AALBORG UNIVERSITY
STUDENT REPORT

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Title: How logistic and manufacturing can support growth in medium size company Lakrids By Bulow.

Semester: 4th Semester

Semester theme: Master's Thesis

Project period: October-February 2019/2020

ECTS: 30 ECTS
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SYNOPSIS:

Many medium-sized companies face problems in their everyday operations. Using observation and data collection this project is setup to show how Lean processes can support growth in medium size production company.

Number printed:	0 Pieces
Pages:	52 Pages
Appendix:	4
Enclosures:	-

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Acknowledgement

I would like to express my sincere gratitude to the supervisor David Hansen for the excellent support, guidance and ideas he gave me during the research work. His effective and useful comments and advices was indeed a source of inspiration to me all through this study.

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Abstract

Many production growing companies face challenges to optimize and organize working process in the most effective way. Lakrids by Bulow is one of those companies. To work with this project, relevant literature and data collection have been used. In this situation Lean Manufacturing is presented a good solution as it provides means and tools for managing the problem. Using observation method I was able to define main challenges that companies face in order to grow, describe them and propose solution to support process in the company.

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1. Introduction

Every company puts a lot of effort in realization of its main goals, which are growth and rendering of certain profits. Logistics and procurement seen as the tools for supporting that growth and the aim of this paper is to examine how exactly they can serve this purpose on the example of medium size company.

Lean Manufacturing and Pull Philosophy provide solutions for the companies that are interested in making more profits while reducing costs. It is a tendency of the 21st century to focus on cutting production and inventory costs as those may seriously hinder the expected turnouts. After all, all entrepreneurs are interested in making profit and there is nothing strange about that. Surely, many of them have in minds also other goals such as realization of a dream (as in the case of Johan Bülow, the founder of Lakrids company), being their own bosses and independence, interest and passion for a business, family tradition and inheritance and so on. Still, no one is getting himself into building a company with no intention to make certain profit. This, in turn, means that the company needs to develop itself and remain competitive at the market as otherwise the expected profit will not be achieved. Cutting down the costs, especially those related to waste, is one of the best ways to keep at the market. It also allows noticeable savings that can be invested in further development.

The paper discusses numerous issues related to the waste avoidance and possible solutions to the problems common among the medium-sized companies achieving for growth, such as space restrictions. The following section introduces in more detail the problem, its reasoning and puts forward research questions. The theoretical part is based on the subject literature review on stock and production costs and on the solutions offered to the entrepreneurs by Lean Manufacturing concept and Pull Philosophy. This is followed by a short section on methodology used within the empirical part. Then there is a case study, including the Lakrids by Bülow profile, the analysis of its activity, mostly within the area of suppliers and warehousing. Finally this section offers some proposal of solutions based on Lean Manufacturing and Pull Philosophy (related to the theoretical part). The paper is finished with discussion of the findings and conclusions.

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1.1 Logistics and procurement in a medium-sized company (space restriction)

The main problem that is directed in this paper is space restriction and ways of solving the issue. The problem may touch every company, despite of its size. The growth in sell and production almost always demands more available space for storage and maintaining the supply chain. Whenever there is a space restriction (due to various reasons), the growth may be interfered by it in many ways. In the worst scenario, the growth may prove to be impossible until the problem of space availability would be solved one way or another.

The problem seems important enough to be dealt with within my diploma thesis. Every company, sooner or later, takes effort to develop and grow its profits. This usually is related to incensement in production/manufacturing/handling sizes and amounts. Usually, it also means that more space is needed to proceed with the increased number of goods and that may prove to be a rather serious problem. There is a seemingly easy solution to this problem: renting or buying additional space for storage and production, but it is easy only at the first sight. First of all, the company aiming at its own growth may not have at its disposal the funds necessary for getting additional space for operation or may not be ready to invest those funds (the reasons for that may include: the risk of losing financial fluency, the overload of other liabilities, etc.). Secondly, it does not sound reasonable to invest funds in additional space without a warranty that it will pay off soon enough. In such cases, companies must seek for another solutions to manage existing space restrictions and to cut the costs without cutting the expected profits.

The subject seems relevant enough as many companies deal with the described above problem on the everyday area. It influences numerous decisions that are made on a daily basis even and often cannot be postponed for later. For example, the company X gets a large order for certain products and it is timely. The company has never before managed such huge commission and its capacity exceeds the space availability. The manager may reject the order stating that it exceeds the company's powers and it cannot be proceeded in such a short time period. It is not a best solution though. Most probably, the customer will never again put any order with X company and, which may be much more disastrous, he may also give the company bad references. This means that the manager has to seek for another solution and this is the main purpose of this paper: to suggest workable solutions for this kind of situation so the company may fulfill its objectives and the customers' satisfaction.

I believe that it is relevant equally in theory and in practice. On the theoretical ground, I would like to underline the need for constant pursue for the best solutions so the companies may choose the one that fits them best depending on the specific occurrences, environment and capacities. As the technology is constantly changing as well as the customers' needs and expectations, everything is changing. It is difficult to offer the

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companies some universal, ever working schema. That requires constant theoretical research and implies why this subject should not be abandoned on any phase of the analysis of the company's functionality.

On the practical ground, it is even more important. Many companies search for reasonable and effective ways of solving the above mentioned problem. Every tip or proposition is of large value for such companies, especially for the medium-sized companies that often lack enough specialist knowledge in regards to the management of space restrictions. They need easy to follow-up, clear and specific instructions due to the existing time restrictions. It would be great if every company could work out its own, individual way of managing this kind of problem, but everyone knows that the reality is completely different, There is usually no time for working out specific procedures and solutions that would fit the company's specific conditions and circumstances. Many companies reach out for some ready to use solutions and schemas. Which means that it would be very useful to create some universal outline that would work, after some adjustments, in almost every situation. Because of that, I believe that formulating some rules and project's ideas can be useful for every manager in order to create a schema working for his own company. Those rules and statements may serve as a kind of guide providing the necessary knowledge and solutions.

In overall, I believe that the theme undertaken in this paper is relevant for the business practice and theory. I do not expect to provide the universal solution to the problem, but hope to find some reasonable and effective ways of managing the issue that can be implemented in the medium-sized companies.

1.2 Topic choice reasoning

Due to my professional interest, I see the subject of the growth of the medium-sized company as well as the factors that may support it, as the most interesting field of research. What we can do to make it better? What are the potential barriers and interferences that may postpone desired growth? What is the potential role of logistics and procurement in solving the problems related to the space restrictions that can slow down the company's growth?

It seems as the under-researched field of the subject matter. The role of logistics and procurement/manufacturing in supporting the medium-sized company's growth is surely significant and cannot be overrated. I decided to deal with this kind of the problem mostly because my own professional interest and the potential usefulness of the findings in my future work. Working in the medium-sized company is challenging and interesting at the same time. It is different from working in a small company, where there are not many opportunities for development and every inno0vation is rather demanding in resources needed

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and chances for realization. In a big company, on the other hand, the chances for development are huge, but the typical challenges are smaller and less important. Things such as space restriction usually do not affect investments of the big company (i.e. corporation), because the enterprises of such size have completely different possibilities and resources. It does not mean that the big company have no challenges – they are just of completely different nature.

The point of my interest is the medium-sized company for several reasons. First of all, it is a kind of organization that have more power and resources for quick and effective development than the small ones and is more interested in such growth than the big companies that are already complex and effective in their workings. Secondly, the medium-sized companies have certain specialties and capacities, but at the same time they also have their specific limitations. Those include such limitations as the mentioned already space restrictions. It is a barrier that actually is not so easy to overcome. Thirdly, I believe that the market of medium-sized companies has its own potential, underrated as for the moment, that should be used in the future development of the economy.

The medium-sized company has much more potential than a small one. It can also take more important place on the market due to its own working powers, its financial liability and fluidity, and – what can be the most important aspect – due to its operational flexibility. That flexibility can be achieved through different means. Some of them will be discussed within this paper in order to suggest what solutions may be the most effective.

Supply chain is the key area in every production company. During the studies I learned how to use lean tools to support processes in supply chain. I have noticed that many small or medium size companies facing problems in this field most of it because of limited space. From theoretical point of view using pull philosophy is the most effective in space limited companies, but very often companies prefer push method which generate extra cost and waste.

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1.3 Research question

In the following chapters my aim is to examine the role that is played by logistics and procurement in supporting the medium-sized company operations and growth. The assumption is taken that, despite the space restriction, the company is able to achieve about 20% growth in production/sell. And that can be done through different solutions serving the process of optimization of logistics and procurement. Thus, the main research question is:

How can Lean and pull philosophy enable optimization of logistics and procurement to support the growth in a medium-sized company with space restrictions?

In order to answer this question, the following sub-questions were formulated:

1. *What is the nature of space restriction problems?*
2. *What is Lean and pull philosophy?*
3. *How the problem of space restriction can be solved?*

2. Theoretical framework

There is always a theory behind every solution, so it is usable to present it first, organize and analyze in order to get a better grasp of the problem itself. There is a plenty of subject literature offering useful tips and hints for the problem at hand, so within the scope of this thesis it is not possible to present every bit of that knowledge. The author did make a choice of those information which seem accurate and important for the subject.

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2.1 Costs of stock and production

There is no doubt that costs are crucial part of every company's operations and that one of the main issues is to limit the costs as much as possible without risking a loss of profits. This may be quite a challenging task taking into consideration the kind of stock and production, space that is necessary to provide it and other resources that may be needed.

The enterprise should be interested mostly in the customers' satisfaction as this provides not only actual financial profits but also prestige and position on the market. The connection between the service level and its measurement with the management of the stocks plays an important role because it affects in many ways the relationships with the clients. Depending on the business's nature, it may have a huge impact on the company's profitability.

The stocks are usually regarded as an element of cost, but for some companies the stocks are active components contributing to the leading of a specific market share. That is performed through the high level of service and being able to offer the products in the quantities requested by the clients the moment they make theory orders. That means that the management of stocks should be constantly improved through (Radasanu, 2016):

- reduction of inventory carrying costs and related ones,
- improvement the service level,
- supporting growth in new channels,
- gaining market share with the use of superior service and product availability.

Determining the inventory holding costs and ordering costs is not an easy task. The subject literature commonly gives the number of 25% per annum of the cost price of the product or its purchasing as the holding cost. This is an estimated average number as it actually ranges, as mentioned in literature, between 5% and 45%. The inventory holding costs may vary noticeably but many companies prefer to take that 25% for granted and seem to be unaware of the actual costs of their stock (Durlinger, 2014).

The components of the inventory holding costs include cost of capital (needed to finance the inventory), costs of storing and handling the stock and cost of risk (such as pilferage, obsolescence, insurance etc.). As Durlinger proposes, it is advisable to look closely at every of those components.

First, there is a cost of capital. For some companies this is just a rate they are charged by the banks for lending them the needed funds. For the others, if they invest their own money in the inventory, the cost of capital seems to be nonexistent. From the shareholders' point of view, it is different because they demand a certain return on their investment expecting it to be much higher than the current interest rate. This simply

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means that the funds tied up in the stock are expected to bring similar result. It becomes to be more popular recently to use the WACC (Weighted Average Cost of Capital) as it reflects the way of financing the company (Durlinger, 2014):

$$WACC = \frac{E}{V} * R_E + \frac{D}{V} * R_D * (1-T_C)$$

Where:

E = Market value of company's of equity

R_E = Cost of Equity

D = Market value of company's debt

R_D = Cost of Debt

V = E + D

T_C = Corporate tax rate

The second category of costs is related to the handling and storing of the stock. Those costs may be very transparent if the company uses the warehousing outsourced because it is charged by the provider of the service (i.e. per pallet, per sq meter etc.). Those costs are not directly related to the value of inventory, but they still provide some estimation of the costs involved in the storage costs. It becomes much more complicated when the company owns its own warehouse. The costs are completely different then. For example, if the warehouse is for 5000 pallet places, it does not matter whether the company actually uses 300 or 3000 of them – the cost is overall the same. It includes such things as electricity and heating, water supply, the necessary equipment such as forklift trucks and many other, depending on the branch and its demands. Some companies rent some of their space to the other firms but still, the cost of storage is probably fixed costs and cannot be cut easily. This includes also the costs for employers working in the warehouse. Those can be considered fixed unless the employers are half-time workers and work only when they are needed (Berg, 2007).

The third component is the cost of risk which comprises everything that is connected to the risks related to holding of the stock. The main component is obsolescence which is strongly product-related. This

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cost can vary widely, even within the same company or in the same product family costs. It has strong relation to the product-life cycle as the higher risk of obsolescence occurs when the product has a short life cycle. The higher risk is also correlated with the phase-out stage of the product-life cycle (Durlinger, 2014).

It is easy to note that the inventory holding costs cannot be measured simply and with the use of one general percentage. It can be done surely, but in many cases the result will not reflect the real costs that are related to managing the stock. It sounds much wiser to calculate the costs individually for a given company, taking into consideration the actual costs of capital, handling and storing and of the risk. For each company those costs will be different, but they are also important part of the overall costs.

Based on what was already stated, it is clear that for the company inventory management is very important because it manages the costs of stock and procurement. The main purpose of inventory management is developing policies for achieving an optimal; inventory investment. An optimal inventory management serves the company to maximizing its rate of return while minimizing its liquidity and business risk. The crucial part of inventory management is comparison between the costs of keeping inventory and the benefits of holding it. When it is successful management, the inventory and costs are minimized while the profitability increases (Kontuś, Kastav, 2014: 245).

Inventory management involves the benefits of holding inventory. The most important benefit is an assurance of goods being available as required. “The primary costs of an inventory are the opportunity cost of the capital used to finance the inventory, ordering costs, and storage costs. Inventory management seeks to maximize the net benefit – the benefits minus costs – of the inventory” (Kontuś, Kastav, 2014).

But inventory is a rather complex phenomena and vary in its sizes, kinds and the space needed for holding it. It also varies in its profitability as some goods may take up a lot of space but return on them is low while some other goods may be small in size and bring a high levels of return. Nevertheless, it is typical situation that higher inventory levels are connected with increased costs for storage, insurance, spoilage and interest on funds that were borrowed to finance inventory acquisition (Shim, Siegel, 2008).

Inventory management is perceived as successful when it minimizes inventory and its costs and improves profitability. This requires appraisal of inventory levels. Those, in tur, are depending on numerous factors such as sales, liquidity, production, supplier reliability, inventory financing at the company’s disposal, seasonality and possible delays in receiving new orders. The higher level of inventory diminish the risks of lost sales resulting from stockouts and slowdowns in production when the inventory is inadequate. Additionally, inventory levels may be affected by short-term interest rates. The increscent of short-term interest rates causes reduction of the optimum level of holding inventory (Shim, Siegel, 2008).

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According to McComas (1995), the following actions should take place in the management of the company's inventory:

- establishing the purchasing review criteria for the inventory characteristics,
- purchasing such amount of raw materials that is needed for a production run or a given period of time,
- collaborating with vendors in order to improve the purchasing processes,
- improving inventory control with the use of effective inventory control systems,
- encouraging materials exchange between different departments of the company,
- considering just-in-time manufacturing.

Financial managers are responsible for the company's overall profitability as well as for gathering the necessary capital required for carrying the inventory. The inventory management ought to ensure that the inventories that are necessary for actual operations are available, while the costs of ordering and carrying them is hold at the lowest possible level. The idea of reducing inventory is usually very strong, but not in every case it is truly justified, so the managers responsible for inventory management should have it always in mind.

Every product should be treated with the economic order quantity analysis. This gives information related to a significant proportion of sales and that is important for planning future inventory. The economic order quantity means the optimum amount fo products or materials that should be ordered each time in order to minimize total costs related to inventory ordering and holding (Kontuś, Kastav, 2014).

To mark the optimum size of delivery and to make choices regarding the best (meaning the cheapest) deliverer in order to minimize the total inventory costs the companies commonly use the Economic Order Quantity (EOQ) model of inventory management. It is a technique serving to determine the optimal amount of inventory to order each time so a given inventory item is never depleted (Chambers, Lacey, 2011).

The EOQ model takes into an account the trade-off between storage costs and ordering costs that need to be considered when ordering the chosen quantity that is missing in the inventory. The company can choose between ordering a larger quantity once in a while or ordering smaller amounts more frequently. The first choice is less costly in terms of ordering costs but requires more space for holding inventory and may generate huge costs in this area. On the other hand, frequent ordering of smaller inventory loads demands more space for holding and reduces those costs, but may be related to increased costs of ordering and the necessity of making orders more frequently which takes time and effort. There are some circumstances that should be taken into account when making such choices. For example, renting a space for holding the inventory may be very costly, so in such situation it may be better (at least in terms of finances) to choose

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making smaller but more frequent orders. The company that has its own magazine may be more prone to choose to make bigger orders less frequently. Surely, the costs of having own magazine may seem to be also quite high, but on other side, the company lowers the ordering costs and the risk of being out of any product when a bigger order comes in. The choice should be made on basis of the company's financial powers and opportunities, the kind of carried goods, the analysis of the actual sales and many other factors that may depend on a given situation.

In the EOQ model there are made certain assumptions (Shim, Siegel, 2008):

- constant and certainly known demand for a product,
- linear and constant depletion of stock,
- no allowance of discount for the quantity purchases,
- constant and not changing time interval between making an order and receiving its delivery.

The EOQ model's formula is presented below (Shim, Siegel, 2008):

$$EOQ = \sqrt{2 * D * S / H * C}$$

Where:

EOQ = target order quantity – this variable is meant to be optimized

D = the annual demand of product in quantity per unit time

S = the product order cost – the flat fee charged for every order

C = unit cost

H = holding cost per unit as a fraction of product's cost.

The classical EOQ model is seen as a way of providing the solution for the matter of minimizing the long-term average cost per time unit. It is not sure though that such optimal policies exist. It is simply a description of the trade-off between the holding costs and the set-up cost (Yan, Kulkami, 2008).

Aside of EOQ, the company may use the reorder Point (ROP) and Safety Stock techniques. The ROP quantity relates to such level of inventory that triggers the placement of a following order for replenished

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units. For the constant demand and known lead time, reorder point is reflected by the following formula (Chen, 1998):

$$ROP = \text{Daily usage} * \text{Lead time (in days)}$$

For the maintained safety stock, the formula goes as below (Gonzales, 2010):

$$ROP = \{\text{Daily usage} * \text{Lead time (in days)}\} + \text{safety stock}$$

The earlier theoretical work was enveloped in a model of inventory holding developed by Cuthberston and Gasparro (1993). The models created earlier were modified by the scholars in order to incorporate financial effects and technological change as, in their opinion, those factors may affect inventory holding and its costs. They found that the manufacturing inventories' levels may be characterized by being elastic with respect to output. The conditional variance of output was positively related to the inventory while the overall gearing position of the company has negative correlation with it.

According to Ozer (2009), effective inventory management is a capability that is necessary to lead in the global marketplace. There are thus four fundamentals of effective inventory management (Ozer, 2009):

- managers are required to know the best ways of using available information,
- they need to quantify the information's value,
- managers should coordinate decentralized inventory operations,
- the decision tools adequate for the users.

The other important costs for the company are related to production. It can be observed that manufacturing companies are able to manipulate production in such a way that the fixed costs are shifted between cost of sold goods and inventory accounts. This way the earning can be managed either downward or upward. In order to manage inventory in a proper way, the company is obligated to revising its inventory policy in the case when net profitability is the result of such a revision. Before doing that, the company should weight the profit potential in relation to the opportunity costs of holding inventory as well as the costs

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associated with keeping its inventory. Those costs include warehousing, handling, insurance and property taxes (Kontuś, Kastav, 2014).

The costs of production may be very high in some companies which depends on kind of manufacturing, the produced goods, the costs of materials, the costs of necessary machines and tools and so on. In every company they will be different but still there are certain rules that can be applied to counting costs of production. The costs of any given amount of the firm's company is based on two main factors, namely (Suman, 2010):

a) the quantities of resources and theory combinations,

b) techniques and productions.

The cost related to producing any input for the company is depending on specific physical quantities of resources and services necessary for the production process. Those may include labor, machine hours, materials and many others. For example, if the company is producing steel, the costs would depend on the quantities of such materials as iron ore, limestone, coal, blast-furnace as they are all used for production. It is logical that the larger output the greater amount of resources is needed which makes the total cost for larger output larger, while the total cost for smaller output is smaller. When resources are combined in optimal proportions, the overall costs also become smaller (Suman, 2010).

The new and improved technologies are the way for the firm to lower the costs of production. On the other hand, production using the old and out-dated technique result in higher costs of production. That mean it may be advisable to invest in new technology of production in order to lower down the costs in the long run. The proper choice of the particular technique of production serve the maximization of the profit. It is also important to note that "in the short period the optimum combination for any given level of output is the least-cost combination possible with the fixed factor units. But this may not be the absolute optimum combination if all the factors could be adjusted. Over the longer period, all factors can be varied, and so the firm is free to select the production techniques of factors" (Suman, 2010).

There are three different cost concepts: total cost, average (total) cost and marginal cost. The first one is the total of producing a given unit of output of the commodity. The total cost is combined of total fixed cost and total variable cost. The fixed costs (or overhead costs) do not vary with output which means that they are always the same in the case of production of one unit, ten units or thousand units of a given commodity. Also, even when the output is zero, the fixed costs are the same. Those costs include insurance charges, depreciation of machinery, interest on bank loans, rent of factory and any office building, annual licence fee paid to the government and many others, depending on the kind of production (Suman, 2010).

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Variable costs on the other hand (or prime/direct costs) vary with every changes made in the output. The variable costs increase with the larger output. This means that in the case of zero output there will be no variable costs. Those costs include wages, costs of power and fuel as well as the costs of raw materials. Adding total fixed costs and total variable costs gives the total cost of production (Suman, 2010).

Average total cost is calculated by dividing the total cost by the output's level and it reflects the cost per unit of output. For example, if one total costs of productions of 10 units of a given commodity is Rs. 90, the average costs is Rs. 9 per unit. There are two components of the average cost (Suman, 2010):

- average fixed costs = total fixed cost divided by the output's level,
- average variable cost = total variable cost divided by output.

There is also marginal cost. It is the total cost resulting from the incensement in the output by one unit. It can be thus described as the extra cost of an extra unit production. Marginal cost refers to marginal variable cost, so it is depending on the amount of production. It is has though no relation to the fixed cost (Suman, 2010).

The average fixed cost falls with the output incensement. The figure for total fixed cost remains unchanged no matter the size of the output, so when the volume of output becomes larger, the figure of fixed cost gets divided by a larger volume of output. This results in distribution of fixed cost over larger and larger volumes of output. This is described as 'spreading overheads'. For example, for the construction company the biggest fixed cost is the cost of land. So, the higher the building, the fixed cost decreases (Suman, 2010).

The changes in the business environment during the last century affected in a significant way the structure of the companies' costs. In the first half of the 20th century well over 90 % of the total costs were the manufacturing-related ones such as materials, the employees' salaries and replacement of the plant. Most part of them had direct character. The overhead costs (indirect ones) rarely exceeded 20 % of total costs. The major changes in the structure of manufacturing industries in the second half of the 20th century include (Glad, Becker, 1996):

- smaller quantities of cheaper materials,
- incensement of competition and thus the higher marketing,
- larger distribution and communication costs,
- numerous new costs such as related to researches,
- prototyping and training occurrence,
- increased mechanization and information,

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– using a lot of information technologies.

The result of the above mentionedreasons is the change in the structure of the company's costs where just about 40 % of the total costs in 1990 came from direct costs. The scholars show that between the 1950's and 1990's there was a huge shift costs for the companies. The overhead costs replaced the direct ones going from about 25 % to about 60 %. Novak and Popesko (2014) state that "the primary cause for the shift is the gradual proliferation in products and service lines. Over the last few decades organizations have been increasingly offering a greater variety of products and services as well as using more types of distribution and sales channels".

For the company's ability to keeping in touch with the strongest competitors at the market it is necessary to react on changes in product and activity structure. Those changes should be featured in the product costing. The costing system that is not changing and not conforming with the process, activities and product dynamics, such system is out-dated and generates the incorrect information related to the company's costs. The ability to properly analyze the costs is crucial for the effective cost management. The company needs to understand the cost behaviour in order to manage its costs correctly. Knowledge of changes of costs in relation to the output's activity changesbecomes an essential part of planning, controlling and making decisions. There are many different ways of dealing with costs analysis and their assessment, but despite of the chosen model, it is necessary to assess the cost behavior and answer such questions as (Nowak, Popesko, 2014):

1. "Is possible to reduce the price to sell more units?
2. What should be planned performance for the next period?
3. How it should be set salary sellers? Would it be better to reward them by fixed or floating wage commissions?"

Making any of those decisions demands the management to estimate the costs and revenues at different levels of performance in order to have prepared alternative courses of action. Without knowing and understanding cost behaviours decisions such as those are difficult to make. It is also easy to make serious mistakes with not enough information regarding the changes in costs and their distribution.

To summarize, the total costs of production is the actual amount that has to be paid by the company for the resources necessary for the goods' production. Those costs also vary. They can be explicit (directly paid for) or implicit (those are not paid directly but can be estimated via opportunity costs). This is also truth for the short-run, but in this case it may be more useful to divide total costs into variable inputs that can be changed by the company and fixed inputs that cannot be changed the company.

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The costs related to inventory and production in some part are fixed which means that even the best managing may not be able to solve that issue and lower them down. On the other hand, there are certain solutions that can be used for example in relation to ordering stock costs or handling it. Some of those solution will be discussed in the following section.

2.2. Lean Manufacturing and Pull Philosophy

In terms to present a concept of Lean Manufacturing, it has to be explained first what Lean Management means. Lean Management represents the family of modern management concepts. More implementation ways of it result in an obvious success. Lean in the subject literature is formulated as a slender approach that "shows the way of producing more volume using less – minimizing human labor, reducing the number of devices, as well as saving time and space – all at increased level of meeting the customers' needs […] it also allows to achieve a greater level of job satisfaction" (Womack, Jones, 2012).

According to Liker (2005), Lean Management is nothing else than an aspiration to managing efficiently given resources in order to reduce expenses, quality orientation and minimizing the orders' implementation's waiting time. It may also be defined as a set of some concepts, principles, tools and procedures that are adapted in order to the production process's improvement by reduction of waste (Taj, 2008).

Lean Manufacturing is the concept allowing for the improvement of production processes. The essence of it is the elimination of all kinds of waste that may occur in the enterprise. The result of it is shortening the time space between ordering and sending the ready-to-use goods to the customers. It is a simple and effective way to reduce manufacturing costs while increasing productivity. There are eight types of waste (Ohno, 2008; Womack, Jones, 2001):

1. Overproduction happens when products are produced in advance and in much greater quantities than it is required by current customers (Sobańska, 2013). It is regarded as the most dangerous kind of waste because it produces significant costs associated for example with storing the goods. The other types of waste are often resulting from overproduction.
2. Inventory is a waste occurring when the company keeps more raw materials, work in progress and finished products than it is required as minimum. It results directly from overproduction. It may lead to damage or destruction of produced goods. Inventory as wastage generates significant storage and transportation costs.

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3. Mistakes and quality defects means that some work was not completed with positive results (Shook, Schroeder, 2010).

4. Waiting for a product means all the time that is lost because of the people's expectations as well as material, information and tools which do not add value in the manufacturing process.

5. Over-processing is related to a necessity of adding value in producing a given product and it mainly includes taking unnecessary time in order to implement the customers' demands and using sophisticated and costly technologies when there is none justification for that.

6. Unnecessary transport means that there is excess movement of materials, semi-finished and finished products within the company itself. This increases the production costs and the risk of destructing or damaging the product.

7. Unnecessary movement or superfluous movement does not add any value of physical employee as it usually results from wrong or inadequate organization of work processes.

8. Untapped potential employee's means that the potential employee is underspending. The ideas, competences, talent and time of employees are ignored or underspent, which means that there are wasted (Rother, Shook, 1999).

Lean Management/Manufacturing offers certain instruments which functioning serves the improved implementation of modern management concepts. Among them the most popular are: 5S, TPM and SMED (Bednarek, 2015).

5S is a systematic way of visual management that utilizes everything from floor tape to operations manuals. It is mostly about maximizing the profit and efficiency. Its elements include observation, analysis, collaboration and searching for possible waste along with the practice of removing it. The system is based on five terms starting with the letters "S" and is presented at the graph 1.

The five steps are: SORT, SET IN ORDER, SHINE, STANDARDIZE, SUSTAIN. The steps involved in the system are related to going through the inventory in a workspace, removal of those elements that are unnecessary, organization of the units, cleaning, performing maintenance and, finally, making sure that those steps become habits of the company in general as well as its units and employees. The order of those steps' occurrence is obligatory as otherwise they would not work properly. This requires making a plan including performance of the tasks associated with the above mentioned steps on a regular basis. The 5S methodology originated in Japan. For the first time it was implemented by the Toyota Motor Corporation (*Creative safety supply*, webpage).

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Graph 1. The 5S system

Source: *Dreamstime.com*, webpage.

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Implementation of the 5S method requires taking into account the human factor. Thos methods is often seen as a kind of recovery plan because its implementation affects the company's financial results. It also takes care of the relation between the employees and the organization within they work on the everyday basis. The starting point for the method implementation is to train the management team as they need to adapt to the new working conditions with the use of the innovative organizational techniques. The workshops for the management team should include planning tasks and tight control of the employees' progress in performance on every work station. The main point is that each unit of an organization should be able to identify with the organizational aim with certain emphasis on the quality, cost reduction and work efficiency, delivery on time, reduce wastage, clean and tidy workplace and the staff's and products' safety (Czerska, 2014).

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The main five practices that are the components of the 5S method (as presented on the graph 1) can be defined as in the table 1 (*Creative safety supply*, webpage).

Table 1. The five key practices involved in 5S

JAPANESE TERM	AMERICAN TERM	DEFINITION
SEIRI	SORT	Sorting through materials and keeping only those materials that are essential for completing of the tasks. It means that all contents of the workspace should be verified in order to determine which of them are needed and which are unnecessary so they can be removed. The work area should be freed off everything that is not used form the work process's completion.
SEITON	SET IN ORDER	Ensuring that everything is organized and that every item has its proper, designated place, and that nothing is "wondering" loose. Whatever is left in a workplace must be organized in a logical way in order to make easier every tasks needed for completion a process of production. It often demands to place items in an ergonomic way which means that people do not have to bend or make extra movements to reach what they need to follow their processes.
SEISO	SHINE	Proactive efforts aiming at keeping a workplace area clean and orderly as this is a condition for ensuring that the work will be purpose-driven. The newly organized workplace thus should be regularly cleaned and maintained. This can be related to very routine and easy tasks such as mopping, dusting and similar, but also performing necessary maintenance of tools, machinery and other regularly used equipment.
SEIKETSU	STANDARDIZE	Creation of unified and well-planned set of standards for the organization itself and for the given processes. It means that at this point a manager takes the first three S's in order to state the rules for how and when every specific task should be performed. The standards include such solutions as charts, schedules, lists and many other documents.
SHITSUKE	SUSTAIN	Sustaining new practices and conducting audits that are meant to maintain a proper discipline. The essence is that the previous four S's need to be continued over time through development of a sense of self-discipline in the employees participating in the method implementation.

Source: Own elaboration based on: *Creative safety supply,* webpage.

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The implementation of the 5S method may affect the production and inventory in many ways, but it surely provides certain sensible and sustainable results. The graph 2 and 3 presents the simple changes that can be done with the use of 5S in the inventory keeping.

Graph 2. The inventory keeping before 5S implementation

Where:

1 – Inventory stacked far out of reach (waste of time and the employees' potential).

2 – Unused older inventory (it is unnecessary and takes up the space for no reasonable reason).

3 – Safety hazard – boxes stacked in the aisles (the employees' health and life may be endangered).

4 – No discernable organization (i.e. inventory dating, barcoding, color coding, naming convention etc.).

5 – Allowance for accumulating of the trash and debris – it's unhealthy for the workers and hazardous for the inventory (it may cause fires etc.).

Source: *Creative safety supply,* webpage, with own comments.

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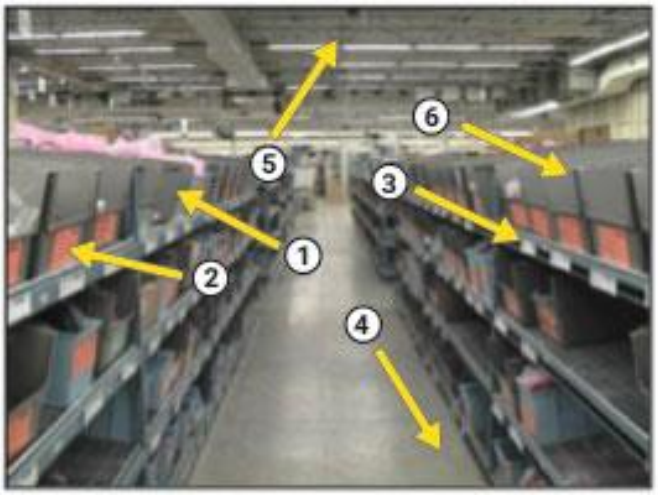
Graph 3.The inventory keeping after 5S implementation



Where:

1 – Uniform bins and racking – it helps to keep everything clean and ordered.

2 –Date tracking of inventory –it saves time necessary for searching through the stock in order to find whatever is actually needed for production.

3 – Bin contents are labeled.

4 – Bins, racks, and floors are kept clean and in good repair.

5 – The sufficient lighting in the facility which is necessary for the employees' health and effective work.

6 – Racks are placed low enough in order to make sure that the employees do not have waste their time for getting on the ladders in order to access stock which (using ladders may also pose certain dangers for the employees using them).

Source: *Creative safety supply,* webpage, with own comments.

The 5S methodology is very useful for every company that attempts to introduce Lean Manufacturing and Lean Management within its operations. Because its main essence is to make it easier for the employees to navigate and find whatever they need for their productive processes while everything reminds organized, planned and maintained, it is a basis for implementation of the other Lean techniques (i.e. kaban, kaizen etc.).

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Once the workplace becomes easy to work in, every other Lean technique is much more successful in its implementation. Sometimes it can be even said that without the 5S, the other Lean efforts would be ineffective.

The next important tool is TPM – Total Productive Maintenance. It covers all activities of the company that are aiming at preventing errors in the quality of products, the possible occurrence of equipment failure and the condition that is required in terms of frequent adjustment (Borkowski, Ulewicz, 2009). The purpose of this tool is acceleration of the machine operators' work. It is also focusing on work safety and easier operations. It is assumed that the aim of TPM is achievement of zero failures and zero defects that may arise within the machine operation processes. In reference to the most basic principles of Lean Manufacturing the purpose of TPM is minimizing losses. The main losses that TPM should eliminate are (Czerska, 2014):

- equipment failure,
- set-up and establishment of workstations,
- short term downtime during operation,
- loss of speed,
- the quality's defects and a need to correction of defective elements or parts,
- low material utilization and losses at start-up of the machine.

The five key elements of TPM are (Kunio, 1992):

- improvements meant to eliminate the causes of the above mentioned six big losses,
- autonomous maintenance,
- scheduled system maintenance,
- training,
- purchase and design of reliable and easy to maintain equipment.

TPM is an innovative Japanese concept. The origins are rooted in 1951 when preventive maintenance was introduced in Japan. The first company that introduced this concept was Nippondenso. The automation of its processes caused that more maintenance personnel was needed, so the maintenance became a problem. The management had to make a decision. The operators of the equipment were supposed to take of its maintenance (now known as Autonomous maintenance – one of the main features of TPM). The company was already following the concept of preventive maintenance and now it added Autonomous maintenance. The modifications in equipment became necessary. The effect was the Productive maintenance, which can be presented by the simple equation (Chandran, 2015):

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Preventive maintenance + Maintenance prevention + Maintainability Improvement

= Productive maintenance

The Productive maintenance's goal is to maximize the plant and equipment effectiveness in order to get the optimum life cycle cost of the equipment needed for production. The quality cycles require involvement of the employees' participation. The result is that all employees of the company take part in the implementation of the Productive maintenance. The main benefits of this approach are (Chandran, 2015):

- increased productivity and OEE (Overall Equipment Effectiveness),
- putting the customers' complaints right (correction of mistakes and failures),
- reduction of manufacturing costs to a great extent,
- satisfaction of the customers' needs at the 100 % level – delivery of the right quantity at the proper time and in the required quality,
- reduction of the accidents' amount,
- following the pollution control measures,
- higher confidence level among the workers,
- keeping the workplace clean, neat and attractive,
- the changes in the operators' attitudes,
- achievement of the goals through working as a team,
- horizontal deployment of a new concept in the company's all areas,
- sharing of experience and knowledge,
- the workers get a feeling of owning their machine.

The idea of TPM is commonly presented graphically as the roof supported by eight pillars that are meant to help in achieving of the goals of it that are usually listed at the steps of the building (see graph 4).

TPM aims at incensement of productivity, efficiency and safety. As a mean for that serves empowering the operators and team leaders so they do play a proactive role in everyday maintenance (including

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lubrication, inspection and cleaning). This needs the company to apply the eight pillars that support continuous activities of the company (Byrd, online):

1. Autonomous Maintenance – the operators are responsible for monitoring the condition of their workplace and equipment.
2. Process and Machine Improvement – team leaders are responsible for collecting information from the operators and their work areas in order to prioritize preventive maintenance and improvements.
3. Preventive Maintenance – the operators and team leaders share between themselves preventive maintenance tasks and schedules.
4. Early Management of New Equipment – the team leaders' participation is requires. They are responsible for planning for parts of the equipment life cycles and reporting to managers with the maintenance reports in mind.
5. Process Quality Management – shared responsibility for maintenance and operation are encouraging from quality improvement ideas occurring within all areas of work.
6. Administrative Work – the managers' task is to prioritize data acquired from the previous pillars in order to get outcomes they can share with the team leaders and the workplaces.
7. Education and Training – it should be continuous in order to imp[rove morale, retention and efficiency of the operators.
8. Safety and Sustained Success – the priorities go for facility-wide safety. This impacts in a positive way the sustained success of TPM implementation.

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Graph 4. The TPM construction and goals

Source: *Reliable.com*, webpage.

One of the most important components of TPM concept is the Overall Equipment Effectiveness (OEE) as it is the most influential element. It is a metric that serves to identify the percentage of the planned production time that can be assessed as a truly productive. The purpose of developing this concept was to support TPM initiatives by accurately tracking progress in the direction of the achievement of 'perfect production'. The numbers of OEE scores are easy to assess and goes as following (*TPM*, online):

100% - perfect production,

85% - world class for discrete manufacturers,

60% - fairly typical for discrete manufacturers,

40% - uncommon for the manufacturers using TPM and lean programs.

OEE is based on the three underlying components. They are presented at the table 2 as they are related to different type of the productivity loss as well as to one of the TPM goals (*TPM*, online).

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Table 2. Components of OEE in relation to TPM goals and the productivity loss' types

COMPONENT	TPM GOAL	TYPE OF PRODUCTIVITY LOSS
Availability	No Stops	Availability takes into account the so-called Availability Loss. This includes all events that may stop the planned production for a noticeable length of time (several minutes or longer). The examples are: - Unplanned Stops (i.e. breakdowns, accidents etc.), - Planned Stops (changeovers, maintenance stops etc.).
Performance	No Small Stops or Slow Running	Performance is about Performance Loss – all the factors that may cause production's operation to be at the lower level than the maximum possible speed. The examples are: - Slow Cycles, - Small Stops.
Quality	No Defects	There is the matter of Quality Loss – some manufactured pieces may not meet the quality standards, some may require rework. The examples are: - Production Rejects, - Reduced Yield of startup.
OEE	Perfect Production	All loses are taken into account (Availability Loss, Performance Loss and Quality Loss). The result is a measure of truly productive manufacturing time.

Source: *TPM*, webpage.

TPM may be characterized as a Lean Manufacturing tool that is directed most of all towards the maintenance and operating of the equipment. It is based on certain important assumptions such as engaging the employees (so they feel responsible and proud of their equipment's condition), early success (building the momentum behind a given initiative ensures that an early success will be followed by the long-term effectiveness), providing an active leadership (it combats the natural tendency of the employees to drift back into their old behaviours and actions) and evolving the initiative itself (continuous improvement techniques).

SMED – Single-Minute Exchange of Die (also known as Quick Changeover of Tools) was developed as a methodology aiming at reduction of set up time during changeover (Shingo, 1985). This methodology finds its use in responding to fluctuations in demands and lead time reduction, elimination of wastefulness and lot sized' reduction (Moreira, Pais, 2011).

SMED refers to the theory and techniques that are useful for reducing setup times. It is applicable in every kind of industrial unit and to every kind of machine. The methodology can be defined as the minimum

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amount of time for changing the type of production activity, so it considers the moment between producing the last piece of the previous lot and the first piece that is produced by the subsequent lot (Shingo, 1985).

Traditionally, the setup costs are regarded by the companies as one of the most expensive ones. Because of that, many companies tend to minimize the number of implemented setups, which in turn resulted in producing very large lots. This contributed to low productivity and excessive inventory (Liker, 2004).

Shingo (1985) states that the place of SMED's methodology was Hiroshima, Japan during the 1950s. Its roots can be traced down to the premises of Mazda Toyo Koyio and Mitsubishi Heavy Industries. But it was widely acknowledged not earlier than in 1970s, as a part of the Toyota Production System. The main purpose of SMED's development was reduction and simplification of the setup time during the changeover (Shingo, 1985). SMED can be described as a Japanese based innovation. It makes possible to respond to demands' fluctuations in order to achieve lead time reductions. It additionally serves to eliminate wastefulness during changeover and to diminish lot sizes (Moreira, Pais, 2011).

The mass production with time became obsolete as the trend of product customization's grows. Consequently, the companies deploy numerous strategies to compete at once in terms of price, quality, product, delivery time and product differentiation. Thus, improvement of production processes requires the analysis of the value added by each activity in order to eliminate all those actions that are not adding any value to the product (Levinson, 2002). This makes the SMED methodology a very important element of Lean Manufacturing.

The large diversity of products makes the company face specific demands, so it became an imperative to produce smaller lots in such a way that will not jeopardize the global productivity of the firm (Blan, 1994). The company has to be capable of producing a large diversity of the goods in smaller quantities. This in turn demands that the company has the competencies required by the changeover activities. The need for competing means that the company should seek the ways of reducing setup times and eliminating wastefulness and those activities which do not add value. Additionally, there is also need for converting idle setup time into the regular production time. This means that the company has to focus strongly on process and organizational innovation (Carrizo-Moreira, 2014).

The problem described above can be easily solved with the application of SMED methodology (Shingo, 1985). The main challenge is implementation of a process-based innovation with standardized and properly documented setup operations. In this manner, the employees are able to follow all the procedures of a given process, which results in the reduction/optimization of setup times (Cazzirzo-Moreira, 2014).

SMED belongs to a number of many lean production methods aiming at reducing waste within a manufacturing process. It is a rapid and efficient way which allows for converting a manufacturing process

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from running a current product into running a new product. This rapid changeover is an actual and effective key to reduce production lot sizes and improving flow thanks to that. The phrase "single minute" should not be understood as meaning that every changeover or startup should take only one minute, but that all of them should not take more than ten minutes ("single-digit minute") (Shingo, 1985).

SMED is closely associated with one more concept, which seems to be much more difficult, One-Touch Exchange Concept of Die (OTED). It states that the changeover should happen in less than 100 seconds. Original reason for developing SMED was to improve die press and machine tool setups, but it principles find their application in every type of changeover. Setup operation is the preparation or post adjustment performed once before and once after processing of each lot. According to Shingo, the setup operation can be divided into two parts (1985):

1. Internal setup – the setup operation demands the machine to being shut down (attachment of removal the dies).
2. External setup – the setup operation does not shutting down of the machine, it may still be running. It means that those operation may be performed either before shutting down the machine or after it – it does not really matter for the effectiveness.

   Based on that, there are three main steps of SMED implementation (Shingo, 1985):

Step 1: Separation of the internal and external setup.

Step 2: Converting internal setup into external setup.

Step 3: Streamlining of all setup operation's aspects.

SMED methodology typically is applied to preparation of some optimal standardized procedure for changeover operations on a defined machine. Into consideration during setup there also must have been taken issues of ergonomics and safety. An ergonomic workplace is important for the operators because it makes easier for them to proceed with operations. This means that they need simple but crucial changes (Ulutas, 2011).

Aside of Lean Manufacturing there is also Pull Philosophy to consider. Pull strategy, in opposition of push strategy, is a manufacturing system with the production based on actual daily demands/sales. It includes the flow of information from the market to the management in a direction opposite to those appearing within the traditional (push) systems. This demands a short explanation what a push based strategy which is "basically the strategy where the material is pushed to the supply chain from the initial raw material end to

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the customer end on the basis of the demand forecasts. At the end of the supply chain, the finished goods await customers' orders" (Sarbjit, 2017).

This strategy demands an existence of expanded inventory in various forms such as raw material, work-in-progress and finished products and that they are available at different points within the supply chain, just in case they may be needed. The environment of such strategy operation is uncertain as the customers' demand are unknown. On the opposite, a customer order is needed to pull a material into a supply chain and then it is known as a pull strategy. The problem with this strategy is the willingness of the customer to wait during the time of the product's processing in the supply chain. If the waiting become too long, the strategy of pull may fail. Pull processes' operational environment is the one where the customer's demand is known. In a perfect scenario, there should be no unnecessary inventories all across the supply chain (Sarbjit, 2017).

Pull strategy becomes more and more popular among the modern companies that noticed the draw-backs of the push strategy such as the costs related to the inventory. As recently the pull system is pushing out the push system, Lean Manufacturing was developed. Surely, not every company can go for pull system due to different limitations and market demands, but for those, who are able to implement this new way of perception of the supply chain, it is undoubtedly beneficial.

It is worth mentioning about one of the most popular tools used by Lean Manufacturing, namely Kanban. Kanban (*kahn-bahn*) comes from Japanese and means literally 'visible record' of 'visible part' (Surendra et al, 1999). It simply refers to a signal of some kind. In manufacturing it refers to Kanban cards. The idea is that a part is pulled by the customer from the supplier of that part where the part's customer si the customer of a finished product (external) or the production personnel at the succeeding station in the factory (internal). The supplier may be also a person at the preceding station in the factory. The main idea is that there must be send a signal in order to produce or move the material, otherwise it waits (Surendra et al, 1999). Achievement of manufacturing excellence in modern times demanded from many companies developing a variety of techniques and methods to make their production operations effective and productive. Kanban system was implemented by most Japanese companies because it helps in saving costs by elimination of over production, developing flexible work stations, reduction of waste and scrap, minimization of waiting times and logistics costs. The results is reduction of the inventory stock levels and overhead costs (Surendra et al, 1999).

There are certain determinants that have to be taken in consideration when considering implementation of Kanban system as it does not have to be necessary a success. The factors to consider include inventory management, quality improvements and quality control, employee and top management commitment, vendor and supplier participation (Kumar, 2010).

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The Kanban is a very powerful tool for reduction of waste during production because it is a direct communication to the supply and the customer. It is the pull signal for producing needed goods. Once the product is withdrawn for production, at that moment the Kanban informs the company what exactly is used by the customer and hence what he will need later on. The material is send as fast as possible to the production line. It can be said that Kanban is doing the "talking" to the production system. It tells that product has to be produced because it was removed. It easily bypasses the accounting and planning systems as it deals real time with realities of things that happens on the line (Apreutesei et al, 2010)..

3. Methodology

The aim of research presented in the following part of the paper is to analyze the current situation in the Lakrids by Bülow company and the possibilities of productivity improvement by 20 % despite the existing space restrictions. The justification for desired improvement comes mostly from the growing customers' demands for the products.

Research was conducted with the use of two methods: observation and documentation provided by the company. Observation is a method of collecting data through observing. It is classified as a participatory study which means that the researcher immerse himself in the setting where observation takes place while taking notes. It has certain advantages because include direct access to the research phenomena, generates a permanent record of the examination to be referred to later and high levels of flexibility in terms of application. On the other hand, it has also certain disadvantages as it requires more time than the other methods, high levels of observer bias and the fact that the observer's has an impact on the primary data because his presence may influence the other participants' behavior (Dudovskiy, 2018). In this case the requirement of more time was no obstruction as the author works in the company so he had a direct access to the desired data in his everyday work without interrupting the others' normal behavior. Data collected through day-by-day observation proved to be very useful for the case study.

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The second method was analysis of documentation provided by the company. It is a form of qualitative research. Documents during this procedure are interpreted by then researcher to give necessary data related to an assessment topic. It is a low-cost way serving obtaining empirical data. The process is also unobtrusive and nonreactive. Its combination with data received from observation allows for bias reduction and improvement of credibility. Document analysis has systematic character. It analyses texts and images that were recorded without any intervention from the researcher which makes them a very objective source of information (Bowen, 2017). Documents brought numerous chunks of information important for the case study and in this way it refilled data coming from observation that could not be received from participatory observation.

My biggest advantage was that I'm part of Lakrids By Bulow. I joined company in 2015 and in very beginning my key responsibilities were warehouse operations. In 2017 my new task was established procurement department and improve purchasing processes in the company. With years of experience from warehouse operations I had knowledge to define key challenges that stops company to grow, like space restriction.

4. Case study

In this section I would like to present main processes in procurement and manufacturing field. 91 % of company turnover is coming from chocolate coated products, it means that chocolate is one of the most important raw material in the company. Using liquid chocolate eliminate space restriction but it requires very good planning since there is limited capacity for liquid deliveries.

On the other side we have packing solutions, that thru low price company main supplier is located in China. In this case to eliminate transport cost orders are placing in big quantities which generate extra cost of external warehouse.

All the labeling of the jars is made inhouse and comes to the stage that during company world-wide expansion, labels need to be print in many languages. Variations of the products during whole year also require new labels. Ordering big batches of labels is not best solution because will generate waste.

I decide to choose those cases because each of them provides different situation and generate different solution by using Lean.

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STUDENT REPORT

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4.1 Company profile

The founder of the company Lakrids by Bülow was Johan Bülow, born into a family of entrepreneurial spirits. He wanted to create something special and he put his interest and passion into liquorice. He felt that this Scandinavian Favorite was underappreciated, so he decided to take it more seriously. He learned the craft in order to cook, roll and cut his first product in 2007 (*Our story*, webpage).

Graph 5. The first Lakrids shop in Svaneke

Source: *Our story*, webpage.

The first Lakrids shop was opened in Svaneke on 07.07.2007. The idea was to cook the liquorice right down in the shop and allows it to being smelt in a radius of 100 meters. It was a full success as everything was sold out within two hours including a sample bowl bought by the last customer (*Our story*, webpage).

The first factory was founded in 2008 to meet growing demand. Johan bought a liquorice machine which was installed in his newly rented factory located in Taastrup in order to scale production. Here the first four liquorices were created. In 2009 Johan together with production manager Tage developed an idea that liquorice could be coated with chocolate despite the opinions that it was impossible. The product A became very popular within a short time (*Our story*, webpage).

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Graph 6. Production of choc coated liquorice

Source: *Our story*, webpage.

The company was moved into new facilities in Hvidovre in 2013. The controlling stake of the company was sold by Johan Bülow in summer 2016 to Swedish fond Valedo Partners. They owned also Joe & Juice. Johan Bülow is no longer a main owner of the company but he still remains its director. At the moment there are 200 employees. The profit gained in 2018 was 22 million DKK which was 6 million more than in 2015 (own data).

Lakrids by Bülow strives for being a sustainable enterprise. The company is not yet 100 % sustainable yet but they constantly work on that in order to reduce its environmental impact. Sustainability means "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (*Sustainable luxury*, webpage).

The result of reusing materials is less waste and minimization of damage of the environment. The company's focus is optimization of processes and packaging in order to become more sustainable in the future. The example of actions taken in order to achieve that are new jars introduced by Lakrids.

They are made from 100 % recycled plastic (R-PET). The metal is removed from the seal of the packaging. The lid is currently produced from virgin plastic but there are works proceeded in order to find more sustainable solution for this part. The emptied jar can be put into the container for plastic waste so it can have a new life (*Sustainable luxury*, webpage).

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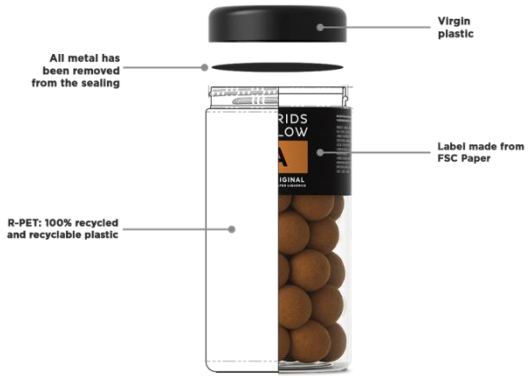
Graph 7. The new recyclable jar



Source: *Sustainable luxury,* webpage.

The company is also working on reduction of the amount of packaging and making the choices of materials so their impact on the environment will be smaller. The gift packaging is made from 70 % recycled cardboard. The carton should be separated after use from the plastic tray and both materials should be put into the right waste containers (*Sustainable luxury*, webpage).

The factory located now in Copenhagen makes 330 pounds of liquorice per hour. The candy is produced from the licorice root and is very popular in Scandinavia. The main point of Johan's idea was to produce a gourmet version of liquorice. He loved to eat it himself as a child but he noted that people were buying the candy in supermarkets and that there is a niche for a very special version of the product. Liquorice has characteristic salty taste and deep black color. After twelve years of operation, the company ships its products worldwide. Liquorice is sold in 1500 shops in different countries (*How Danish…,* webpage).

Making a batch of liquorice takes between eight and twenty four hours. Then molasses is added and the mixture is pressure-cooked until the air is squeezed out. Then it is cooled on a conveyor belt in the form of long strands. When dried completely, it is snipped into small pieces. On the surface chocolate drips for eight hours so it covers each liquorice in thirty thin layers. It ends with adding fruit powders, liquorice powders or salt (*How Danish…,* webpage).

Quite the contrary to the large-factory produced liquorice, Lakrids produces truly gourmet liquorice due to their ingredients' sources. Molasses comes from South America, locally produced oil from the island of Bornholm and liquorice root comes from the Middle East (*How Danish…,* webpage).

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Interestingly, in 2018 for the first time in the company's history, 50 % turnover comes from exports to the other countries. Liquorice is currently sold in 1500 shops in six different countries (including Germany and Dubai) but it is also shipped worldwide. Johan's team, before entering any new market, travels to that country to get to know its culture, tastes and preferences. Then he creates liquorice according to that knowledge (*How Danish…,* webpage).

Product portfolio includes four main types:

- Standard products: 9 different types of products, some of them available in 3 different sizes. Standard products are available during the whole calendar year.
- Seasonal product: products categorized by 5 seasons (Love Line, Easter Line, Summer Line, Anniversary, and Christmas Line). Products are developed for a special period and available just during the seasons.
- Organic products: handmade products manufactured by original recipe from 2007.
- Food line: two types of powders and sirups

4.2 Analysis of warehouse and suppliers

The warehouse and suppliers chain in Lakrids is depending on certain factors, including space restriction for storing raw materials and ready products as well as the need for ensuring high quality of the goods (gourmet product should be made of the best possible materials). It is presented at graph 8.

As it can be seen from the graph 8, the suppliers may deliver inventory either directly to the factory or to the external warehouse. Using mostly the external warehouse is cost-effective but can cause delays in receiving the needed raw materials for production. Raw materials are delivered directly to the factory only in amounts needed actually, while the rest is stocked in the external warehouse. It is more cost-effective than ordering small quantities frequently, as it was already discussed in the theoretical part of this paper. The costs of ordering larger quantities of materials are usually lower than the costs of frequent orders of small quantities. Additionally, ordering large quantities from the suppliers lowers down the waiting time for the necessary materials as they can be brought in from the external warehouse every moment when needed without too much waiting.

Internal warehouse is designated mostly for keeping the products before they are sent out to the customers, either through retail, wholesale or e-com. That is due to the limited space. Mostly, orders are

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composed quickly and efficiently, so they do not stay at shelves too long. The stores send in their orders and those are proceeded in one line, while special orders (such as company gifts with logo) go on the other. This way special orders do not have to wait for realization which is important for the customers. Additionally, the stores are not overloaded with stock but get the proper quantities of each type of liquorice which are calculated based on regular reports of sales.

A good solution for cutting costs of inventory is Liquid Chocolate offshore manufacturing project launched by the company in 2018. The space savings are not large though the company could eliminate the space used for melting chocolate, time consumed by it and labor, so overall savings are noticeable. Also, liquid chocolate costs definitely less than solid one.

The company purchase chocolate needed for liquorice production in Poland and Belgium. There are numerous liquorice types that are covered with layers of dark, white or milk chocolate, so the need for chocolate is constant, especially that the factory cannot stock too much of it at a time. The table 3 compares the costs of bought solid chocolate in 2017 and in 2018 on one hand and liquid chocolate in 2018 on the other one.

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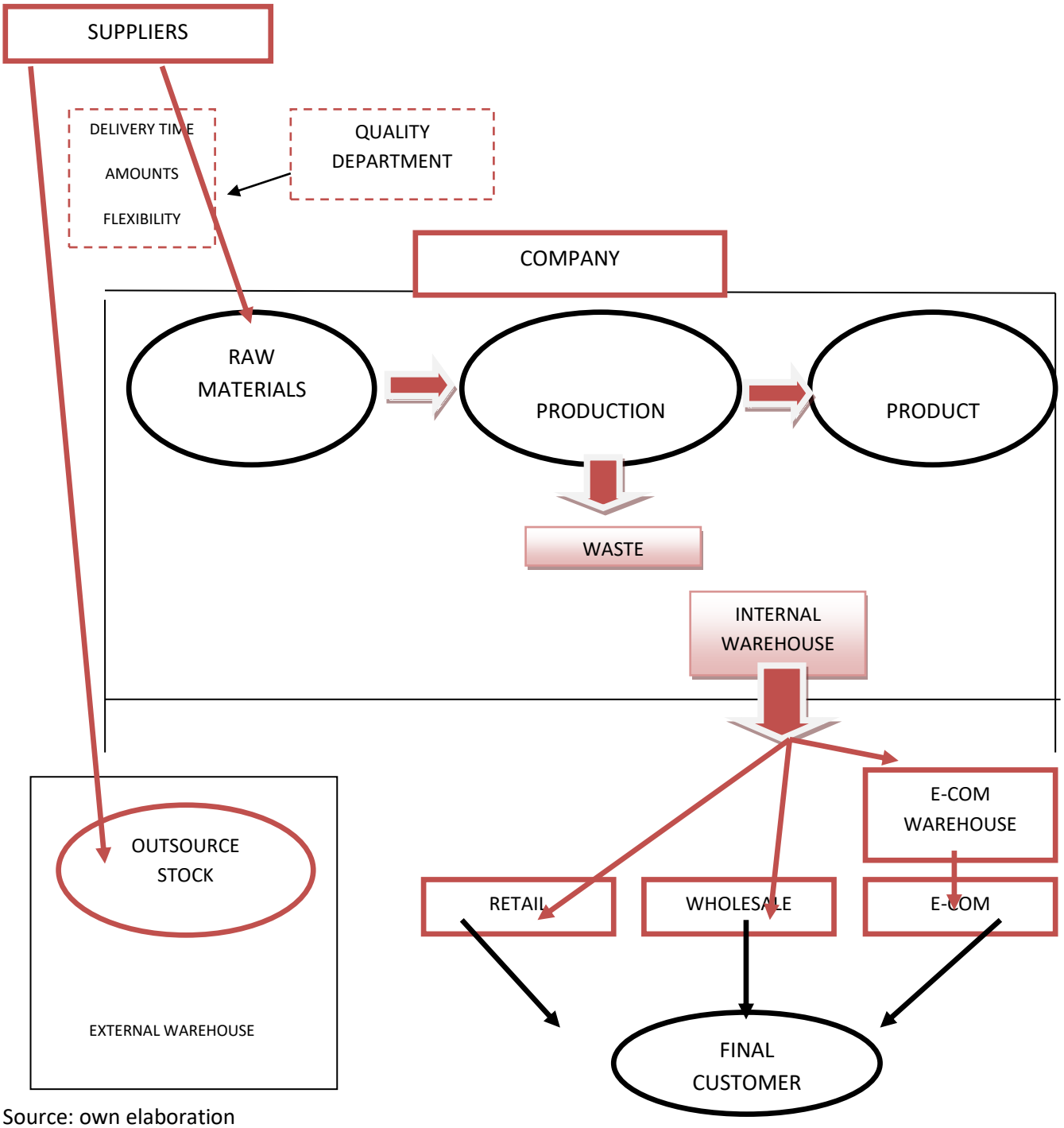
Graph 8. Schema of inventory flows in Lakrids



Source: own elaboration

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Table 3. The comparison of prices of solid and liquid chocolate

	Price 2017	Price 2018	New price 2018	Amount 2017 kg	Amount 2018 kg	Savings pr kg	Savings Total
Choc. **dulce de leche**	35,62	32,58	24,41	96,464	138,186	8,17	1,128, 316
Choc. **white**	25,25	24,73	22,79	115,449	217, 167	1,94	421,303
Choc. **milk**	25,95	24,79	23,35	105,960	75,121	1,44	108,174
							1,657,793

Source: own elaboration.

The table indicates that there is a significant difference in the prices of solid and liquid chocolate. For example, one kilo raw material Chocolate Dulce de leche costed 35,62 DKK in 2017, 32,58 DKK in 2018 and in a liquid form 24,41 DKK in 2018 respectively. If we compare prices 2018, liquid chocolate cost price is 8,17 DKK cheaper than solid chocolate cost price. Further, one kilo raw material Chocolate White costed 25,25 DKK in 2017, 24,73 in 2018 and in a liquid form 22,79 in 2018 respectively, which is 1,94 DKK cheaper than in solid form same year. Finally, one kilo raw material Chocolate Milk costed 22,95 DKK in 2017, 24,79 in 2018 and in liquid form 23,35 in 2018 respectively, which is 1,44 cheaper than in solid form same year.

The main advantage of using liquid chocolate in production, as indicated by the table and the company data, is about 10 % savings in the company annual income (turnover). It achieved up to 1,657,793 DKK out of around 8 million income in 2017 and 10 million income in 2018. The savings lies in the raw material price consisting of purchasing in Poland and Belgium, transportation, storing in warehouse and preparation of chocolate. The significant reduction of production costs resulted from abolishing chocolate melting process and off-shoring it to another country. It also allowed for saving space waste for storing the stock of chocolate. The inventory waste was also significantly eliminated.

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It is possible to consider offshore manufacturing and the whole Liquid chocolate project as continuous improvement. First - it is innovative, second - it represents small incremental improvement, that leads to big structural improvements (savings, significant waste elimination, process optimization) and create processes that are highly effective and efficient. It creates better practice, and prevents the future additional expenses.

Due to the space restrictions Lakrids cannot keep the maintained Safety Stock, so it uses the Reorder Point to calculate a following order for replenished units. As liquid chocolate is ready to use and does not have to take time and space for preparation, ROP sounds as a good solution for calculating how much of it should be ordered and how often. A complication comes from the fact that daily usage of chocolate in the factory fluctuates for several reasons. First, there are produced not only chocolate covered liquorices, but also the kinds that do not demand use of chocolate. The amounts of each kind fluctuates on the daily basis depending on specific orders. Nevertheless, demand is constant, though it differs from time to time. The lead time is 15 days, so every new delivery of chocolate should arrived every fifteen days in order to not overfill the warehouse. Since the space restrictions do not allow for overproducing one or more kinds of the treat, the production numbers are based on actual orders.

Based on the amount of chocolate ordered in 2018 (including both solid and liquid) average daily usage can be calculated as 973,77 kilo daily. Thus:

ROP = 973,55 kilo * 15 days = 14 606,55 kilo.

Having that number the company may track its stock of chocolate and order it whenever its number gets closely to ROP, even when the lead time differs. This way, there is no need for storing too much stock and there is no risk of production interruptions due to the replenished material. Similar calculations are done for the other raw materials and packaging materials in order to secure enough stock and limit its overload at the same time. Since the company is using mostly exterior warehouse for storing inventory, it is important to control how much space is needed for storing. The problem is that the fluctuation of production of different types of liquorices may still cause difficulties and additional costs, for example related to payment for storing of the inventory in the exterior warehouse. Those are variable costs as orders are estimated on the average daily usage which may not reflect the actual use of the material.

At this moment it is crucial to analyze the costs of warehousing inventory. The ready-made products are shipped immediately, so they do not generate noticeable storing costs. It is definitely different with the raw materials storing costs in the exterior warehouse.

Due to the space restrictions, the company uses the exterior warehouse which allows for savings related to maintaining the interior warehouse for storing whole inventory. The analysis unit is one pallet. In

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the exterior warehouse the cost per one pallet is 60 DKK and is payable only for physical storing of every pallet, so it varies depending on the amount of stock stored.

In the case of using own warehouse the costs include:

- number of pallets located in the warehouse: 2200 (70 % would be taken up by raw materials),
- the number of employees: 3 with average monthly pension around 30 000 DKK,
- rent (along with cost such as energy, water etc.) – 250 000 DKK monthly.

Monthly cost per 1 pallet is:

$$(250\,000 \times 12) + (90\,000 \times 12) / (70\% * 2200) / 12 =$$

$$3\,000\,000 + 1\,080\,000 / 1540 = 220{,}78 \text{ DKK}$$

Those costs cannot be limited because they are fixed, which means that it does not matter whether all pallets are used or no. The cost is the same all the time and may increase due to such aspects as rent and energy prices rise. This makes maintaining own warehouse inefficient and costly, while renting storing spaces in the external warehouse is much better choice. The only problem is that it limits the number of raw materials that should be purchased at one order because buying more than needed in a lead time could in a noticeable way increase costs of storing. Since this cost is variable, the company's objective should be to keep it as low as possible.

Storage waste is one of main issues when there are space restrictions. One of the solutions launched by the company in 2018 is Rework of chocolate. This simply means that used chocolate as well as the remnants from the previous seasons and collections are not stored and do not take up the costly and insufficient storing space. Instead, they are reused which saves not only costs of storing the inventory but allows for lowering the amounts of chocolate ordered from Poland and Belgium. The data provided by the company proves that both kinds of chocolate (solid and liquid) are reworked.

The numbers provided by the company indicate that reworking chocolate allows for large savings, even up to 90-100 % of initial amount of purchased raw product, which is presented in table 4.

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Table 4. Savings on reworking chocolate

Product name	Amount Q1-Q3	Amount Q4	Savings
Choc.dulce de leche	86, 474	53,281	139,755
Chocolate white	111, 069	70,867	181,936
Chocolate milk	38,862	24,788	63,650
			385,341

Source: own elaboration.

Total product savings of reworked chocolate in 2018 are 385, 341 kg, which is around 80-90% of annual raw chocolate purchase 2018 (430,474 kg) and more than 100% of annual raw chocolate purchase 2017 (317, 872 kg). That amount of product savings is significant and represents closed production cycle. This way the company is able to switch to waste-free or low-waste production. The result of that is reduction of the raw materials' cost. Once the cost price is reduced, the profits of the company grow.

But the main point here is that raw materials do not require storing and do not take up the space, while at the same time they do not lose their value. There always is a product that raw materials can be used for: if not for one, then for another one. The advantages of this kind of production is elimination of warehouse waste (materials are not stored), facility and space waste and time waste. Waste gets converted into value, which agrees with Lean Manufacturing basic principles.

Based on the above observations and notions, it can be stated that Lakrids is doing very well with managing its space restrictions, but the question here is whether there can be something more done in order to increase the productivity even more or not. That will be considered in the following part of the paper.

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4.3 Solution of the problem

The problem that the company is facing is space restriction which limits to some degree the scale of production. Since it was stated that using internal warehousing is not profitable and the company's storing rests mostly on the external warehouse, some issues still remain unsolved. Using external warehouse, even though is less expensive, still generates some additional costs such as transport of the materials from the warehouse to the factory when they are needed for production. Additionally, for the flow of production it is necessary to keep some materials on place, at least in the quantity needed for time lead production. As it was noted, the company orders new quantities of materials (it was discussed based on chocolate example, but it is similar with the rest of materials) every 15 days or so. Some of materials go directly to the factory and some are send to the external warehouse and then in smaller portions come to the factory every few days. This means that even the most of materials are stored externally, there is some inventory kept on situ. Due to space restrictions though this is a problematic issue.

The solution may be implementation of 5S theory which helps in organizing the on situ inventory maintenance. These demands applying the five steps: sort, set in order, shine, standardize and sustain. In practice this can be done through the following actions:

1. The starting point – first of all, it is necessary to quantify the existing storage profile. It demands full understanding of the flow of utilization of the actual layout. The elements that should be included are: slotting/pick philosophy, rack configuration, put-away, receiving, replenishment, inventory management, packing, shipping. Another thing important to consider are seasonal peak trends as well as thorough analysis of product flow (inbound and outbound).
2. Using vertical space – it is important to make sure that all vertical space is use efficiently. It is often a case that not all clear span height is used, so it should be investigated. It needs a design of facility that will allow for easy and comfortable access to the higher cubic feet of vertical space, but once it is done properly, it will pay off.
3. Analysis of department space –it should be identified which areas do not require high ceilings and can be moved to the spaces with lower ceilings. It is an often case that some departments like packing and shipping, which are clearly horizontal, have a lot of empty space overhead that is not used at all and is not needed for the department's activities.

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4. Consolidation of locations – in order to utilize space, it needs to be checked whether the same item is not stocked in multiple localization or not and if it can be moved into one spot. This can be done as a standalone function or during the put-away process.

5. Right-sizing the slots – matching the size and sales of every item to make sure that the pick slot is right size. This maximize the utilization of the picking slot cubes. This process can be facilitated by having various sizes of picking slots. The same applies for storing reserve and overstock if they exist.

6. Reconsidering the amount of excess inventory that is stocked in the internal and external warehouse to make sure that the balance between them is correct and appropriate for daily production needs.

7. Aisle width – it can be useful to design the minimum width that is required for material handling equipment use but remembering about the operating efficiency that should not be compromised.

8. Best utilization of the building –it is advisable to determine how the building can be utilized in terms of space standpoint. The aspects worth of considering are: clear stacking height, building impediments, column spacing and overall process flow. The vertical space needs should be matched with the building features. It is possible that there are unused spaces or spaces used in non-efficient way that could be otherwise utilized for storing inventory.

9. Depth of storage – not only height locations can be used effectively or not. It also goes for the depth of storage such as double-depth racking.

10. Supply storage – double check whether supplies and packing materials are not overstocked or not. A good solution may be having the supplier to keep some of the inventory at his site and ship them every few days.

11. Door use – the space may be saved by combing shipping and receiving docks.

12. Mezzanine installation – if there is a mezzanine available in the building, it can be used for housing functions not requiring high-bay storage. The mezzanine may also be installed, i.e. over the shipping or packing department if there is an available space. Although it is expensive and fairly permanent, it helps to maximize warehouse space utilization, which in the case of space restrictions is a good and efficient solution.

13. Keeping everything simple – whenever there is a choice between a simple and a complex solution, the simple solution is definitely a better choice. The good example may be adding pallet rack tiers upward.

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Following the above steps can help in saving the space for more on situ inventory. This in turn saves time needed for waiting for a new delivery of the materials from the external warehouse. It also can be used to minimize the number of pallets rented in the external storage, while the costs of using the space in the building in more efficient way are limited. It does not change the costs of maintaining the factory, energy etc. It does not require more employees and probably the only costs are related to some needed investments in additional equipment etc.

Another proposed solution is to install a computer program that will control and manage actual inventory needs. As it was stated before, the quantities of delivery are calculated based mostly on the average daily usage which is not exact and changes frequently depending on such aspects as special orders, seasonal trends etc.

Typical inventory management software can be used for tracking inventory levels, orders, sales processes, deliveries etc. It can also serve for generating production-related documentation (bill materials, work orders). The main purpose of using such systems by the companies is to avoid overstocking of products and outages, which in case of space restrictions is especially important. Main features include management of orders, asset tracking, product identification and service management.

The software for Lakrids should be able to combine management of the inventory stored in the external warehouse with those materials that are already on situ in order to ensure that whenever the stock on situ comes to a shortage, a new delivery from the external warehouse will be already prepared. Also, this way it can be ensured that the orders for new shipment of materials from the suppliers will be send just on time – meaning that when the inventory in the warehouse is getting low, it is time for sending in a new order. This should help in keeping the flow of materials even and uninterrupted, responding well to the actual production needs.

The software additionally should include management of the final products, ready to ship to the customers and stores. Keeping track of all orders integrated with the inventory management helps in maintaining a flow of production.

The system that would be appropriate for those tasks should have the following features:

1. Product categorization – products can be migrated from one group or channel into another. They are categorized by type, name, price, supplier, supply channel etc. This provides the management with full inventory control as every product/material ban be tracked

And demand is forecasted.

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2. Sales/purchase orders – managing both sales and purchases from a single system. The system should include order tracking tools, invoice management tools, inventory control tools and similarly. This way the full integration of selling products and purchasing materials helps in minimization of waste and allows for better usage of available space.

3. Electronic scanning – enables electronic data interchange and caters for global trends in selling. Scanning and tracking assets with the use of electronic introduces a new level of controlling inventory. Electronic shipment and complete tracking of the warehouse is also available.

4. Automatic ordering – it saves time and manual efforts taken up by managing billing and tracking projected sales in the most optimized way as it is possible.

5. Dynamic material/product information –it means full access and inventory control of the stock as well as a close eye on every available material and product. It allows for easy management of products and all information can be integrated which helps in calculating amounts of needed materials and the lead time.

The actual choice of inventory managing software should be based on the detailed analysis of existing problems and needs in this area. It is though definitely sure that integration of all assets into one system can save a lot of waste and be very helpful, especially for the company that have space restrictions but despite of those inspires for increasing its productivity by 20 %. It does not mean that they should produce more than they need, but rather that in this way waiting time for orders' realization will be shorter.

Also, it is necessary for potential entrance into new markets that demands increasing of production. Every new market means the need for new products and larger number of the goods in general as it cannot cause lowering amounts of produce for the already existing markets. Entering new markets means development and it was already indicated in the description of the company's profile that development and making more people in love with the treat is a main goal of the director and the company itself.

4.4 Supply chain challenge – China versus Europe

Most of the boxes and packing materials are produced and imported from Asia (China). The solution was working quite well for a time being, but there are some disadvantages that are causing problems and prove to be costly for the company. The negative consequences of this solution were already experienced by the company several times, so it needs to be examined and adjusted to work better.

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The main reason for importing packaging from China is its relatively low price. One box produced in Asia with the cost of delivery is 8.01 dkk. It is presented in table 5.

Table 5. Prices of boxes from China

	GIFT BOX A	GIFT BOX B	SUME
Yearly consumption (in pieces)	120.000	100.000	220.000
Cost (in dkk)	961,200	801,000	1,762,200

Source: own elaboration.

The standard delivery time is 4 months after ordering which is quite long. Additionally, the distance causes one of the main problems with this supply chain, namely too long waiting for packing materials. The negative result was that there were shortages in the warehouse when there was a sudden surge in orders. That put the company in very difficult situation as the customers had to wait for their orders which is not good for the company's reputability.

The other problem related to using materials imported from China is that due to the customs service. Because of its slow proceedings there are often delays which also are not good for the business. On the other hand, ordering more materials so there would be a reserve of it in the case of delays and overload of orders isn't a good solution due to the limited storage space that was already discussed. It is possible to speed up delivery when necessary but it creates additional costs as the container swims to Hamburg and then goes by a truck to Copenhagen. It adds the cost of 16,000 dkk to the overall costs of packing materials imported from China.

The space limitation creates one more problem. The minimum order of packaging is 40' container which makes 50 pallets of boxes. There is no place for storing such amount of materials in the internal warehouse, so it demands using the external warehouse. For the moment it means that the strategy used is Push instead of Pull that would be much better and effective. Using the external warehouse, as it was already discussed, increases an overall cost for the company.

There are also problems when the material comes damaged as the time of complaint processing is longer and it involves additional costs of transportation. Another thing is that the company's mission involves sustainability and using boxes produced in China is risky in this matter. It is hard or even impossible to control the production in China, the materials they are using and the factory equipment. There is also a matter of the factory's employees as it is widely known that the Chinese laborers are underpaid and overused which does not go exactly in one line with sustainability.

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PROBLEM SOLVING:

It seems that some of the problems related to importing packing materials from China can be eliminated or reduced by changing the supplier of materials for one or more operating in Europe. That would definitely shorten up delivery time. It would also be possible to use Pull strategy by optimization of deliveries: smaller orders more often and depending on actual need. That would also limit the space needed for storing the boxes and probably even eliminate renting the external warehouse for this purpose, especially if proposed earlier changes to the company's building organization would be performed. Also, the production process can be controlled and that answers the question about sustainability.

There is just one down point in this solution which is the higher price of an unit. One box delivered by an European supplier costs (including delivery) 9.1 dkk, but there is a noticeable shortening of delivery time to just 1 month and there is no additional cost related to speeding it up and for storing.

DISCUSSION:

It seems that there is more advantages in changing the packing materials' supplier from the one in China to the European one, while the main disadvantage (costs) is not so big problem as it may seem at first, because it is balanced by limitation of additional costs such as speeding up delivery, renting out the external warehouse and eventual costs of transportation in the case of complaint. The table 6 presents the numbers for comparison.

Table 6. Comparison of costs related to importing packing materials

	CHINESE	EUROPEAN	DIFFERENCE
Yearly consumption (in pieces) of gift box A and B together	220.000	220.000	none
Cost (in dkk)	1,762,200	2,002,000	+ 239,800
Additional costs (dkk): -Monthly rent of external warehouse for 50 pallets -Yearly cost for 50 pallets -Cost of speeding up transport -Costs related to complaints (transport)	 3,000 36,000 16,000 (or more when used more frequently) 5,000 + (depending on frequency)	none	60,000 or more

Source: own elaboration.

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It is true that using the supplier from Europe is more expensive, even when calculating the additional costs of using the one from China, but the overall benefits of such change are difficult to overemphasize. The possibility of using strategy Pull instead of Push has numerous advantages and it may help in strengthening of the company positive image which is priceless.

4.5 Labels system in Lakrids

The company has a wide variety of products. Additionally, there are specific demands of the Food Authorization Department. Due to those reasons, the company uses a lot of different labels which take up quite a lot of space. This adds to the problem of space restrictions faced by Lakrids on a daily basis. The labels are divided into language categories (Denmark/Finland, Germany/United Arab Emirates, USA and Australia. There are also two categories of products (within each of language categories): regular and seasonal. The seasonal ones are the most problematic because due to their variety and different ingredients they have to be changed very often.

The problem is that labels tend to be used quickly and the current production system is not effective which results in often shortages in the warehouse. They have to be counted frequently manually which is time consuming and misleading. This is because the counting system is not adjusting the number of labels remaining in warehouse every time part of labels is taken out until the production process is completed. It means that it make take few hours up to few days before the number of labels in warehouse is adjusted, so the person responsible for supplying them is misled. This is resulting in the shortages that delay production and shipment of the ordered products. The process is presented at the graph 9.

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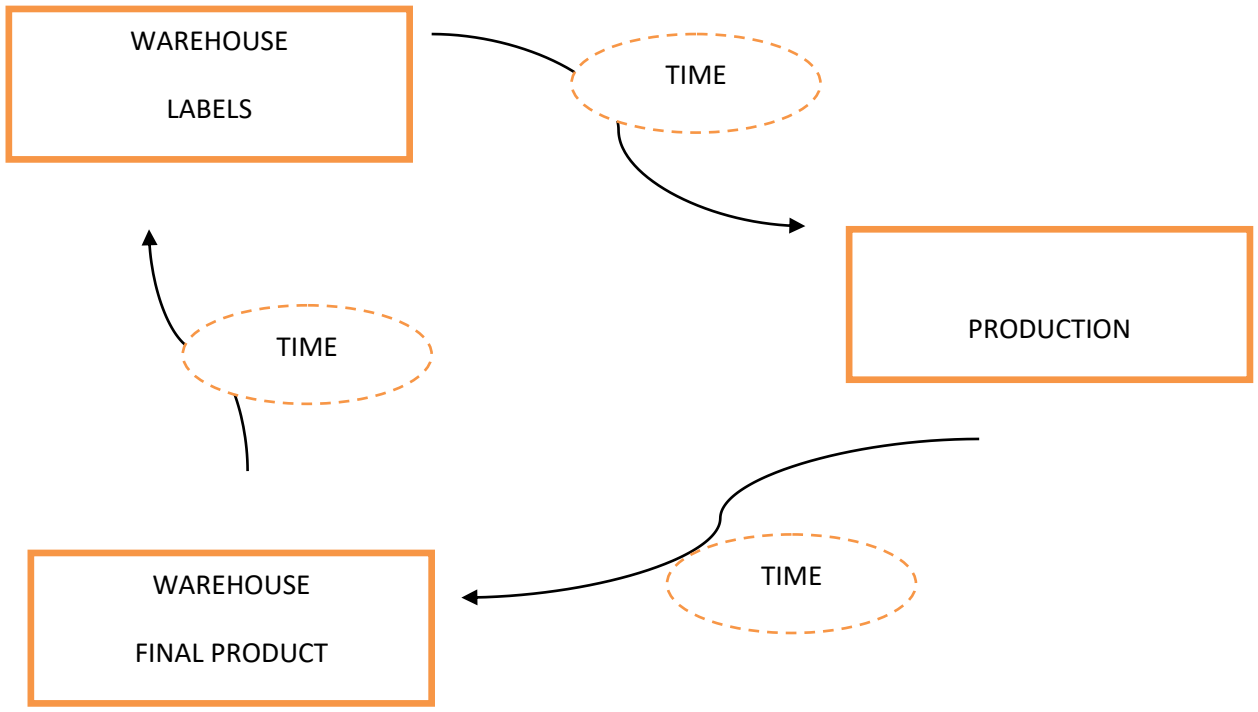
Graph 9. The cycle of labels in production process



Source: own elaboration.

The problem can be solved by implementing the Lean Kanban System. The system is supposed to inform immediately about using labels and their changed number in warehouse, so there would be no need for waiting till the production process ends with ordering new batch of labels. This should improve the overall performance as there would be no tome lost for waiting and unnecessary breaks in the process of production.

The costs related to breaks in production resulting from the shortages of labels and the lack of actual information about labels' condition in warehouse are a substantial loss for the company, so using Kanban System should eliminate that costs and this way improve the production's effectiveness.

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5. Discussion

The solutions proposed in the previous section were not implemented yet, so there is no data regarding their effectiveness. Still, it can be discussed in terms of its advantages and disadvantages from different points of view.

It is better to start with disadvantages or barriers that can appear while implementing those propositions. First of all, there is matter of the management's attitude towards such changes. One may argue that they are eager to implement various solutions that can bring waste elimination and savings and are in line with Lean Manufacturing and Pull Philosophy such as liquid chocolate ordering instead of solid one or reworking chocolate. The point is though that solutions proposed in this paper may demand certain investments and changes in the structure of the factory and the whole system that may seem difficult to implement. Plus, nobody can warrant for sure that the results will be as good as expected. It depends mostly on the way the process of implementation will be directed so it demands appointing to its realization the right people who will take full responsibility and will treat the matter as seriously as it should be. That can be challenging for everyone if it does not proceed correctly.

Some of the elements cannot be introduced easily and there may be some obstructions that are closely related to space restrictions and cannot be overcome easily. Solving the problem is not as easy as it may seem, because otherwise it would probably be solved long ago. Yet, the possible advantage that those solutions may bring to the company and its growth a true driving force and speed it up, are a huge argument for using the ideas. Both propositions are based on theories existing within Lean Manufacturing and Pull Philosophy and aim at two main goals.

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First, it is about using as much available space as possible. This may require certain adjustments and some investments, but it may result in increasing the capacity of internal storage within the factory building. That may lead either to enlarging inventory and thus production on a daily basis while ensuring there is no drop downs and breaks, or to lowering down amount of the pallets rented in the external warehouse without any additional costs on situ. In both cases, one of the positive outcomes may be less frequent ordering of the materials from the suppliers which means the costs of ordering and delivery will be lower. The space may be limited, but there is a possibility that with a thorough analysis of its utilization and implementation of some good design solutions, it can be used more efficiently than it is used currently.

Secondly, the company is using computer systems for managing inventory, supplies, production and orders, but they are not fully integrated at the moment. This results in the loss of some useful information and makes it more difficult to match the inventory with actual production needs on a daily basis. Complete integration of all parts of the system, including the inventory stored in the external warehouse, should make it much easier to coordinate the flow of raw materials and final products, saving time and manual work of the employees. It is advisable to chose such inventory managing program that can offer such full integration or have it specially projected for the company's needs. The second option may be slightly more expensive, but it will ensure that everything works as expected. This kind of investment is justified as it has long-term usefulness and the return on it may be expected in a short time in form of savings and further waste elimination.

Both propositions are related to the basic principles of Pull Philosophy. The inventory costs are well under control and depends on demand for the products, not the other way around. Especially, the software integrating orders, products and materials in warehouse and on situ into one flow, allows for matching in a perfect way production with its outcome reflected in selling numbers and the inventory costs kept on the appropriate level. This way, the overproduction and waste related to it may be almost completely avoided, while the actual needs of the customers are a driving force for the company's actions.

It seems that Pull Philosophy is the perfect solution for the company to use and be able to grow without extra cost of external warehouse. Unfortunately, there are barriers that Lakrids By Bulow is facing now, like human error or poor operation software. In order to gain success and improve some investment and training needs to implement.

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6. Conclusions

Many medium-sized companies face numerous barriers and problems in their everyday operations as well as in terms of development and growth. One of the most common difficulties is space restriction and waste and costs correlated with it. It is often a case when the company is growing very quickly in the amounts of produced goods, but is not ready or cannot afford for changing a place of its operation for a bigger one or having its own warehouse of the size corresponding with the inventory size. In such situation Lean Manufacturing is a good solution as it provides means and tools for managing the problem in the most cost-efficient and effective way possible.

Responding to the research question (*How can Lean and pull philosophy enable optimization of logistics and procurement to support the growth in a medium-sized company with space restrictions?),* it can be stated that there are many ways to support the company's growth with the use of lean and pull philosophy. As that philosophy is aiming mostly at waste elimination, it is obvious that it can be especially useful for the companies with space restrictions. Since such restrictions may be an obstruction for the growth, every way that allows for overcoming them can be seen as supporting. Optimization of logistics and procurement is actually one of the most important results of waste elimination and is reflected by numerous savings in the company's operations. Thus, full integration of all elements of those operations as well as the aggregated utilization of space available (even when it is limited) brings certain benefits in terms of the company's development and growth.

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