Optimizing internal logistics of Plato International B.V.

Final thesis:

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Optimizing internal logistics of Plato International B.V.

How can the internal logistic processes be optimised for the current market situation?

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Februari 2012 - June 2012

Preface

This study is written to fulfil my final thesis at University of applied sciences Van Hall Larenstein for the study International Timber Trade. During the study, practical traineeships including this final thesis traineeship, were very important to develop myself and my knowledge about timber trade and the timber industry. What I've learned during this education will help me in different aspects of my further life.

Thanks to my former classmate Boris Bakker I had the opportunity to do my research and final thesis at Plato International B.V. After my earlier traineeships at timber trading companies, I was interested in finding a producing company to see different aspects of the supply chain. I am grateful to Plato International B.V. for working in their professional organisation which was very instructive for me.

I would like to thank all personnel of Plato for the good atmosphere and collaboration during my traineeship. Without them it would be impossible to finish this research with good result. Also thanks to Richard Kok of Mevo houtindustrie, for his willingness to show me the company and answer my questions.

Special thanks go to Ad Olsthoorn, my supervisor from Van Hall Larenstein. He helped me during the period with advice and motivated me to bring this thesis to a good end.

Of course I would like to thank my internal supervisors Edo Kegel and Tjalling Haisma for their support during my period at Plato. Their knowledge and experience learned me a lot.

Another big word of thanks goes to Eveline van den Bos and my dad for helping me with the correct use of language in this thesis. And last but not least I would like to thank my family and friends for their support and their motivating words during this period.

Arnhem, May 2012,

Jos Jorissen

Summary

This report is written as a final thesis for the education International Timber trade at the School for Applied science Van Hall-Larenstein in Velp. Plato International B.V. wants to optimise its internal logistics for the current market demand. Therefore this research is conducted.

The research question for the stated problem is:

How can the internal logistic processes be optimised for the current market situation?

- Which internal logistic processes are taking place within Plato international B.V.?
- Which improvements can be made to be more effective?
- Which improvements are most useful, regarding costs and benefits?
- How can these improvements be implemented within the organization?

The greatly improved quantity of small and specific orders contain much work for the expedition department. The materials handling has improved a lot due to this trend and the costs per order increased. Important is, to reduce the costs and improve the profitability of the orders. This is achieved by reducing the handling costs.

Especially the classification of the storage hall is not sufficient for the current situation. Over the years the situation at Plato changed a lot but the storage classification did not change. The sections are very large and include a lot of timber which leads to much unnecessary restacking.

This problem can be solved or improved by making a new classification of the storage hall with much smaller sections. Changing the sections will bring not only measurable time and cost reduction, but also other advantages such as better stock overview and better allocation of the timber. Also repackaging which is necessary for the small orders can be improved.

The outcome of this research is that Plato international B.V. can improve its internal logistics by implementing the recommended improvements of this research.

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1 Introduction

Plato International B.V. aims to improve its internal logistical processes in order to be more effective and provide good customer service. The trend in the market is that companies no longer want to keep products in stock. Only well selling products are kept in stock but even these in smaller quantities than before. The companies who do not have products in stock prefer delivery on demand and a high turnover rate to make sure that they can have quick deliveries to their customer. The quantities that are ordered by these customers are also much smaller and more specific. They try to buy exactly what is needed for their customers, whereas in former times, it was usual to buy full packages and they keep in stock what was not sold.

Background of Plato International B.V.

Plato international B.V. is a company that is specialised in the thermal modification of wood. This thermal modification or heat treatment is an effective method to improve the dimensional stability and biological durability of wood. With this method fast-grown and non-durable timber species can be upgraded into durable and dimensional stable wood products. These products can be an environmental friendly replacement for tropical hardwood species and traditional preservative treated timber in different applications. (Appendix 2, Houthandel en Nijverheid, jaargang 87, nummer 17)

In the seventies Shell researched different ways to find alternatives for fossil fuels in their laboratory. One researcher discovered the PLATO-method (Providing, Lasting, Advanced, Timber, Option) as a method to convert biomass to liquid fuels. When the oil prices dropped in 1985 Shell stopped the development of this project. During the development of the PLATO-method researchers discovered that the method could be used to preserve timber species. Shell registered patents for the methods and processes but they decided that the preservation of timber was not their core business. Shell sold the patents to two ex-employees who developed and commercialized the processes. In 2000 the production was started in a new build factory in Arnhem at industry park “Kleefse waard” with a capacity of 50.000 cubic meter per year. Drying company Soetekouw B.V. is a subsidiary of Plato International B.V. at the same location. Plato and Soetekouw cooperate with the use of the drying kilns.

Figure 1 drying kiln

The PLATO-process involves three steps which are called ‘platonizing’(Dutch: ‘platoniseren’). First the timber is stacked into a production package with drying slats which will be heated with saturated steam at 160-180 degrees. This step in the process is called ‘thermolyseren’: depending on the size of the timber this will take a few hours, roughly. After these first steps the packages are taken to the drying kiln where they will be dried to a moisture content of around 8%. This step takes several days, depending on the timber species and cutting size. In the drying kiln the moisture content is measured continually. Moisture content, drying kiln temperature and relative humidity together form the control parameters for the automatic control system. After the drying period the timber will be cured in the curing oven. In this oven the wood will be heated to 160-180 degrees with hot air while the oxygen percentage is lowered to a maximum of 2%, so as to avoid the risk of fire. This process step takes 12-16 days, also depending on timber species and section size. After curing the timber is ready but bone-dry and therefore it will be conditioned in the drying kiln to reach a 3-5% moisture content. This makes the timber ready to be processed in different applications. An extensive description of the production is given in Chapter three.

As a result Plato timber is much more durable than non-treated timber, because the wood structure has been altered and is, therefore, less susceptible to the attack of micro organisms. Due to this process dimensional stability also has become much better. Plato International B.V. sells their products to different dealers mainly in the Netherlands, Belgium and England. It is used in the building industry, mostly for cladding. Other applications are civil engineering and garden applications.

Problem analysis

Over the last few years ,orders received by Plato became much more specific regarding to different sizes and smaller amounts per size. The reason for this is that the timber traders, who are dealers for Plato, not want to have big amounts of stock these days, instead they prefer delivery on demand with a high turnover rate. In addition, the change in the economical situation since 2009 has influence on this. Companies are more reluctant to buy full packages of timber keeping in mind that they will sell it sooner or later. There are producers who do not want or are not able to deliver smaller amounts but this is not really customer friendly. So in order to provide good customer service Plato has decided to deliver smaller amounts but there will be surcharge taken into account.

The change in customer behaviour has brought far reaching consequences for the material handling of Plato. This is why logistic processes must be as effective as possible, especially when orders are more specific as mentioned before. The extra work is mainly at the expedition department because order picking takes more time per person.
Some of the bigger companies are not able to deliver small quantities, as their logistic systems are not equipped to deal with these smaller, more specific orders.
Until now Plato does not have suitable procedures that describe these required logistic processes and ways how to deal with these different situations. Therefore they asked me to research their internal logistic processes. I intend to formulate improvements for these processes and to elaborate on existing ideas on these matters.
The internal quality manual which describes the procedures and handlings at Plato is dating from 2002. And while there are some additions according to FSC and PEFC, it is outdated. To make these procedures up to date it is important to know how the material handling is organised now and what the optimal situation is. Updated procedures are essential for the implementation of the improvements in the logistical processes. Plato is willing to get ISO 9001 certified too in order to provide good customer service and offer the right quality. This requires the right description of the procedures according to quality checks and complaints. Results from this research will be included in these procedures.

The current staff and machinery is sufficient for the current production level but when the sales will be higher and the production must increase, investments in staffing and possibly machinery are needed to be able to get a higher production. Currently there is an additional potential interested customer who requested thermal modified spruce. This customer already ordered two trial orders and if they are satisfied with the quality and price, they plan on becoming a regular customer who will order a large quantity of timber per year.

With the current personnel a higher production is impossible unless there will be more automation. A reason for this is that the personnel of Plato also work in the operations for Soetekouw timber drying. It is hard to make strict appointments with some of the Soetekouw customers regarding the bringing and picking up of the timber. This requires extra flexibility from the company.

In finding improvements for the internal logistical bottlenecks it must be taken into account that there are no large investments possible in the current situation with the current production level. So, a distinction can be made between:

- improvements for the current situation (most important)
- improvements for the future when the sales and production will possibly grow.

The research question for the stated problem is:

How can the internal logistic processes be optimised for the current market situation?

- Which internal logistic processes are taking place within Plato international B.V.?
- Which improvements can be made to be more effective?
- Which improvements are most useful, regarding costs and benefits?
- How can these improvements be implemented within the organization?

Goal

The goal is to give advice on possible improvements of logistic processes within Plato.
This report for Plato International B.V. is a research thesis about the internal logistic processes within this company. This report will support the logistic personnel in improving the processes in the company with the implementation of the improvements for the current situation. This report may be used in the future when it comes to methods to improve the processes at Plato. Hopefully it may also stimulate people within the company to think about processes and improvements.

Target audience

This report is written on behalf of Plato International B.V. and University of applied sciences Van Hall Larenstein, Velp. Other people who are interested in internal logistics are welcome to read it as well.

2Methodology

This chapter will explain the methodology of this research. The goal of this research is to answer the main question. This main question is divided in sub questions. The methodology will be described for each different sub question because these different question need different ways to find satisfying answers.

2.1 Methodology per subquestion

Which internal logistic processes are taking place within Plato international B.V.?

Information that will be collected to answer this question will be found by discussing the processes with the personnel and by observation. The different processes are divided in logistical subsystems: supply logistics, production logistics and distribution logistics. I will compare the logistic processes of Plato and Mevo houtindustrie, in order to create a reference. Additional information about logistics will be obtained by literature study.

Which improvements can be made to be more effective?

The opinion of the personnel involved in the logistic processes of Plato is important to answer this question. For this reason there will be an interview with employees from the sales, production and expedition department. They will be asked about the processes and possible improvements. To broaden my vision on these, I will also visit Mevo houtindustrie. This company deals with the same conditions and market situation as Plato so it is interesting and useful to discuss with Mevo employees as well. They can also tell me where and how they improved internal logistics to adjust to the current market demand. Information about more effective logistics will be found in literature.

Which improvements are most useful, regarding to costs and benefits?

Before implementing the possible improvements it will be necessary to find out what their real value is in comparison with the old situation. For this reason KPI's (Key Performance Indicators) will be established to make it measurable. After comparing situations it will be clearer what benefits most. The cost of the improvements must also be taken into account to decide if these improvements are feasible. The improvements that offer the highest benefits compared with the lowest cost will be implemented in the organisation. Literature study will help choosing the right KPI's and compare them.

How can these improvements be implemented within the organisation?

When improvements are ready for implementation it must be clear how this can be implemented in the organisation. This must be discussed with the internal supervisors. Also, personnel involved will be informed about the improvements and implementation because they have to work with it every day.

2.2 Theory

This section describes the different research techniques that are used during the research at Plato. The explanation of the techniques helps to understand this research. These techniques are necessary to collect the relevant data and arrange them in the right way.

Desk research

Desk research is the gathering and analysing of already existing information in literature or documents on the internet[1]. Desk research is done in:

- answering the sub questions
- finding backgrounds for field research
- providing reliable sources and support

Desk research will provide valuable information about the logistic processes and systems for the theoretical part of the research. This information is very important for proper field research. The literature will mainly be used to find information about logistic systems and making things measurable. In my handbooks (*werken met logistiek, handboek interne operationele logistiek and kostencalculaties in de houthandel)*examples are found with KPI's and calculations. These will help choosing the right KPI's and make proper calculations. The used literature concerns general logistics, so the specific information about logistics in the timber industry will be searched for online. The online search shall focus on specific information about delivery on demand, size of orders and storage methods. Tools such as library.wur.nl, jstor.com and scholar.google.nl will be used to provide articles with reliable sources.

Unfortunately not all the online found information is very useful for this specific case. Most of the written articles considering timber logistics are focussed on the forestry sector instead of the timber production or processing sector. Other specific articles or chapters regarding storage methods or calculating ideal section classifications focus mainly on the design of new layouts. Most of this information is not usable for the situation at Plato because of different preconditions.

Field research

Methods used for collecting primary (original or otherwise unavailable) data, include face-to-face interviewing, telephone and postal surveys, and direct observation[2]. The interviews will provide opinions from the personnel about the logistical processes. Next to that direct observation is important, especially in the early stage of my research. In this field research, time studies are done to collect data and make comparisons for different situations. Also a comparison shall be made with another company which deals with the same products and difficulties. All in all this field research will provide important information in finding improvements for the logistic processes.

[1] Bron: http://www.businessdictionary.com/definition/desk-research.html
[2] Bron: http://www.businessdictionary.com/definition/field-research.html

3 Internal logistic processes within Plato international B.V.

Within the production cycle of Plato®Wood, logistics is very important. This chapter describes the different internal logistic processes within Plato International B.V. First of all in paragraph 3.1 the general theory and selected methods are discussed. Paragraphs 3.2, 3.3 and 3.4 describe the theory applied to the situation at Plato. In paragraph 3.5 the situation at Mevo houtindustrie is discussed.

"logistics includes the organization, planning, control and execution of the goods from the development and purchasing, through production and distribution to final customers in order to reduce the cost and use of capital to meet the needs of the market[3]"

3.1 Logistical subsystems

Logistics can be divided in three different subsystems:

- Physical supply
- Materials management
- Physical distribution

Physical supply

Physical supply is the logistic aspect of the purchasing function. It includes the control of the material flow and the associated data flow of the raw materials and intermediates until the starting of the internal processes.

Materials management

Materials management includes the planning and supporting of the material flow from entry to finished product. Materials management can be divided in different subsystems:

- inventory raw materials, auxiliary materials and intermediates
- production planning and controlling of the plans
- materials handling

Physical distribution

Physical distribution includes the delivery of the end products to the customers. This should be done according to the agreement with the customers. The relation with other departments like production and sales is very important for physical distribution. This subsystem is often divided in:

- inventory finished goods
- warehouses and depots
- transportation

[3] Source: Werken met logistiek, Visser & Van Goor, 1994

The following part of the research describes the different logistical processes within Plato. To be more specific: this research will mainly focus and investigate materials handling and physical distribution of the company. Plato is a producing company in the timber industry. Companies like these are mainly focussed on materials management because there are a lot of production steps. This means that the companies can benefit greatly by improving their materials management.

Materials handling

Visser & van Goor (1994) indicate that materials handling is the internal transportation or movements of materials (raw materials, intermediates and end products). Important in materials handling is the lay-out and device of storage locations and the material flow control within the warehouse, depot or distribution centre. The following goals for materials handling can be formulated:

1. to maximize the use of available space
2. to make internal transportation distances as small as possible
3. to eliminate handling steps were possible
4. to realize the best possible material flows
5. to retain sufficient flexibility to deal with changes in the material flow
6. to keep investments as low as possible

Layout planning

In layout planning there are two methods that are often used. *Muther (1979) quoted in: Werken met logistiek, Visser & van Goor(1994)* invented the *systematic lay-out planning* (SLP) and *systematic handling analyse* (SHA). The SLP method is mainly focussed on situations where a new layout from an existing or new space has to be designed. The SHA is an analysis which focusses on improving the movements of the material flow in an existing layout. Both these methods mainly involve the same basic information. The so called PQRST-key can be used to collect the needed data.

P = Product	What will be moved?
Q = Quantity	How much will be moved?
R = Route	Where will the materials be moved?
S = Service	Which support will the movements require?
T = Time	When will the movements be realized?

In case of Plato all improvements will take place in an already existing basis layout. Therefor the SHA analyse is most suitable. Parts of this analyse are used to come up with improvements for the layout of the storage hall. Data from the PQRST-key is used to form KPI's.

3.2 Physical supply of Plato

The physical supply of Plato consists of the purchase of timber. This is divided in three different species that are used in the Plato process. All timber species require different purchasing processes depending on: supplier, availability and delivery time.

Spruce

The mostly applied timber species in the Plato process is spruce. Spruce is mainly purchased in Sweden and it comes in as raw timber mostly kiln dried. The spruce is delivered to Arnhem on demand when Plato is in need of timber. The delivery time is usually between one and one and a halve weeks. Some sizes such as 23mm thick, need to be sawn at Mevo houtindustrie first because they are made from spruce beams of 50mm thick. In this case Plato's purchaser will have to take in account that the delivery time is a few days longer. The supplier makes sure that the timber is directly delivered to Mevo and, after sawing, it will be transported to Plato where it will go through the process. The prices which Plato pays for their timber are not the lowest in the market but they are quite uniform and constant. This is because Plato wants to have good quality timber which is very important for the process. In this way the relationship between Plato and their suppliers is reliable, which has a higher value for Plato than having the lowest price and switching between suppliers. If Plato receives specifications and they need to make the timber a little cheaper there is always space for negotiations with the suppliers.

Poplar

The case of poplar is a lot different because it is a niche product for Plato with ≤5% of the total sales. Poplar has been one of the main species for Plato in the early years of production. Over the years other species were found to be better for the process. The disadvantages of poplar are that it will easily bend and sometimes cracks can occur. Another point is that there are almost no long and straight lengths available. Even though the production of Plato poplar has decreased since the beginning there is still a small demand for it on a yearly basis. The purchasing of poplar is different to spruce and fraké because complete logs are bought. This is only done once a year with an quantity of 150 cubic meters. These logs are sawn at a local sawmill before the timber can go through the process. When not much poplar has been sold, a year of buying poplar will be skipped because there is enough in stock. The cutting on length and sorting is done manually on site.

Figure 2 unloading a truck

Fraké

Fraké is a relatively new (started in 2006) timber species that has been treated with the Plato process. Fraké is a non-commercial middle-African timber species which has a low natural durability. After testing different tropical timber species fraké turned out to be suitable for the process. The purchasing of fraké is done at sawmills in middle-Africa and through timber traders. There are two cutting periods a year in this African region due to the seasonal weather. Between these periods the sawing of the timber is locally done. Every cutting period Plato has to indicate the amount of timber they need. Plato have their own sawing specifications which must be delivered to the sawmills. The difficulty with purchasing fraké is that the indications and specifications must be delivered a long time before the timber will be delivered to Plato actually. This difficulty increases when suppliers' indications on delivery times are not reliable, which is often the case. And from time to time these problems are aggravated because the quality of the timber is sometimes very bad, containing timber with wrong specifications or not ordered materials.

This will sometimes lead to drop out percentages up to 50%. This is because Plato only wants to offer error free fraké. With spruce the case is different, because that can be rejected and sent back. Because the availability of fraké is not very high and it can not be sent back to the supplier, Plato refuses to pay the bad quality part. To be able to get money out of this timber, it needs to be optimised with the cutting saw. All in all this purchasing process needs a lot of attention from Plato. A good relationship with the suppliers and helping them with improving the processes leads bit by bit to better results.

3.3 Materials handling Plato

In this part the materials handling at Plato's is described and made clear by a flow chart of the factory and the materials' trajectory from raw material until finished product.

Esmeijer (2008) indicates two different production methods:

- line production
- functional production

Line setup

The setup of processing machines and processing places is based on the successive processes of the product. This method is often used in assembly operations. Advantages of this method are: a quick turnaround, good routing, low materials handling costs, limited registration and organisation, low chance of damage, good use of the floor area and good coordination possibilities. Disadvantages of this method are: limited flexibility, occupancy losses, lower machine efficiency and failure of one part interrupts the whole production line.

Functional setup

This setup consists of similar processing machines which are at the same location. The processing method is taken as the starting point. Advantages of this method are: flexibility, lower fixed costs and an easier change in planning and production. Disadvantages of this method are: less favourable routing, high materials handling costs, waiting times between processing steps and intensive monitoring and registration.

The production method of Plato is functional production. In fact line production is not possible considering the processing steps taken at Plato. Most of the processes take several days and kilns for thermal treatment can not be compared with planing and milling lines or assembly lines. Within the functional setup, good planning is essential to have a constant production flow.

Production Planning

The production of Platonized timber takes a few weeks from raw material to end product, depending on the sizes and timber species. For this reason production planning is very important. When an architect wants to use Plato cladding for a building, it will be discussed with the people from Plato and noted in the specifications. These specifications also include the finishing dates for a project. With this information Plato knows what orders they can expect and on which term. That will help them to make an efficient production planning. Of course different dealers have Plato timber on stock or have an average demand for certain products. Therefore the people at Plato know which products must be available on stock.

Production chart Plato

In figure (fig. 4) the production chart from raw material to end products is displayed. The different production steps are numbered and described. The coloured lines display the route of the timber during the process. Important in the Plato process are the different sizes of the packages during the process (fig. 3). Buying timber which is already stacked with slats is impossible because of the different size in packages. This change in package size has its influence on the logistics of the company. For example, production forklifts need to have longer forks to deal with this packages. The Plato packages need to be this large to have an efficient use of the autoclave for the hydro-thermolysis.

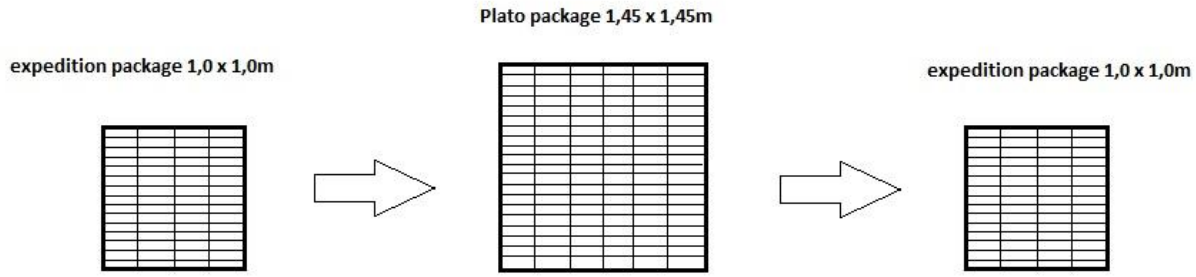

Figure 3 Sizes of the different packages

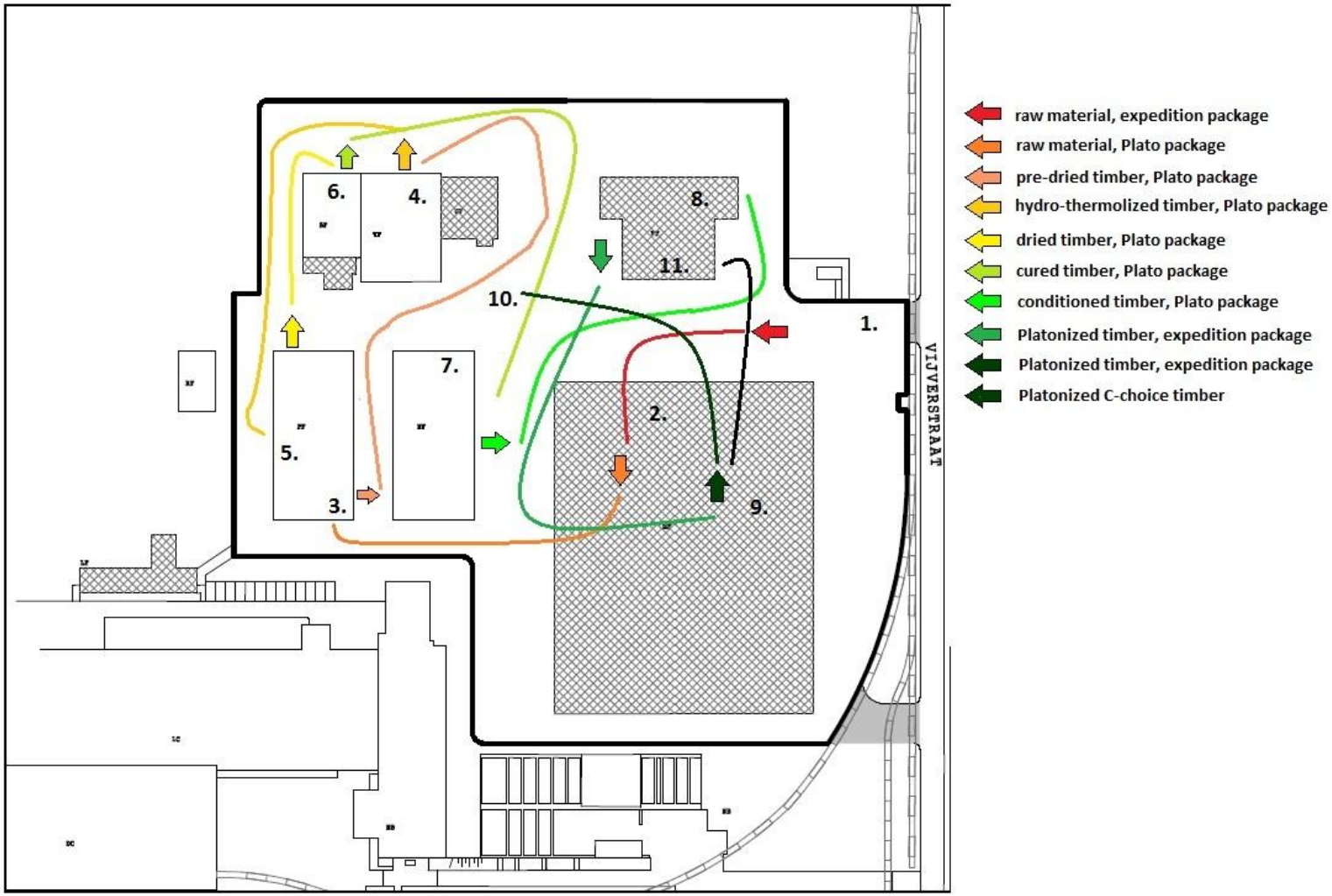

Figure 4 current processing layout Plato timber, numbers are declared in the text

1. **Receipt of material**

   At the first stage when the timber comes in, an intake control will take place. The freight documents and the timber will be checked. Load contains will be checked too: do the freight documents correspond with species, sizes, amounts and quality? At this time a material label will be made, with a batch number. This label always includes quantities, certification and the sizes of the timber.

2. **Sticker-stacking**

   At the second stage of the production process the raw material is taken to the sticker-stacking location. The forklift driver brings the expedition package of timber to the hall where the sticker-stacking is done. The expedition package is opened now and will be stacked with slats and formed to a Plato package. The process is done manually with two employees per sticker-stacking rack who can handle 6-8 Plato packages a day. Sum total there are four racks available for the sticker- stacking. When the package is ready the batch number is written on the package and a package number and the quantity of beams are added. This is also written down to the sticker-stacking list.

3. **Pre-drying**

   Before Plato packages with raw material are moved into the drying kiln they are placed in a section which is almost the same length as the lorries which are used for the hydro-thermolysis. The list is made with the length of the packages in mind to come as close as possible to 17,70 meters. This is because the lorries have a length of 18 meter and some space between the packages is needed. The closer the load comes to 17,70 meters, the more efficient the hydro-thermolysis is. The pre-drying is the step before the Plato process starts and it is taking between 2-5 days depending on thickness and timber species.

4. **Hydro-thermolysis**

   During this step, the pre-dried timber is put on the previously mentioned lorries which are put into the so called autoclave. In this autoclave the hydro-thermolysis of the timber takes place by heating the timber with saturated steam under pressure. This process step takes 4-5 hours per batch which is about net 20 cubic meters of timber.

Figure 5 autoclave for hydro-thermolysis

5. **Drying**

   After the hydro-thermolysis the timber will be dried at one of the eight drying kilns. Each drying kilns capacity is around 160 cubic meters of timber. The timber will be in the drying kiln between 5-21 days depending on the species and the sizes of the timber. During the drying process the moisture content is measured with sensors. Kiln temperature, relative humidity, time and moisture content together form the control parameters for the process. After drying the moisture content of the timber is around 8% and ready for curing.

6. **Curing**

   The following step of the Plato process is curing. The curing takes place in a big oven where around 80 cubic meters of timber is heated up to 180 degrees. The heating is done with dry air which is circulated by fans. To prevent the risk of fire, the oxygen level is kept below 2% by injecting overheated steam into the oven. This process step takes 12-15 hours depending on sizes and timber species. After the curing the timber is bone-dry.

7. **Conditioning**

   The bone-dry timber is transported to the drying kiln where it will be conditioned for three days. This is needed to get a moisture content between 3-5% to make the timber ready for processing.

8. **De-sticking**

   The Plato process is ready after the conditioning of the timber. The timber is still stacked with the production slats. Before the timber is ready for delivery or to come into stock the slats must be removed and the timber has to be stacked into expedition packages. This de-sticking is done by a machine which also changes the amount of boards or beams per layer. Four employees are needed to run the machine. A forklift driver who puts the Plato packages at the machine for de-sticking also picks up and straps the expedition packages. A machine operator handles the quality grading of every piece on the production line. Another employee collects the slats, separating the good slats from the broken ones. The last person is standing at the end of the assembly line, where the expedition packages are formed; he adds a few laths, adds the expedition label to the package and writes down the quantities at the de-sticking list.

   Every piece rejected by the machine operator is collected in a box for drop-outs. This so called c-choice timber is stacked in different packages either by hand or by machine. Especially when the quality of the timber is not satisfactory the box for the drop-outs fills up rather quickly. This interrupts the machine process because the machine has to stop until the forklift driver has picked up the c-choice timber from the box. When the expedition package is ready a label is added. The finished packages are noted on a list which is taken to the office where it will be included in the stock. The drop-outs get a c-choice label.

9. **Storage**

   The finished expedition packages of Plato which are included in the stock are driven from the de-sticking hall to the storage location beneath the roof. This is where the timber is kept dry. The timber is classified in the different sections with the different species and (section)sizes in mind. The storage methodology is nearly all block stacking. The c-choice timber is kept apart from the normal expedition packages. The c-choice timber is sometimes sold to customers who want to have errors in the timber but most of the timber is optimized.

10. **Expedition**

    The sales department makes appointments with customers when timber is sold. The order will either be picked up by the customers or it is delivered by an external transportation company. The office personnel instruct the expedition department when packages will be picked up so that these can be put in the expedition sections separately when possible. This saves loading time.

11. **Optimization C-choice timber**

    In the hall where the de-sticking is done there are two saws for the optimization of timber. Sawing personnel take the packages of c-choice timber over to the hall where they will cut out all the errors of the boards. The sawing personnel try to get the longest possible error free parts out of the planks. The small error free parts are in most situations finger jointed at Mevo houtindustrie.

Figuur 6 optimization C-choice timber

3.4 Physical distribution

The physical distribution is a very important factor in providing good customer service. Especially nowadays when customers are strenuous. Because most of the customers do not want to keep stock or only small amounts they all prefer delivery on demand.

The communication between the sales personnel and the expedition department is very important in order to ensure that delivery is in time and the needed products are available. The sections in the storage location are deep and so there are a lot of packages of timber per section. As a result the expedition forklift driver can already save some time when he is able to take the packages in front of the batch in the section. Unfortunately the sales personnel do not exactly know where the different packages are located. When possible sales people contact the expedition forklift driver to ask which package is easiest to get. This can only be done when there are more optional packages of the same size and species. In principle, sales people take the *'fifo'* system into account when it comes to choosing packages. This means: first in first out. The oldest packages or batches will be sold first to keep the stock fresh. Currently the 'fifo'system is not applied that strictly because this would be rather cumbersome with this block stacking method. If the forklift driver takes a package from the front of the batch, but if the sales people ordered another package on their bill of lading it will bring a lot of administrative work with a fair chance of making mistakes. The package picked to load should always be the same as that mentioned on the bill of lading. When a truck driver arrives to pick up a load, he has to report at the office which issues the bill of lading which he has to sign. With this bill of lading he goes to the expedition forklift driver who will load the truck. Most of the time the load is already at the expedition sections so the truck can be loaded quickly. When loaded the truck driver can leave without going to the office again for paper work. This saves time for the truck driver and it makes sure the trucks are no longer at the site than needed.

When it comes to repackaging we have another situation in which communication between the sales department and the expedition forklift driver is very important. As mentioned before orders have become much smaller and more specified over the years. This leads to much more repackaging to get the required quantities. In some situations the order is already received while the timber is still in the production process. The specified packages could be made at the de-sticking machine. However, most of the time the ordered timber must be taken from stock, so repackaging is needed most of the time.

The de-sticking machine is filled with the same batch of timber which mainly contains different sizes. The packages of the same size are put on the machine following each other to create only one residual package per size. These residual packages are taken up into storage as well. Other residual packages originate from the repackaging of full packages for specific orders. If there is an order, the sales department has an overview of the packages and which quantity of pieces per package is in stock. When the sales department receives a specific small order they can check for residual packages in stock of the required sizes and amounts. If a residual package of the right sizes contains an amount of pieces close to what is required, sales can negotiate with the customer. If the customer wants to have this residual package he can save re-packaging costs which is normally 25%.

The finished timber is stored at the big sections beneath the roof of the storage hall. Usually the expedition forklift driver and the operation manager know best where the different batches are located. The expedition forklift driver also takes care of transport of the finished expedition packages from the de-sticking machine to the storage. When it is clear that a certain order will be picked up the expedition forklift driver puts the right packages apart in the expedition sections. This saves a lot of time when a truck arrives because the forklift driver does not have to re-stack the whole batch to get the right package. Another advantage is that when the expedition forklift driver or the operation manager are not present, someone else can load the truck because he will find the right packages in the expedition sections. Smoothly running the expedition depends on the expedition forklift driver and the operation manager. Therefore at least one of these two employees should always be at work. Because of the huge quantities of timber per section, there are fewer possibilities of a division per size and per section. Another disadvantage occurs when a section has to be restacked in order to get a package from the back of the batch; in that case, a lot of timber has to be moved to another section. This means that at least one section of the same size must always be kept empty.

Not only Plato timber is stored under the roof of the Plato precincts, but timber from Soetekouw timber drying as well. This timber is all contract work and nor Plato's nor Soetekouw's property. Before the drying process the timber is stored outside but after drying is has to be stored under the roof. Normally the timber is picked up soon after the drying process is finished. But sometimes it takes time before the customer is in actual need of the timber so it will stay in Arnhem longer. To ensure that the timber does not stay too long, customers have to pay storage costs.

The roof for the storage of timber is open at all sides. This means that at the edges of the roof there are weather influences. Some of the timber species are not allowed to get wet so these timber species can not be placed close to the edge of the covered storage. This limits the functionality of the covered storage, of course.

Figuur 7 large section with large batch of timber

3.5 Situation Mevo houtindustrie

As said before I have visited Mevo houtindustrie to compare the situation at Plato's with another company. This offers a nice comparison of the logistic processes.

Mevo houtindustrie is one of the biggest wood processing companies of the Netherlands. Processes done at Mevo's are: finger jointing, planing, profiling, laminating, warehousing and distribution. Their processing is done both for their own products and contract work for others. Plato's has a lot of its timber processing done at Mevo. The main ones are: Mevo brickwork profiles, Mevo formwork carriers, Mevo fall protection and Mevo side mouldings. Mevo precincts measure about 60.000 square meters, including 35.000 square meters for timber storage, because they keep a fair amount of stock for third parties. Efficient logistic processes and planning are essential for the company.

The main customers for Mevo houtindustrie are timber traders and the woodworking industry. Mevo has big production lines so they prefer to work with bigger quantities in order to be more effective in producing. Sometimes they will do small quantities for important customers who have much timber processing outsourced to Mevo. Constructors who want to have everything pre-processed for smaller building projects will order these from smaller local carpentries, because Mevo is not fit for these smaller customers. Especially small-size processing orders are rather time consuing, relatively seen, with additional higher costs.

Over the last period Mevo has done a lot to improve their internal logistics. Some twelve years ago Mevo moved to their current location. This location used to belong to a woodworking company before, so they took over production lines which where already there. They expanded these with their own machinery. In this period they built two more halls for production and storage. This meant an increase of internal transport between different production lines. To give an example: the processing steps for production of brickwork profiles were done at three different locations. To be more efficient Mevo decided to combine all processing steps of the production line of brickwork profiles in one hall. This meant a change *from* functional *to* line production. Through this move Mevo saved a lot of internal transportation and personnel. In the current situation production is less flexible and more stock keeping is needed but this does not outweigh the savings on staff and transport.

In the storage halls the usual storage method is block stacking and almost all of the timber is classified at length. Mevo has chosen for this system because it saves storage space regarding to classification at cutting size. Stock keeping for others has increased at Mevo. Especially timber traders and agents have their stock kept at Mevo. This also is a result of the current trend to have as little stock as possible. Companies do not want to take risks with expensive stocks and they want to keep short delivery times. At Mevo, customers have to announce they are coming two days before they pick up their orders.

4 Improvements internal logistical processes.

In this chapter possible improvements for internal logistic processes of Plato international B.V. are described. In order to determine where improvements are needed most it is important to look at the bottlenecks in the processes as described in Chapter Three.

4.1 Bottlenecks in the logistical processes

In the previous chapter the logistic processes are described for three different subsystems: physical supply, materials handling and physical distribution. Bottlenecks present within the physical supply are mainly external factors, i. e. these bottlenecks are hardly influenced by internal logistic processes of the company. That is the reason why this subject will not be elaborated on this report.

In fact the rise of the subject in this thesis derives from the market demands which require smaller order quantities and delivery on demand. *Van de Woestijne (1982)* indicates that more than half of the activities in trade do not cover the costs. In dividing trade-activities the 10-30-60 rule is valid. This means that 10% of the orders is over profitable, 30% is about cost recovery and 60% is loss. In other words: 10% of profitable orders has to cover 60 % of orders with a loss. Of course the percentages can vary but this rule of thumb often applies. Small orders with relatively high costs per unit must be in balance with the profitable orders. The smaller the order the harder it is to recover the orders cost. For instance Plato charges 25% for quantities smaller than one package. Even so, the smallest orders will not recover the costs because the handling costs are higher. A decrease of handling costs can change the turnover point for the better. In that case a small order quantity can more easily recover the costs.

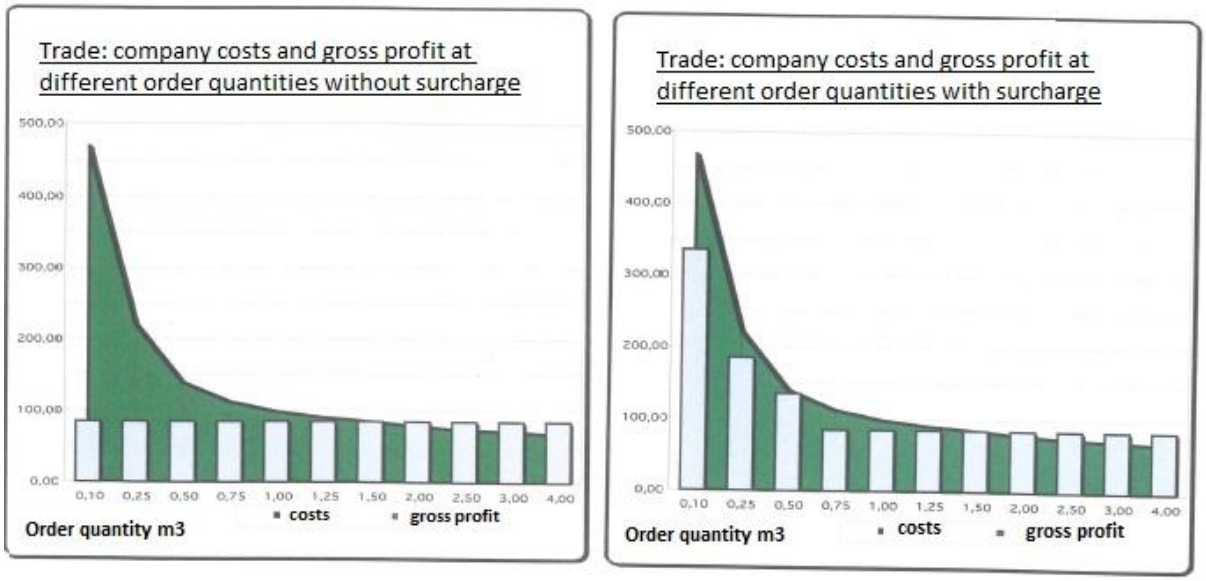

Figure 8 company costs and gross profit with different order quantities with and without surcharge (Spaan, VVNH, 2005)

As described in the flow chart in Chapter three, the timber passes a lot of different production steps. These steps are all needed to achieve a good quality end product. These different steps at different locations require a lot of internal transportation of the materials. Mevo houtindustrie had a similar situation with their production of brickwork profiles. They decided to change to line- instead of functional production and moved all the different machinery for the processing steps to one production hall. Mevo created one big production line for their brickwork profile production. This saved the company a lot of internal transportation and additional costs. Unfortunately a similar change in Plato's production process is not possible. The kind of processing steps, especially the heat treatments, can not be done in line production because these take place in different buildings. An improvement without a big effort, like rebuilding, is changing the layout classification of the storage hall.

An often named problem is the re-stacking and driving back and forth with the timber, to get access to the right package. This problem is a disadvantage of the block stacking method but in this situation it has two main causes. One is the deep sections where a lot of timber is stacked, which will be discussed later on in this Chapter. The other cause are the residual packages which come along with the de-sticking of the machine and the strapping of the expedition packages. A big quantity of residual packages within a batch of timber requires more re-stacking work for the forklift driver. Another disadvantage of residual packages is that less timber can be stacked per square meter. In the current situation the aim is to keep residual packages in front of the batch of timber. A solution for the problem of the residual packages, could be keeping them separate from the normal packages. When there will be another batch of the same timber species and size, they can be combined at the machine. This is a solution close to the core of the problem and it will make the quantity of residual packages smaller and the stock more tractable.

All in all this solution for one problem, namely helping out the forklift driver, will lead to other difficulties. One of the problems which would occur when it would be done this way is the tractability of every individual batch regarding to certification. Like mentioned in the description of the production process, every batch of timber receives its own batch and package number at the incoming inspection. At this inspection is listed if the timber is FSC, PEFC, pure or mixed. So apart from timber species and sizes this is another variable that has to be taken into account. Mixing different batches, which have different certificates or different values like mixed and pure, is not allowed by the certifying bodies. This is because the origin and route of the timber is not traceable when mixing different batches. This may lead to sanctions or the loss of certificates.

Other disadvantages of this solution are the space that is needed to keep residual packages separate and the extra work that has to be done by machine personnel. An advantage of having residual packages is the possibility to sell small quantities without having the extra work of repackaging full packages. to sum up, this makes the mentioned solution not achievable or at least not satisfying. It would be more likely to find solutions for improving the storage system.

The repackaging of timber on behalf of the small orders is rather time consuming. This is because it requires a fair deal of manual handling. It starts with picking up and setting aside the right packages for restacking. Next, the materials for repackaging have to be collected, consisting of flitches, rest planks, nippers, steel strip, strapping machine, new label and if it concerns planed timber also plastic foil and stapler. At the repackaging list the quantity of pieces and the package number are listed. Stacking of the pieces is done by one or two persons depending on sizes of the timber. When the right quantity is stacked the new label will be added to the package. The label of the basis package will also be changed. If the upper layer is not flat because there are for example two planks on top, the rest planks are used to fill the gap between the two planks. This makes the packages suitable for stacking. After this both the packages will be strapped with the steel strip. Planed timber will be wrapped up with the plastic foil as well. The repackaged timber is taken to the expedition sections and the rest of the basis package is brought back into stock. What strikes is that most of the materials needed for repackaging are located at a different location. Almost all repackaging work is done at the storage hall so it would be best to have a central place for all materials because this would much time.

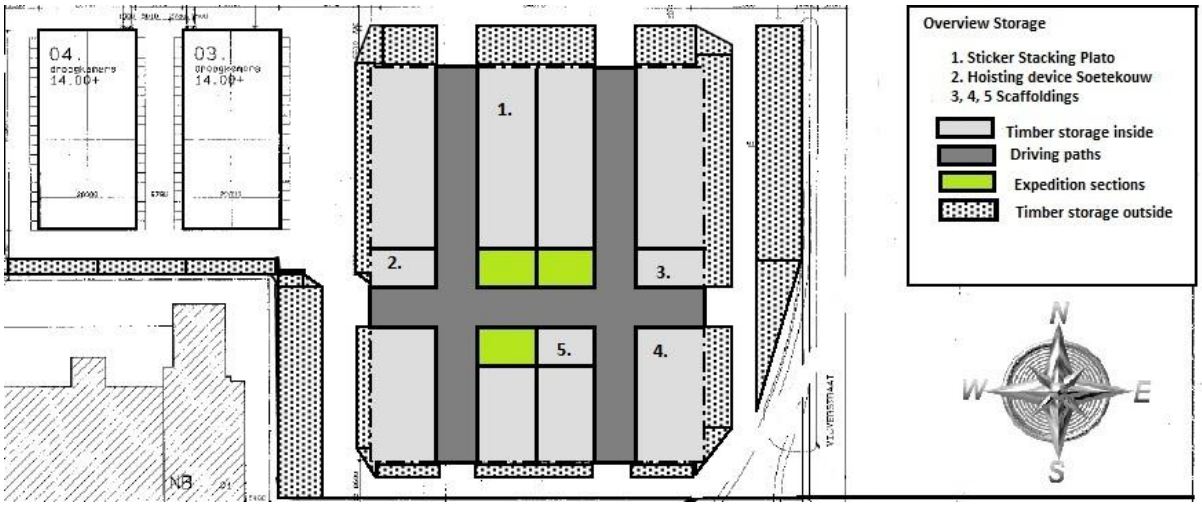

Figure 9 Overview of the timber storage

The storage hall is not only used for storage of timber but there are also two parts that are used for sticker-stacking and de-sticking of dried timber (fig. 9). Number one at the ground plan indicates the location where sticker stacking of Plato packages is done. Number two is the hoisting device that is used for sticker stacking and de-sticking of timber for Soetekouw. It would be better if the storage hall was only used for the storage of timber. In the current situation expedition personnel and personnel for other activities are in each others way. Unfortunately there is no building available for the manual sticker-stacking and de-sticking and because the storage hall is not completely filled with timber there is space to have working activities under the roof.

Classification of the storage hall is important when it comes to physical distribution of the timber. As mentioned before in the current situation the hall is divided in deep sections with big stacks of timber. The layout of the storage hall is the same as it was when Plato started. The current situation is much different than earlier regarding to: production, storage of raw material, storage of end products and diversion in products. Especially the bulk stock of raw material is gone. Most of the raw material comes on call and goes directly in process so there is no space needed for raw material. In the meantime Soutekouw timber drying joined Plato international and they are doing stock keeping for their customers in the storage hall. Concluding it means that the diversity of products is much higher but the storage classification is unchanged. This way of classification has several disadvantages regarding to materials handling and physical distribution. Disadvantages are:

Few possibilities in dividing timber regarding to sizes, certifications or customers

The deep sections for the storage of timber limit the possibilities of dividing the timber at different sizes, certifications or customers. This is because the sections can store such big batches of timber that there have to be different sizes in the sections to fill them and use the space.

Big empty sections needed for re-stacking timber

With the big sections and the necessary re-stacking to get the right package it is inevitable to have empty sections as big as the other sections available. This means that there is a big space which is unused.

Figure 10 restacking

Takes a lot of time when a package from the backside must be taken

When the expedition forklift driver needs a package that is at the backside of the batch it takes a lot of time to get it. All the time that is needed to move aside the timber to get to the needed package is lost time. Especially when the production would increase and there comes more loading and unloading at Plato it's important that the expedition forklift driver uses his time effective.

It is harder to get an overview of the physical stock

When the sections are filled with large quantities of timber with a many different sizes it is harder to get an overview of what is actually there. So it takes more time to find the right package. With the yearly monitoring of the stock a good overview is important.

Other bottlenecks regarding to the storage hall are the weather influences especially at the backside of the storage hall. This limits the functionality of the storage hall because most of the species should not become wet when they are dried or Platonized. Also the accessibility of the required materials and tools under the storage roof can better. This will save time looking for the right materials when re-packaging.

4.2 Improvements for the bottlenecks

The bottlenecks that are described in the previous paragraph are mainly influenced by the layout of the storage hall and how it is classified. The first part of this paragraph describes the theory of the storage systems and the application or possibilities at Plato.

Storage system

Visser & van Goor (1994) Indicates that the storage system must be focussed on avoiding of distances as much as possible (handling-costs). Also the available storage space has to be used as efficient as possible.

When dealing with voluminous products and big fluctuations in the stock level (sometimes much, sometimes less) there is mainly chosen for a free location system. This is often done with bulk products.

ABC-analyse

By classification of the stock according demand frequency the products are classified based on an ABC-analyse which indicates 'fast movers' and 'slow movers'. The A articles are the 'fast movers', the articles with the highest demand, followed by the B and C articles. Most of the time the A articles are 20% of the total article stock which generate 80% of the total turnover. B articles are 30% of the total article stock which generate 15% of the total turnover and C articles are the remaining 50% of the total article stock which generate the remaining 5% of the total turnover. In this classification system the A articles are the best accessible and have the shortest distance to the loading location followed by the B articles and finally the C articles. This classification system is only applicable when a fixed or a semi-free location system is used.

Fixed location system

A fixed location system is used a lot in warehouse planning. Every article has its own place within the warehouse. This has advantages because the fastest moving articles can have the most favourable place in the warehouse and a simple registration system will be sufficient. Disadvantages of a fixed location system is the amount of space that has to be available for the maximal occurring quantity of each article. The utilization of the warehouse space is lower compared with free location systems or semi-free location systems.

Free location system

A free location system is based on a totally different principle compared with the fixed location system. In this system utilization of space is very important. Every free section of the storage location can be used with a random article. The occupancy rate is often ≤95%. Normally a storage registration system is needed in order to get an overview of the location of location of the products. One of the important disadvantages of the free location system is that the demand frequency of the products is not taken into account. This means that in this system 'fast movers' can be placed at the backside of the storage hall.

Semi-free location system

A semi-free location system has in fact the benefits of both systems. The demand frequency of the products is taken into account to a certain extent. With the semi-free location system it is assumed that there are three storage sectors for: fast moving articles, normal moving articles and slow moving articles. Within this sectors the location for the products is free.

Block stacking

The block stacking storage method is one of the most simple ways of storage (fig. 11). This storage method has been the fundament for the development of modern storage techniques. In this system bulk products are stacked as much as possible. This is of course only possible when the products are strong enough to be stacked. Other products must be down on the floor or on top of the stack. With this system a good filling level is possible but when it contains different products at one stack it lacks work efficiency. This is because in a lot of situations restacking is needed in order to get the right product.

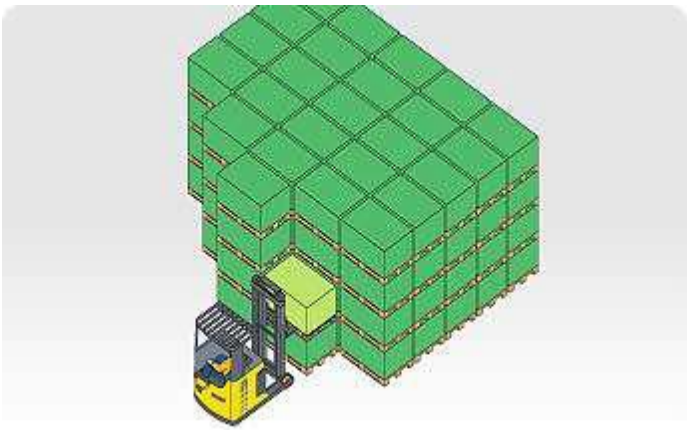

Figure 11 block stacking method

Location system and storage and transportation method Plato

Plato uses a free locations system combined with the block stacking storage method. This is a very simple method because there are no racking systems, reach trucks or side loaders needed. Only for small amounts of long timber have a place in a few cantilever racks (fig. 9 number 3, 4 and 5). There are also two pallet racking's. These are used for small obsolescence packages or pieces of timber. The timber, especially full packages are very useful for the block stacking method because the material is strong enough to stack and it will take less space than any other storage method. All internal transportation is done with 4.5 ton forklifts. This means that the driving lanes have to be wide enough for driving through with the longest packages (6m).

Improving the layout

The needed improvements that will be focussed mainly on the layout of the storage hall. The block stacking storage method will be maintained because this storage method is definitely the one with the most efficient use of space. Almost all the timber is very suitable for the block stacking method. The method to make the timber more reachable in general is to change the size of the sections and create extra driving lanes. To make a start the complete storage hall is divided into 4 sections indicated with the letters A, B, C, and D (see fig. 12). Changing the layout will be started in one section because not all sections are suitable. Also calculations with one section can be applied in other sections when it is wanted. Section B will be used to calculate the sizes and make a new layout design. This is the most suitable section because it is only used for timber storage and not like section A, for sticker-stacking and de-sticking. In section B the weather influences are less compared with the other sections and therefor it is very suitable to store all (dried) timber species.

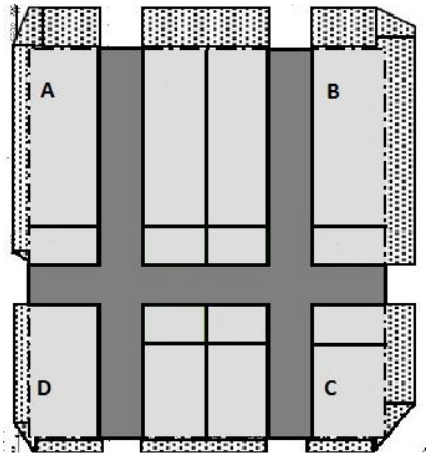

Figure 12 sections storage hall

Current situation

In the current situation one wide driving path divides two deep sections in two. Including the lines the path has a width of 8,2 meter. In practice this width is never needed because the maximum length of the packages is 6 meter. Although the width can be practical when two forklifts are passing. De sections have a depth of 11,3 meter which makes sure that depending on the size, a maximum of 10 packages can be put in a row. The total effective bulk space in the current situation is 850 m2. This is without the racking's and the expedition section. Over the last period the occupancy rate was not higher than 80%. With an average width of 5,5 meter there can be a maximum of 13 different sections in this classification.

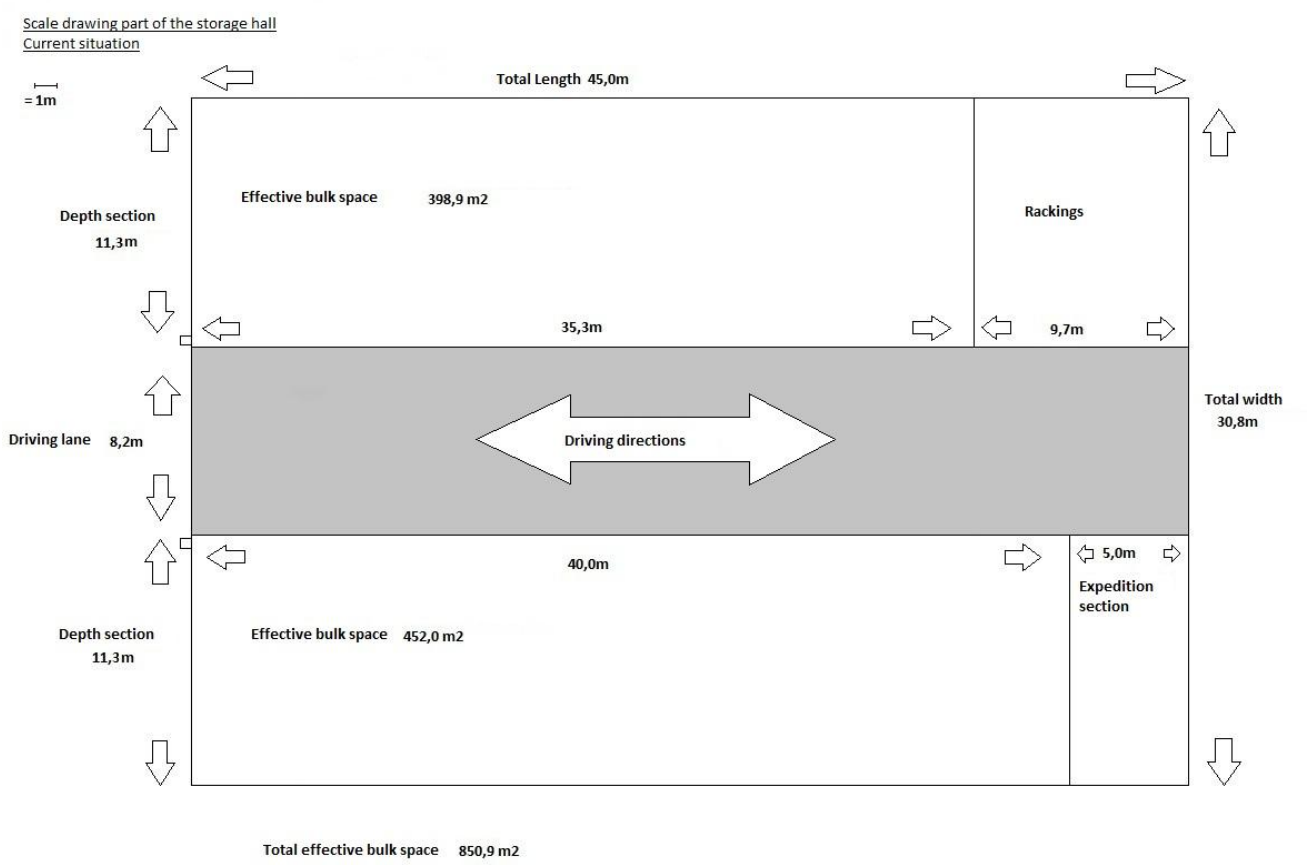

Figure 13 section B current situation

New situation: 'small sections'

The first option for changing the layout of section B is making four smaller sections instead of the current two big sections. In this situation two driving lanes make the timber on average more assessable. The driving lanes are with 5,2 meter more narrow than the wide driving lanes in the current situation. This means that not all the packages can be placed in this section of the storage hall. Packages that are longer than 4,8 meter have to be placed in another part of the storage hall. The share of long packages is not high in the total amount of stock. The expectation is that this share will only drop, because it is hard to get the wanted quality raw material in lengths longer than 4,5-5 meter. In this situation it is unnecessary to have all the driving lanes over 8 meters wide. The block stacking method and the free location system will be continued because it is a cheap system with efficient use of space. However this free location system will be more limited compared with the current situation. This is the result of more dividing possibilities in the sections. Sections will be used for certain sizes, certifications and big customers may get an own section for their orders. In the drawing below (fig. 14) section 2 and 3 continue to the point where the rackings are located. This means that the upper driving lane can not be entered from both sides. The best option would be to move the rackings from section B to section C where other rackings are located as well. This would make it possible to enter the driving lane from both sides and it would expand the effective bulk space of section B to 892 m2 instead of the now drawn 744 m2. If this is not wanted there can be a passage made by making section 2 and 3 shorter. If they are 5 meters shorter the total effective bulk space would be 693 m2. The lower driving lane is also an one way driving lane because at the outside of the roof some of the uprights are connected with a diagonal strut. This strut is just in front of the driving lane and hampered the forklift for going through. In this case there should be a change in the construction to make a passage. The depth of the sections in this first new situation are 5,1 meter. This allows a maximum of five packages, depending on width, can be stacked in a row. This will result in a drastic reduce of re-stacking time for the expedition forklift driver and a lot more possibilities in dividing the timber. With an average section width of 5,5 meter there can a maximum of 25 different sections.

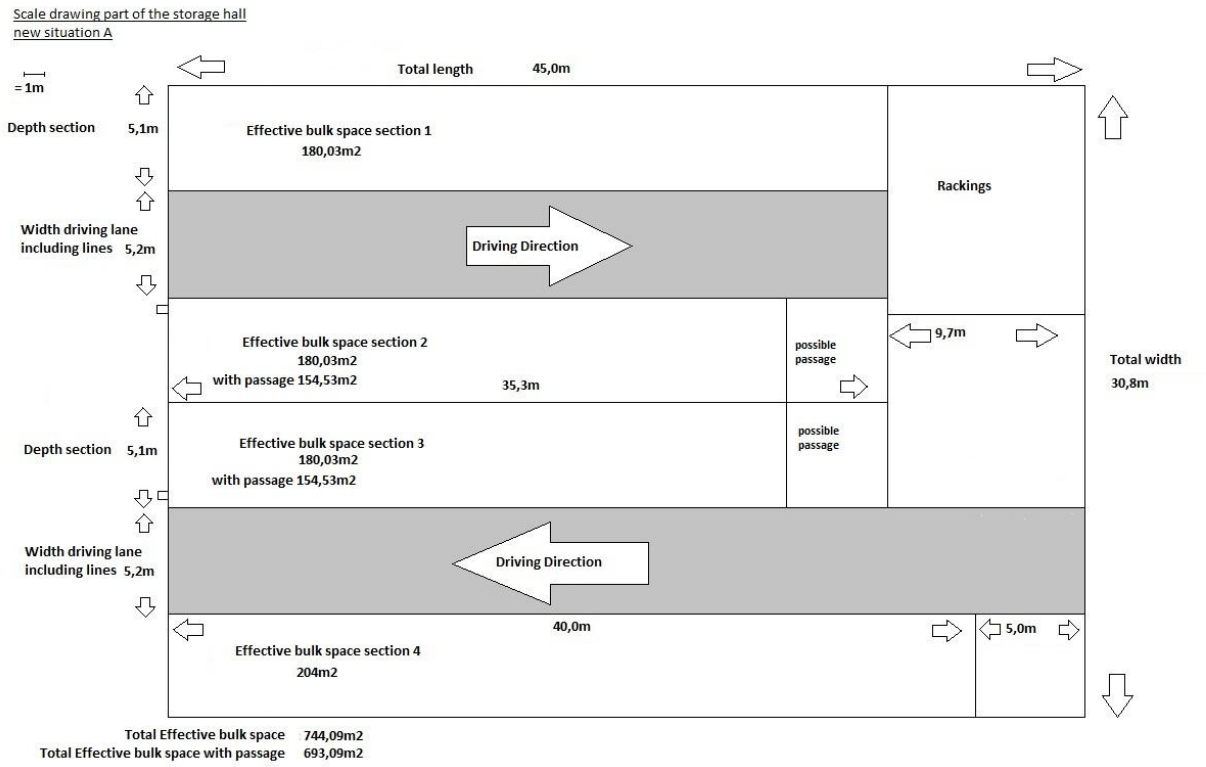

Figure 14 scale drawing of new situation: 'small sections'

New situation: 'transverse driving lanes'

In this situation the directions of the driving lanes are changed. Entrance of the lanes is now at the long side of the roof. The uprights in this situation are closer together and between the second and third and also the fourth and fifth are diagonal struts to support the construction. This limits the opportunities to make an entrance. The driving paths are one direction because they will end in the middle of the roof close to the sticker-stacking. The total effective bulk space is 716m2 but in this case the expedition section is much bigger than in situation 2. If the calculation is done with the same expedition section as in situation 1 the storage space would be 800 m2 which is only 50m2 less compared with the current situation. With an average section width of 5,5 meter the maximum amount of sections possible is 16. The first two sections with a depth of 7,25 meter can store a maximum of 7 packages in a row per section. The third section can store 8 packages.

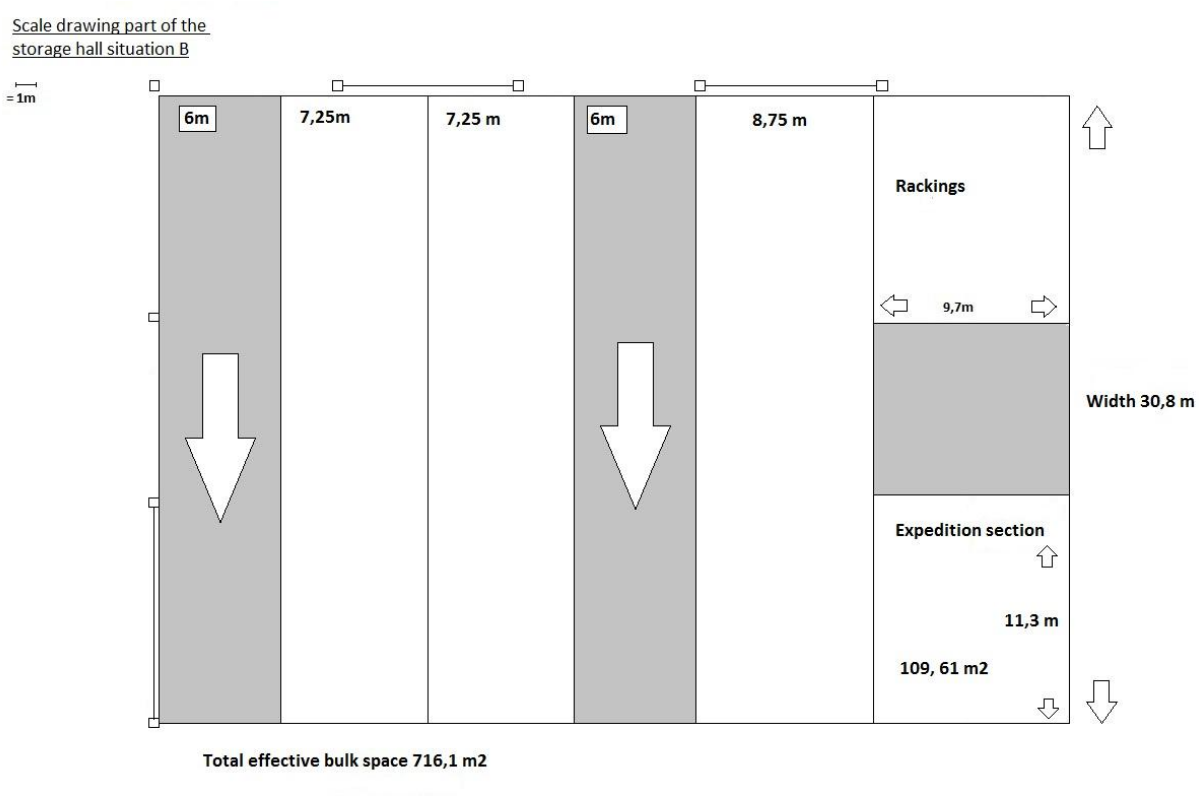

Figure 15 scale drawing of new situation 'transverse driving lanes'

Other improvements

The overview of the storage hall (fig. 9) shows the sticker stacking location (1) and hoisting device(2), both at the different sides of the driving lane of section A (fig. 9). The hoisting device should be moved to the same size of the sticker stacking location at the location of the expedition section. The expedition section can moved to the side where the hoisting device is located. This makes a clear distinction between the section for working activities and timber storage. Between the sticker stacking and hosting device should come a section were all materials for repackaging are collected. This place is centrally located in the storage hall. This will save time in collecting materials when repackaging because there is no search for materials needed. Another benefit is that working activities are at the same side section A. This results in less activities in each other's way for both expedition and production.

Sections C and D

As mentioned previously sections C and D (fig.12) are limited in functionality by the weather influences especially at the backside of the storage hall. In the current situation there is lots of c-choice and not easily marketable products produced in the past. Most of these products are depreciated so on paper these products do not cover any value. These products are sold occasionally but not often in big quantities. The outside of the storage hall where these products are placed is not suitable for high quality processed or dried timber. Although it would be best if these old stock could be sold as soon as possible. The disappearance of these stocks would increase possibilities in these sections and improve flexibility. The problem of weather influences at the backside of the storage could be obviated or solved by using scaffold mesh. This materials stops up to 90% of the wind and it will keep out the rain. This improvement can be considered when the production will go up and more stock keeping is needed.

5 Improvements regarding to costs and benefits

In this chapter previous described improvements will be approached in their relation to cost and benefits. Options for the new situations will be compared with each other and the current situation. KPI's are defined to give value to the improvements.

5.1 Starting values for calculations

Important in calculating the value of improvements are the basic values that are taken to calculate with. In this case time measurements are done for repackaging and restacking (appendix 1). These time measurements are important to calculate the total time on a yearly basis. Therefore calculations are done with average occurrences of the handlings. In table 1 and 2 are the two most important handlings elaborated for the current situation. Important to note is that the average times a day are basic values which are used in the new situations as well. When it comes to restacking, the average time per pile will stay the same in the new situations as well. This is because the improvements do not increase the working speed of the forklift driver. Only the average quantity of the piles is changed and reduces handling. The price four one man-hour is €25 and a forklift including driver costs €45,75[4]. Per minute this costs are €0,42 for a man and €0,7625 for a man with a forklift.

5.2 Current situation

The KPI's of the different situations are based on time, efficient bulk space and possibilities in division. The current situation is indicator to judge the value of the improvements. Results from the time studies will be used to make cost calculations. The required investments and the cost reduction weighted against each other determine when an improvement recovers the costs. For a clear overview, similar tables are displayed for all different situations with the different values.

Handling:	Repackaging
Average times a day:	8x
Average time:	26 min.
Total time per day (two persons):	208 min.

Table 1

Handling:	Restacking
Average times a day:	2
Average quantity of piles:	5
Average time per pile:	2:38 min.
Total time per day (one person and one forklift):	26:33 min.

Table 2

Location:	Storage hall section B, current situation(fig. 7)
Total effective bulk space:	850 m2
Maximum available sections:	13

Table 3

[4] Appendix 1

Repackaging
The total costs of labour for repackaging, assuming 50 working weeks for the company, is: 50 weeks x 5 days = 250 days x 208 min. = 52.000 min. x € 0,42 labour per minute = €21.840

Restacking
The total cost of labour and forklift, assuming 50 working weeks for the company, is: 50 weeks x 5 days = 250 days x 26:33 min. = 6637,5 minutes x €0,7625 = €5061,-

5.3 Situation 'small sections'

Storage space and sections
The storage space in situation 'small sections' (table 4) is 87% of the current situation. Although this is less the maximum available sections are with 192% almost doubled. In this situation the pallet racking will be removed and the passages (fig. 14) are not needed.

Location:	Storage hall section B, situation: 'small sections' (fig. 8)
Total effective bulk space:	744 m2
Maximum available sections:	25

Table 4

Restacking
In this situation, the sections are considerably less deep compared to the current situation. This results in halve as less time needed for restacking each day (table 5).

The total cost of labour and forklift, assuming 50 working weeks for the company, is: 50 weeks x 5 days = 250 days x 13:17 min. = 3320,8 minutes x €0,7625 = €2532,-

Reduction of the restacking costs is €5061-€2532=€2529,-

This improvement results in a reduction of 50% of the restacking costs.

Handling:	Restacking
Average times a day:	2
Average quantity of piles:	2,5
Average time per pile:	2:38 min.
Total time per day (one person and one forklift):	13:17 min.

Table 5

Costs of achieving improvements
The total costs for achieving this improvement consists of: materials for marking the new sections, the labour costs for marking and the costs for restacking (labour and forklift costs) (table 6). It will take less than three months to earn back the investments.

Marking materials	€ 100,00
Labour marking	€ 150,00
Restacking costs	€ 366,00
Total costs	€ 616,00

Table 6

At the time this is written the costs of moving the diagonal strut in front of one of the driving lanes, has not yet been clear. Assuming that this would cost €2000,- the total cost would be €2616,- and this would take just over one year earn back time. An important remark: removing the strut is not necessary for the implementation of this classification, it will only save driving time for the forklift driver.

Advantages

In the preceding part the saving of time is linked to the costs which has an certain outcome. This reduction of costs is clear just like the maximum available sections. Although new situation 1 offers more benefits that are less measurable. Although this benefits are not measurable the advantages they offer may be at least as important as the previous described costs benefits.

- **Clearer overview of the stock**

Timber can be more divided in species, sizes, certifications or customers, so getting a overview of the stock is much easier. Other personnel may become more familiar with the stock. Also administrative actions like, for example, the yearly monitoring of the stock become much easier.

- **Less chance of damaging timber**

In this situation where a lot less restacking of the packages is needed, the chance of damaging the timber will be less as well. Timber pieces with damage can not be sold as error free timber, or will lead to complaints when the damage is unnoticed during loading.

- **Higher chance of getting the right package without the need of restacking**

In the calculation the quantity of restacking's is assumed as being the same to have a good comparison. In practice it is most likely that the quantity of restacking's is lower because the chance of getting the timber at the first row of the stack is higher. This results in even more cost reduction.

Disadvantages

- **Reduction of effective bulk space**

As made clear above the storage space is reduced with 13% compared to the current situation. It must be clear that the needed empty space for restacking is a lot smaller compared with the current situation. Also the occupancy level has not been over 80% over the last period so a shortage of space is not expected.

- **Not much space for longest lengths**

Because of the smaller paths the longest timber lengths can not be stored everywhere in section B. This is not a big problem because the quantity of lengths longer than 5 meter are a small part of the stock. At the beginning of the section long lengths can be stored, because in that situation there is no need to drive through the small lanes.

5.4 Situation: 'transverse driving lanes'

Storage space and sections

The storage space in situation 'transverse driving lanes' is 84% of the current situation (table 7). An important remark is that the expedition section in this situation is 194% larger than the current one. The maximum available sections are 123% compared to current.

Location:	Storage hall section B, new situation 2 situation(fig. 8)
Total effective bulk space:	712,1 m2
Maximum available sections:	16

Table 7

Restacking

Situation 'transverse driving lanes' is a middle course when it comes to section depth. The total restacking time per day is just in between the current situation and situation 'small sections'.

The total cost of labour and forklift, assuming 50 working weeks for the company, is: 50 weeks x 5 days = 250 days x 18:43 min. = 3320,8 minutes x €0,7625 = €3568,-

Reduction of the restacking costs is €5061-€3568=€1493,-

This improvement results in a reduction of about 30% of the restacking costs.

Handling:	Restacking
Average times a day:	2
Average quantity of piles:	3,5
Average time per pile:	2:38 min.
Total time per day (one person and one forklift):	18:43 min.

Table 8

Costs of achieving improvements

Costs of achieving this improvement are the same as situation 'small sections'. The only difference is that the this situation will take more time and so the costs are higher. Also the reduction of costs is not as high as in situation 1. This results in a earn back time of almost six months.

Marking materials	€ 100,00
Labour marking	€ 175,00
Restacking costs	€ 457,50
Total costs	€ 732,50

Table 9

Advantages

Situation 'transverse driving lanes' offers the same advantages as situation 'small sections' although to a lesser extend because the sections are a lot bigger. This situation offers an extra advantage in comparison with situation 1 because longer lengths can be stored everywhere in the section.

Disadvantages

- **Longer driving distance**

The driving distance between section B and the loading/unloading spot is on average 45 meter longer compared with the current situation and situation 'small sections'. This is because the entrances are at the long side of the storage hall.

- **Reduction of the efficient bulk space**

In this situation the efficient bulk space is reduced like in the situation above. It must be noticed that the expedition section is much bigger compared to the current situation and especially situation 'small sections'.

- **Different layout direction compared with other sections**

This classification is totally different from the other sections. To get coherence in the storage hall every section has to be changed. In situation 'small sections' that is not necessary.

5.5 Improving repackaging

The central location for all repackaging materials will save approximately 2,5 minutes every repackage.

Handling:	Repackaging
Average times a day:	8x
Average time:	23,5 min.
Total time per day (two persons):	188 min.

Table 10

Repackaging

The total costs of labour for repackaging after improving the circumstances, assuming 50 working weeks for the company, is: 5 days x 50 weeks = 250 days x 188 min = 47.000 minutes x €0,42 = €19.740

This improvement will result in a reduction of €21.840-€19.740=€2100,-

The reduction of repackaging costs is almost 10%

5.6 Improving backside of the storage roof

The total surface of the backside of the storage roof that can be covered with scaffold mesh is 586,88 m2. The scaffold mesh costs €1,09 p/m2 so the total costs for cover material are €639,70. A constructor should calculate if the current uprights of the roof are strong enough for attachment of the mesh. This determines the costs of labour and mounting and so on the total costs for the improvement.

5.7 Comparing different improvements

If the comparison between the current situation, situation ‘small sections’ and situation ‘transverse driving line’ is made, it is clear that situation ‘small sections’ offers the most benefits and has the least (important) disadvantages. Situation ‘transverse driving lanes’ does have benefits to the current situation but all to a lesser extent compared with situation ‘small sections’, except for the longer length packages. The disadvantages are also less insuperable compared with situation ‘small sections’. This is why situation ‘small sections should be implemented instead of situation ‘transverse driving lanes’.

Improving the repackaging by making a central spot for all repackaging materials is an easy method to work more effective. In the current situation, too much time is spent for collecting packaging materials. These materials are mostly located at different locations and collecting them takes to much unnecessary time. And this improvement is very easy to achieve.

Returning to the materials handling goals, formulated at page 13 of this thesis, and comparing the current situation with situation ‘small sections’, it is clear that this situation scores better at point 1, 2, 3, 4 and 5. Although the available space is less compared with the current situation, the use is optimized because of smaller sections for restacking. Transportation distance of the packages is lower in new situation 1 because of less unnecessary restacking. This also applies to the elimination of handling by about 50%. Of course, investments are needed for the implementation of situation ‘small sections’, but these investments will earned back in about one year, as calculated previously. Also the investments are kept low because restacking of the timber and painting new section lines is done by company personnel.

Figure 16 forklift at hoisting device location

6 Implementation of the improvements

This chapter describes the steps that have to be taken in order to implement the improvements correctly. For a smooth implementation it is important to know the different focus points for each improvement.

6.1 Implementing situation 'small sections'

Because it became clear that new situation 1 offers the best benefits for the storage hall, this improvement should be implemented. Of course the map of the new section classification will be useful to make a planning for different products and sections (paragraph 4.2). This planning will made by the operations manager in cooperation with the expedition forklift driver. They have the overview of the current stock and their experience is needed for the right classification and new location of species, sizes and customers. Because the stock level fluctuates a lot, it would be best if the actual change of sections is done when the lock level is relatively low. This will save restacking time and other sections of the storage hall are not totally blocked by timber from section B. Not all the timber from section B has to be removed for the changing of the sections. The first five meter of the two big sections in the current situation can still store packages because this will not change. If it is not possible to store the timber at section A, C and D on a temporary base the middle of section B can also be used. Important is to point out the middle line between section 2 and 3 (fig. 14). When this line is clear the timber can be stacked from both sides. Important is to keep the front of the sections free to paint the remaining section lines. When stacking the timber at the new sections it should be done according to the classification planning. If more space is needed, the pallet racking can be removed and the cantilever racking of section B can be removed to section C next to the other rackings. In the table below the assumed times, requirements and constraints of the different tasks.

tasks	required time	requirements and constraints
section classification	1 hour	overview current stock, transportation directions
marking sections	6 hours	painting equipment, dry/clean surface
restacking timber	8 hours	section classification drawing, forklift

Because the period when stock levels are low is often in June or July before the holidays, this is the right period for implementing situation 'small sections'. So the goal is to have implemented this improvements at the end of July.

6.2 Implementing repackaging improvement

The implementation of repackaging is relatively easy to achieve. The hoisting device at the left side of section A (fig. 9 nr. 2) is moved to the right side and exchanged with the expedition section over there. The space between the sticker-stacking location (fig. 9 nr. 1) and the new location of the hoisting device is used to collect all materials needed for restacking. It will take approximately one hour to achieve this improvement.

6.3 Implementations regarding possible future growth

Of course, the previous described improvements are useful or will be even more useful in the situation of future growth. This is because when one handling takes less time per person, this person is able to do more handlings a day which can save on personnel. Another benefit is the good stock overview which gets even more value if bigger quantities of timber are stored. Therefore it is important to have a special focus on previous mentioned sections C and D (page 36).

Improving section C and D is only interesting when more storage keeping is needed. This could be when there will be more production or when larger customers want to have more stock keeping at Plato, and pay for it. A big part of this sections is used for c-choice timber and not easily marketable products. If this space is needed for other timber that is more beneficial, Plato should get rid of the not easily marketable products. As previously mentioned the backside of the storage roof can be covered with scaffold mesh to reduce the weather influence. The costs of this investments should be calculated and compared with the assumed revenues. This is how the earn back time can be specified.

When production will go up there are also other drastically changes necessary such as hiring extra personnel, doing more production shifts and consider automation of sticker stacking. To make this clear there will be extra research needed.

7 Conclusions

This chapter describes the answers to the research question. First of all the sub questions are answered because these questions are needed to give an answer to the research question. Finally a conclusion is given.

How can the internal logistic processes be optimised for the current market situation?

1. Which internal logistic processes are taking place within Plato international B.V.?

   The production chart of Chapter three makes clear that many different processing steps must be taken at different locations, which results in much internal transportation. This so called functional production is necessary because of the different buildings used. The physical distribution requires good communication between the sales and distribution department, also to ease the work of the expedition forklift driver. The relatively simple administration system works well. It is clear that the current section classification is not sufficient for the current situation (paragraph 3.4).

2. Which improvements can be made to be more effective?

   The small orders take relatively much time for the expedition department and sales people while the profits are low. Although there is a surcharge taken on these orders it's hard to make them profitable. By working more effective these orders will become more profitable, so this is where improvements must be found. Especially the restacking takes a lot of time due to the big sections and block stacking storage system. Two drawings for new section classifications are made to reduce restacking time (paragraph 4.2). Also improving the repackaging is important to be more effective.

3. Which improvements are most useful, regarding costs and benefits?

   By doing time measurement in the current situation and calculations with section sizes, it became clear which improvement is most effective. Both options are compared with the current situation to find the theoretical benefit. This gives confidence in the implementation of the improvements. The advantages, disadvantages and costs of both improvements are compared and it becomes clear that situation 'small sections' offers the biggest advantages (less restacking time, better stock overview) and least disadvantages (less effective storage space)(paragraph 5.3). Also the effect of improving repackaging by making materials more accessible is calculated (paragraph 5.5).

4. How can these improvements be implemented within the organization?

   Chapter six made clear which of the improvements has the best support for implementation. Important are the steps and preparations to be taken for a proper implementation of the improvements. Most of the implementation of the improvements can be done by company personnel. A constructor is needed to calculate if and how the diagonal strut can be moved. It would be wise to start implementing situation 'small sections' in the summer when stock levels are low and personnel have time to do the implementation (paragraph 6.1).

How can the internal logistic processes be optimised for the current market situation?

The handling of the small orders will take less time by implementing the previous described improvements (paragraph 4.2). Especially the expedition forklift driver will use his time more effective, because less handling is needed to obtain the right package. This will be achieved by making smaller sections. Also repackaging will be more effective by having all materials at a central place in the storage hall. The main benefit of these improvements is to reduce the handling costs of an (small) order. This makes it easier to recover the costs of an order and it will improve the profitability.

Conclusion

Plato can improve the logistic processes by implementing the suggested improvements. In theory these improvements result in time and cost reduction. Although these calculations are based on practical time measurements, it's still theoretic. In practice there may occur problems or disadvantages that are not taken into account in this report. In that case it's wise to start with the implementation of only one section of the storage hall. If the advantages have proved themselves in practice, other sections can be classified the same way.

Next to the financial benefits of situation 'small sections', there are other benefits that are less measurable but even important. The overview of the stock is more clear which offers benefits by reducing search time and making stock monitoring more easy. Also other personnel, besides the expedition forklift driver and operation manager, will be more familiar with the actual stock. More available sections result in more allocation possibilities. Another advantage is the chance of getting the right package without restacking has become much higher. Also creating a central place for all repackaging materials will have a positive effect on handling time and costs. All in all this improvements will help Plato to the deliver their customers what they want without too much effort. With this flexibility Plato will be able to distinguish themselves from their competitors.

8 Recommendations

This chapter contains the recommendations formed after the research done at Plato International B.V. Arnhem. Goal of these recommendations is to indicate how Plato International can improve their internal logistic processes to meet the current market demand.

Implementation of situation 'small sections'

According to the previous chapters, situation 'small sections' is the best option for implementing at the storage hall. Although the total effective storage space of section B is reduced a bit, this improvement offers several advantages regarding to the current situation. The restacking time has reduced with 50% in this situation. On yearly basis the cost reduction is around €2500,-. The assumed costs including the removal of the diagonal strut is €2600,-. This means that the earn back time is approximately around one year. This cost reduction and the other advantages (paragraph 5.3) give confidence and will make this improvement successful.

Implementation of repackaging improvement

With this improvement the hoisting device moves to the other side of section A. This is a mobile device which makes it easy to move. All repackaging materials will be collected between the sticker-stacking location and the hoisting device. This makes the material within closer reach for everyone. The production and expedition activities are separated in this situation. For repackaging this improvement saves a much time because there is no searching for materials needed. The total time reduction is assumed at 20 minutes a day leading to a cost reduction of €2100,- on yearly basis.

Keep up good communication

It's important to keep up good communication between the different departments. Especially when it comes to repackaging, there can be saved much time if these can be done all at once. Therefore the sales department has to inform the expedition department well-timed if they receive new orders for repackaging. The sales department should still contact the expedition forklift driver when different packages of the same sizes are available. Although the restacking work has been reduced with situation 'small sections', keeping contact can save time because the forklift driver can take the package in front of the row.

Calculate the costs of small order quantities

It would be interesting for Plato to calculate the costs of their small orders and compare them with the bigger orders. Determine of the turnover point when a order recovers the costs is also very important. With this data Plato can find out if there 25% surcharge for smaller orders is sufficient. Of course the lower handling costs has improved the percentage of profitable small orders but still the turnover point is interesting to know.

Future growth

When it comes to future growth possibilities in having more functional storage space are available (paragraph 6.3). The needed investment for installation of the scaffold mesh has to be elaborated and a cost-benefit analysis shell be made. Further research is needed to elaborate all steps which has to be taken.

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Appendix 1 measurements & calculations

The following table shows three different time measurements that are representative for repackaging. In this situation only the stacking phase is done with two persons, other activities are done by one person. The extra persons is doing other working activities next to the stacking. This results in a average repackaging time of 26 minutes per person. About 25% of the repackaging can be done by one person. This is when the length is ≤3 meter and the pieces are not too heavy. In this case the average repackaging time is 17 minutes. Important to notice is that these times do *not* include the restacking time of the packages and the transportation of packages back to stock or expedition section.

Repackaging	Spruce planed 45 pcs.	Fraké Beams 50 pcs.	Spruce planks 25 pcs.
Collecting materials	6 min.	4 min.	4 min.
Stacking	10 min.	11 min.	6 min.
Administration, tie/pack	5 min.	3 min.	3 min.
Total time	21 min.	18 min.	13 min.
Avarage repackaging time	17 min.		
One extra person for stacking	9 min.		
Avarage repackaging time per person	26 min.		

The tables below show a representative time measuring of the restacking per pile of timber. This measuring was done when the timber was stacked at the driving lane (first table). After the necessary package is taken the other timber has to be put back. This results in a more than double time of restacking because when it has to be stacked back (second table) it must be neatly. Than more time is necessary because the forklift driver has to drive more precise and lost flitches has to be put back.

Restacking per pile	time
1	2:01
+2	3:49
+3	5:47
+4	7:48
+5	9:45
+6	11:34
+7	13:19
+8	15:46
Average time per pile	1:58

Stacking back per pile	time
1	2:13
+2	4:26
+3	6:39
+4	8:52
+5	11:05
+6	13:18
+7	15:31
+8	17:46
Avarage time per pile	2:13

The situation of stacking at the driving lane and stacking back when the necessary package is taken occurs in about 25% of the cases. When this appears, the times of both of the tables has to be summed. For the final 75% only table 2 is applied because in this case the timber is restacked to another (empty) section so stacking back is not necessary.

% of the cases	Average driving time per pile
25	4:11
75	2:13

The total average time per pile calculated with these percentages is 2:38 minutes.

Costs man-hour + forklift

Costs per:	hour	minute
Man-hour	€ 25,00	€ 0,42

Costs forklift + driver	
Lease + maintenance per hour	€ 13,43
LPG per hour	€ 7,32
Man-hour	€ 25
Total costs per hour	€ 45,75

Appendix 2, Houthandel en Nijverheid, jaargang 87, nummer 17