WORKING HARD OR EFFICIENT?

A THESIS ON THE EFFICIENCY AND LEAD TIMES AT THE AMSTERDAMSCHE FIJNHOUTHANDEL.
Foreword

This thesis is the result of five years of studying at Van Hall University of Applied Sciences in Velp. When I started studying right after high school I would never have imagined that I would ever get my bachelor in International Timber Trade. Thanks to travels and experiences I found myself interested in nature and her studies.

My road to finish this degree was all but easy. During the four years I took one year off to focus myself on side projects. I will never regret that period in which I learned a lot.

First I would like to thank the Amsterdamsche Fijnhouthandel with in particular CEO Ivar Brugman. Giving me the opportunity to learn at the company and fall in love more with wooden products than I already had, is something that made me who I am today. Secondly I would like to thank my parents who kept motivating me to finish this thesis.

I hope the future for wooden products will be bright. With competition of other materials that are comparable or even better I believe that wood will survive in this completion anyway. Together with my graduated colleagues I will have to find ways to let wood keep a good name.

With kind regards,

Rick Kamphorst
Abstract

A research on the efficiency and lead time at the Amsterdamsche Fijnhouthandel.

Since the start of the Amsterdamsche Fijnhouthandel the customers were mostly business to business (B2B). This has been a great market for a lot of years but since 5 years the market for private consumers is growing. The market focus of the AFH changed from B2B to a combination of B2B and B2C. With an upgraded sawmill it became easier to help consumers with specific demands for dimensions. This change resulted in a rapid growth for the company. The company grew to more employees and bigger turnovers.

The growth has not been good for all aspects of the company. The lead time for processed wooden products is getting bigger every month. At this moment, a six week delay on any kind of processed wooden product is normal. In practice, there is no difference between orders from private consumers and companies. This means that somebody ordering two beams on special dimensions has to wait just as long as a bigger contractor who orders 5 m$^3$ of battens. Sometimes orders are rushed when they involve higher turnovers, but this is not a normal practice. An important factor of these rushing orders is that it’s easier to make mistakes which is not motivating for the employees.

This research is done to formulate an advice on how to reduce the lead times and improve the efficiency within the Amsterdamsche Fijnhouthandel.

The main research question for this report is; How can the delivery time be as low as possible and a turnover as high as possible in a growing market for both the business and the consumer market?

This question is answered using the Lean Six Sigma model and desk research within the company.

The research results in the following advices;

- Create a digital system that is totally infiltrated in the whole company. Everything that is written down about orders can be easily found back by others. This will diminish interpretation faults and will also result in fewer problems between employees and a more efficient working environment.

- Hire an extra employee for the saw mill and work in multiple shifts. This will increase the labor costs but creates more efficient working hours. With this extra employee the amount of orders that can be processed are higher due to more working hours.

- When the need is high, outsource to other wood processing companies. The test was relatively successful with simple processing orders. The costs are a little bit higher than when the work is done by the AFH itself. But this doesn’t weigh up to the amount of extra orders the company will receive.

- Work out an efficient training for both yard employees as saw mill employees to get on the same level of understanding on what is important in raw material for the processed wooden products. This will result in less recollections of raw material and a better flow in the working process.
1. Introduction

1.1 Problem description

The global economy is recovering from a huge financial crisis. One of the timber trading companies in the Netherlands that did not have any problems with that period was the Amsterdamsche Fijnhouthisandel. Since the start of the Amsterdamsche Fijnhouthisandel the customers were mostly business to business (B2B). This has been a great market for a lot of years but since 5 years the market for private consumers is growing. The market focus of the AFH changed from B2B to a combination of B2B and B2C. With an upgraded sawmill it became easier to help consumers with specific demands for dimensions. This change resulted in a rapid growth for the company. The company grew to more employees and bigger turnovers. The growth has not been good for all aspects of the company. The lead time for processed wooden products is getting bigger every month. At this moment, a six week delay on any kind of processed wooden product is normal. In practice, there is no difference between orders from private consumers and companies. This means that somebody ordering two beams on special dimensions has to wait just as long as a bigger contractor who orders 5 m³ of battens. Sometimes orders are rushed when they involve higher turnovers, but this is not a normal practice. An important factor of these rushing orders is that it’s easier to make mistakes which is not motivating for the employees.

The expectation from the CEO of the AFH is that the company is missing out in turnover because of this longer lead/delivery time. It’s difficult to tell customers that they have to wait approximately six weeks for their orders of processed wood. Why is the lead time this long? Is the company missing out in turnover? And more important, what are the possibilities to decrease this lead time?

1.2 Thesis outline

The main research question for this report is;

*How can the delivery time be as low as possible and a turnover as high as possible in a growing market for both the business and the consumer market?*

In the plan, the following research questions are used to answer the main research question;

- **Will a short delivery time lead to a lower loss of turnover?**
  In this question, the customer satisfaction will be checked by non-structured interviews with bigger B2B customers. The customers are selected from the 20th biggest consumers of the company. In the interviews the following topics are discussed: Product quality, lead time, service/transparency, and the value of the AFH. In this research, the focus has been on current customers and not on potential customers.

- **How did the turnover and lead time evolve during the last years?**
  In this question, the company result is being researched. What has been the amount of turnover? And what has been the delivery time in the last five years?

- **How efficient is the current company model for processed wooden products?**
  In this question, the efficiency of the company is been discussed. If the company is not efficient, there is a logical explanation for the fact that the lead/delivery times are long. In this chapter the process stream
for processed wooden products is being followed. What are all the different steps the product takes and how will the products find their way to the customer?

- **What would be the best scenario/solutions for a high turnover and a low lead/delivery time?**

What are the possibilities for the AFH to decrease the lead time on processed wooden products? In this question, the possible solutions are tested.

The purpose of this research is to get an insight in the efficiency of the company. The hypothesis is that the company is not getting as much turnover as they could due to lead/delivery times. Could this change if the lead times are shorter?
2. Methodology

To answer the main research question, multiple researches have been done in both desk and field research. The field research is done by interviewing customers of the AFH and an efficiency research within the company. The desk research was mostly done by collecting and analyzing current information and information from the past. This is done to get to know as much as possible about the company. With answering these questions, the main goal is to give an advice on how to reduce the delivery/lead time on wooden products and to increase the efficiency within the Amsterdamsche Fijnhouthandel.

The company has multiple different product streams. To give a good and solid result on the research questions, the product stream ‘processed wooden products’ is been followed through the whole company process. This is the product stream that is taking every process step through the company. When this product stream is going more efficient, it’s highly credible that this will also have effect on the other product streams.

The research focuses mainly on business customers. These are the biggest turnover influencers and from this customer group the company got the most complaints lately. When this customer group can be more satisfied, it’s highly credible that this will also have effect on the private customer market.

The research is done by working with the Lean Six Sigma method. Lean Six Sigma is a company process method that connects employees, processes, and customers. It is a method to organize quality and efficiency improvements in a production process of a company. The different tools from Lean Six Sigma provide a systematic construction to improve a production process. Since the goal of this research is to reduce the lead time on products, using this method will result in possibilities to reduce lead/delivery times and give a good overview of the production problems in the company. The most important rule in the Lean Six Sigma method is that the voice of the customer is the most important. What does the customer want and how can we provide it?

The reason to choose for Lean Six Sigma is the proven quality. Many different big corporations use Lean Six Sigma to improve their business processes (verbeteren.nl, 2017). In contrast to other business process methods, Lean Six Sigma works for both product processing as service minded companies. Since the AFH is both. The method is ideal for the AFH. Another important reason to choose for the Lean Six Sigma is the collaboration from the start with the whole team of AFH. The company has some issues with social irregularities. Since everybody is involved from the start with the changes the company has to deal with, it’s more likely to have more support from the employees.

The research runs according the Lean Six Sigma DMAIC method (Define, Measure, Analyze, Improve, & Control). The DMAIC provides a chronological structure to:

- Define the critical aspects of processes.
- Establish a guided baseline performance.
- Determine faults within a process.
- Determine the main causes of the faults
- Improve the process with solutions.

Source: The Lean Six Sigma company

To answer the main research question the following sub questions are researched:

Chapter 4. Will a short delivery time lead to a lower loss of turnover?
Chapter 5. How did the turnover and lead time evolve during the last five years?

Chapter 6. How efficient is the current company model?

Chapter 7. How can the delivery times set by the customers for the B2C and the B2B orders be as optimal as possible?

**Define phase (Chapter 3)**

In chapter 3 the define phase is been covered with a separate chapter. In this chapter there isn’t a sub-question for the research. Chapter 3 gives an overall look into the problems, stakeholders, and the profile of the company. When later in the research is referred to a problem or a stakeholder, this chapter can be used refer to as the overall picture of the project.

An important tool in the define phase is the SIPOC analyses (Supplier, Input, Process, Output, and Customer). This Lean Six Sigma tool is a visual tool to explain the business process from beginning to the end. The analysis is from high end perspective and doesn’t contain any detail. The SIPOC is made to give a brief overview on the AFH and can be referred to later in the research when something is explained about the company’s process.

**Measure phase (chapter 4)**

Measurement is critical throughout the life of the project and as the team focuses on data collection initially they have two focuses: determining the starting point or baseline of the process and looking for clues to understand the root cause of the process. How will I measure the results? What is the baseline? And what will be the goal?

Chapter 4 and 5 cover the Measure phase. In chapter 4 the current customer satisfaction is measured. The reason to research the customer satisfaction is because there are only assumptions so far that the delivery/lead time is too long. The sub question of chapter 4 is: *Will a short delivery time of processed wooden products lead to a lower loss of turnover?*

In chapter 4 the customer satisfaction of the AFH is researched. The customer satisfaction is researched by using non-structured interviews. For the non-structured interviews a topic list was made to help stay on track during the interviews (appendix 2).

The companies are named with a number. This is done so the customer could speak freely about his or her feelings towards the questions. The reason behind the non-structured interview is the natural way of doing in interview. The person questioned can speak freely about what he wants to say about the subject.

The following characteristics are used as structure for an unstructured interview;

- The interviewer and respondents engage in a formal interview in that they have a scheduled time to sit and speak with each other and both parties recognize this to be an interview.
- The interviewer has a clear plan in mind regarding the focus and goal of the interview. This guides the discussion.
- There is not a structured interview guide. Instead, the interviewer builds a rapport with respondents, getting respondents to open-up and express themselves in their own way.
- Questions tend to be open-ended and express little control over informants' responses. (mcleod, 2015)
In the interviews the following topics are discussed: Product quality, lead time, service/transparency, and the value of the products of the AFH.

A recap of these interviews and the bullet list can be found in appendix 3. In this recap different important factors are found as a result of this interviews and as a result of the sub question of this chapter.

As a result of the chapter a KANO model is made. The KANO model is a Lean Six Sigma tool to describe the actual voice of the customer. The KANO model is used to simplify the needs of the customers and to see which factors are important for the AFH. The factors that have been found in the interviews are can be given a level of importance. In the KANO model, these factors are divided in three different categories. These categories are:

- Delighters (excited quality)
  If the requirement is absent, it does not cause dissatisfaction, but it will delight clients if present.
- Must be (expected quality)
  Requirements that can dissatisfy if not present. (Expected, but cannot increase satisfaction)
- One-dimensional (desired quality)
  The more of these requirements that are met, the more a client is satisfied.

What category the different needs are, is chosen by the interviewed customers.

There is no research been done to test the customer satisfaction on private customers. The assumption for the rest of the research is that the outcome of the B2B customer research is the same for B2C customers.

**Measure Phase (Chapter 5)**

To inquire and provide information about current and past lead times only desk research is done.

The sub-question in this chapter is: *How did the turnover and lead time evolve during the last five years?*

The answer of this sub-question is needed to provide exact information for the main research question.

The data collected about lead times comes from order information from the last five years. These orders have been analyzed and the given information is been put in a data box. The given figures are analyzed, converted and summarized in different graphs. The graphs resulted in patterns that show in what way the lead time evolved in the AFH.

In the same research the revenues and turnover are researched. The data about the turnover is provided by the bookkeeper of the AFH. This data was also converted in graphs which made it easier to look for patterns and comparisons with lead times.

To inquire more information about the amount of orders, a four-week stocktaking has been done to get exact numbers of the amount of orders within the AFH. This has been done with the sales department of the AFH. They had to keep track of the offer requests they got and send out. These results can be found in appendix 5. This numbers project a good overview on the amount of request that turn into an actual order.

**Analyze phase (chapter 6)**

What does your data tell you? This phase is often intertwined with the Measure Phase. The data collection from the measure phase is now analyzed.
In chapter 6 the analyzing phase of the Lean Six Sigma method is done. The analyze phase goes deeper into all the different steps of processing in the company. Since the AFH has multiple product streams, the subject processed wooden products is chosen. This product stream undergoes all the different production steps of the AFH. The problems and difficulties that can be found will also tell us something about the processing steps of other product streams.

The sub-question used in this chapter is: How efficient is the current company model for processed wooden products?
The answer to this question is important to see if the longer lead/delivery time is caused by problems within the company or because business is just doing very well. The main information in this chapter is provided by employees of the AFH in a series of meetings with the whole team.

In this chapter multiple lean six sigma tools are used to answer the question. At first the processing model is used. The processing model provides an overview that shows all the different production steps. This steps are chosen by employees of the AFH. Besides these production steps the processing map also providing information about cycling times (C/T) of the products. That information is also provided by the employees.

The next step after the processing model is a detailed map on the processed wooden product. This is basically a more detailed processing map with all the different steps a processed wooden product goes through. Again, this information is provided by the employees of the AFH. This is important so that every member of the team can tell the rest what he needs to do with every step. This provides understanding with the rest of the team.

Then the Value Stream mapping (VSM) is used. The VSM provides the so called difficult points (bottlenecks) in the company’s process. Following the detailed process steps with the employees. All the different difficulties or problems that the employees are experiencing are written down here. With these results, a new map is made. This map shows all the current difficulties of a processing wooden product. As a result, it provides a list of problems that makes the company process less efficient.

From this bottleneck VSM a fishbone diagram (cause and effect diagram) is made. This is a template that provides information on what employees think might be possible causes of the bottlenecks. This is filled in using 6 possible sectors:
- Planning
- Materials
- People
- Communication
- Environment
- Method

From this fishbone diagram and VSM, the biggest bottlenecks in the production process are tested through a Failure mode & effect analysis (FMEA) (appendix 12). With this tool, the most important bottlenecks are given grades to the severity and occurrence of the bottlenecks. It provides information on which problems need to be handled first and which problems will provide the most effect when solved?
The most important bottlenecks are chosen by vote in the meetings with the employees of the AFH. A clear explanation of the points can be found in appendix 12. How higher the outcome of the FMEA, the higher the need to create a solution for the bottleneck.
An important assumption is that the lead/delivery time will decrease with fixing the problems in the production process.

Eventually the efficiency of the saw mill is researched. This is done because the assumption of the AFH is this could work more efficient. Because of social irregularities, actual timing and being part of the process in the saw mill isn’t possible. The figures on efficiency are based on the feedback that saw mill employees gave back on every order. The employees gave information on how long they work on a specific order and all these orders can be found in a weekly overview. This can be found in appendix 7. With this information a boxplot is made to provide information about a single order. A boxplot is a diagram that gives a visual representation to the distribution of the data, highlighting where most values lie and those values that greatly differ from the norm, called outliers.

The boxplot is made using data of all the different processing orders in 4 weeks (appendix 7) (SoftSchools, 2017). The boxplot is made to collect information how long at average the saw mill employees are working on a processed order.

**Improve phase (chapter 7)**

Once the project teams are satisfied with their data and determined that additional analysis will not add to their understanding of the problem, it’s time to move on to solution development. The team is most likely collecting improvement ideas throughout the project, but a structured improvement effort can lead to innovative and elegant solutions.

The problems/bottlenecks as found in chapter 6 need to be solved. In the chapter, the solutions are provided. The sub question for this chapter is: *What would be the best scenario/solutions for a high turnover and a low lead time?* By answering this question, a final conclusion can be made to answer the main research question.

The most important bottlenecks from chapter 6 are thought of by the employees in a mind mapping session. Mind mapping is a Lean Six Sigma method were every problem is written down in the middle of a piece of paper. Then all the employees are asked to work out possible solutions. An example can be found in appendix 14. The most promising solutions are chosen in the same session and are weighted in a Pugh Matrix.

The Pugh matrix is a Lean Six Sigma tool which helps to determine which potential solutions are better than others. It is a scoring matrix used for concept selection in which options are assigned scores relative to criteria. The Pugh matrix allows the team to:

- Compare different concepts.
- Create strong alternative concepts from weaker concepts.
- Arrive at an optimal concept that may be a hybrid or variant of the best of other concepts.

The Pugh matrix is set up in 5 different subjects that are variable with every improvement suggestion. In this case these subject are:

- **Reachability** (easy or hard to infiltrate into the company?)
- **Efficient working hours** (more or less efficient working hours on processing)
- **Environment** (is it a positive or negative influence on the environment?)
- **Costs** (will the costs for the company get higher or lower)
- **Capacity** (will the total capacity be higher or lower in the saw mill)
These factors have been given an importance factor chosen by the CEO of the AFH. For the current situation all marks are yellow (no difference). If the suggestion changes the situation in a good way, the box is green (+ score factor). If it changes in a bad way, the box is red (- score factor). The end score is deciding if a suggestion would be good for the company. How higher the score, the better the solution.

Within the Pugh matrix. For two solutions, a criteria-based decision matrix is made. This is comparable with the Pugh matrix. It is a scoring matrix used for concept selection in which options are assigned scores relative to criteria. The selection is made based on the consolidated scores. These weight scores are provided by the director of the AFH. How higher the score, the better the solution.

An important assumption in the Pugh matrix is that when there are more people hired, the capacity enlarges which results in a higher turnover.

There has been looked into sawmills and companies that work with wood within a range of 50 km. from this research at least one test is been done with an external sawmill. A series of orders is sent to test the quality of the work.

At last the benefit/effort matrix is used. This system is also part of the Lean Six Sigma method. Together with the employees that were involved with the Value Stream Mapping the different solutions were discussed. The solutions are given a grade on how easy it will be to start using them and how much effect it will have on the total efficiency. This benefit/effort matrix shows what the easiest solutions compared to the amount of effort that you have to put in. it basically gives you a quick overview how to increase the efficiency of the AFH the quickest. The most important reason to add this matrix is to increase the pro-activeness of the employees. They have voted what is easiest to change to make their work easier. This results in an easier infiltration of the solution.

**Control phase (discussion)**

Since this research is all about giving an advice towards the AFH. The control phase is covered in the Discussion of this research. What needs to be done with the recommendations and what follow-up studies need to be done to get to the goal of a reduced lead time.
3. Project charter

The project charter is the first step of the DMAIC method of the Lean Six Sigma method. It gives a quick overview of the total project in with the specific issues, key persons, and an overview of the company. In the following chapters the project charter can be referred to check the basic outlines of what is important to keep in mind.

Problem in the company
- The delivery/lead time for product seems to be getting longer. Customers are complaining more and more about the amount of time they have to wait for their products. It seems that this has a negative effect on the potential turnover.

Additional problems
- The way of working/documenting between working sections within the AFH differs.
- All the sections working on their own island instead of together.

Who is dealing with these problems?
- Customers
  The customer wants his processed wood as quick as possible and of good quality.
- Sales employees
  The sales employees wants to sell as much products as possible.
- Sawmill employees
  The sawmill employee wants to work as secure as possible without interruptions in their flow of working or having to deal with process problems of others.
- Amsterdamsche Fijnhouthandel
  The AFH wants to have a professional and reliable image. The company wants to be the answer to everything that has to do with hardwood species.

Possible causes
- Inefficient working method.
- Absence of flow in the production process.

Hypotheses by client (CEO AFH)
- There is missing a flow in the process steps in the company. Too many orders need a lot of discussion which leads to mistakes, repairs, and because of that; extra processing time. This problem is keeping our business from having more turnover and it leads to a negative working environment.

Project members / stakeholders
Rick Kamphorst - Project leader/researcher
Ivar Brugman – CEO Amsterdamsche Fijnhout

Employees AFH
- Office (4 people)
- Sawmill (3 people)
- Yard (2 people)
- Transport (2 people)
**Company profile**
Appendix 11

**Goal**
The goal of the project is to give an advice on how to reduce the lead/delivery time on processed products so that most customers are more satisfied which leads to a higher turnover.

**Supplier, Input, Process, Output, and Customer analyses (SIPOC)**
The SIPOC analyses gives a brief overview of the AFH Company profile in this project.

- **The supplier**
  Provides information about the key person that provide materials for this project.
- **Input**
  Provides information about what the company puts into the product process.
- **Process**
  What are the different head steps the company takes in the product processing?
- **Output**
  What are the results of the process?
- **Customer**
  Who are the customers of that Output?

*Figure 1 Supplier, Input, Process, Output, and Customer analyses*
4. Customer satisfaction

In this chapter the customer satisfaction of the AFH is being researched. For the B2B clients the customer satisfaction is checked by non-structured interviews (appendix 17). The customer satisfaction is also called the voice of the customer (VOC). What are the important factors in ordering wooden products for the customers?

The sub question of this chapter is: Will a short delivery time of processed wooden products lead to a lower loss of turnover?

The customers interviewed are chosen from the 20 biggest business customers of the AFH. Seven of them replied positive to an interview. A recap of these interviews and the bullet list can be found in appendix 2 and 3. In the interviews the following topics are discussed: Product quality, lead time, service /transparency, and the value of the products of the AFH.

4.1 Product quality

The overall quality of processed goods meets the standard of clients. The quality standard of the wood itself results in a good quality of the product. The wood itself has a lower quality than ten years ago but this is a problem that is known. More wood trading companies experience this problem. Compared with other wood trading companies the AFH is providing a high level of quality with their products. An important thing about the processed goods is that they really need an after check. It seems that the saw mill is sometimes ignoring or missing small mistakes in the planed work. The products have to return to the AFH to correct the mistakes. This is not helping with the planning of companies towards their customers and projects.

The AFH is known to be a company that is in the higher segment of wood trading. A suggestion would be to provide bigger projects where the profit margin is a little bit lower and the standard of the wood quality too. This might result in more projects. The average grade that the AFH gets for the product quality is a 7. These results can be found in appendix 3.

4.2 Lead time

The lead time is a difficult subject for the clients of the AFH. The lead time as is provided for raw sawn material is all right. Whenever a product is not in stock the AFH provides a transparent service on how to get the product as soon as possible. For the processed goods this is not as transparent. The lead time as given at request is considered way too long. Whenever a carpenter needs to build something for his clients he usually cannot wait four weeks on his materials. Customers know that the lead time for processed products is with 4 till 6 weeks quite long. They calculate this when accepting new jobs. If something needs to be done quickly they will not even try to buy from the AFH knowing that it takes too long. If the request is special in terms of the wood specie, in most cases the wood is bought raw sawn and the customers will do the work themselves.

The maximum lead time differs per order. For simple processing steps in very small quantities the lead time should be at maximum 8 till 10 working days. For bigger order the maximum should be around 15 working days. Customers don’t agree with 4 or 6 weeks. The answer from the AFH is that at the moment it is quite busy in the saw mill. This is an answer they hear already a couple of years.

The Lead time for raw material is seen as all right. Difficulty is that consumers have to have contact with the sales department to get a check on the actual stock. Sizes of the wood may differ per month. There are no problems noticed with the stock of plywood.
4.3 Service / transparency
Customers feel that doing business with the AFH is fun. The service has a personal touch which results in a friendly way of doing business. Customers feel that they quickly have a personal relationship with the AFH. The factor of goodwill is something that customers have with the company. It is fun to drive by and help each other out in the wood trading business.
The communication factor is sometimes not quick enough. Whenever something turns out to last longer than was calculated, customers don’t get information about that. An update on the changes in lead/delivery times is strongly advised. At this point customers feel like they have to constantly ask for updates. Whenever customers ask for an offer by email, an answer takes sometimes more than a week. This is seen as annoying. Especially when the customer called first and was asked to do his request by email.
The transparency of the offers is not really clear. When customers have an offer for a processed order, the next time other prices might be calculated. There is a feeling that it differs per employee what the price is they have to pay.
Whenever something is wrong with the delivered products, the AFH has an excellent customer service. The workers are listening seriously to the problems and it seems that almost everything is done to please the customer in the end. A certain amount of trust is felt which leads to a higher satisfaction.

4.4 Value
Doing business with the AFH is doing business with a company in the higher segment. Clients know that the price is often higher than the prices provided by other companies (concerning common species). Then again, the provided quality and the lack of providers of special wood species is something which is getting the customers to come back. The pricing is regarded to be high but not unreasonable.

4.5 Private consumers
The reasons for this research are complaints from B2B customers. The sales employees do not have a recall of problems with private consumers about lead time. The assumption in this research is that the problems of the B2B customers are also applicable to B2C customers. As an alternative for a research to the customer needs of B2C customers. A survey has been done to collect the data on the amount of requests. Over a 4 week period approximately 180 requests are done by private consumers. In approximately 11.7% the offer is turned down because of the lead time. This survey can be found in appendix 1.

4.6 Recap/conclusion
Customer satisfaction is not only about the delivery time. It is a combination between factors like; service, product quality, value and lead time. The overall quality of the product is considered good. But there can be made some improvement steps within the service towards the customer.
A big issue is the lead time of the processed products. This is considered to be too long which results in fewer orders by some companies. It also results in a lower customer satisfaction. Looking into the desired lead time, to increase customer satisfaction the lead time should be decreased with 30 till 50% on processed orders.
Important is, to keep the quality/pricing factor right. Customers accept the fact that the pricing is higher because of the special niche market, and are overall satisfied with the delivered goods.
Also something that should be taking into consideration is that the AFH has to keep the local environment and atmosphere. Companies are coming back with orders because they feel they are returning in a local environment where they are treated well.
4.6.1 KANO model

The Kano model provides information on what the level of interest a specific need is. What are the most important needs and what needs should be taken care of first. This is according to what the customers mentioned in the interviews. A report of the interviews can be found in Appendix 3.

To sum up, the things the AFH can do for a higher customer satisfaction according to their customers:

- Cut down in lead times where possible.
- Proactive communication about orders to their customers.
- Structured quality control on processed goods.

Things important to maintain:

- Quality range, price range.
- Personal customer service.
- Local environment and atmosphere.
5. Turnover and Lead time

In this chapter the company result is written. What is the turnover and what has been the delivery time for products in the last five years? The values written down are all excluding VAT.

The research question for this chapter is:
How did the turnover and lead time evolve during the last five years?

The source for the stated figures can be found in the data collection plan (appendix 15)

5.1 Turnover

The turnover is an important number for a company’s health. The turnover of the last five years is projected like this;

<table>
<thead>
<tr>
<th>Year</th>
<th>Total turnover AFH</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>€ 1.588.647,98</td>
</tr>
<tr>
<td>2012</td>
<td>€ 1.542.154,55 -3%</td>
</tr>
<tr>
<td>2013</td>
<td>€ 1.714.698,22 11%</td>
</tr>
<tr>
<td>2014</td>
<td>€ 1.865.781,00  9%</td>
</tr>
<tr>
<td>2015</td>
<td>€ 2.128.605,37 14%</td>
</tr>
</tbody>
</table>

growth in last five years 34%

Figure 2 total turnover of the last five years

Figure 3 total turnover of the last five years
Within a book year, January till December. The revenue total can be projected as this;

<table>
<thead>
<tr>
<th>Year 2015</th>
<th>Turnover</th>
<th>Processed orders</th>
<th>Raw material</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>€ 143.309,28</td>
<td>€ 36.794,45</td>
<td>€ 65.118,47</td>
<td>€ 41.396,36</td>
</tr>
<tr>
<td>February</td>
<td>€ 156.003,85</td>
<td>€ 41.347,70</td>
<td>€ 55.229,56</td>
<td>€ 59.426,59</td>
</tr>
<tr>
<td>March</td>
<td>€ 213.907,82</td>
<td>€ 37.707,91</td>
<td>€ 121.850,19</td>
<td>€ 54.349,72</td>
</tr>
<tr>
<td>April</td>
<td>€ 161.510,34</td>
<td>€ 35.674,44</td>
<td>€ 90.335,00</td>
<td>€ 35.500,90</td>
</tr>
<tr>
<td>May</td>
<td>€ 169.992,41</td>
<td>€ 39.611,86</td>
<td>€ 80.434,47</td>
<td>€ 49.946,08</td>
</tr>
<tr>
<td>June</td>
<td>€ 182.401,91</td>
<td>€ 51.381,17</td>
<td>€ 88.602,96</td>
<td>€ 42.417,78</td>
</tr>
<tr>
<td>July</td>
<td>€ 122.143,11</td>
<td>€ 41.163,46</td>
<td>€ 51.140,82</td>
<td>€ 29.838,83</td>
</tr>
<tr>
<td>August</td>
<td>€ 154.383,69</td>
<td>€ 47.303,87</td>
<td>€ 64.449,45</td>
<td>€ 42.630,37</td>
</tr>
<tr>
<td>September</td>
<td>€ 207.112,15</td>
<td>€ 49.475,59</td>
<td>€ 90.443,35</td>
<td>€ 67.193,21</td>
</tr>
<tr>
<td>October</td>
<td>€ 218.356,50</td>
<td>€ 62.702,30</td>
<td>€ 91.317,05</td>
<td>€ 64.337,15</td>
</tr>
<tr>
<td>November</td>
<td>€ 197.994,90</td>
<td>€ 53.250,68</td>
<td>€ 97.749,08</td>
<td>€ 46.995,14</td>
</tr>
<tr>
<td>December</td>
<td>€ 201.489,41</td>
<td>€ 50.679,19</td>
<td>€ 97.749,08</td>
<td>€ 53.061,14</td>
</tr>
<tr>
<td>Turnover Total</td>
<td>€ 2.128.605,37</td>
<td>€ 547.092,62</td>
<td>€ 994.419,48</td>
<td>€ 587.093,27</td>
</tr>
<tr>
<td>Percentage %</td>
<td>100%</td>
<td>25,70%</td>
<td>46,72%</td>
<td>27,58%</td>
</tr>
</tbody>
</table>

*Figure 4 Total turnover by month and category in 2015 of AFH.*

As shown in the figure 8 the seasonality of the turnover is caused by vacation periods. In the beginning of the year (January) and the vacation months (July and August) the turnover is far below average. In
practice, this means that the saw mill is making time up on the lead time or that they are using the time for different aspects like filling up the inside stock for with sawn and planed processed wood.

5.2 Turnover B2B / B2C

The turnover divided by B2B customers and B2C customers is as follow (appendix 10)

<table>
<thead>
<tr>
<th></th>
<th>Turnover</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>B2B</td>
<td>€ 1.814.238,56</td>
<td>85%</td>
</tr>
<tr>
<td>B2C</td>
<td>€ 314.366,81</td>
<td>15%</td>
</tr>
<tr>
<td>Total</td>
<td>€ 2.128.605,37</td>
<td>100%</td>
</tr>
</tbody>
</table>

*Figure 6*

The AFH makes most of its turnover out raw material. This consist of raw sawn wood that is been bought in bulks and is been sold in smaller packages. Almost half of the turnover of the AFH consists out shuffling boxes. This can be seen as the main core business of the company.

The exact figures of the turnover per group of materials is missing due to a change in the booking system. The estimation taken by the AFH is that the seasonality per year is relatively the same.

The group other exists out of plywood and non-wooden materials such as tools, bamboo, and treatment products.

5.3 Lead time

The lead time for the different wooden products of the last known years are as follow; (the numbers used are with an average)
The above graphic shows a company in a growing market. As shown earlier in this chapter, the annual turnover is rising and it’s only logical that the amount of work is growing with that turnover also.

- Raw sawn
  The AFH has always had a decent amount of stock. From the products they claim to sell, there are always pieces available in their stock. The company has close partners in the wood trading business so whenever an order is bigger that they can handle, the wood is easily brought in by suppliers.

- Plywood
  The AFH tries to keep the amount of plywood in stock as low as possible. For the bestsellers like exterior marine plywood, birch plywood, and poplar plywood veneered with the most common wood species are always in stock.
  The supplier used to visit the company every week, this changed in 2015 to once every two weeks. The order quantity of the AFH wasn’t enough for the supplier to supply them every week. The standard delivery was set to once every two weeks. If the AFH wants a more frequent delivery, the products need to be picked up by the company itself. This is the reason for the increase in delivery time in 2015 on plywood. The change in delivery time has led to a bigger stock for the plywood products. The more specialized plywood products have a delivery time of two weeks.

- Cut and planed processed products
  The amount of lead time for processed wooden products that involve cutting and planing has evolved dramatically in the last five years. Since 2011 it has grown from two weeks to a stable four week since mid-2014. A couple of months during 2015 it has been even five weeks. This is brought back to four weeks relatively fast.

- Glued and milled processed products
  The glued and milled processed products show the same trend line as the cut and planed processed products.
5.4 Recap

The AFH is a growing business. Both lead times and turnover have grown in the last five years. The lead/delivery times, divided in four different product groups are almost all increased. The lead/delivery time for raw sawn material stayed stable in the last years. This means that the control of stock is working properly. It also means that the AFH work with reliable suppliers who deliver the products fast enough when needed. The groups that have the most problems with the growing turnover are the ones who need processing. In the last five years, these groups have grown rapidly.

The turnover shows a rapid growth as well. In the last five years the total amount of turnover has grown around 34% (appendix 10), this is a very healthy growth rate for the company. The only negative number that is shown is the difference between 2011 and 2012. This is due to the global economic crisis (Statistiek, 2012)
6. Efficiency analyses and bottlenecks

In this chapter the efficiency of the company is handled. If the company is not efficient, there is a logical explanation for the fact that the delivery times are long.

The sub-question used in this chapter is; 
*How efficient is the current company model for processed wooden products?*

The sub question is answered by using different tools of the Lean Six Sigma method. For this analyses the product group processed wooden products has been chosen. This product group undertakes all the different process steps in the company. Other products groups skip certain process steps.

6.1 Value Stream Mapping (VSM)

Value stream mapping is a paper and pencil tool that helps you to see and understand the flow of material and information as a product or service makes its way through the value stream.

The processing model of the AFH looks as follow;

The graph shows the different steps of a processed wooden product in the AFH. This is the total possible mapping. This means that not all the products take the same route. Whenever a step can be skipped the processing time is shorter. The AFH has 8 different main steps. It all starts with the order. From there it takes 1 to 3 days for the order to get into the planning. This means that it could last up to half a week before the order reaches the planning. From the planning it takes around 3 days for the yard employees to collect the available resources needed for the order. This involves mainly planks and beams. The yard puts the wooden products into the raw storage. The wood is saved there around 2 to 4 weeks. This means that the delivery time for processed wooden products is mainly storage time. When the saw mill is ready for the actual processing it takes a maximum of two days to finalize the product. When the customer is called and he will pick the order up or let it deliver within 14 days. The delivery time with the driver of a certain product is quite fast and mostly done within an hour.
When looking into the different activities of a processing step, there is a clear overview on the amount of activities that has to be done. These steps are provided by the employees of the AFH themselves. In a series of two meetings, all the different steps an employee has to make are written down. This gave an insight for their coworkers in what somebody has to do for an order. The different steps can be found in figure 10. A specific analyses of the order process can be found in appendix 11.

Figure 10 order process for a processed order.

The actual working time on an order in the different departments is relatively low. Employees are mostly not working several days on one order. The cycle time between departments is most of the time longer.
because the flow is interrupted by previous orders that need extra attention. The place where the order is staying most of time is in the storage before the saw mill. This means that the company model in not inefficient. It seems that the company is handling more orders than they can handle. If the amount of time that it takes to process the order in the saw mill is relatively low, it is a logical conclusion that there needs to be an upgrade, as in more workers or machinery, in the saw mill to process more orders in the same amount of time.

6.2 Bottlenecks
The bottlenecks in the VSM are a conclusion on the difficulties within the process map of the AFH. The Value Stream Mapping has been done in a meeting with all the workers of the company. The employees were put in their own working group. The four different groups were:

- Office (4 people)
- Sawmill (3 people)
- Yard (2 people)
- Transport (2 people)

Taking the process map of the AFH, every employee could mention the different difficulties they have to deal with in their working process. The different bottlenecks/difficulties can be found in figure 9.
According to the saw mill employees, there are numerous things that can be done to make their work easier and more efficient. As they said, they are working around 30% percent of their time with issues they shouldn’t have to take care of. This percentage is an estimation made by the employees themselves and is not based on a factual research.

In the same meeting session the reason for these bottlenecks are captured in a cause and effect diagram (figure 12). What could be the reason/causes for the bottlenecks that result in a longer lead time and a disruption of the flow of a process? This is captured in six different sections which are: Planning, materials, people, communication, environment, and method.
As seen in figure 12, most possible causes are based on possible miscommunications, uncertainties, and planning. These are bottlenecks that can be handled with direct solutions. Causes that have something to do with the location of the company are put aside due to the limitations in space this location has.

6.3 Failure Mode & Effect Analysis (FMEA)

According to the workers, ten different points are the biggest bottlenecks in the processing process. These are derived from the VSM and the Fishbone diagram. The most important bottlenecks chosen by the employees are:
1. **Wrong specification information on the work order sheet.**  
   The work is not written down correctly on the work order form (appendix 8). This results in extra time necessary to consult the sales department on what needs to be done exactly.

2. **The attached drawing isn’t correct**  
   To clarify a specific order, customers often send in drawings. They are translated by the sales employee to a work order.

3. **Not enough working space**  
   The employees need more working space to store wood or to place machinery. This is sometimes difficult due to the size of the saw mill.

4. **Getting feedback from the right sales employee.**  
   Different sales employees sometimes work on the same order. This is considered confusing when there are questions from the saw mill employees towards the sales department.

5. **Maintenance machinery**  
   The maintenance of the machinery is done during working hours. This often takes a long time from the efficient working hours.

6. **Cleaning up after Saturday crew**  
   Since the saw mill is only open from Monday till Friday, employees from the Saturday crew often use materials in the saw mill that are not put back correctly. This means that the saw mill employees are using valuable working time on Monday to clean up the saw mill.

7. **Wood disposal after finishing order**  
   The raw material that is picked for a processed order is often a lot more than actually needed. A possible explanation is that the yard workers don’t have the same idea on what is needed for an order. Or they just want to give them some more options. The extra material is then planed for selling in the stock as leftover pieces. The fact that this needs to be planed consumes more time which results in less actual order working time.

8. **Cleaning up the saw mill**  
   Every week the saw mill needs to be cleaned. This is done during opening/working hours.

9. **Weight/volume of the orders**  
   The weight and volume of the wood is often an issue. With bigger volume orders three people have to work together which takes more hours.

10. **Raw material incomplete for processing.**  
    The raw material is not collected by the wood yard workers in a correct way. The wood can contain faults like knots and cracks. Whenever this happens the employees from the saw mill have to ask for new material from the stock yard and exchange materials. Estimation by the saw mill is that this happens about 25% of the orders.

These most important bottlenecks were captured in a Failure Mode & Effect Analysis (FMEA), which can be found in appendix 12.
According to the point given in the FMEA. The most important bottlenecks in the processing order process are bottlenecks 1, 2, 4, 7, 9 and 10. These are all bottlenecks with a Risk Priority Number above a 100. These issues are discussed in chapter 7.

6.4 Efficiency sawmill
Within the saw mill there are three FTE’s (120 hours a week). These are divided by three people that work 40 hours a week. The three employees work in two groups. At the beginning of the day the work for the coming day is divided. Three FTE can be translated to 120 hour a week. From these 120 hours, 22 hours and 30 minutes is break time. These breaks are not applicable with the collective employment agreement (CEA) (Nederland, 2017) of timber trading companies but are set by the companies CEO. Due to the relatively long breaks, the amount of working hours is 97 hour and 30 minutes per week.

The sawmill employee writes down on every order what they exactly did and how much time it took. A result of this research can be found in appendix 7. According to appendix 7, the average amount of efficient working time working on orders is 33 hour and 45 minutes per week. Compared with the efficient working hours this means that the saw mill is spending only 34.6% of their time on actual order processing. (Efficient working hours / amount of working hours * 100%)

6.4.1 Boxplot of the processed orders
The boxplot is made as an analysis after a 4 week survey of the actual processed wooden orders. This can be found in appendix 7.
According to the boxplot, the average time an order takes is 1.57 hours. The standard deviation is 1.29 hours. This means that the actual time working on an order is relatively low compared to the total delivery time. The delivery time is between 4 and 6 weeks. But the actual working time is 1.29 hours. This means that the efficiency of the saw mill working on actual orders is not disproportional. Because this amount of time is a fraction of the actual lead/delivery time of the products.

6.5 Recap
The company model has its ups and downs. The actual working time on an order is relatively low. This means that whenever an employee is processing an order the work is despite the recurrent disturbances done efficiently.

When you compare the available working time (97.5 hours per week) with the actual worked time (33.75 hours per week) the conclusion is that the workers are too busy with other things than working on actual orders. There is too much interference. This interference is troubling the flow of the process. Ten different bottlenecks have been mentioned as the biggest problems in this flow and should be looked into.

As an answer to the sub question, the company model does not have problems with efficiency in the working process, but there are certain that can be done to make the total working time more efficient.
7. Solutions and recommendations

In this chapter the possible solutions and possibilities will be mentioned. What is achievable within the demand of the AFH to reduce lead times? The best options will be explained. The best options will be chosen within an internal and external option. Internal options are possibilities that can be done within the company. External solutions are solutions that can be done outside the company. The solutions are made up both from desk research as the VSM from chapter 6.

The sub-question for this chapter is;

What would be the best scenario/solutions for a high turnover and a low lead time?

The possible solutions are collected with the principle of mind mapping. Together with the whole team there has been a separate meeting to work on the solutions by making mind maps. An example can be found in appendix 14. The solutions are worked out in a Pugh Matrix and Analytical Hierarchy Process (AHP). These matrixes help selecting the best solutions. The matrixes can be found in appendix 13.

7.1 Possible solutions

Possibilities to decrease the processing time for wooden products can be divided in internal and external solutions. The solutions are made in the second meeting held for the VSM (chapter 4). All the workers within the AFH worked together to formulate the following solutions.

7.1.1 Internal;

A) Improve the given problems according to the workers in the saw mill.
Whenever things have improved, the workers can save up to almost 30% of their time. This time can be used for working on extra orders which would decrease the delivery time. This 30% is set by the sawmill workers themselves. This is an assumption and not a researched figure.

B) Hire extra employees.
When there is too much work in the company and the current workers cannot handle the amount of work that needs to be done, it’s a logical solution to hire extra workers. An extra worker will increase the amount of working hours within the saw mill per day which increases the amount of work that can be done on a day. With extra employees there will be more time for cleaning up, maintenance, and wood disposal after finishing orders.

C) Work in multiple shifts.
When the availability of working space isn’t big enough, an extra shift on a day could increase the amount of working hours per week. This would involve extra employees. With the current 3 workers, this would mean that one of the workers should work alone. Although this is possible according to the Dutch government (portaal, 2016), this is due to safety for the AFH never a possibility when working with machines.

D) Accept fewer orders.
When the amount of orders is too high, this could be decreased by accepting fewer orders. It could be interesting to only accept orders of a minimum amount of value.

E) Divide the orders between B2B and B2C.
Assuming that B2B customers ask for bigger orders, the B2B orders and the B2C orders can be split in the planning for the sawmill. With this method, the B2B orders can be done sooner what would result in more satisfied customers. The lead/delivery time for private consumers will probably be higher using this method.

**F) Work with a digital version of a work order.**
At this moment the working orders are handwritten (appendix 8). This working order is a paper version that goes through the whole company chain. The readability of this form depends on the quality of the handwriting of the sales employee. When the work form can be printed digitally there can’t be misunderstanding about information that is written on the form. This will help preventing conflicts about the information written down on the form. It is also a solution for the saw mill employees getting back to the sales department.

**G) Better quality control by the wood yard Employees**
The raw material forms the basis of a processed wood order. The quality of the wood is something they start with. If the employees take a bit more time to check the wood correctly and set ground rules with the saw mill where they have to look for, less wood has to come back or has to looked up again.

7.1.2 External;

**H) Outsource work for the saw mill.**
Whenever there are too many orders for processed wood and the saw mill of the AFH cannot handle the amount of work. A possibility would be to ask other companies to do the processing work. Within this option there has to be some ground rules about quality and such.

**I) Outsource the maintenance of the machinery.**
This will result in more time for the actual employees in the saw mill. The maintenance can be done outside working hours. Downside of this solution is that the costs will be higher.

7.2 Best solutions
To determine what the best solution would be, a Pugh matrix has been made. This matrix can be found in appendix 15. The higher the score compared with the current situation, the better the solution would be for the AFH.

7.2.1 Internal

**A) Improve the given problems according to the workers in the saw mill. (+4 points)**
If the 30 percent of the time can be saved with the solving the given issues (appendix 4). This would mean that the employee can work 30 percent more on orders during the week. Stated that the employees work on average 33 hours and 30 minutes on actual orders. This could increase to 43 hours and 30 minutes of processed wooden product orders.

**B) Hire extra Employees. (+7 points)**

**C) Work in multiple shifts. (+7 point)**

Solution B and C can be put together. The costs of all the factors within the saw mill are put together in a table.
Assumptions (Brugman, 2016)
- Leasehold is € 2.925, - per year. The saw mill is 15 m$^1$ by 19.5 m$^1$. A total of 292.5 m$^2$. The total leasehold price per m$^2$ is € 10,-
- The rent of the ground is set on € 65.000, - per year. The sawmill takes about 10% of the company. The rent price for the sawmill is set on € 6500,-
- The staff salary costs are set on average € 28.372,21 per person per year.
- The costs for pension, gasoil, gas, machinery write-off, tools, and maintenance are set on one workweek of 40 hours.
- The AFH only wants to work with full time employees.
- The machinery write off is based on a certain amount of life-hours per machine.

- **Scenario 1**
The current situation. There are no changes whatsoever. This means three employees working in one shift.

- **Scenario 2**
Four employees work in two shifts of two. Within this scenario the total amount of working time is raised with 8 hours to 16 hours per day.

- **Scenario 3**
Four employees work in one shift together.

- **Scenario 4**
Three employees work in two shifts of two. Within this scenario the total amount of working time is raised with 8 hours to 16 hours.

<table>
<thead>
<tr>
<th>Scenario 1</th>
<th>Scenario 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No Change</strong></td>
<td><strong>2 times 2</strong></td>
</tr>
<tr>
<td><strong>costs sawmill 2016</strong></td>
<td><strong>costs sawmill 2016</strong></td>
</tr>
<tr>
<td><strong>Fixed</strong></td>
<td><strong>Fixed</strong></td>
</tr>
<tr>
<td>Leasehold</td>
<td>€ 2.925,00</td>
</tr>
<tr>
<td>Rent</td>
<td>€ 6.500,00</td>
</tr>
<tr>
<td>staff salary</td>
<td>€ 85.116,63</td>
</tr>
<tr>
<td>Gasoil</td>
<td>€ 1.500,00</td>
</tr>
<tr>
<td>Electrics</td>
<td>€ 9.600,00</td>
</tr>
<tr>
<td>Gas</td>
<td>€ 1.920,00</td>
</tr>
<tr>
<td>Machinery write-off</td>
<td>€ 25.000,00</td>
</tr>
<tr>
<td>Tools</td>
<td>€ 5.000,00</td>
</tr>
<tr>
<td>machinery maintenance</td>
<td>€ 4.000,00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
</tr>
<tr>
<td>€ 34.425,00</td>
<td>€ 59.425,00</td>
</tr>
<tr>
<td><strong>Variable</strong></td>
<td><strong>Variable</strong></td>
</tr>
<tr>
<td>€ 107.136,64</td>
<td>€ 157.528,85</td>
</tr>
<tr>
<td><strong>Grand total</strong></td>
<td><strong>Grand total</strong></td>
</tr>
<tr>
<td>€ 141.561,64</td>
<td>€ 216.953,85</td>
</tr>
</tbody>
</table>
**Figure 14** different scenarios for the saw mill AFH

<table>
<thead>
<tr>
<th></th>
<th>Scenario 3</th>
<th>Scenario 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 times 4</td>
<td>2 times 3</td>
</tr>
<tr>
<td><strong>Costs sawmill 2016</strong></td>
<td><strong>Fixed</strong></td>
<td><strong>Variable</strong></td>
</tr>
<tr>
<td>Leasehold</td>
<td>€ 2,925,00</td>
<td></td>
</tr>
<tr>
<td>Rent</td>
<td>€ 6,500,00</td>
<td></td>
</tr>
<tr>
<td>staff salary</td>
<td>€ 113,488,84</td>
<td></td>
</tr>
<tr>
<td>Gasoil</td>
<td>€ 1,500,00</td>
<td></td>
</tr>
<tr>
<td>Electrics</td>
<td>€ 9,600,00</td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td>€ 1,920,00</td>
<td></td>
</tr>
<tr>
<td>Machinery write-off</td>
<td>€ 25,000,00</td>
<td></td>
</tr>
<tr>
<td>Tools</td>
<td>€ 5,000,00</td>
<td></td>
</tr>
<tr>
<td>machinery maintenance</td>
<td>€ 4,000,00</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>€ 34,425,00</td>
<td>€ 135,508,85</td>
</tr>
<tr>
<td><strong>Grand total</strong></td>
<td>€ 169,933,85</td>
<td></td>
</tr>
</tbody>
</table>

|                  | **Fixed** | **Variable** |
| Leasehold        | € 2,925,00 |            |
| Rent             | € 6,500,00 |            |
| staff salary     | € 170,233,26 |        |
| Gasoil           | € 1,500,00 |            |
| Electrics        | € 19,200,00 |        |
| Gas              | € 3,840,00 |            |
| Machinery write-off | € 50,000,00 |        |
| Tools            | € 10,000,00 |        |
| machinery maintenance | € 8,000,00 |        |
| **Total**        | € 59,425,00 | € 212,773,28 |
| **Grand total**  | € 272,198,28 |            |
The best solution according to figure 11 would be to go with scenario 2 or 4. This means that an extra shift of sawmill work per day provides the biggest effect on the lead/delivery time of the AFH. Compared with the current situation. Both scenarios will have a big effect on the costs. Both the fixed as the variable cost will increase. The scenarios also involve extra workers. The assumption in this conclusion is that extra costs for employees would be compensated with extra capacity and turnover.

**D) Accept fewer orders. (-5 points)**

Accepting fewer orders would mean that smaller orders with a lower profit margin should be declined when needed to make sure the lead/delivery time would not be too long. This is not considered to be an option because the AFH feels they would lose too many current customers and new customers in the future. As seen in appendix 7, a good amount of orders is considered small. These are all different/unique customers.
When customers hear that their order will not be processed they are not likely to come back in the future with other requests

E) Divide the orders between B2B and B2C. (+3 points)
At this moment there is only one planning list for processed orders. This list provides the chronological way to work on the orders and gives information about when they have to be ready. B2C and B2B customers are mixed in the same list. When there will be two lists with B2C and B2B split up. It could become clearer on what has to be done with a higher priority.

F) Work with a digital version of a work order. (+9 points)
A simple solution that is comparable with solution A. When the work order (appendix 8) can be filled in on the computer and printed out as a worksheet. There can’t be made any more mistakes or miscommunications about numbers and specifications. It is important to set ground rules on how to fill in this document. This has to be done in collaboration between all the involved departments within the AFH.

G) Better quality control by the wood yard employees. (+9 points)
One of the big issues from the employees of the saw mill is the quality control of the wood yard employees. These can be improved by setting ground rules between the saw mill and the wood yard. What are the different things that they have to check on and what is enough wood to get a good order out?

7.2.2 External

H) Outsource work for the sawmill (+3 points)
To decrease the amount of orders waiting within the production process one of the possibilities is to not do everything within the AFH. There are multiple options of companies that are known for contract work.
The demands for outsourcing stated by the CEO of the AFH are;

- Available for small orders
Most processed wooden product orders from the AFH are small orders (appendix 7). This means that the outsourcing company has to work with a lot of changes in production processing without using a lot of wood.

- Possibilities for sawing, cutting, plaining, milling and sanding.
These are the options the AFH offers for their processed wooden products as well.

- Located close to Amsterdam.
The raw sawn wood needs to be transported to the outsourcing company. This company needs to be within a close range of Amsterdam to keep the costs of the transport low. The transport cost by the truck from the company is set on € 1, - per km. this is excluding the cost for the employee. The real costs will be higher. The search area for companies is set on 50 km within the range of the AFH.

- Possibilities for quick production.
The lead time cannot be longer than ten working days according to the B2B customers (chapter 4). This means that the outsourcing company cannot take longer than five working days. This gives the AFH the time to work to pick collect and deliver them to the client.
Test Houthandel Hoogendam (Hoogendam, 2016)
The wood trading business Houthandel Hoogendam has done a test for the AFH. This company is comparable with the AFH on machinery. The most important proceedings can be done by this company as well. It's located 11.9 km from the AFH. This means it's relatively close to the AFH which means low costs in transportation.
The company sent 16 relatively small orders. These small orders were done in four working days. The AFH delivered the raw sawn wood and picked the processed wood up themselves.
The company calculates by the hour. A rate of € 70, - (excluding VAT) per hour has been set. This rate is set regardless the types of work. This rate is comparable with the rate that the AFH has set for their own production work.

From the total of 16 orders, 14 orders were done exactly right. Two orders had faults in them that did not meet the quality standards of the AFH. The amount of time the AFH had set for the orders was reached exactly. This means that except the loss in working time of the driver and the transportation there wasn't any extra profit lost.

1) Outsource the Maintenance of the Machinery. (+2 points)
The sawmill machinery can be maintained by the distributors of the machinery. At this moment the machinery gets checked every year by the distributors. This check-up is not reliable enough for the machines that need maintenance. This maintenance could be done by the extra sawmill worker. Just so the other workers can continue with their work.

7.2.3 Benefit / effort matrix
The benefit and effort matrix is part of the Lean Six Sigma system. Together with the employees that were involved with the Value Stream Mapping the different solutions were discussed. The solutions are given a grade on how easy it will be to start using them and how much effect it will have on the total efficiency. These grades are set up from 1 to 3. With these grades the following matrix is set up.
The letters used in the benefit/effort matrix correspond with the letters in chapter 7.
The benefit/effort matrix show that the solutions B, E, F, and, H show the most benefit compared to the amount of effort it takes.

### 7.3 Recommendations

The recommendations for the AFH can be divided in short and long term solutions. On the short term it seems important to reduce the delivery time of processed goods as soon as possible.

**Short term**

*Outsource work for the saw mill.*
Whenever there are too many orders for processed wood and the saw mill of the AFH cannot handle the amount of work. A possibility would be to ask other companies to do the processing work. Within this option there has to be some ground rules about quality and such.

**Long term**

*Hire extra employees.*
When there is too much work in the company and the current workers cannot handle the amount of work that needs to be done, it’s a logical solution to hire extra workers. An extra worker will increase the amount of working hours within the saw mill per day which increases the amount of work that can be done on a day. With extra employees there will be more time for cleaning up the saw mill while working and using the wood disposal after finishing orders.
Work with a digital version of a work order.
The working orders at this moment are written down on a form (appendix 8). This working order is a paper version that goes through the whole company chain. The readability of this form depends on the quality of the handwriting of the sales employee. When the work form can be printed digitally there can’t be misunderstanding about information that is written on the form. This will help with conflicts about the information written down on the form. It is also a solution for the saw mill employees getting back to the sales department.

Better quality control by the wood yard Employees
The raw material provides the basis of a processed wood order. The quality of the wood is a starting point. If the employees take a bit more time to check the wood correctly and set ground rules with the saw mill where they have to look for, less wood comes back or has to be collected again.

Divide the orders between B2B and B2C
According to chapter 4, B2C consumer are willing and able to wait longer on their processed order than the B2B consumers. The person in charge of the planning should divide both streams and keep them divided. A separate planning and separate lead time will result in B2B customers ordering more often and an increase in turnover.

7.4 Recap
There are multiple options that will lead to a higher turnover and a lower lead time. Looking into the bottlenecks that were found in the previous chapter, the way to a lower lead time on the long term is achieved by working with a digital version of a work order, better quality control by the yard employees and hiring extra employees. On a short term the best way to bring the lead time down would be to outsource as much as possible processed wood orders.
8. Conclusion

In this chapter the conclusion on the thesis question is been given.

The main question within this research report is:

*How can the delivery time be as low as possible and a turnover as high as possible in a growing market for both the business and the consumer market?*

The AFH have had some good years. The turnover has grown in the last five years with numbers that other companies would be proud off. But with growth, problems occur. Within the AFH the problem is the lead/delivery time for processed wooden products. The company maintains a lead time which is relatively long for the amount of work that needs to be done. Products that can be bought such as raw sawn wood and sheet materials don’t have lead time problems. The customers are satisfied with the current lead/delivery times on those products.

In a research about customer satisfaction it became clear that B2B customers have the biggest problem with the delivery time. At least 11% of the orders doesn’t go into process because B2B customers don’t accept the long lead time of 4 till 6 weeks. The company is missing with this issue more that 11% of their processed order income on the total turnover each year. This could be a highly extra turnover/growth.

The lead time that the AFH has to aim for processed wooden products is a maximum of 10 working days. This is considered to be acceptable for B2B customers. On the other hand, the AFH can take her time for the orders of B2C customers.

One of the problems is that the company as for now is not ready for all those extra orders. The efficiency could be a lot better by improving issues in the process chain. The possibilities for change and improvement within the process chain are given and formulated by the employees of the AFH themselves. Support from the employees for the changes will not be a problem.

There are four main different possibilities to reduce the lead/delivery time and increase the turnover. These can be distinguished between short term and long term solutions. The advice for the AFH would be to combine them all.

On the short term:

- When the need is high, outsource to other wood processing companies. The test was relatively successful with simple processing orders. The costs are a little bit higher than when the work is done by the AFH itself. But this doesn’t weigh up to the amount of extra orders the company will receive.

On the long term:

- Hire an extra employee for the saw mill and work in multiple shifts. This will increase the labor costs but creates more efficient working hours. With this extra employee the amount of orders that can be processed are higher due to more working hours.
- A digital system that is totally infiltrated in the company. Everything that is written down about orders can be easily found back by others. There can be no interpretation faults anymore and this will also result in fewer problems between workers. And a more efficient working environment.

- Work out an efficient training for both yard employees as saw mill employees to get on the same level of understanding on what is important in raw material for the processed wooden products. This will result in less recollections of raw material and a better flow in the working process.

With these improvement, the flow of the processes within the AFH will run better and faster. The company will be able to take in more orders and will have a higher turnover.


9. Discussion

Besides the fact that the recommendations/conclusions are clear, this study does not engage everything as correct as it could be. The following subjects are up for discussion.

Opinions and assumptions.
In most of the Lean Six Sigma tools, the outcomes are based on opinions and assumptions by the employees or the CEO of the AFH. This most relevant for chapter 6 and 7. If these assumptions, for example grading the weighing factors, was a little different. The scores and outcomes would be a lot different. This also means that the conclusion of this research could be different. Part of the success of the Lean Six Sigma method is the support of the employees of the company. This is why it is necessary to work whit these opinions.

Processed goods.
The main research question doesn’t say anything about a specification in products that increases the delivery/lead time of products. In order to realize this report in a correct way. The specific product processed wooden products are chosen. This is the only product group in the AFH that runs through the whole organization. Assumptions that are made for other products groups are based on the outcomes of the products group processed wooden products.

Lead time average.
Within the research the lead time is constantly written down as an average. There is little information about the seasonality of the lead time. The amount of monitoring time is set on 4 weeks. This means that whenever the AFH had a really good month or a really poor month the numbers can differ. According to the information that there was about the seasonality the numbers are quit correct.

Customer needs.
Although the research provides in the lead time wishes of customers both B2B as B2C, it doesn’t provide in the actual needs in different products. The assumption is that the needs are the same for both customer groups. But when this assumption is not correct, the outcome can change the customer satisfaction for B2C customers.

Competitor analyses.
This thesis doesn’t have a decent competitor analyses. To discover what competitors undertake to reduce lead/delivery times and improve efficiency a good analysis would help. It is difficult by doing a thesis for a company to get ideas and improvement from other companies. This is seen as personal and confidential.

9.1 Follow-up study
A follow-up study is necessary for the CONTROL phase of the Lean Six Sigma method. After the different solutions are given and stated. It is the responsibility of the AFH management to choose and try to work with some of the recommendations. Each choice that actually is used in the process should be evaluated. Not just after six months or a year. But also quick, maybe five minutes, every day or week. This will improve the responsibility of the workers with the efficiency changes as well.

Within the follow up study it is import to keep looking into the changes that the company undertakes. Important is to keep looking into the average index of how much B2B and B2C customers are. These
figures will undergo a change in client market. The subject of this thesis could be a big part of a changing client group.

Another chance for the company would be to split both the B2B and the B2C customers. This could result in lower lead times for both customer groups. When workers of the AFH don’t have to focus anymore on both client groups. Different interests wouldn’t cross each other anymore. This could result in a better efficiency in both the company as the service towards the customer. An informative follow-up study would be to investigate what could be the possibility of a split company on a new location.

Finding a digital version of the working sheet would be a good idea. This probably needs to be manufactured or there might be a possibility to buy a system. The possibilities need to be investigated in a follow-up study.
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