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Development of the flow of packing in Bluefors Oy

Standardizing packing materials

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Abstract

Bluefors Oy is the world's leading manufacturer of ultra-low temperature dilution refrigerators. For a manufacturing company, such as Bluefors, processes are the key to success. The lack of them, or having inoperative ones, is therefore, the key to wasting both time and money. Since the company in question has been rapidly growing to its current magnitude, the processes have not been able to keep up with the pace. Thereby, the need for improvement was obvious. The logistics department managers decided to begin the development from the packing process, which then led to research in the form of a thesis work. The main goal was to develop the flow of packing in Bluefors by standardizing the packing materials and clarifying the packing process.

Qualitative research methods were used, and with the help of interviews, questionnaire, observations and theoretical research on the upcoming issues, a clear picture of the current situation and its challenges was formed. The results and conclusions of the study were focused on two aspects: standardizing and optimizing the packing materials and creating a working process with the help of Lean methods. Implementing these methods was deemed to make the packaging easier for the operators, up to 75% faster to perform, and therefore, overall more cost-effective for the company.

The results gotten are mainly suitable for any manufacturing company that wants to develop its processes with the help of optimization, standardization and Lean process development methods. Further development is also possible based on the results, but the company must first create and practically implement an applicable basic process for packaging before it can be developed further.

Keywords/tags (subjects)

packing, packaging, packing materials, packing process, standardization, optimization, Lean

Miscellaneous (Confidential information)

Contents

Figures

Tables

1 Introduction

1.1 Background of the thesis work

Bluefors Oy is the world's leading manufacturer of ultra-low temperature dilution refrigerators. In just ten years, the company has been transferred from an idea into a market leading company that is focused on helping to solve the most fundamental questions and fascinating challenges at low temperatures. Bluefors wants to refine the technology even further and make it readily available on an even larger scale. As said on the website:

> *"We are here to enable the quantum technology breakthrough, to support scientists and industries to go further, to allow new innovations, and to grow and care for our global community." (Bluefors Oy n.d.)*

Because of the rapid growth of the company, Bluefors has had some trouble with keeping its inner functions up with the pace. For example, in the logistics department, the volumes of the materials keep growing so fast that the materials management must be fully re-organized in the near future. One important target for development in the logistics department was also the packing process, or more importantly, the lack of it. Since Bluefors is quite a new company, and with a background of the rapid growth, certain "processes" still seem to follow the routines of the time when only a few people were running the whole firm. In those days, practically everyone did everything, and, for example, every single packing case was different, and most of all, not many deliveries were even sent. However, nowadays, since the volumes of deliveries are growing all the time, it is time for new logistics processes to be created.

The purpose of the thesis work was to try to find ways in which the flow of packing could be developed by, perhaps, standardizing the packing materials and creating guidelines for the packing process. The goal of the thesis work was also to examine what kind of packing materials would suit best for the company's purposes, and how

the company could find the most cost-effective solutions. Currently, the packing of the separate small orders takes a great deal of time and plenty of packing material is wasted during the process. The company would like to change this.

1.2 Purpose of the thesis work

The main goal of the thesis work was to develop the flow of packing in Bluefors Oy by standardizing the packing materials and clarifying the packing process. The goal was to find the answers to the following questions:

What is desired packing process for Bluefors?

What kind of packing materials would suit best for the company's needs?

What kind of methods can be used for optimizing packing process?

The aim was to develop the packing policies in the company so that the packing would become faster and easier to do, and at the same time, more cost-effective.

In this thesis work, the focus was on the packaging of the products delivered to the customers only, not on the ones packed for storing. However, the products did not include the system deliveries, because the systems' packing had already been out-sourced to Transval Oy. Figure 1 below shows a ready-packed system.

Figure 1. A Bluefors system packed by Transval ready to be shipped.

2 Bluefors Oy

2.1 General description

Bluefors Oy is the world's leading manufacturer of ultra-low temperature dilution refrigerators. The company's aim is to deliver their customers the most reliable and, at the same time, easy to use products with the highest quality possible. Each system is customized for each individual customer. Right now, Bluefors has already almost 200 employees and 6 representatives globally. *(Bluefors Oy n.d.)*

In just 10 years, Bluefors has transformed from an idea and a dream, into a market leading company. They are determined to solve the most fundamental questions and fascinating challenges at low temperatures. The company's one and only mission is progress. They keep on perfecting, even at times when others would give up. Bluefors relies on innovative engineering and impeccable functionality to obtain the highest-end technology combined with scalable production processes. By pushing old boundaries and re-thinking old beliefs, they have been able to set a new standard for cryogenics. *(Bluefors Oy n.d.)*

2.2 Company history

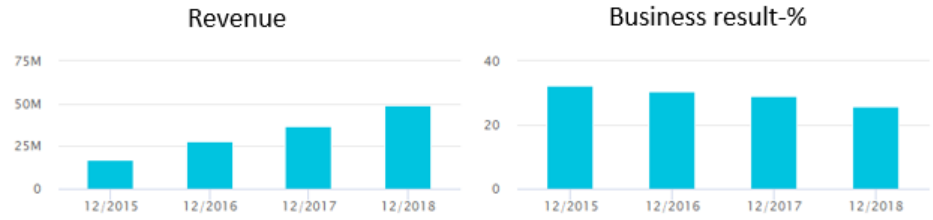
Bluefors' name comes from the founders Rob Blaauwgeers and Pieter Vorselman (BlueFors = *Blaauw*geers-*Vors*elman). The story began in 2005 when the company's current CEO Rob Blaauwgeers was hired to move and upgrade all the dilution refrigerators (DR) systems at the renowned Low Temperature Laboratory (LTL) of Helsinki University of Technology. One of his tasks was to construct a versatile, fully automated gas handling system that was capable of working in combination with all the different DR systems. At that time, Blaauwgeers was inspired to begin developing the first cryogen-free DR system for LTL. *(Bluefors Oy n.d.)*

The newly developed system underwent the first tests in the summer of 2006 in combination with the first prototype of the cryogen-free DR system. Immediately it

became apparent, how simple and easy it was to operate the fully automated cryogen-free DR system as compared to a conventional “wet” DR system. This became the business idea behind commercializing these systems. *(Bluefors Oy n.d.)*

Blaauwgeers wanted to continue the journey together with a study friend and cryogenic engineer Pieter Vorselman. Together they optimized the automated cryogen-free DR system for reliability, easy usage and performance. In 2007, the NANO group of the LTL took the first system into use. Shortly thereafter, in 2008, BlueFors Cryogenics was founded. *(Bluefors Oy n.d.)*

BlueFors quickly became a market leader in the field of cryogen-free ultra-low temperature systems. Today, the company is known as Bluefors Oy. It has almost 200 employees and its annual revenue is approximately 50 million euros. *(Bluefors Oy n.d.)* As seen below in Figure 2, the company’s growth has been quite rapid over the past few years:



	12/2015	12/2016	12/2017	12/2018	
Revenue (€):	16 881 000	28 255 000	37 136 000	49 129 000	(ATT)
Business result (€):	5 444 000	8 599 000	10 818 000	12 669 000	(ATT)
Duration of accounting period:	12 mo	12 mo	12 mo	12 mo	(ATT)
Number of employees:	31	49	73	110	

Figure 2. Bluefors yearly revenue from 2015 to 2018. *(Taloustiedot Bluefors Oy n.d., modified to English)*

According to Kauppalehti.fi, the revenue and the business result have more than doubled over four years. At the same time, the number of employees has almost quadrupled. *(Taloustiedot Bluefors Oy n.d.)*

3 Packing

The purpose of packing is to protect the products from mechanical, chemical, biological and climatic stress. The package might be dropped, squeezed, it might tremble or become wet during transport, or there might be variation in temperatures, sudden ultraviolet radiation, or, perhaps, a pest attack. If the packing material is chosen correctly, it might prevent the above-mentioned from happening, or at least lessen the damage. The most common packing materials are cardboard, hardboard, plastics, wood and plywood. The usage of the materials depends on, for example, the nature of the packed product, the way of transport, and the kind of stress that the package is probably going to experience during the transport. The package should always be chosen in a way that it protects the item inside, but also so that the possible damage of the item inside can be determined by looking at the condition of the package. *(Pakkausmateriaalit n.d.)*

3.1 History of packing

In a way, the packaging industry has existed just as long as the humankind has. In one way or another, there has always been a way to transport, store and protect a variety of items by packing them in a suitable way. Packing materials and processes have developed together with advancements of technology advancing, as seen in Figure 3 below. *(The history of packaging. N.d.)*

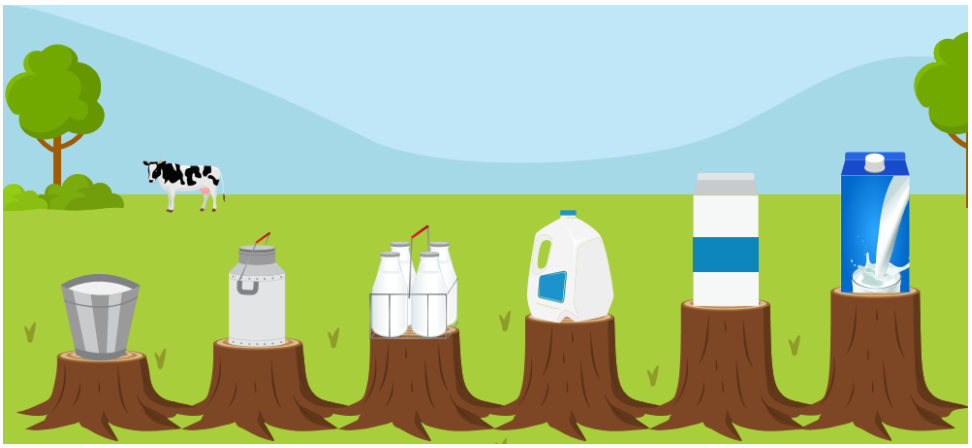


Figure 3. The evolution of packaging materials. (The history of packaging – Part one. The evolution of packing materials n.d.)

3.1.1 Early Packaging

Early humans, the nomadic hunters and gatherers invented different packaging methods. These people were forced to find ways and construct devices for carrying and containing nourishments and apparatuses. It is not certain what the first packaging products were made from, but for example, large leaves, animal skins and wood were possibly at least some of the first raw materials used. *(The history of packaging. N.d.)*

After villages began to increase, the introduction of communities created the need for more extensive storage and transportation systems. Woven sacks and baskets, wooden boxes, shaped clay as well as animal skins were used to produce, transport and store different goods. With these utilities, for example storing food for winter and protecting it from animals became possible. *(The history of packaging. N.d.)*

The establishment of cities was the next major leap in the evolution of packing materials. Cities began trading, which made supplies available to regions that did not yet even know they existed. By the increase of transportation, also the packing materials were forced to develop to still be able to protect the products. During this period, for example, blown glass and barrels were invented. Both items made it possible to store and transport high quantities of liquids and other bulk goods. At the end of this period, after the fall of Rome and before the Industrial Revolution, China started producing paper. That invention became a common material used in the packaging industry for centuries. *(The history of packaging. N.d.)*

3.1.2 Modern packaging

After the Industrial Revolution, products started to be produced by machines instead of by hand. People moved into cities to work and their increased income encouraged producers to develop durable, dependable and efficient packaging methods. Meanwhile, the production quantities increased, which resulted in needs for more storage and transportation bins, bags, food packaging methods, primary packaging materials

and in-store packaging options. The need for individual packing instead of bulk packaging was a new issue. Paper became handy with the development of food, primary and in-store packaging options. *(The history of packaging. N.d.)*

In the early 1900s, plastics were introduced to the packing industry. Cellulose plastic dominated the packing sector for decades, until in the 1960s, polyethylene was developed and it quickly became the preferred packaging material. Different plastics packing products continue to dominate the packing industry nowadays, side to side with, for example, aluminum cans and different kinds of carton containers in the food industry. *(The history of packaging – Part one. The evolution of packing materials n.d.)* Plastics are a great way to extend life and better protect products, but at the same time, the question of environmentally friendly packing materials rises. In the future, the packaging material industry is probably going to move towards more environmentally friendly options, but without giving in on the quality and durability of the packaging products. *(The history of packaging. N.d.)*

Biodegradable and recyclable packing materials

As the packing materials continue to develop, the craving for biodegradable and environmentally friendly options is increasing. Many companies have nowadays green values, and they want to choose the packing materials accordingly. *(Gupta 2019.)* The problem with non-recyclable packing materials is that since they cannot be reused or recycled, they end up left to rot for years in landfills, or even worse, they will never decompose. Moreover, if the amount of that kind of waste keeps on growing, there will eventually be few places left on this planet that would not be completely covered in decomposable trash. Therefore, by seeking biodegradable and recyclable alternatives for packing materials, such as paper and cardboard, cornstarch (for mainly food packages) or biodegradable plastic, we will help the environment, and our future grandchildren as well as ourselves at the same time. *(Pullen n.d.)*

3.2 Different packing materials

3.2.1 Bubble wrap

Bubble wrap is a lightweight low cost adjustable option for securing products all around. It is available in different types and sizes, but as seen in Figure 4 below, Bluefors uses only the 60cm wide which is delivered in a roll and can be cut to length, and which has the smaller kind of bubbles.

Figure 4. Bluefors 60cm wide bubble wrap roll.

The protective quality of bubble wrap is based on hundreds of small air pockets that are encased within layers of polyethylene. The downside of bubble wrap is that it can leave small cell marks on materials such as polished metal, glass or wood. *(Bubble vs Foam 2018.)* Bubble wrap can be made from recycled polythene and manufactured so that it is completely degradable. The greatest problem with the usage of environmentally friendly options of packing materials is not the lack of the articles, but, instead, making major manufacturing companies and their suppliers to use them. These kinds of companies consume great quantities of packing materials, and therefore, they have the biggest impacts on the environment. *(Pullen n.d.)*

3.2.2 Packing foam

Packing foam is also made of polyethylene, or polyurethane, and it offers excellent protection by very lightweight and thin material. *(Know Your Foam: Which Packing Materials are Right for You 2015.)* The foam has tiny air bubbles inside that provide cushioning and give the foam bounce. Foam, unlike bubble wrap, is non-abrasive, so it does not scratch or leave any other marks to any surfaces. Therefore, it is perfectly suitable to be used with polished and shiny items, such as metal, glass or wood. Moreover, foam does not usually build static electricity as bubble wrap does. Foam is available in wraps and blocks. *(Bubble vs Foam 2018.)* Bluefors' logistics department uses both wraps and blocks, in multiple thicknesses and made from polyethylene. Foam wraps can be used to protect delicate items in the same way as with bubble wrap. Foam blocks (see Figure 5 below) can be used for bracing and blocking packages, or they can be carved or cut to shape by hand or with a machine to be able to fit a product with a certain shape inside. The blocks are more solid than the wraps. To some extent, they are like polystyrene, but they are far easier to shape. Foam is a reusable option for packing filling, unless, of course, it is cut to shape or carved inside, because then it usually cannot fit to be reused with another, different kind of shipment. *(Bubble vs Foam 2018.)*

Figure 5. One example of Bluefors' foam blocks (on the left) and a ready hand-carved foam piece in a cardboard box (on the right).

3.2.3 Instapak

Instapak is an effective way of filling a box (or pallet with collars) of any size or shape. It is a secure way of protecting the packed products from vibrations and other kinds of shocks during transport and handling. That makes Instapak most suitable for packing fragile equipment, which Bluefors has many different kinds. Instapak works with two components (A and B), that increase in volume and flow around the product while filling the void space in the container (for example, a cardboard box) when mixed. The best protection from Instapak is achieved when two or more bags are placed around the product. Ready polyurethane foam can be up to 280 times the volume of the original liquids. Instapak "Quick RT", see Figure 6 below, used in Bluefors expands up to 27 times the original size. *(Instapak Quick RT n.d.)*

Figure 6. Packing with Instapak Quick RT. *(Instapak Quick RT n.d.)*

Instapak is a lightweight easy to use option for packing fragile products. The operation is safe and fast, and the storing before use does not require plenty of space compared to the capacity with which the product fills the boxes when used. *(Instapak n.d.)*

3.2.4 Plastic wrap

The most commonly used plastic wrap in logistics is stretch film. Due to its elastic recovery, it is ideal for pallet wrapping and protecting packages. Stretch film is made

from linear low-density polyethylene. By covering pallets with stretch film, both product loss and worker injuries can be reduced. Even though basic stretch film is the most commonly used option, also by Bluefors, many speciality films are also produced for different special needs. There are, for example, UV stretch films, vented pallet wraps, anti-static stretch films and coloured stretch films. Stretch films are nowadays usually recyclable with other soft plastics. *(Stretch Wrap 101. N.d.)* Bluefors uses 450mm and 100mm wide stretch films. The 450mm wide film can be seen in Figure 7 below.

Figure 7. Bluefors' 450mm wide stretch film.

3.2.5 Kraft paper, PadPak & FillPak

Kraft paper is stronger than regular paper, so that it offers more durability and flexibility, and therefore, more protection when used in packaging. It is made by chemically converting wood into wood pulp. This is called the Kraft process. The method separates two parts of wood, lignin and cellulose, from each other, since lignin does not make good paper. This happens by cooking wood chips in so-called "white liquor" made of sodium sulphide and sodium hydroxide. This leaves solid wood pulp and "black liquor" behind. The pulp then needs to be washed from any residual cooking liquors, and it can then be manufactured into paper (see Figure 8).

Figure 8. Kraft paper rolls. *(Voimapaperit n.d.)*

Due to its reduced lignin content and high sulphur ratio, kraft paper is much stronger than regular paper. In addition, it does not involve extensive bleaching, which decreases paper's strength and increases costs in manufacturing. Kraft paper can also be manufactured from all types of wood, even the ones that are left out of the traditional paper making processes, for example, resinous pine and bamboo. *(Pochini 2013.)* Kraft paper is a reusable and a 100% recyclable choice for packing. Kraft paper can also be manufactured from recycled wood pulp instead of the original one, so it can really be seen as an environmentally friendly choice for packaging. *(Top 18 Kraft Paper Properties You Should Know 2019.)* Kraft paper is not purchased as packing material to Bluefors Oy, but the logistics employees recycle the kraft papers from incoming deliveries and use it for the outgoing ones when possible.

PadPak and FillPak

Both of the items are manufactured from kraft paper by a machine, as seen in Figure 9 below.

Figure 9. PadPak machine on the left and FillPak machine on the right. *(PadPak JR n.d.), (FillPak n.d.)*

PadPak is made of two-layer kraft paper that is manufactured into a cushioning pad *(PadPak JR n.d.)*, and FillPak is a conversion from single-ply fanfold kraft paper into a fast and efficient void-filler *(FillPak n.d.)*. PadPak is best suitable for cushioning manually packed fragile products, since it is highly shock absorbent after PadPak-machine converts it by using a patented folding and stitching process into a shape that forms a protective pad when wrapped around the protected product. *(PadPak JR n.d.)* Packages packed using PadPak and FillPak can be seen below in Figure 10.

Figure 10. Packages packed with PadPak (on the left) and FillPak (on the right). *(PadPak JR n.d.), (FillPak n.d.)*

Both PadPak and FillPak machines are easy and fast to use and do not require plenty of space *(PadPak JR n.d.), (FillPak n.d.)*. Since the material used is kraft paper, these are also ecological and cost-effective ways of packing. From these two options, PadPak would probably be more suitable for Bluefors' needs, since it has better shock absorbing capacity and still, less material is needed to provide optimal protection.

3.2.6 Cardboard boxes

The Chinese invented cardboard in 1600s. By using the invention, the English created the first cardboard box in 1817. The box industry kept on developing, until in 1879 an American called Robert Gair came up with a die-cut and scored box that could be stored flat and then easily folded for use. After this development, cardboard boxes began the journey to substituting labour-intensive, space-consuming and heavy

wooden boxes. Nowadays, cardboard boxes are highly appreciated and widely consumed since they are seen as strong, light, inexpensive and recyclable. *(Cardboard box 2005.)* Paper and cardboard products are naturally reusable, recyclable and biodegradable. They can be made into multiple different packaging and container products, as seen in Figure 11 below. *(Pullen n.d.)*

Figure 11. Biodegradable paper packaging materials. *(Gupta 2019.)*

Cardboard boxes can be produced into different sizes with multiple different layer and wave combinations. Cardboard can be printed in colours and every company will be able to have custom designed boxes made according their visual requirements. *(Cardboard and paperboard n.d.)* Bluefors uses white boxes with company logo printed on them for shipping (as seen below in Figure 12) and smaller black boxes for packing small products inside the shipping packages. Bluefors has the big boxes in five different sizes and the small black ones in three different sizes.

Figure 12. Bluefors' cardboard boxes packed and waiting for delivery.

3.2.7 Wooden packing materials

Wood is the oldest packing material that is still in common use. Wood is cheap, strong and easy to work with. Many dry goods can be safely transported in wooden boxes and crates, and wet goods in barrels. In addition, softwood grown in sustainably managed forests is a renewable resource to use. *(Webb 2013.)*

Pallets and collars

Bluefors uses mostly EPAL Euro pallets (size 1200x800 mm) and half-pallets (size 600x800 mm). A half pallet with one collar can be seen in figure 13 below. High quality pallets are safe to use and they ensure smooth transport and stable storage of goods *(EPAL Euro pallet [EPAL1] n.d.)*. Wooden pallet collars protect and secure products placed on pallets during storing and transport. Collars can be stacked by simply slotting them securely on top of each other. The hinges on the corners make sure that the collars stay stacked and, on the other hand, make storing the collars easy when they are not being used. *(Wooden pallet collars n.d.)*

Plywood and OSB

Plywood is a wooden packing material shaved from veneers, and therefore, it is a quite high-cost material, even though it includes knots and splits. That is why many companies prefer using Oriented Strand Board – OSB – instead of plywood when possible. OSB is made of relatively small, specifically layered strands of wood that are bonded together with resin under high heat and pressure. The structure eliminates weak points on the board and gives it excellent impact strength. Construction also holds screws and other fixings securely all over the board. Using a low-carbon recyclable and sustainable material such as OSB is again also an ecological option. *(Webb 2013.)* OSB is also used in Bluefors, as seen in Figure 13 below, but it is not purchased as packing material, but instead the logistics employees reuse the boards from incoming shipments to pack the outgoing ones.

Figure 13. A ready package in Bluefors Oy with a half-pallet, collar and OSB.

3.2.8 Straps

Pallet strapping is the process of bundling products together. Strapping is applied either manually with a hand tool or automatically with a strapping machine. Strap is first fed around the product and then pulled tight. The ends of the strap are then secured by a fastening method and excess material removed. Strapping materials can be found in different strengths, sizes and materials. The most common materials are steel and plastic, with the plastic ones made from either polyester or polypropylene. The material is chosen based on the material of the package and the way of transport. It is important that the material and size of the strap are chosen correctly, so that it will not harm the package and the product, but also so that it will not stretch and bend too much during transport. *(How to Use Different Types of Strapping Material n.d.)* Bluefors uses mainly polyester strapping. It is strong and durable, but not as heavy-duty as steel. It can be used on medium to heavy-duty loads and it keeps both cardboard boxes and wooden ones secured, as can be seen in Figure 14 below. Polyester may bend a bit, but it will not break as easily as polypropylene. *(How to Use Different Types of Strapping Material n.d.)*

Figure 14. Bluefors' pallet and box secured with polyester straps.

3.2.9 Tapes

Packing tape is used to secure cardboard packages. Tapes can be found in different sizes, strengths, materials and colours. *(Teipit, liitospaperit ja merkintä n.d.)* Bluefors uses 50mm wide white PVC-tape with the company logo on it. Tape can be seen below in Figure 15.

Figure 15. Bluefors' packing tape.

3.3 Packing process

According to *Cambridge English dictionary*, the word "process" means "*a series of actions that you take in order to achieve a result*" *(Process n.d.)*. In packing world that would mean a series of packaging actions performed in reasonable order to get to the result in the most productive and profitable way. When improving packaging processes, the most common two goals are to save money through labour costs and material usage, as well as reducing waste and making more environmentally sustainable choices *(Case Study: A simple packaging process improvement saves time, money 2016.)*.

3.3.1 The purpose of packaging and packing process

The purpose of packaging is to protect and preserve goods while handling, transport and storing. These are the main principles while planning a package for new product, even though nowadays the visual desires of sales and marketing teams seem to be just as important as durability and protection. *(Regattieri & Santarelli 2013.)*

The packing process, as in consolidating all items in a sales order into an appropriate container and getting it fully prepared for shipment, is all about speed, efficiency and accuracy. It should be made as simple and repeatable as possible, but without cutting

back on quality. Two most important things in covering the required factors are choosing an appropriately sized box for the items and adding the most suitable and cost-effective packing materials for protection. *(What is order packing? 2018.)*

3.3.2 Four types of packaging

Primary packaging or sales packaging

Primary packaging means the first packaging layer in which the product is contained. Primary packaging is suitable for both the product itself and the possible secondary package. For example, a bottle for the wine or an inner bag in a cereal box, as seen in Figure 16 below. The main purpose of primary packing is to contain and preserve the product. *(Perez n.d.)*

Secondary packaging or group packaging

Secondary packaging is purposed to protect both the product and the primary package during distribution and storage. Secondary package is usually the cardboard carton/box/crate that contains one or more sales unit(s) in primary packaging(s) for easier handling in sales environment. This can be done by grouping the products together when selling them to the retailer. Secondary packaging is mostly used by the beverage, food and cosmetics sectors for displaying primary packs on shelves. Therefore, secondary packaging is sometimes also referred to as display packaging. Secondary packaging example can be found in Figure 16 below. *(Perez n.d.)*

Tertiary packaging or transport packaging

Tertiary packaging might include for example cardboard boxes, wooden pallets and shrink-wrap. This is the type of packaging that is used for transport (and sometimes storing) purposes, but usually removed by retailers before products are displayed for sale. Tertiary packaging is used to prevent physical damage of product's sales unit or secondary packaging, as seen in Figure 16 below. The package usually contains a number of the primary or secondary packages. *(Perez n.d.)*

Unit load

Unit load is the group of consumer or industrial packaging brought together for loading/unloading work (see Figure 16 below). Consumer packaging means the packaging that starts from a commercial sales point and arrives to the retailer as a sales unit. Industrial packaging is used to deliver goods from producer to consumer and sometimes to transfer goods to the next point of production. *(Perez n.d.)*

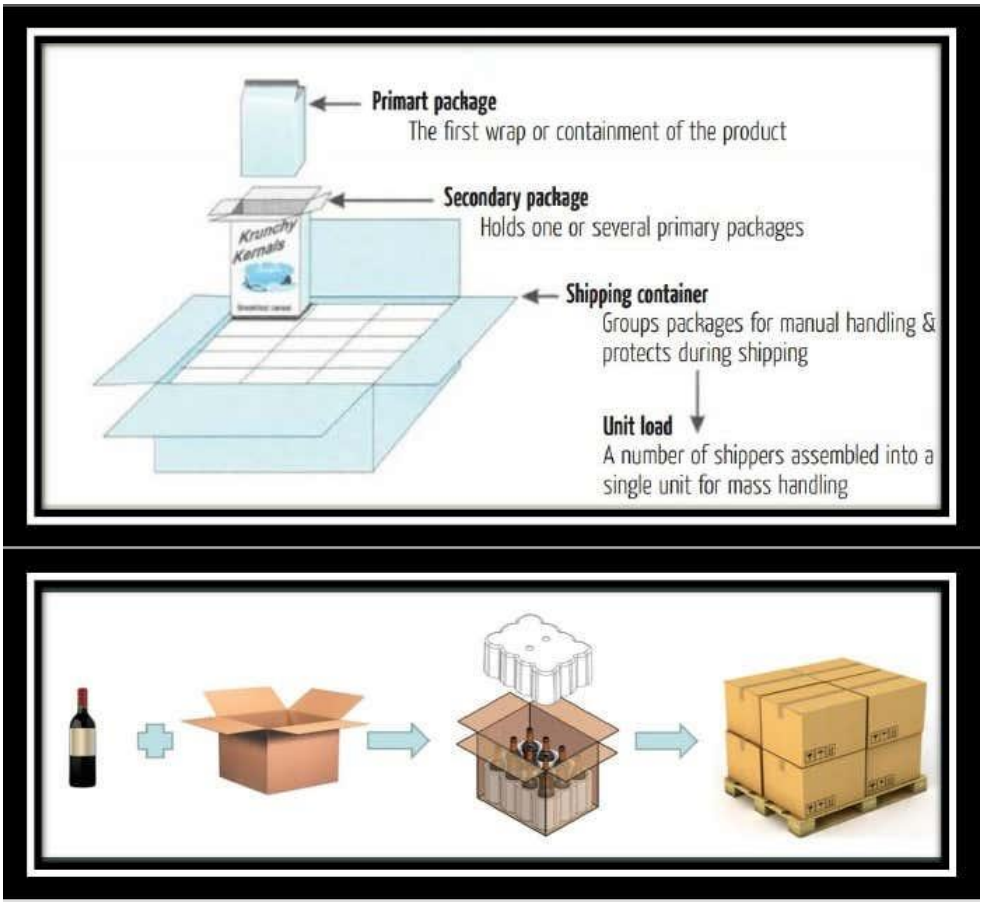


Figure 16. Types of packaging. *(Perez n.d., Figure 2.1.)*

3.3.3 Automation in packaging

When a company faces difficulties in for example speed, quality or costs in packaging, it might be time to consider automation. Automation of the packaging line can save money, cut down material waste, lessen work injuries, enhance secondary or tertiary packaging's presentation and increase efficiency. Packaging machines are

able to speed up the packing while still maintaining high quality and cutting down material waste. A professionally sealed product also looks good in the eyes of a customer. Through automation, this can all be achieved while decreasing the need of employees in packaging, since the machines will be doing all, or at least most, of the work on the packing line. For example, the first machine on the packing line could erect the carton and seal the bottom, and then, after the product is placed inside, another machine could be used to seal the box. The machines can be automated, so that the machine does all the work, or semi-automated, so that the machine does the work but an operator uses it. These kind of machines can erect and seal even dozens of boxes per minute. The need of automation depends on the amount of packaging, the nature of the products and the company's need for process improvement. Sometimes semi-automated line is the best choice, sometimes fully automated, and sometimes there is no need for automation at all. *(Green 2019.)*

4 Standardization

"*To make things of the same type all have the same basic features*". This is how the *Cambridge English dictionary* defines the word "standardizing". *(Standardizing n.d.)*

4.1 The benefits of standardization

The goal of standardization is for a company to give its employees an established, time-tested process to use. Standardization, at its best, decreases ambiguity and guesswork, guarantees quality, boosts productivity and increases employee morale. A standard process eliminates the need for guesswork and extra searching. Because the work is done in an optimized way and each step is pre-defined, the employees do not need to waste time asking around or searching for answers in documentation. Clear standards also make teaching the process to new employees simpler, and after the employees have mastered the process and refined their skills, they can be proud

of themselves and feel good about achieving the goals set for them. This then perfects the company's customer service, since motivated employees handle every task in the best way possible. *(Brandall 2018.)*

4.2 Lean

4.2.1 Principles of Lean

Lean is a method of optimizing the people, resources, effort and energy of an organization to create value for customer. It is based on two main principles: continuous improvement and respect for people. Lean is a growing aspect all over the world. Teams and organizations are using the method to bring more value to their customers sustainably, while building healthier and more resilient environments for their employees. *(Lynn n.d.)*

Continuous improvement

To succeed in one of the two main pillars of Lean, continuous improvement, the organization has to become a learning organization. It has to learn what the customers want and need, and figure out how to eliminate what they do not. The work must be done to continuously improve so that the value of the whole stream is constantly optimized to create more value for the customer. The organization must strive for perfection, and then, through both failures and success, they will improve and eventually achieve their goals. The continuous improvement cycle seen in Figure 17 below is a huge help for organizations in practicing Lean methodology. *(Lynn n.d.)*

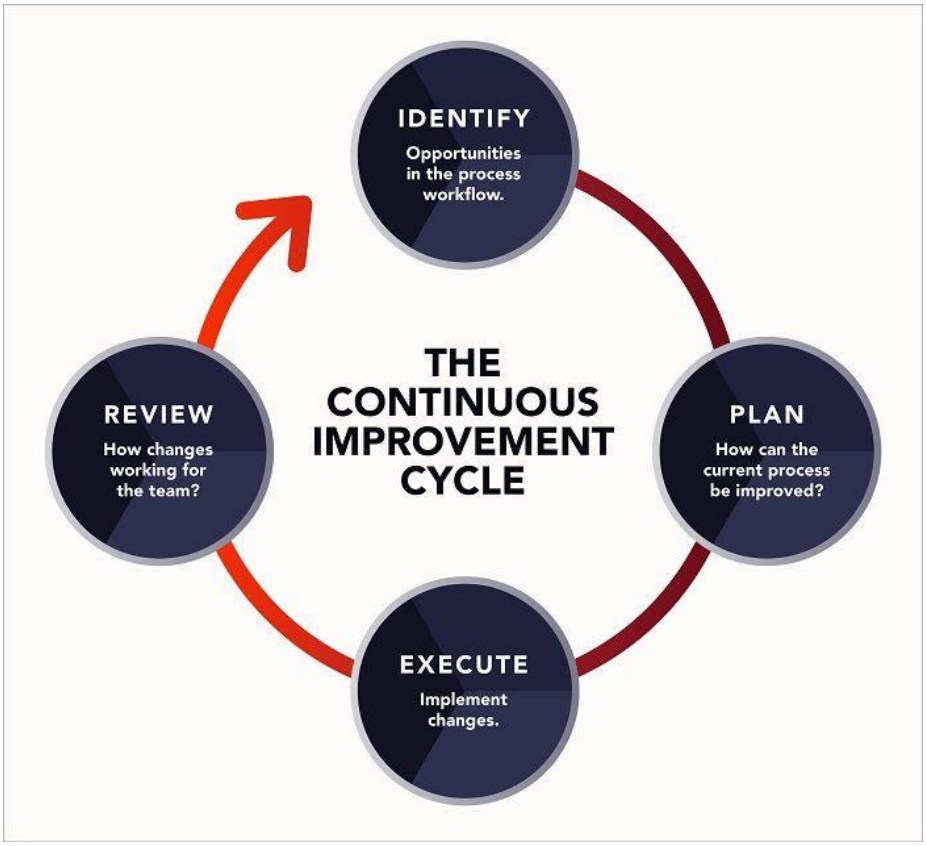


Figure 17. Continuous improvement, one of the two pillars of Lean. *(Lynn n.d.)*

Respect for people

Lean organizations are known for encouraging their employees towards innovation. It is believed that the best ideas come from the people with their hands on the product. Most organizations do not utilize the frontline workers in developing and decisions, but Lean method is based on that. Lean thinking encourages allowing everyone to have an equal voice and ensures that every voice is heard. One of the Lean concepts to perform this is “gemba”, which means going to the place where the work is done to get ideas for improving work and creating value. Behind this is the idea of evolving the role of leadership from command-and-control form into empowering employees with the autonomy to make decisions and to find the purpose behind their work through understanding the value of their efforts. Leaders are not anymore supposed to tell what to do and where and when, but instead to define the goal ahead and trust, that the employees will discover the right route towards it when encouraged to allow their talent to shine. The basic idea of this pillar of Lean method is

to motivate people to do their best work through getting the leaders regularly into the frontline and appreciating each worker equally, regardless of the level they are placed on at the organizational structure. *(Lynn n.d.)*

4.2.2 History behind Lean method

Lean has its roots in the 1950s, post-World-War-2 Japan, where it originated with the Toyota Production System. Since Japanese economy was only beginning to recover, the resources were scarce and could not afford to be wasted. That is when Toyota engineers, with the lead of the currently known father of the Toyota production System, Taichii Ohno, began developing and introducing new methods for increasing productivity, while still maintaining high quality. They eventually created a set of principles that were designed to add value by removing things that do not add value. This was achieved by shifting the thinking from the utilization of just machines, into getting the product to flow seamlessly through the whole process. Nowadays the method is better known as Lean manufacturing and it is utilized in all business industries to help eliminate waste (both physical scrap and hidden waste, for example time), improve processes and boost innovation. It is all about creating a system that provides the right solution for each customer with the optimal use of resources. *(Vasisht 2019.)*

4.2.3 Lean process improvement

Lean techniques help companies achieve the unachievable: delivering the customer what they want and when they want it, while still maintaining low costs, high flexibility, high quality and fast turnaround times. By following Lean's four interrelated concepts - flow, pull, value and perfection – the method can be utilized in improving any process. *(Vasisht 2019.)*

The first thing, flow, is what Lean is all about. By reducing both the physical and hidden waste, an optimal flow of work is created. In manufacturing environment, this

means optimizing the usage of raw materials, machines, people, and therefore, processes. Maximizing flow is all about ensuring that the process is efficient and effective. *(Vasisht 2019.)*

Pull is the other concept in the central of Lean. It is all about flexibility and controlling the speed of the flow. In manufacturing, it means taking actions only after getting the order from the customer, and hence avoiding overproduction, over-ordering and big stocks. *(Vasisht 2019.)*

Value, on the other hand, is kind of the climax of Lean. It is where all the concepts come together and it is always specified by the customer's wants and needs. The value has to be understood in order to adapt the flow and pull accordingly, and to get the best possible result: in manufacturing, to give the customer the product they are willing to pay for. If the flow is smooth and the speed correct, the optimum value will be delivered. *(Vasisht 2019.)*

Lean thinking strives towards perfection. The improvement with processes is never complete, there is always a way to create something even better. By continuously searching for aspects leading to waste of time and resources and poor quality, Lean mindset strives towards creating the perfect process. This is an endless journey of continuous improvement, and when a company realizes that, it is just the start of releasing Lean's true powers. *(Vasisht 2019.)*

4.2.4 6S

Leans concept on zero waste can be executed also in manufacturing areas physically, including a warehouse and its packing area. 6S is a system that has been created to apply systematized Lean mindset also in the working environment. 6S is based on Japanese 5S ideology, with safety as a new element. The six S's are Seiri, Seiton, Seiso, Seiketsu and Shitsuke, or in English Sort, Set in order, Shine, Standardize, Sustain and Safety. These can be seen in Figure 18 below. The 6S system takes a lot of time to implement, but once it is up and running, the decrease of non-value adding

activities, improved floor space utilization and many other utilities will be worth all the time. *(Lean 6S management system 2019.)*

Figure 18. 6S system. *(Lean 6S management system 2019.)*

"Sort" is about recognizing and sorting out the required items and the unused or damaged ones. The damaged ones should be marked with for example red tags or black tape, so that they can be put aside from the required ones for future reuse or dispose. This makes room for the daily used essential items so that they are better available for efficient working. *(Lean 6S management system 2019.)* In packing area, this could mean marking the broken packing materials and tools so that they can later be fixed or thrown away.

"Set in order" is about setting the remaining essential items in easily accessible spots and in the reach of all the employees that need them. *(Lean 6S management system 2019.)* In packing area this could mean getting the most used cardboard boxes and tools placed on the packing table or its immediate proximity by marking own areas for each supply with colored tapes and labels or pictures.

"Shine" is the step towards keeping the working environment clean. For the workers, this means cleaning after themselves and returning the used objects on their marked

places after finishing task or shift. *(Lean 6S management system 2019.)* For example, when a logistics operator has finished packing an order, they put the tapes and pencils and other leftover packing materials used back to the right places. This step goes hand-in-hand with the next step, “safety”.

“Safety” is the newest addition to the former 5S, current 6S system. It was added to ensure the safety of the working environment. The addition was done to make employees more aware of potential hazards and therefore, to be able to perform more comprehensive preventive actions. *(Lean 6S management system 2019.)* In warehouse packing area, this could mean for example having first-aid equipment up-to-date and easily accessible in case of a minor cut accident. Alternatively, having cut-proof gloves when working with knives to prevent minor cuts from happening at all.

“Standardize” is the step that helps make the first four steps a work routine by implementing them into the workplace. This includes the administration identifying ways to increase worker responsibility through establishing improved practices as a standard, and then bringing regular quality assurance checks to practice. The actions help employees adapt the first four steps into their daily routines and avoid the old inefficient ways. *(Lean 6S management system 2019.)* In a packing area, this could mean putting the first four steps to use and then having weekly checks on how the employees follow them.

“Sustain” is the last step on the 6S cycle. Its role is to make sure that all the implementations are continuously conducted as planned. The first five steps will have no effect in process development if the change is not long term. Behind this step is also the idea of continuous development. If the company settles for the first results and does not keep on developing, it can never achieve the greatest results. *(Lean 6S management system 2019.)*

4.2.5 Lean house

The tools used for Lean implementing can be visualized by using a house format. The houses can be quite different in each company, but there is always the foundation of

the house, some pillars on top and then finally, the roof. The foundation needs to be built before the pillars, so the foundation should represent the Lean tools that have to be implemented before the tools that the pillars represent. Each part of the house should have a clear connection to the other ones. *(Panneman 2013.)* For a manufacturing company, for example Bluefors, that wants to standardize the work process to keep producing high quality products by motivated professionals to happy customers, the simplest lean house could look like the one on Figure 19 below.

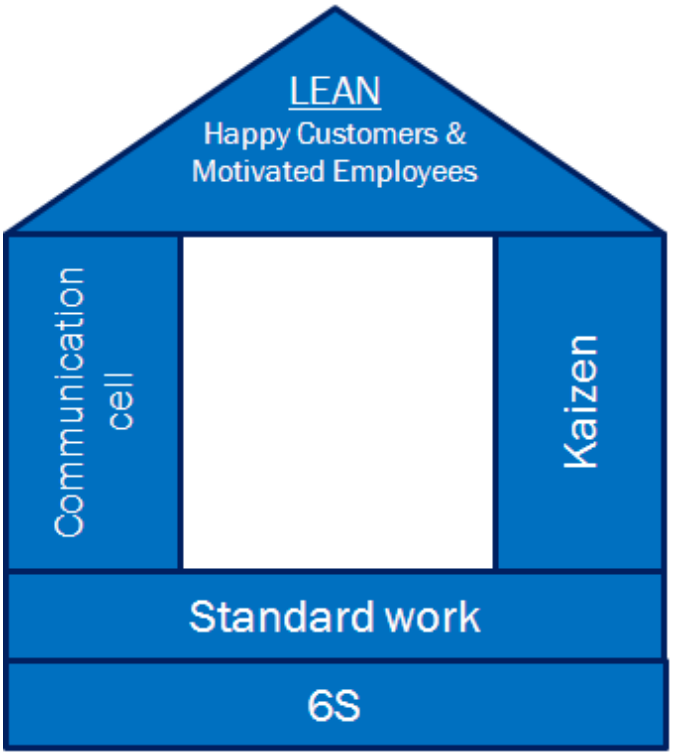


Figure 19. Simple Lean House for manufacturing company. *(Panneman 2013.)*

This house contains only the most important tools that affect all the employees. 6S and standard work are the foundation of the house. 6S is essential because a clean workplace motivates employees and continuous 6S checks help discover potential problems and hazards in advance. The other part of the foundation, standard work, is the key for improvement, training and keeping the required knowledge and skills in the organization rather than just in the minds of individual employees. *(Panneman 2013.)*

Communication and Kaizen are the pillars on top of the foundation. Communication is often said to be the key to success. In this case, communication's role is to help the people, teams and the whole organization to know every important detail in and between each shifts and departments. This is made possible by the tools on the foundation, since all the employees will know how to act in different situations and when and where to report the good and bad happenings in each department. The kaizen pillar is all about continuous improvement, one of the two principles of Lean. Everyone should always seek to find ways for at least small improvements to help gradually improve the big picture. *(Panneman 2013.)*

All the four tools are interrelated. For example, when an improvement ("Kaizen") is done, it will be communicated ("Communication cell") to required parties and will then lead to a change in either working process ("Standard work") or 6S ("6S") policies, and then the enforcement will be followed with, for example, the use of 6S ("6S"). By using the methods in the foundation and pillars, Lean becomes perfectly implemented in the company, resulting in the strong construction of the roof of the Lean House and hence, producing motivated employees and happy customers. Lean House is a way of visualizing this process of using Lean tools in practice. It is a tool to help every employee of the company to understand the methods of Lean used in the company, and to see how they are all connected to one another. *(Panneman 2013.)*

4.3 Reducing costs by standardization

4.3.1 Packaging costs

Packing is the part on the manufacturing that does not bring in any profits, but instead causes significant costs for the company. These costs are inevitable, but the magnitude can be influenced. Personnel costs are the most significant part, and after that, the material costs. There are many ways to find the most cost-effective way of packaging. It can be handled immediately after production, as a separate work task by another function inside the company, or it can be completely outsourced for a third party provider. In manufacturing companies the products' nature, production

volumes, personnel's expertise and sometimes market areas or destination country affect the packing solutions. *(Packaging costs n.d.)*

4.3.2 Standardizing materials

Packing costs can be influenced through choosing packing materials so that they are suitable for the products and comport with each other. As stated in previous chapters, different packing materials have different qualities, and costs are one of the variables. Using recyclable and reusable options may also reduce costs. One way to affect is to use standard sized boxes that can fit the basic module of 600 x 400 mm. All the variables of sizes should also be designed accordingly to avoid waste of space on unit loads, as seen in Figure 20 below. *(EFR Pakkausopas n.d., 4)* Another important thing to consider when choosing the box sizes is to decide whether the smaller boxes need to be able to fit inside the bigger ones to make tertiary packaging possible. Bluefors says to have standardized the box sizes, but still the boxes do not fit conveniently inside each other.

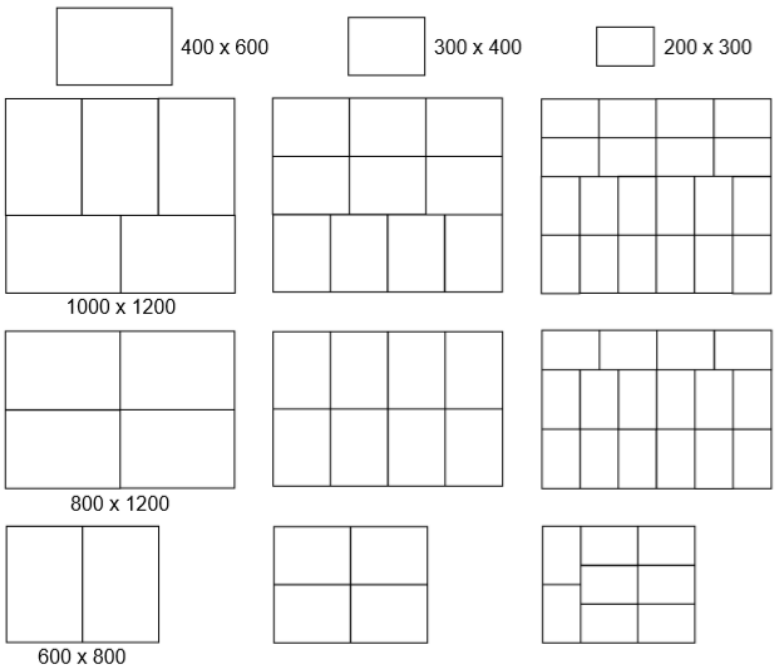


Figure 20. Box sizes according to the basic module of 600 x 400 mm. *(EFR Pakkausopas n.d., 10)*

4.3.3 Single sourcing in purchasing packing materials

One way to reduce costs without compromising on quality is to concentrate on single sourcing instead of using multiple source suppliers for purchasing packaging materials, as Bluefors does. When depending on one single supplier the desired costs, quality, delivery quantities and lead time information is usually achieved in the best possible way, since both the supplier and the manufacturer company have to put in time and effort in creating a relationship that satisfies both parties. *(4 Reasons why Single Sourcing is Still Good Strategy n.d.)*

The manufacturer's efficiency increases, since all the negotiating and paperwork needs to be done only once in the beginning and only minor adjustments need to be made during the contract. The inventory costs will lower since the supplier makes frequent deliveries of small lots. The product quality also becomes a mutual issue instead of the supplier just dispatching the lot and the manufacturer doing all the quality checking. When there is a need for new products, they can be designed together with the supplier's experts to find the most convenient solution for both parties. *(4 Reasons why Single Sourcing is Still Good Strategy n.d.)*

The manufacturer party is not the only one that benefits from single sourcing. The supplier also has to do the negotiating and paperwork mostly only in the beginning of the collaboration. When having better insight for the future desires of the manufacturer-customer, production capacity can be better-utilized and finished goods inventory reduced. Working in close co-operation with the customer makes it easier to produce items that meet the customer's needs and the amount of customer complaints can be minimized. *(4 Reasons why Single Sourcing is Still Good Strategy n.d.)*

5 Research methods

Quantitative methods are best suited for looking at cause and effect, while qualitative methods are better suited for looking at the meaning of particular events or circumstances. However, the difference between the two methods is sometimes quite

difficult to describe. Mixed-methods research is a flexible approach using both quantitative (for example, a questionnaire) and qualitative (for example, case studies) methods. The choice of the research method is based on whether the research is about breadth or depth, or both, and whether it wants to find causality or meaning, or both at the same time. In many cases, mixed-methods research approaches the subject in the most suitable way. *(Introduction to quantitative research 2010, 1-2,8,10.)*

5.1 Quantitative research

The key to all research is explaining phenomena. In quantitative research, that happens by confirming hypotheses about phenomena through numerical data and analysis by using mathematically based methods. This means that the collected data must be in a numerical form. This is the proper research method when the purpose of the research is to determine, for example, the quantity or the percentage of something, or the numerical increase of a happening over time. Several kinds data might not naturally appear in a quantitative form, but they can still be collected in a quantitative way. If the data is available in a numerical form, the research can be conducted quantitatively. This can be achieved by, for example, designing a questionnaire asking to rate a number of statements and giving a number to different answers. *(Introduction to quantitative research 2010, 3-4.)*

5.2 Qualitative research

Qualitative research seeks to explore and understand the researched phenomena by describing variation, individual experiences and group norms, and by explaining relationships. The question formats are more open-ended, and the collected data is in a textual format (for example, field notes) instead of being numerical. The aspects of the study are flexible, and the data collection and research questions are continuously adjusted according to new information. *(Module 1 - Qualitative Research Methods Overview n.d., 3.)*

6 Case study Bluefors Oy

A case study was chosen for the thesis because it was considered to be the best for investigating a phenomenon within its real-life context *(Definition of Case Study 2018.)*. The study included qualitative methods, such as observations in the working environment (including orientation and timing study), an open-ended questionnaire for the marketing department and theme interviews with individual logistics employees, to find the most significant problems in the current process and practical solutions for them. Theme interviews were chosen as an interview method with the logistics personnel since they were a way of letting the employees tell about the situation in their own words as widely as possible, but within limits defined in advance. In a theme interview, the questions are also adjustable based on the previous answers, and many additional questions can be asked instantly when necessary. *(Puustinen 2013, 5.)* The marketing department was asked to comment on the visual requirements of Bluefors packaging. They received a questionnaire by email, and they answered via email.

A case study is about constantly alternating between theory and practice *(Puustinen 2013, 5.)*. The current situation and processes werebest explained by using many pictures, and the results were based on researched theory, observations, interviews and questionnaires. The theoretical material was mainly taken from reliable online sources, and the names of the authors, publications and publishers were mentioned when possible. The research methods used were effective in gaining the kind of data required.

6.1 Preparing and implementation of the research

The purpose of the thesis was to find ways to improve the packing process by making the packing faster and, at the same time, more cost-effective through standardizing the packing materials. The study was implemented by using interviews with the Bluefors logistics personnel, as well as by using observation and actually getting new

worker's orientation to current packing practices. The first interviews, or rather conversations, were with the logistics managers to determine what the claims and baseline for the thesis work were. The topic needed to be precise in order to contribute to the logistics department's needs while still being extensive enough for considering several different options before moving to conclusions. Based on this, the subject was decided and the research questions created. There were no strict structures; rather the planning and implementation were completely left for the author's discretion. There were a few informal conversations about the advancement of the work with the workplace mentor during the working process. These conversations were, however, not documented.

The logistics staff was interviewed a few times during the research process. First, the first interview question was asked from all the interviewees, and only after getting the answers, the second question was asked from everyone. The interviews happened while working as a logistics operator at Bluefors' warehouse, and three of the colleagues took part in them. The summary of the notes from the interviews can be seen in Appendix 1. Two interview questions guided the logistics employees to give information about the right subjects during the theme interview:

1) How does the packing happen now and why should the policies be changed?
2) How should the packing process be improved?

Bluefors' marketing department was asked to comment the visual requirements of the company's packaging. The original questionnaire can be seen in Finnish in Appendix 2. Marketing department received five questions via email:

1) Why has Bluefors chosen to use the current packing materials (for example white cardboard boxes, foam, bubble wrap)?
2) Why doesn't the company use kraft paper or some other more environmentally friendly material?
3) What are the marketing department's visual requirements for packaging?
4) Has the company ever considered single sourcing the purchasing of packing materials (from for example PakkausÖhman) instead of purchasing them from multiple different suppliers?

5) Is there anything else you want to mention about packing materials or packaging in general in Bluefors Oy?

The research process then began in practice with the observations and orientation in the working environment. Observations included a timing research about the time used in different functions of packaging in current process versus an improved process, and then later an analysis was made about the amount of time wasted in the current process. The original record of the timing analysis can be seen in Appendix 3. Documents about the current packing processes and instructions were asked from the company, but not obtained. Apparently, the current process did not even exist, and the logistics operators tried to manage and use their own creativity in packaging.

6.2 Data collection

The data collection about the current situation and its challenges was conducted by using observation and interviews with the logistics operators, a questionnaire to the marketing department, as well as by multiple different online sources with theory about essential subjects. The first interview question was about how the packing happened currently and why the policies should be changed. The interviews gave the same kinds of answers as the observations. After learning to know the problems better, it was time to ask what the colleagues thought about how the packing process should be improved. The answers were again aligned with the observations regarding the matter. Notes were taken from the interviews in the form of text, and a summary was created of the most important facts.

The questionnaire included five questions about the current packing materials, and it was both sent to the marketing team and then later answered by email. Observation happened during three months of the spring 2020. Based on the answers and observations, the theoretical research topics were decided and the theoretical research began. Finally, conclusions and suggestions for the future were made based on the information obtained from the interviews, questionnaire, observations and theoretical research. The data inventory table (Table 1) can be seen below.

Table 1. Data inventory.

Data type	Quantity	Original data source	Original intended data audience
Interviews	4	Informants – logistics employees	Researcher – analysis in this study
Observation (including orientation and timing study)	Three months (spring 2020)	Author in practice, trainer	Learning to know the process through new employee's orientation
Questionnaire	1	Marketing department employees	Author – analysis in this study
Theory about essential subjects	multiple	Multiple online sources	The readers of the blog/websites/articles

7 Results

The main goal of the thesis was to develop the flow of packing in Bluefors Oy by standardizing the packing materials and clarifying the packing process. The goal was to determine if the packing process worked as desired, the kind of packing materials that best suited for the company's needs and how the packing process could be optimized. The aim was to develop the packing policies in the company so that the packing would become faster and easier to do, and, at the same time, more cost-effective.

7.1 Current situation and relevant problems

The current situation and relevant problems were surveyed by using interviews, a questionnaire and observations including new workers orientation and a timing study.

7.1.1 Staff surveys

Logistics interviews

The interview questions guided the interviewees to list the facts that made the packing work difficult and to tell their own ideas about what should be improved. A summary of the notes from the interviews can be seen in Appendix 2. All the interviewees had the same kinds of ideas about the problems and, therefore, improvements about the company's packing process. The interview results were in line with the observations. All the interviewees thought that there should be proper instructions for packing. The packing should not happen in different ways by different employees, but instead there should be clear guidelines on how to pack different items, and which packing materials to use and when.

Another problem that the interviewed logistics operators stated was that the packing materials should be easier to handle to make the packaging faster and simpler. Currently, the excessive use of foam blocks took a great deal of time from the packer. The cutting and carving were considered hard, difficult and time-consuming, and the outcome was usually not even pretty (as seen in Figure 5 on page 14 in Chapter 3). This did not seem like a way to make the package look clean and presentable, which one of the interviewees stated to be the only instruction for packing ever gotten from the company.

In addition, one of the interviewees stated that the cardboard boxes could be more conveniently sized. For example, a couple pieces of the smaller boxes should be able to fit perfectly together in one bigger one to make tertiary packaging possible and suitable. The second biggest box could not currently fit two small boxes in properly,

so when an order had multiple small boxes, they needed to be packed either separately, or all in one, way too big box. The smallest boxes then did not fill the biggest box in the most optimal way, which left plenty of empty space to be filled with some kind of packing material. The interviewee also told that the sizes of similar boxes might vary a bit depending on the batch delivered, so the boxes were never homogenous.

Marketing department questionnaire

Marketing department did not have an answer to all of the questions. They told that the cardboard boxes were chosen, as they are, to fit the company's brand. The logistics leaders chose other packing materials and some of the manufacturing departments had their own requirements, which were not told in the answers of the questionnaire. The environmentally friendly options have not been considered before, but marketing department seemed to have nothing against considering them as an option as long as the quality, price and visual appearance of the packages would not suffer from it. The visual requirements were not commented any more precisely, at least not in the way that was meant in the question about the matter. The marketing department saw single sourcing as a reasonable idea. Packing materials have been ordered from multiple different suppliers before, because there has not been one supplier that could have provided all the materials the company needs. It did not become clear how much different companies had been compared before. In addition, marketing department did also agree that packing process should be created, if one does not already exist.

7.1.2 Observations during orientation

The observations took place in Bluefors' warehouse during packaging orientation in spring 2020.

Packing area

The current packing area is quite narrow, and there was not much room for working, or storing the important packing materials near the place where they were needed (see Figure 21 below). Different packing materials were currently sprinkled around the warehouse to wherever some room for them was found. Only one logistics operator contributed the packaging every day, since the amount of shipments was currently low. The packing area is not functional as it is, and it could use some upgrading and reorganizing.

Figure 21. Bluefors' current packing area. Packing table on the right.

Packing with foam blocks

Figures 22-29 below show the phases of packing a power supply on a half-pallet by using foam blocks. The item needs to be protected from shocks and jittering during transportation. First, the pallet needed to be measured inside the collar. Then the measurements were drawn on the foam so that the correct sized bottom foam could be cut from the 30mm thick foam block (see Figures 22-25). Measuring and cutting the foam was hard and slow, especially since the foam block was so huge that it did not fit on the table and had to be measured and cut on the trash can instead.

Figure 22. The foam blocks used for packing a power supply.

Figure 23. Measuring the inside of the pallet and then the foam.

Figure 24. Drawing the measurements of the pallet's bottom and then cutting the piece.

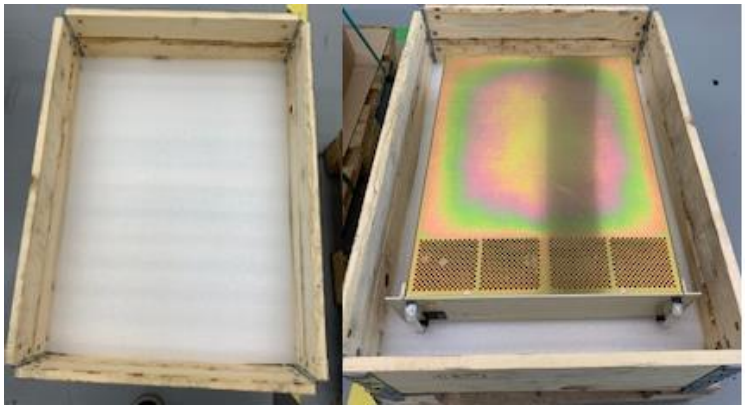


Figure 25. Ready foam on the bottom of the pallet and the power supply on it.

After the bottom piece was ready and the power supply was placed on the pallet (Figure 25 above), the void inside the collar needed to be filled. This was done by placing around pieces of 50mm and 30mm thick foam blocks, as seen in Figures 26-29 below. All the salients, for example the handles in Figure 25 (on the right) above, needed to be taken into account (see Figure 27).

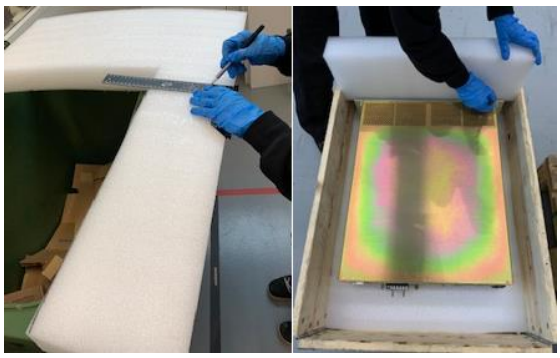


Figure 26. Measuring and marking the foam blocks to cut proper sized pieces to fill the void.

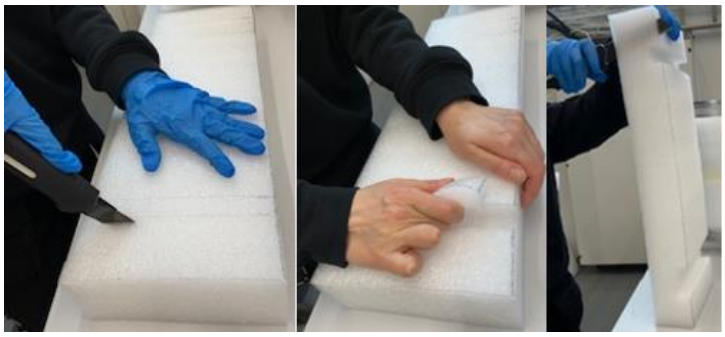


Figure 27. Carving the tracks for the handles of the power supply.

Part of the pallet was then filled with foam, as seen in Figure 28 below. The next step was to fill the rest of the pallet accordingly and then secure the top with foam. This can be seen in Figure 29 below.

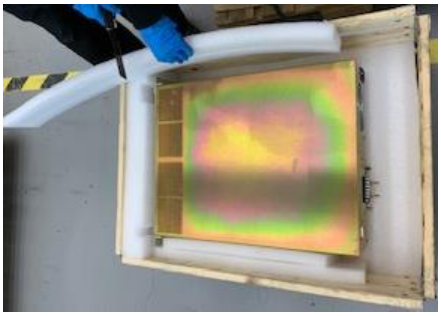


Figure 28. Measuring and cutting the next void filling parts.

Figure 29. Power supply secured with foam. The pallet without the top foam on the left and the complete package with the top foam on the right.

The power supply was now safely packed and the pallet could be sealed. The picture of the sealed pallet ready to be shipped can be seen in Figure 14 on page 21 in Chapter 3. As seen in the Figures 22-29 above, the foam blocks are quite arduous to use in packaging a pallet. The product inside is certainly well secured, but the packing took lots of time and creativity from the packer.

Packing with Instapak

Instapak packing, seen in Figures 30-33 below, seemed to be more suitable for the company's need for a flexible and adaptable packing material. Again, the bottom of the pallet needed to be covered with foam (see Figure 30 below) for support and protection. The foam was measured and cut to proper pieces as in the foam-packing example above.

Figure 30. Covering the bottom of the pallet with foam.

After covering the bottom, the next step was to place the items on the pallet so that the pallet became as balanced as possible and that there was room for the Instapak packages between the pallet collars and the items (see Figure 31 below). The Instapak bags were used to block the movement of the items during transport.

Figure 31. Items placed on the pallet (on the left) and activating the Instapak (on the right).

Instapak Quick RT used in Bluefors needs to be activated by pressing the bag on the right spot (see Figure 31 above) and getting the two components to mix and, therefore, expand. After the components have mixed, the bag immediately starts to balloon and needs to be rapidly placed on the right spot to get the wanted form for protection (see Figure 32 below). Finally, after using multiple bags of Instapak, the pallet was secured as below in Figure 33 and was now ready to be shipped.

Figure 32. Packing with Instapak. Work on process on the left and ready package on the right.

Figure 33. Pallet packed with Instapak ready to be shipped.

Instapak seemed to be a more flexible and adaptable method for packing than the foam blocks, but since there are no current packing instructions, no one actually knows what kind of packages, and in which situations, require the use of foam and which ones the use of Instapak. Again, packers just try to be creative and “do as they think is best”.

Packing with kraft paper

As stated in previous chapters, kraft paper is not a material purchased for packaging in Bluefors, but the logistics operators recycle the clean papers from incoming deliveries to be used again. The stash of craft paper under the packing table can be seen in Figure 34 below.

Figure 34. Stash of kraft paper under packing table.

Kraft paper is perfect for filling empty space in cardboard boxes, as well as surprisingly shock absorbent when produced into PadPak. Bluefors logistics employees have a habit of using the material to fill the empty spaces in cardboard boxes when possible. They see no need to “waste” the foam (and the time it takes to carve the foam) or bubble wrap for filling the big voids in light packages, so the reused kraft paper is an optimal choice for that use.

Tertiary packaging

Bluefors does currently have standard sized boxes, but the problem is that they cannot fit properly inside each other to make tertiary packaging possible (see Figures 35-37 below). The smallest box on the figures is about 32x22.5x14 cm, the middle-sized one is about 45x32x24 cm and the biggest one is about 61x42x52 cm. One small box inside a middle-sized one inside a bigger one can be seen below in Figure 35. The boxes are manufactured so that the height of the boxes can be adjusted if needed by cutting the corners.

Figure 35. The smallest box inside the middle-sized one inside the bigger one.

Figure 36 below shows that the smallest boxes do not fit properly next to each other or on top of each other inside the middle-sized box. If the middle-sized box was a bit bigger, it could easily fit four pieces of the smallest boxes inside to make tertiary packaging possible.

Figure 36. Two pieces of the smallest boxes do not fit properly next to, or on top of each other inside the middle-sized one.

The biggest box also cannot fit two pieces of the middle-sized boxes inside (see Figure 37 below). This makes tertiary packaging quite hard for the logistics operators, since they always have to choose a box that is excessively big for the smaller ones. This then leaves lots of empty space inside the bigger box, which of course then must be filled with lots of such packing material as kraft paper, bubble wrap or foam pieces.

Figure 37. Trying to fit the middle-sized box inside the bigger one in a way that the bigger one could fit two middle-sized ones inside it.

7.1.3 Timing study

After the observations, the need for a timing analysis about the current process versus the improved process became an essential part of the research to concretize the ideas behind the improvements. The original record of the timing analysis can be seen in appendix 3. The test subject was a logistics operator with the most experience in packaging in the company. The test subject did not hurry or linger, the timing was done in her average working pace. The study was executed with the most frequently used sized cardboard box (according to the packer), which was filled with foam in the most typical way (again, according to the packer): two pieces of 30mm thick foam (top and bottom) and one piece of 50mm thick foam (in the middle). The thicker foam would have been the one where the packed item had been carved into, but the carving was not done in this study since it was not relevant, because the examined aspects were about how much implementing 6S and ordering foams in ready-cut pieces could speed up the process. In the future, if the company wants to keep on developing the packing process, there could be another study made about finding out the items that are sent out most, and then timing how long does it take to carve the foams for them. Then some conclusions could be made about whether the foam pieces for certain products should be bought as already-carved-to-shape or not.

The timing study began with timing the packer's current way of packing. The packing included fetching the materials needed (cardboard box and couple foam blocks), sealing the bottom of the box, and then measuring the box and marking and cutting the foam to right sized pieces. After that, the foam pieces needed to be fitted into the box, and then the box's corners were cut and the box was sealed with tape. The time used for the packing process in total was 378 seconds, or 6.3 minutes.

After getting the time of the current packing "process", it was time to implement the changes and time the packing process again. The first planned development was to organize the area following 6S, so that all the most used materials would be near the packing station. Currently the boxes and foams need to fetched from quite far, so this time the timing was executed as in if they were now stored near the packing

area. Fetching the materials (box and foams) happened 52 seconds faster than with the current process. Tape was already located on the packing table, so taping the bottom of the box took the same time as before. Measuring the box, drawing the lines and cutting the foam no longer needed to be done, since the foams would have been already ordered in box-sized pieces, so the time saved in this step was 230 seconds, or about 3.83 minutes. Next step was to put the foam pieces inside the box. In this case the time for that was about the same as before, but the packer pointed out, that sometimes the self-cut foam pieces are wrongly sized at the first try, so after fitting they need to be modified a bit and then fitted again, which would naturally again increase the time used in the current process. Finally, the box's corners were cut to get it tightly closed and the box was sealed with tape. These steps took the same time as before. The total time used for packing with this improved system was 94 seconds, as in 1.57 minutes. Summary of the timing record can be seen below in Table 2. The time decrease in packing a single box using foam blocks was 284 seconds after improvements, so by implementing the proposed changes the packing time can be decreased even 75%. Therefore, the proposed changes would definitely speed up the process, and through that, bring savings to the company.

Table 2. Summary of the timing record

	Current system (s)	Improved system (s)	Time decrease after improvements (=improved minus current system) (s)
Fetching the materials	65	13	-52
Taping the bottom of the box	20	20	0
Measuring, drawing and cutting	230	0	-230
Fitting/putting the foams inside the box	10	8	-2
Cutting the corners of the box	18	18	0
Closing the box and sealing it with tape	35	35	0
Total time (s):	**378**	**94**	**-284**
Time saved (%):			**75 %**

7.2 Summary of results

Table 3 below summarises the problems, causes and solutions that came up during the research.

Table 3. Summary of the results of case study Bluefors Oy.

Problem	**Cause (1) and Solution (2)**
Lack of instructions in packing	1. There is no current process for packing and, therefore, no instructions either. Every operator packs the items just based on the only instruction gotten: “do as you think is best”. 2. Packing process and instructions need to be created to clarify the packing work and keep the quality of packaging up while reducing both the physical and hidden waste.
Packing materials are often difficult and time-consuming to use (for example foam blocks)	1. The materials are not purchased based on how they fit together with boxes or how easy and fast they are to use. The biggest factor in choosing the packing materials has so far been the visual appearance, not the practicality and suitability. 2. Packing materials should be updated to make the packaging easier, faster and more cost-effective. Maybe the foam blocks consumption should be reduced and instead, for example the usage of kraft paper products increased. Alternatively, maybe the foam blocks should be bought as ready-cut pieces to fit straight into the different sized boxes to save time and money.
Tertiary packaging is challenging	1. The current boxes are chosen based on the fact that they can fit some designated item(s) inside, but not so that multiple smaller ones could fit conveniently inside the bigger one to make tertiary packaging possible when sending extra items to sales orders. 2. All cardboard boxes’ sizes should be updated to make them more conveniently sized and suitable to be used as efficiently as possible.
Current packing area is not the most optimal place for working	1. The area is narrow and unable to fit all the required tools and materials near the table where the packaging is performed. The materials currently need to be fetched from all

	around the warehouse and the current area is usually too small to work fluently. 2. Packing area should be relocated, reorganized, and 6S implemented to reduce hidden waste in packaging.

8 Conclusions

Because of the rapid growth of the company, the processes clearly have not been able to keep up with the pace. The instructions for packing are nonexistent, and the logistics operators clearly have no communal rules about how the items should be packed, and which packing materials should be used and when. The packing also seems to take a lot more time than it would, if a few crucial improvements were made with the help of optimization and standardization. The observations and results gotten match with the company's wishes about the research. The logistics leaders wished that the most common and time-consuming problems could be found and eliminated, and the research found the ways.

8.1 Relevant issues and development suggestions

8.1.1 What is desired packing process for Bluefors?

The biggest problems and most time-consuming factors became clear quite quickly in the beginning of the interviews and observations. Constructing the inside of the package with the foam blocks seemed to be the hardest and most time-consuming part of the packing. This produced also lots of scrap when excess material became so oddly sized that it could not be utilized anymore. The usage of packing materials needs to be optimized to speed up the process.

The need for automation in packaging was also considered, but since the products of the company are so high mix – low volume, and the quantity of orders is still going to be quite low for a while before the company grows even more, there emerged no

need to implement any kind of automation in packaging. If some kind of machine to help packaging should be purchased, it would be just a simple PadPak machine (see figure 9) for producing void-filling packing pads out of kraft paper. One operator can currently handle all the packaging work, and when the process is improved and all the excessive waste eliminated, the packaging work will not take even one full working day's work from a single operator in the company's current situation.

The lack of instructions was another big problem. This became clear very early in the orientation. When the trainer asked a shipment to be packed, but could not give any instructions or even tips on how to, the task seemed quite impossible to be accomplished properly. There was no way to know which packing materials should be chosen and how well the part should have been protected. If the only advice for the new worker is to "do what you think is best", the results can indeed be anything between heaven and earth.

8.1.2 What kind of packing materials would suit best for the company's needs?

According to the insight of different packing materials in chapter 3.2, Bluefors could consider updating the materials used to decrease the amount of wasted time and money in packaging. Since the products sent are usually easily scuffed, and therefore, have to be packed accordingly, maybe the company should focus on using foam wraps and kraft paper products instead of bubble wrap *(Bubble vs Foam 2018)*. If the usage of foam blocks continues in an as excessive way as before, the foam blocks should be purchased in ready-cut box-fitting pieces instead of big sheets to save time in packaging.

In addition, in case of the usage of kraft paper increasing, the company could consider purchasing a PadPak machine (seen in figure 9) to be able to create cost-effective and recyclable cushion pads out of paper. These would fit perfectly to fill the empty space while providing protection in cardboard boxes. Using a recyclable and reusable packing material such as kraft paper could also make Bluefors to be seen as an environmentally friendly company. This is a growing trend nowadays among many

other manufacturing companies, so this would be a great first step for the company to gain more value and respect in the eyes of current and future customers.

8.1.3 What kind of methods can be used for optimizing packing process?

A packing process and instructions for packing in general should be created. It would decrease the time used and time wasted if every packer knew which materials to use for packing and when. The instructions would be universally applicable and no one would anymore have to “do as they think is best”. In addition, the methods below could maximize the productivity in packaging and make it more cost-effective.

Standardizing packing materials

As stated above, the current process of packaging is hard and slow, when it actually should be fast and easy. Since Bluefors uses big amounts of foam blocks, one way of speeding up the use of them would be to order the blocks in ready-cut different sizes, so that they would fit straight into the different-sized cardboard boxes and wooden pallets. Not having to cut each piece used for boxes or pallets out of a big (1m x 1m) foam plate would significantly reduce the time used for packing with foam blocks. According to the timing study made, the packing time when using foam blocks could be decreased even 75% with the help of this factor.

In addition, the size of the bigger cardboard boxes could be re-designed. In one of the interviews, it became clear that the logistics operators could not properly utilize tertiary packaging when packing the orders since the multiple smaller boxes did not fit conveniently inside the next-sized bigger ones, and the biggest box was excessively big for the smallest ones. Choosing the right packing materials in most suitable sizes and most adequate features would reduce the costs in transportation and decrease the possibility of transportation injuries, and hence, result in decreasing the need of replacement deliveries.

Single sourcing

Bluefors currently purchases the packing materials used in the company from at least six different suppliers. Maybe the costs could be reduced and standardizing made possible by ordering the packing materials from only one single supplier. Perhaps making a deal with a supplier such as PakkausÖhman and considering the option of shelving service could provide a lot more value to the company than the current six suppliers put together ever could. The supplier could also handle the stock balances and deliver just the correct amounts when needed, especially if a contract about a shelving service would also be made. PakkausÖhman could provide all the same products that the company is using nowadays *(Tuotteet n.d.)*, and perhaps a more cost-effective and valuable deal could be made due to single sourcing. In addition, the current handling of six different suppliers worth of purchase orders, invoices etc. could be reduced to handling all the orders, invoices etc. of packing materials with only one single supplier. This would save time in the office, since the total amount of different documents, paper work and supplier contacting would decrease.

Lean implementation and 6S of packing area

A Lean way of working could be implemented into the working in the warehouse and, therefore, also into the packaging. The two pillars of Lean, continuous improvement and respect for people, are exactly what a growing company, as Bluefors, needs. By maximizing “flow”, both physical and hidden waste could be minimized, and through “pull”, the packing process can be designed to meet the requirements and adjust the “flow”. Through process optimization and respecting people generates value, which then leads to perfection in business, as in satisfied and happy customers. In the company’s logistics department, this could all be done with the help of implementing proper 6S to the packing area. The current packing area is tight and the packing materials and tools unorganized. The steps of 6S could help with that, resulting in the flow to improve as well. According to the timing study, implementing 6S and re-organizing materials near the packing area would help with decreasing the packing time even by 75%. The company could also create its own Lean House to visualize the most important aspects of Lean for them.

8.2 Summary of conclusions

Table 4 below summarises the conclusions made based on the results gotten.

Table 4. Summary of the conclusions of case study Bluefors Oy.

Research topic	Conclusions
Desired packing process	1. Lots of waste is produced in current packing "process", so usage of materials needs to be optimized. 2. Instructions for packing need to be created to create a process and simplify the packing work.
Most suitable packing materials	1. Materials used could be updated to ones that do not create so much physical and hidden waste in packaging. 2. Environmentally friendly options could be considered to improve the company's image.
Methods for optimizing packing process	1. Cardboard boxes could be re-designed and, therefore, all the packing materials standardized to make them easier and faster to use, and to reduce packaging costs in a long run. 2. Focusing the purchasing of packing materials to one single supplier instead of six different ones could provide a more cost-effective deal and make optimizing packing materials possible. 3. Implementing Lean and 6S for packing area could improve the flow of packing by reducing waste.

9 Discussion

The main target of the research was to develop the flow of packing by standardizing packing materials. The most important thing was to get the understanding of how the current process works and what were the biggest problems in it. The research did not include systems packaging. Having interviews, a questionnaire and observation

of the working were all the most crucial factors to get the results to meet the needs of the research. The outcome is supposed to help Bluefors Oy develop the packing work. The first presumption was that the usage of foam blocks should be made faster and simpler. As the research advanced, the excessive usage of foam blocks in packaging became a questionable way of packing the company's products and instead, the research drifted into "thinking outside the box" and searching alternative, more suitable choices for materials too instead of just trying to improve only one way of packaging.

9.1 Relevance, validity and reliability

The relevance of the interviews and questionnaire depends on whether the right questions were asked to get the most out of the answers. Since the purpose of the research was to develop the flow of packing, the questions about the current situation and the challenges in it, as well as the suggestions about ways of development, were completely relevant.

The validity of the interviews depends on whether the right persons were interviewed and about how motivated they were to give truthful answers *(Puustinen 2013, 8.)*. Both the participants of the interviews and the questionnaire were chosen so that they would best represent the people in the company daily facing the subjects in the questions. The interviewees and targets of observations were all logistics employees who actually work in the frontline with the current packing process and who will benefit the most on the development of it. Therefore, it can be presumed that the interviewees gave the most helpful and truthful answers they could to help make their own work flow more seamlessly in the future. The questionnaire, on the other hand, did not give exactly the answers needed. The marketing department was not the right department to answer all of the questions, so they did not have the answers to everything.

The interviews, though, are never completely reliable, because the answers gotten depend fully on how the questions were asked and what was the state of mind of the

interviewee during the interview. Same thing with the questionnaire. However, the theme interviews usually give the researcher lots of real-life examples and those usually become the most valuable material for describing the current situation and finding solutions and ways to develop *(Puustinen 2013, 5.)*. This is what happened also in this research. The interviewees gave many real-life examples about packing and its challenges. Therefore, the research could not have gotten any better answers out of the employees than it already now did. The questionnaire also had good questions to find out the needed information, but the questionnaire as a method was not as good as the theme interviews, since it was not as flexible and natural.

9.2 Research implementation and results

The observation period was long enough to dig deep into the upcoming problems. During new worker's orientation, the challenges of the packaging became clear and the development suggestions began to evolve. The questionnaire for marketing department would have been more suitable to do rather as a theme interview to get the answers through conversation about the definite subjects, but the growing corona situation at the spring of 2020, and therefore remote working as well as social distancing due to it, led to the questionnaire via email being a more suitable option. The corona situation also affected the researching of different suitable theories, since the libraries were closed and online sources were the only ones available. In addition, the overall quantity of orders in question in the company was lower than usual during the corona-spring. The upside of that was that there was enough time for the proper orientation, but the downside was that maybe the observation time did not include all of the most typical and time-consuming packaging occasions. At the end though, the research got most of the needed information despite the questionnaire, and the online sources provided limitless information about needed subjects. The upside of the whole corona situation was that since most of the world stopped for a while; there was lots of time, energy and other resources to be used for doing the research as thoroughly as possible.

This kind of research requires lots of the front line information to be successful in developing the working process in the future. Overall, the interviews provided the needed information. The targets of the interviews were chosen because they were the company's best professionals according to the subjects in question. They were the best possible choice for providing insiders' knowledge about the matters on hand, so the information provided can be trusted to be valid. The observations also gave the research even more of that inside knowledge needed and hands-on experiences of the challenges in packaging. The timing study then concretized the conclusions made based on the theories, interviews and observations.

The questionnaire, on the other hand, did not quite provide all the needed information. The answers took very long time to get and the marketing department needed to be reminded multiple times to reply to the questionnaire. When the answers were finally gotten, it became immediately clear that the questions should have also been asked in the form of a theme interview. Maybe then, the answers could have been more precise and provided more needed information. In an interview situation both the interviewer and the interviewees could have asked more particularized questions during the interview, instead of having to wonder what this and that question or answer actually meant. In addition, the marketing department was not the right department to answer to the question about purchasing the packing materials from multiple different suppliers. That question should have been asked from purchasing or sourcing department instead.

Based on the staff surveys, observations and theoretical research, the results and conclusions of the research were focused on two aspects: standardizing and optimizing packing materials, and creating a working process with the help of Lean methods. With these methods, the packaging becomes faster and easier for the operators, as well as more cost-effective for the company. Optimizing packing materials makes them more suitable to use for the company's products, and creating a process for packing also implements clear instructions for the operators so that all of them will do the packaging work in the same way. The results gotten are mainly suitable for other manufacturing companies' logistics departments too, since the optimization,

standardization and implementing Lean methods can benefit any manufacturing company.

After the implementation of the proposed changes, the packing process could be developed even further by studying it again to find out what would be the next steps in improving it. For example, the company could find out what are the products with the highest volumes in packaging, and then figure out how to speed up the packaging of them by for example purchasing ready carved-to-shape foam pieces, so that most of the time-consuming foam carving work could be gotten rid of next. In addition, the implemented 6S and Lean-methods could be surveyed to find out how they have been working, and whether they should be updated to fit into the company's packing process even better to get even more benefits and savings. However, the company first has to create an applicable basic process for packaging, and actually implement it to practice and get it to work smoothly, before it can be developed even further.

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Appendices

Appendix 1. Summary of the notes from the interviews

Interviewee	1) How does the packing happen now and why should the policies be changed?	2) How should the packing process be improved?
Logistics leaders	There are no instructions or rules for packing. The biggest issue is that no one knows the absolute truth how it should be done.	First, the packing materials should be optimized. For example the time the foam carving takes should be gotten rid of somehow. Then some rules and instructions for packing should be created.
Logistics operator 1	Everyone uses his or her own imagination and creativity. Carving and cutting the foams is quite hard, slow and difficult, and the outcome doesn't even look nice. The packing boxes are funny size, since they don't fit inside each other like they usually should. And also it feels that out of two boxes the smaller one is always too small and the bigger one too big for the needs of the item.	It should be more clear what kind of packing materials to use and when, and which maybe should not be used and when.

Logistics operator 2	As above. In addition, there are no instructions for packing and every operator tries to do their best while using creativity with each different product. It is also difficult to come up with instructions and processes for packing since every delivery is so different to one another (high mix – low volume).	Rules and process for packaging. In addition, same as above.
Logistics operator 3	As above. In addition, the only instruction for packing is to make the package “clean and presentable”. It would be nice to know what that means in practice.	Same as above.

Appendix 2. Picture of the questionnaire for Bluefors marketing department

1) Miksi on valittu käytettäväksi juuri nuo pakkausmateriaalit mitä käytetään (esmi. valkoiset pahvilaatikot, vaahtomuovi foamit, kuplamuovi)?
   Pahvilaatikoissa haluttiin käyttää mustaa ja valkoista brändin visuaalisen ilmeen mukaan. Isot pakkauslaatikot ovat valkoiset ja pienet mustat. Vaahtomuovien valinta oli hyväksi havaittu aikaisemmin, Matiaksen tai Villen toimesta? Esim. Wiring tiimillä oli tarkat vaatimukset minkälaista vaahtomuovia tulee mustiin laatikoihin.
2) Miksi ei käytetä voimapaperia tms ympäristöystävällisempää ratkaisua?
   Ympäristöystävällisyydestä emme ole keskustelleet logistiikan kanssa. Mikäli ympäristöystävälliset vaihtoehdot täyttävät laatuvaatimuksemme, eivätkä ole merkittävästi kalliimpi vaihtoehto, niin miksi ei? Tosin, johdolle on tärkeää, miltä meidän pakkaukset näyttävät, joten siinäkin pitäisi pystyä huomioimaan visuaalista ilmettä.

3) Mitkä ovat markkinoinnin kannalta pakkausten visuaaliset vaatimukset?
Ulla: En tiedä mihin viittaat visuaalisilla vaatimuksilla, mutta varmaan brändin mukaista, sisäistä ohjeistusta? Ingela voi vastata brändiin liittyvääänkysymykseen. Kun epähuomiossa tilasin huomiomerkit valkoisiin laatikoihin keskelle alas, niin voisi ajatella että visuaalisia pakkausohjeita voisi muokata niin, että käytetään kirkasta teippiä pahvilaatikoiden sulkemiseen jotta huomiomerkit eivät peity logoteippiin. Näitä sisäisiä visuaalisia vaatimuksia pitänee kerätä kirjoihin ja kansiin, ellei jo ole. Vastaan kuitenkin tuohon visuaaliseen osaan siltä kantilta, että pakkauksissa pitäisi ”consistency” liittyen ”information for use”. Jouni[redacted]n tulisi varmaankin tarkistaa asia standardin IEC/IEEE 82079-1 näkökulmasta. Pakkausmerkinnöissä mentiin geneerisellä merkinnällä, ja otaksun, että se on jatkossakin pätevä, muta en tiedä, onko pakkausmerkinnöissä toteutettu tarvittavia ja nykyisin implementoituja prosesseja. Pakkausten visuaalisiin vaatimuksiin kuuluu kuitenkin merkinnät, joista voit kysyä Jounilta. Markkinointi toteuttaa.
Ingela: Meidän pitää lisätä nämä ohjeet Brandbokiin.

4) Onko ajateltu pakkausmateriaalien hankinnan keskittämistä yhteen firmaan (esim. PakkausÖhman) nykyisen hajauttamisen sijaan?
Ulla: En tiedä muista materiaaleista, mutta joillain toimittajilla ei ollut tarjota haluamaamme vaahtomuovivaihtoehtoa esim. Wiringin vaahtomuovitarpeisiin. Toimittajilla on tietty tarjonta, joka ei ole vastannut käytännöntarpeisiimme. Jollain toimittajalla on mattalakkamahdollisuus, toisella ei ole. Keskittäminen olisi toki järkevää.

5) Vapaa sana; onko vielä jotain, mitä haluatte mainita Blueforsin pakkausmateriaaleista tai –käytännöistä?
Ulla: Warehouse on valinnut pakkaustapoja, ainakin esim. Temperature Controllerin kohdalla. Pakkausprosessiakin varmaan tarvittaisiin, jos sellaista ei jo ole.

Appendix 3. Record of the timing analysis

Timing record of foam packing

	Foam packing with current system:	Time consumed (s)	
1.	Fetching a cardboard box	25	
2.	Taping the bottom of the box	20	
3.	Fetching the foam blocks (1x30mm and 1x50mm)	40	
4.	Measuring the inside of the box	14	
5.	Measuring and drawing lines on 30mm foam (2pcs)	115	
6.	Cutting 30mm foam (2pcs, bottom and top)	30	
7.	Fitting the 30mm foam inside the box	5	
8.	Measuring and drawing lines on 50mm foam (1pcs)	46	
9.	Cutting 50mm foam (1pcs)	25	
10.	Fitting the 50mm foam inside the box	5	
11.	Cutting the corners of the box	18	
12.	Closing the box and sealing it with tape	35	
		378	total time (s)
		=6,3 minutes	

	Foam packing after 6S implementation (re-organazing packing area and materials) and purchasing ready-cut, box-fitting pieces of foam instead of big (1m x 1m) blocks:	Time consumed (s)	
1.	Fetching a cardboard box	5	
2.	Taping the bottom of the box	20	
3.	Fetching the foam pieces (2 pcs of 30mm and 1 pcs of 50mm foam)	8	
4.	Putting the foams inside the box	8	
5.	Cutting the corners of the box	18	
6.	Closing the box and sealing it with tape	35	
		94	total time (s)
		=1,57 minutes	

Decrease of the time spent on packaging after improvements: 75 %

Summary

	Current system (s)	Improved system (s)	Time decrease after improvements (=improved minus current system) (s)
Fetching the materials	65	13	-52
Taping the bottom of the box	20	20	0
Measuring, drawing and cutting	230	0	-230
Fitting/putting the foams inside the box	10	8	-2
Cutting the corners of the box	18	18	0
Closing the box and sealing it with tape	35	35	0
Total time (s):	**378**	**94**	**-284**
Time saved (%):			**75 %**