, the agreement can be for a longer period because then Merus Power can be sure that the vital components are in their warehouse at the right moment.

“Overall the key points that should be looked at when making a contract according to (Sammons 2017, 62) are:

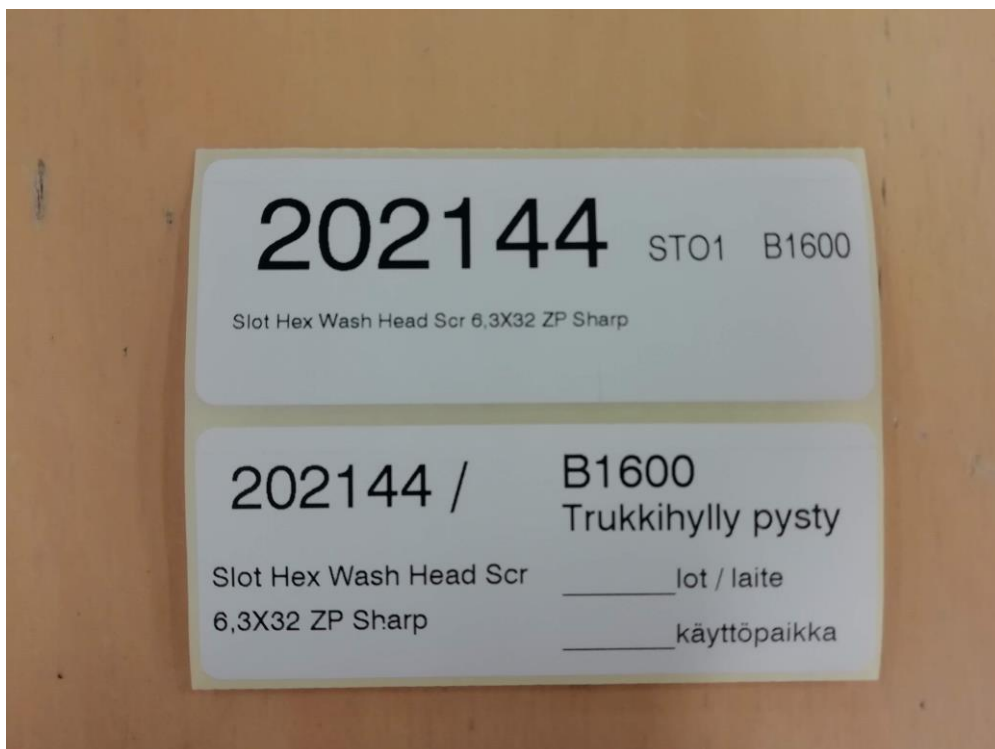
- The What, definition and the specification
- The Where, destination
- The When, timescales/timing of performance
- The How, method of delivery
- The How much, price and payment
- The what else, dependencies/incidentals”

The Contract Agreement suits well with one of the seven mudas mentioned earlier. The ‘muda’ that suits well with this is the savings of inventory (Basu & Wright 2008, 202).

Making more contract agreements with several suppliers can suit Merus Power very well, because they will have the assurance that the ordered goods are there at the right moment in time and that the warehouse will not be filled with components that have been ordered too early, just to make sure the goods are there in case.

3.3 Recieval of the goods

When components arrive at the warehouse they are put into the lean system by hand. To check if the right goods and the right amount have been delivered to Merus Power the packing list is compared with the purchase order and the goods are checked physically. After this check is completed each component will get a sticker with the corresponding code that links to the item. Depending on the physical size or the lot size the box is stickered, or each item is stickered. Picture 1 below shows an example of a sticker that is currently used at Merus Power.



PICTURE 1. Current product stickers at Merus Power (Merus Power Dynamics Oy 2018)

4 STORAGE OF GOODS

In this chapter the storage of goods will be reviewed in more detail. This will focus on how to keep a better track of the goods that are in the warehouse at any moment in time and how the goods are stored, especially how the locations can indicated be more accurately. This can be stock or items that are items that are on the production line. Different possibilities will be reviewed that could be used by Merus Power for the traceability of their goods during the period that the items are in stock or in production at the warehouse.

4.1 Stock tracing

To keep track of the stock at Merus Power there are several options that could be used at the warehouse. As mentioned before Merus Power is using stickers to identify their components on the shelf. However, this system does not work if Merus Power chooses the option of using an electronic picking system. Then there needs to be a system in place that supports this. Therefore, we will have a look at two options for a new stickering system: Barcoding and RFID tags, where the pros and cons of each system will be reviewed.

After this the way the shelves are used at Merus Power and which options there are to improve these will be looked at. This can help with saving space and picking time.

4.1.1 Barcoding & LeanwareWMS

One of the options for Merus Power is to start using barcodes for their components and the shelving in the warehouse. This can improve the visibility of the components on the shelf. However, this system needs a warehouse management system that can work in cooperation with the Roima Lean system, since barcodes need a scanner or a device with a camera to be read, for example an PDA or iPad.

A system that Merus Power could use for its Warehouse Management System is supplied by Leanware and is called LeanwareWMS. According to Leanware their WMS is more

intelligent than using an ERP system for warehousing. Due to using a regular ERP for the warehouse, companies lose an average of € 50.000 - € 500.000 per year. This was calculated by the total efficiency of the warehouse. (Leanware Oy 2018.)

When switching from ERP to an WMS to manage your warehouse the efficiency will grow from 5 lines/person/hour to 15 line/person/hour. This is the main saving point of the LeanwareWMS. (Leanware Oy 2018.)

“The other benefits from the LeanwareWMS are:

- delivery accuracy 99.9%
- shorter delivery times
- errors eliminated
- accurate inventory turnover (First In First Out, First Expired First Out)
- balance accuracy at least 99 %
- 100 % automatic traceability
- learning curve shortened to even one hour”

(Leanware Oy 2018.)

One of the more interesting benefits from this system which can suit Merus Power very well is the flexibility of the storage location or the so called ‘intelligent dynamic warehousing’. The products in LeanwareWMS do not have a fixed active or reserved location. (Leanware Oy 2018.)

This can work very well for the warehouse at Merus Power, because of the different projects that are always changing, and so the products are not always the same size, weight and amount on the shelf. A dynamic and always adapting Warehouse Management System can be one of the solutions.

In table 2 below, you can find the benefits of intelligent dynamic warehousing over an ERP-managed warehouse.

TABLE 2. ERP vs. LeanwareWMS method (Leanware Oy 2018)

Deficiencies in ERP-managed warehouses	ERP method	LeanwareWMS method	LeanwareWMS benefit
Poor product placement, which results in poor picking efficiency	<ul style="list-style-type: none"> Does not implement product placement according to turnover class (XYZ) at all, or does it very rarely Cumbersome, manual and completed very rarely (data searches and use of Excel) Done using the wrong assumptions: relying on ABC classes or delivered total quantities Active locations are allocated to low-turnover products 	<ul style="list-style-type: none"> Automatic daily calculation of turnover rating (XYZ) based on number of deductions Racking and refill placement based on current turnover rating Easy positioning for seasonal products 	<ul style="list-style-type: none"> Items are always in optimal locations Increased picking efficiency due to shorter transitions Turnover ratings used to refill active or pick from reserve
A lot of work that does not generate additional value, resulting in poor total efficiency	<ul style="list-style-type: none"> Fixed warehouse locations in ERP results in mixing products and unnecessary moving of items and looking for locations Put-away and refill management often deficient 	<ul style="list-style-type: none"> Always directs SKU to new empty inventory location An item is never touched during put-away or refilling 	<ul style="list-style-type: none"> Improves put-away and refilling processes by up to hundreds of percentage points
Insufficient balance precision	<ul style="list-style-type: none"> Annual stock-taking Warehouse location-specific inventory balances 	<ul style="list-style-type: none"> Real-time stock-taking against zero-balance 	<ul style="list-style-type: none"> No need for separate stock-taking Allows 98.5 – 100 % inventory balance accuracy
Lack of space	<ul style="list-style-type: none"> Empty rack space is not used efficiently Products that are not in inventory take up rack space Partially full pallets take up unnecessary space Receiving area is large, because receiving process is not dynamic 	<ul style="list-style-type: none"> Racked optimally based on pallet height and width Product does not have fixed location. If a product is not in inventory, it does not take up space. Maximizes rack capacity by emptying partially full pallets as effectively as possible Received balances can be racked right away 	<ul style="list-style-type: none"> Space is always used as efficiently as possible Minimal number of partially full pallets of the same product at the same time Possible to reduce size of receiving area, which allows for more rack space

The estimated costs integrating the LeanwareWMS are about € 35000 for the basic version of the WMS and this can go up to € 100000 for the WMS plus system, depending on the integration of systems and extra processes that can be put into place, which is quite a large amount of money, but it will be saving Merus Power money over the long run. (Leanware Oy 2018.)

If Merus Power wants to get a good view of what systems can be integrated in the warehouse and how big the return on investment is, the best thing would be to set up a meeting and see what system can be put into place that suits Merus Power the best.

4.1.2 RFID

RFID which stands for Radio Frequency Identification is a system where tags are put on a single component or a whole box/pallet of components with the specific data about this component.

“There are two types of RFID tags:

- Passive Tags operate without internal battery source. Electromagnetic waves sent from the reader starts a current in the tag’s antenna, and the tag uses that energy to respond to the reader.
- Active Tags operate with internal battery source and are typically read/write devices.”

(Muller 2011, 90.)

Figure 8 below shows the applications of and RFID supply chain.



FIGURE 6. RFID in the supply chain (Zetes 2018)

For Merus Power the usage of RFID tags might be not worth the investment that is needed into implementing the RFID tags, because they are more expensive than barcode stickers. The production and warehouse are not at the scale yet where the components and produced goods are so many that they need to be traced better than using a barcoding system. As you can see in the picture above the RFID tags are used in quite an extensive logistics chain, which is not the case at Merus Power yet.

4.2 Shelving options

How the goods are stored is a very important part of the visibility and traceability of the items that are stored in the warehouse. Currently the goods are stored by stock locations that are indicated by place. In picture 2 below stock location B1600 is shown. B1600 consists of 3 different shelves as seen in the picture.



PICTURE 2. Stock location B1600 at Merus Power (Merus Power Dynamics Oy 2018)

In this case it is stock location B1600, B1600 consists of 3 different shelves as seen in the picture. Each shelf does not have its individual indication. Using individual indication can be one of the options to improve the traceability of the good in the warehouse. When making it even more specific where the component is stored in a certain stock location and on a certain shelf it will be easier to track if the component is on the right shelf and if the amount is correct in the system.

The system could be set up so that each vertical shelf has its own number and that each horizontal shelf as well, the components can then be easier traced. At the moment there three shelves are called B1600. This could be then adapted to B1600A (the shelf on the left), B1600B (the middle shelf), B1600C (the shelf on the right) for the vertical shelves. For the horizontal shelves it could then work like this: if something was to be put on the vertical shelf on the left on the second shelf from the bottom it would be indicated as B1600A-2. If something else was going to be stored on the middle vertical shelf on the top vertical shelf it would be indicated as B1600B-5.

This option does however require a similar mindset of all the people who are involved in putting the component on the shelf and the people who are using the component in the production of the products. Everyone would have to follow the system of where the goods are stored and indicate this the right way when receiving the goods into the system.

4.3 Vertical carousel

For the smaller- and middle-sized components in the warehouse, a vertical carousel could be an option to keep better track of each component. The vertical carousel is a solution where goods are stored vertically in an enclosed shelf that rotates around and is able to store a lot more components than a conventional shelf like B1600 shown earlier. There are many different options to choose from, but for this example the Megamat RS from the company Kardex Remstar will be looked at in more detail. This device is also sold in Finland. (Kardex Remstar 2018.)

The device suits with the Lean manufacturing and just-in-time principles. The device will give Merus Power a space saving of 75 to 90 per cent compared to the conventional

shelves that are in place now and according to the customers of Kardex an increase of 100 to 400 per cent in efficiency. (Kardex Remstar 2018.)

The main selling points that are interesting for Merus Power are:

1. “Speed and Productivity

- Very high picking productivity
- High running speed
- Optimized utilisation and reduction of storage space
- Reduced picking errors
- Short picking times

2. More space. Better organisation

- Up to 60 per cent more storage capacity
- Well-organized storage of small parts
- Positioned at the point of, rapid access
- Suitable for all customary containers and storage bins

3. Individuality and Flexibility

- Modular structure
- Flexible carrier concept

4. Quality and Efficiency

- Certified quality and environment management systems
- Worldwide service network

5. Safety

- Emergency hand crank in case of power failure
- Clip system for simple, quick assembly and greater system stability
- Access control
- Optimal protection for personnel and stored goods
- Certified safety

6. Ergonomic Design

- ‘Good to person’ principle
- ‘Drive and view’
- Optimized user-friendliness
- Multifunctional profile: customized attachment for operator controls and accessories
- Smooth-running sliding doors

- Confirmation bar

7. Technology

- Low-wear operation thanks to the automatic chain tensioner
- State-of-the-art and endurance-tested materials
- Logicontrol unit management
- Power Pick Global warehouse management software

8. Secure Investment

- Long service life
- Retrofit and conversion packages available as needs change’’

(Kardex Remstar 2018.)

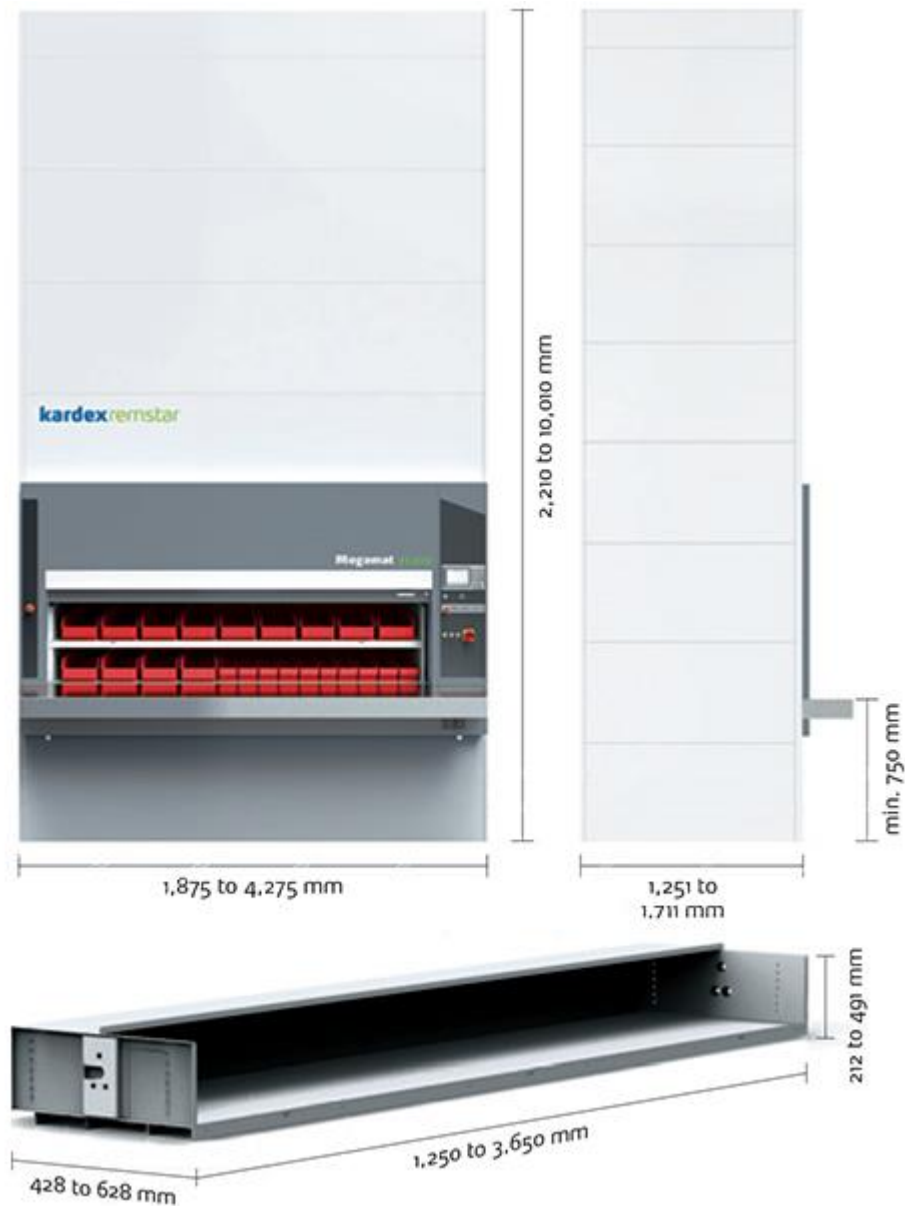
There are three different models of the Megamat RS: the 180, 360, 650 this regards to the amount of weight of kilograms each shelf can hold in the machine (Kardex Remstar 2018).

Picture 3 shows an example of the device.



PICTURE 3. Kardex Remstar Megamat RS350 (Kardex Remstar 2018)

The device can be configured in height, width and depth. There height can vary from 2,21 to 10,01 meter, the width from 1,87 to 4,27 meter and the depth from 1,25 to 1,71 meter. The configurations can be found in picture 4 below. (Kardex Remstar 2018.)



PICTURE 5. Kardex Remstar dimensions (Kardex Remstar 2018)

There are also multiple shelf configurations that can be put into the machine. A picture of three configurations are shown in picture 5,6 and 7 below.



PICTURE 5. Shelf configuration (Kardex Remstar 2018)



PICTURE 6. Shelf configuration (Kardex Remstar 2018)



PICTURE 7. Shelf configuration (Kardex Remstar 2018)

Each shelf can for example be used to sort products from a certain supplier or to sort products that are used in a single project or to sort product for the Merus Power device that they are used in. There are many variations that can be applied because the shelves are so versatile. (Kardex Remstar 2018.)

The Kardex Remstar can be integrated to the ERP system that Merus Power is currently using and so the stock levels of the smaller components can be kept track of very specifically (Kardex Remstar 2018).

Merus Power has an agreement with a supplier for the small components that are used for the products they manufacture. These are components such as screws, bolt, nuts, wiring and other similar components. The items are visually checked each week and ordered accordingly. However, this sometimes causes problems with wrong items being ordered or items that do not get ordered on time. The carousel could solve this problem, because every time something is put into the carousel or taken out the system know and makes an order proposal if necessary.

The total costs for one Kardex Remstar vertical carousel will vary from € 30000 to € 40000, depending on the configuration of the machine such as the height, width and depth. Of course, this is quite an extensive amount of money to spend on a single machine. However, the space and time saved by this machine will improve the efficiency at Merus Power and will save money in the long run. (Kardex Remstar 2018.)

5 OUTGOING GOODS

In this chapter the last part of the flow of goods at Merus Power is reviewed, the outgoing goods. How is the shipping company selected for each delivery? How can this be improved? These are all questions that will be looked at and answered in the following chapter.

5.1 Forwarding options

There is a very large amount of options when it comes to forwarding companies. In the past few years Merus Power has used a few forwarders for transporting their shipments. There has not been a lot of research at Merus Power on how to get the best price for each shipment, this mainly due to the exponential growth that Merus Power has had over the past few years and the resources were limited to investigate this topic further. With the three topics below some options that could be thought of to have a better view of the shipping costs are highlighted.

5.1.1 Spot quotes

Spot quotes are freight shipments that are made each time separately. Usually the forwarder will be chosen by the cheapest price or by the fastest delivery time. Sometimes a shipment is time critical and needs to be booked before a certain day in which case time is part of choosing the right forwarder for the particular shipment. This is how Merus Power is arranging most of its shipments. This is because the Merus Power ships mainly to a different destination each time and does not have a lot of set shipment destinations.

In the past few months (02/2018-07-2018) Merus Power has tried to compare a large scale of forwarders by contacting them for spot quotes for different shipments. In the table below, you can find an example of a few quotes per forwarder.

TABLE 3. Quotations from forwarders

Forwarder	Quote 1	Quote 2	Quote 3	Quote 4	TOTAL
Forwarder 5	€ 302	€ 1317	€ 1785	€ 313	€ 3717
Forwarder 3	€ 313	€ 1212	€ 2194	€ 341	€ 4060
Forwarder 15	€ 339,80	€ 1057	€ 1355	€ 255	€ 3006,80
Forwarder 14	€ 350,80	€ 1079	€ 1905,09	€ 410	€ 3765,80
Forwarder 2	€ 324	€ 1116	€ 2100	€ 331	€ 3871

As you can see in table 3 above is that the quotes are quite close to each other and that not one forwarder has the cheapest price for every quote. It is also important to check in which geographical area each forwarder has the most experience or the biggest presence. For example, Expeditors is an American company and thus has a better network to North-America. On the other hand, DB Schenker has one of the biggest road networks in Europe and can therefore offer very competitive prices compared to forwarders with less presence/experience in these areas. All the spot quotes that have been used during the internship/thesis period can be found in appendix number 1, the names of the forwarder have been left out for confidentiality.

5.1.2 Freight Forwarding agreement

A Freight Forwarding Agreement (FFA) is a contract that a company (e.g. Merus Power) can sign with a forwarding company (e.g. DSV, DHL) for a certain shipping route(s). This can save time and money for the company, because they do not have to spend time asking for quotes each time they have a shipment to the same place.

The following items are usually agreed in the contract:

- (a) The agreed route
- (b) The date, month and year of the settlement
- (c) Contract size
- (d) The contract rate at which differences will be settled. (Baltic Exchange Ltd. 2018.)

At the moment this is not a very viable option for Merus Power, because almost all shipments are transported to completely different places around the world.

5.1.3 Online forwarding services

An online freight forwarding service is a website from a forwarder where the customer can book or get a quote for a shipment that they would like to ship soon. These online services save time, because there is less e-mail contact needed between the customer and the forwarder.

The online freight forwarding services are growing and more forwarders are making it possible to make a booking through their online services. Merus Power has used the online Systems from several forwarders for the bigger shipment bookings. Before the end of this year another forwarder will also have an online booking system online which Merus Power can make use of. The online system from the forwarder that Merus Power is using at the moment has been especially easy for Merus Power, because they also give immediate quotes for standard shipments.

For the smaller shipments such as documents and letters Merus Power uses the online system from a courier service which is one of the easiest to use so far in their experience. Another courier service has also a system for this but it is far more complicated to work with according to the experience at Merus Power. For shipments within Finland, Merus Power uses Kaukokiito, which is a Finnish logistics company which only has services within Finland. Their online platform is easy to use and makes it easy to transport shipments throughout Finland if necessary.

5.1.4 FreightOpt

FreightOpt is a new platform where companies such as Merus Power can add a request for a shipment quote and multiple forwarding companies can give their quote before a certain deadline that you can set. The mission of FreightOpt is to:

“To connect customers and forwarders with the most economical and least time-consuming means of transport” (N-S-B Logistics Management Oy 2018).

There was a trial period for this platform which was used for the purposes of this thesis, to see if this would be an option for Merus Power to use. The trial period was from 22.10 – 05.11.18.

When setting up a request for a quote, first the mode of transport must be selected: over-land, airfreight or sea freight.

When you have selected one of these options the following details have to be given to make the request:

- Direction, with the options: Import, Export, Domestic or Crossland
- Incoterm
- Freight type, with the options: general cargo or thermal cargo, if thermal cargo is chosen you can set the required temperature.
- Freight, there are three options to choose from here:
 - 1) EUR Pallet, where you have to select the amount and the weight.
 - 2) Full truck
 - 3) Units with dimension, where you have to fill in the dimensions and weight in yourself according to the package(s) you want to send.
- Pickup and Delivery address
- Pickup date
- Latest delivery date
- Deadline for quotes, the date when the forwarders must have submitted their quotes by.
- Extra information
- Internal reference, this can be a reference to your delivery number, invoice or packing list etc. (N-S-B Logistics Management Oy 2018.)

After having filled in all these details the quote can be saved, and the forwarders can submit their quote until the deadline. Once some quotes have been submitted forwarders can also compare their prices with each other, and lower their prices to compete, if they want to. Once the deadline is near the customer (Merus Power) can select a quote that suits their needs the best. The cheapest option might not always be the best option, because it can be that the more expensive quote is a faster option, if the shipment is time critical.

For Merus Power, this is an interesting platform, since Merus Power is now not looking for a contract with a single forwarder, because they are not yet shipping so regularly to one location as explained earlier. FreightOpt gives the opportunity to compare a lot of different forwarders at the same time. The platform is quite time-saving compared to e-mailing forwarders and getting quotes from them manually every time.

There is also a negative to FreightOpt. When the 2-week trial period is over, there is a monthly fee to be paid. The monthly fee for the spot quote package is a € 150 a month. The costs of the fee should be weighed up to the savings made by the shipments. (N-S-B Logistics Management Oy 2018.)

Lastly, FreightOpt suits with the Lean way of thinking at Merus Power. This system will save time and money which perfectly fits in with one of the seven 'mudas': unnecessary motion, because there is no need to e-mail each forwarder separately anymore (Basu & Wright 2008, 202).

5.2 Pros and Cons Forwarding options

In below 4 the pros and cons of the different forwarding options are reviewed. After reviewing the table, a conclusion will be made based upon the findings.

TABLE 3. Pros and cons forwarding services

TYPE	PROS	CONS
Spot quotes	<ul style="list-style-type: none"> - easy to compare prices between several forwarders. 	<ul style="list-style-type: none"> - time consuming to be in contact with several forwarders
Freight Forwarding Agreement (FFA)	<ul style="list-style-type: none"> - one price - one contact point from forwarder 	<ul style="list-style-type: none"> - a bigger amount of shipment to the same place is needed - usually a fee is used for the services from a forwarder
Online forwarding services	<ul style="list-style-type: none"> - time saved by not needing to be in e-mail contact with several forwarders - easy to use (depending on forwarders website) 	<ul style="list-style-type: none"> - more challenging to compare the prices between several forwarders.
FreightOpt	<ul style="list-style-type: none"> - easy to use - Ability to compare different forwarders - No need to e-mail several forwarders 	<ul style="list-style-type: none"> - monthly fee

After reviewing all the different options for different forwarding options, the most suitable option for Merus Power is the FreightOpt system. This is because the system is easy to use especially because Merus Power is not using a freight forwarding contract with a single forwarder. The best solution for Merus Power is to look at the overall cost for the freight for a certain period of time and then check the costs of the FreightOpt (€ 150 per month) system plus the costs of the shipment and compare this to the freight costs without FreightOpt for a period of time. However, the savings of time alone already will make it worth it for Merus Power to use an online system such as FreightOpt.

6 CONCLUSION

When looking at all the options that could improve the flow of goods at Merus Power some options might be more viable than others. The suitability of all options brought forward in this thesis have been evaluated from the perspective of what would be beneficial for Merus Power.

6.1 Incoming Goods

The options that have been mentioned in this chapter are relatively easy to implement but can however save costs and improve the scheduling of the incoming goods.

Firstly, the small order fees can save quite a substantial amount if counted over a longer period of time. If for example the small order fee is 25 euros per order and Merus Power makes a small order each week over a period of a month this counts up to 100 euros in small order fees. This small order could possibly be avoided by making two bigger orders every other week thus saving Merus Power 100 euros per month in small order fees. This example gives Merus Power a saving of 1200 euros per year.

Secondly, the contract agreements can improve the scheduling of incoming goods and this fits in with the thinking of the just-in-time principle in which the goods are there at the right moment and do not take up any valuable stock locations (Slack Chambers & Johnston 2010).

This option is easy to implement but must be given a lot of careful thought. Since a contract agreement is usually quite valuable, the supplier must be reviewed very carefully before signing the contract. However, Merus Power already has experience on signing various contract agreements and this experience can help when signing more contracts.

6.2 Storage of Goods

For the storage of goods two main options came up that could be beneficial to the flow of goods at Merus Power, which are the barcoding/Leanware system and the vertical carousel. The option for RFID tags is currently not the right choice for Merus Power since their whole supply chain is not of the size where RFID can be an asset.

Barcoding/LeanwareWMS and the vertical carousel however, are very interesting options that can be implemented at Merus Power.

The LeanwareWMS is a complete system to improve the accuracy, flexibility and efficiency at the warehouse of Merus Power. Since each business has its own process, the savings will be difficult to estimate for Leanware and they suggest meeting with them to give a realistic estimation of the costs- and time-savings that will be made by implementing their system at Merus Power. Accordingly, the cost of the LeanwareWMS system depends on the savings that Leanware thinks it can achieve when implementing their system at Merus Power. (Leanware Oy 2018.)

Secondly the vertical carousel from Kardex Remstar, can make a significant improvement to the flow of goods at Merus Power. Looking at the Lean perspective there are savings of waste (Basu & Wright 2008, 202).

Firstly, it will reduce the amount of space that the device takes up in the warehouse, up to 75-90 per cent less than conventional shelving according to Kardex Remstar (2018). Secondly, no inventory will be misplaced because the carousel will be directly linked to the Roima Lean system and can also be linked to the LeanwareWMS if Merus Power chooses to incorporate this system. (Leanware Oy 2018.)

The costs savings of the vertical carousel lay in the space and efficiency savings above but also in the possibility of saving costs with the just-in-time thought, when the goods are there at the right moment and are used very shortly after arriving in the warehouse. This can only be achieved when you know exactly how much components you have in stock at any moment in time. Figure 4 on page 13 shows the advantages of a just-in-time purchasing strategy very clearly (Slack, Chambers & Johnston 2010).

The costs of one carousel are quite high and this could be cut into parts by seeing if it is possible to disperse the costs over a longer time, by paying off the device in for example a year.

6.3 Outgoing Goods

For the outgoing goods four different options were compared with each other. These options were: spot quotes, freight forwarding agreement, online forwarding services and FreightOpt.

At the end of the chapter it was made clear that FreightOpt is the most suitable option for Merus Power. The reasons that FreightOpt is the best option for Merus Power is that it saves a lot of time compared to getting spot quotes from various suppliers and being in constant e-mail contact with them. Secondly, the ability to compare many forwarders with each other is very good.

The monthly fee of a € 150 will be compensated and money will be saved by the time that does not need to be spent on e-mailing several forwarders when getting spot quotes and by being able to compare different forwarders quotes with each other. Comparing quotes would not be possible when using one online forwarding service from a single forwarder.

6.4 Future research options

When looking at the results and conclusions of this thesis, some/a research proposal(s) could be made that could be beneficial for future.

Firstly, a research could be made of how to make the best and most efficient lay-out for the upcoming renovation of the warehouse at Merus Power and how the options that have been mentioned in this thesis could play a role in this process. This research should be done by involving all departments in the company that are using the warehouse in some way. Everyone has a different opinion of how it should be set up and compromises will be part of this process for each party involved.

Secondly, when looking a few years ahead a research could be conducted on the subject of a new warehouse/office location for Merus Power. This is because Merus Power has the objective of growing exponentially in the next coming years and the space where Merus Power is at the moment will be not as suitable anymore in the future.

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APPENDICES

Appendix 1. Spot quote

Quote 1	
Forwarder 11	393,37 €
Forwarder 7	532,00 €
Forwarder 12	504,51 €
Forwarder 5	302,00 €
Forwarder 13	350,80 €
Forwarder 14	368,53 €
Forwarder 15	339,80 €
Forwarder 3	313,00 €
Forwarder 10	443,00 €
Forwarder 4	383,00 €
Forwarder 16	435,00 €
Forwarder 17	369,92 €
Forwarder 9	442,00 €
Forwarder 1	516,00 €
Forwarder 2	324,00 €

Quote 2	Sea	Air
Forwarder 17	451,33 €	
Forwarder 3	538,85 €	1 212,00 €
Forwarder 12	375,50 €	1 362,00 €
Forwarder 5	233,77 €	1 317,00 €
Forwarder 16	588,96 €	1 855,00 €
Forwarder 13	440,51 €	1 079,00 €
Forwarder 7	375,00 €	
Forwarder 10	610,00 €	
Forwarder 20		2 377,00 €
Forwarder 9	452,00 €	1 166,00 €
Forwarder 4		1 403,00 €
Forwarder 2		1 116,00 €
Forwarder 15		1 057,00 €

Quote 3	
Forwarder 2	2 100,00 €
Forwarder 17	2 288,22 €
Forwarder 5	1 785,00 €
Forwarder 15	1 355,00 €
Forwarder 3	2 194,00 €
Forwarder 18	1 318,50 €
Forwarder 12	1 624,46 €
Forwarder 10	1 845,00 €
Forwarder 14	1 878,33 €
Forwarder 6	1 625,05 €
Forwarder 4	2 226,54 €
Forwarder 7	1 565,00 €
Forwarder 8	660,00 €
Forwarder 13	1 905,09 €
Forwarder 21	2 827,90 €

Quote 4	
Forwarder 5	313,00 €
Forwarder 13	410,00 €
Forwarder 3	341,00 €
Forwarder 14	317,00 €
Forwarder 17	295,00 €
Forwarder 9	325,00 €
Forwarder 7	365,00 €
Forwarder 10	365,00 €
Forwarder 12	338,00 €
Forwarder 21	307,00 €
Forwarder 15	255,00 €
Forwarder 2	331,00 €

Quote 5	
Forwarder 1	660,96 €
Forwarder 2	397,50 €
Forwarder 3	320,00 €
Forwarder 4	294,34 €
Forwarder 5	157,33 €
Forwarder 6	420,00 €
Forwarder 7	365,00 €
Forwarder 8	380,00 €
Forwarder 9	360,00 €
Forwarder 10	465,00 €
Forwarder 11	440,00 €
Forwarder 12	455,00 €

Quote 6	
Forwarder 18	1 500,00 €
Forwarder 4	1 109,01 €
Forwarder 17	932,00 €
Forwarder 3	572,00 €
Forwarder 14	950,00 €
Forwarder 8	520,00 €
Forwarder 9	1 037,00 €
Forwarder 10	1 190,00 €

Quote 7	
Forwarder 12	455,62 €
Forwarder 5	335,00 €
Forwarder 14	317,30 €
Forwarder 8	370,00 €
Forwarder 9	379,90 €
Forwarder 13	385,00 €
Forwarder 6	484,00 €
Forwarder 10	550,00 €
Forwarder 19	388,00 €
Forwarder 17	320,00 €

Quote 8	Sea	Air
Forwarder 3	894,24 €	1 758,80 €
Forwarder 18	500,00 €	1 090,00 €
Forwarder 5	394,00 €	
Forwarder 7	445,00 €	1 017,00 €
Forwarder 10		1 525,00 €
Forwarder 4	462,80 €	1 343,00 €
Forwarder 6	541,00 €	1 094,00 €
Forwarder 12	430,47 €	1 429,00 €
Forwarder 16		1 305,21 €
Forwarder 11	548,00 €	1 807,49 €

Quote 9	Sea	Air
Forwarder 18	2 055,00 €	9 200,00 €
Forwarder 3	2 256,38 €	10 094,95 €
Forwarder 12	2 352,00 €	
Forwarder 15	2 346,00 €	9 130,46 €
Forwarder 5	2 537,00 €	9 100,00 €
Forwarder 7	2 685,00 €	9 965,00 €
Forwarder 16	2 836,77 €	10 852,23 €
Forwarder 9		9 080,00 €
Forwarder 8	2 480,00 €	6 950,00 €
Forwarder 4	2 228,37 €	9 096,20 €
Forwarder 2	2 243,00 €	8 421,98 €
Forwarder 11		9 800,00 €
Forwarder 6		11 299,70 €
Forwarder 13	1 972,00 €	8 247,96 €

Quote 10	Sea	Air
Forwarder 18	969,00 €	3 800,00 €
Forwarder 3	1 367,15 €	4 712,28 €
Forwarder 15	900,00 €	3 738,30 €
Forwarder 5	1 325,00 €	4 200,00 €
Forwarder 7	1 065,00 €	4 885,00 €
Forwarder 16	1 459,86 €	5 307,53 €
Forwarder 9		4 525,00 €
Forwarder 8	1 350,00 €	3 500,00 €
Forwarder 4	1 176,00 €	4 303,00 €
Forwarder 2	1 162,00 €	4 096,00 €
Forwarder 11		4 750,00 €
Forwarder 6		5 406,00 €
Forwarder 13	1 017,00 €	4 052,00 €

Quote 11	
Forwarder 5	905,00 €
Forwarder 11	1 003,00 €
Forwarder 13	723,00 €
Forwarder 6	711,00 €
Forwarder 3	675,79 €
Forwarder 4	1 220,00 €
Forwarder 14	927,66 €
Forwarder 17	1 030,00 €
Forwarder 12	539,00 €
Forwarder 10	1 538,00 €