THESIS
Building process improvement in Finland

Authors: R van Doorn and PJT de Kok
Thesis about process improvement for Finnish construction companies in the housing industry.

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Contact information

Information Avans University of Applied Sciences
Academy Building and Infrastructure
Address Professor Cobbenhagenlaan 13
4073 DA Tilburg
The Netherlands
Phone number +3113 595 81 00

Information Seinäjoki University of Applied Sciences
Academy Technology
Address Kampusranta 9A
60101 Seinäjoki
Finland
Phone number +358 40 830 3966

Graduation supervisor Avans University of Applied Sciences
Name Joop de Zwart
Function 1st examiner
E-mail jg.dezwart@avans.nl
Phone number +3188 525 8198

Name Moniek Heitbrink
Function 2nd examiner
E-mail m.heitbrink@avans.nl
Phone number +3188 525 66 11

Graduation supervisor Seinäjoki University of Applied Sciences
Name Marita Viljanmaa
Function Coordinator department of Technology
E-mail Marita.viljanmaa@seamk.fi
Phone number +358 40 830 2192

Name Petri Koistinen
Function Lecturer department of Technology
E-mail petri.koistinen@seamk.fi
Phone number +358 40 680 7228

Graduation provider
Company name City of Seinäjoki
Contact person Kirsi Joensuu
Function Project manager Housing Fair 2016
Address Kirkkokatu 6
60100 Seinäjoki
E-mail kirsjoensuu@seinajoki.fi
Phone number +358 40 840 0642
### Student Information

<table>
<thead>
<tr>
<th>Name</th>
<th>Richard van Doorn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address NL</td>
<td>Prinses Margriettlaan 22</td>
</tr>
<tr>
<td></td>
<td>4002 AS Tiel</td>
</tr>
<tr>
<td></td>
<td>The Netherlands</td>
</tr>
<tr>
<td>Address FI</td>
<td>Puskantie 38 K28</td>
</tr>
<tr>
<td></td>
<td>60100 Seinäjoki</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="mailto:richardvandoorn@hotmail.com">richardvandoorn@hotmail.com</a></td>
</tr>
<tr>
<td>Phone number</td>
<td>+316 388 909 14</td>
</tr>
<tr>
<td>Student number</td>
<td>2055779</td>
</tr>
<tr>
<td>Study</td>
<td>Construction Management</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Petrus Johannes Thomas de Kok</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address NL</td>
<td>Louis Armstrongerf 7</td>
</tr>
<tr>
<td></td>
<td>4614 XV Bergen op Zoom</td>
</tr>
<tr>
<td></td>
<td>The Netherlands</td>
</tr>
<tr>
<td>Address FI</td>
<td>Puskantie 38 K28</td>
</tr>
<tr>
<td></td>
<td>60100 Seinäjoki</td>
</tr>
<tr>
<td>E-mail</td>
<td><a href="mailto:tommydekok@hotmail.com">tommydekok@hotmail.com</a></td>
</tr>
<tr>
<td>Phone number</td>
<td>+316 142 476 33</td>
</tr>
<tr>
<td>Student number</td>
<td>2049581</td>
</tr>
<tr>
<td>Study</td>
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Foreword

This thesis is the end of our (R van Doorn’s and PJT de Kok’s) study Construction Management. This thesis is completed in 20 weeks, from 2 February till 19 June 2015. We have gained much information and many experience from the field and desk research, the experience to study abroad and the consultation sessions with the teachers and project managers. It has made us looking forward to entering into the business life.

This thesis is about building process improvement in Finland. It is necessary to start with getting to know the building environment in Finland. Therefore the field research is based on the companies Hartman Oy and Omatalo and the projects are located on the Housing Fair 2016 in Seinäjoki. The companies asked us to write a report with improvements and innovations in the field of the building management in exchange for information of their projects. We have conducted this research and reports with great pleasure.

This report contains different points of view about differences and similarities between construction in The Netherlands and in Finland, it also contains innovations and recommendations for Finnish and Dutch construction companies.

During the research we have learned that there are a lot of differences in the Finnish building culture compared to the Dutch building cultures. This makes it very interesting to write about an innovation that is based on the differences. This thesis is in many ways different from others because at Avans University it is not common to graduate abroad and at the same time cooperate with two companies and two different universities.

We would like to thank a lot of persons who helped us with the thesis. First we would like to thank Joop de Zwart, our first supervisor who has helped us weekly to improve the report and of course also our second supervisor Moniek Heitbrink. We also would like to thank the supervisors from the University of Seinäjoki, Petri Koistinen and Marita Viljanmaa. They were able to translate some interviews and Finnish sources. We also would like to thank the project manager of the Housing Fair 2016, Kirsi Joensuu. She helped us finding the two companies and was able to give general information about the Housing Fair. Finally, we would like to thank the two construction companies Omatalo and Hartman Oy for the released information and their collaboration.

We hope that the Housing Fair 2016 will be a success and that our report is of value for the fair.
Summary

In 2016 there is a Housing Fair in Seinäjoki. This fair is about improvements and innovations in the Finnish construction industry. This report is written as an input for that fair and therefore also for the Finnish construction industry in general. The innovation has a direct relation with the personal experience from the writers in The Netherlands. The innovation is based on the differences and similarities between Finland and The Netherlands.

After desk and field research on the companies Hartman Oy and Omatalo, who are building for the Housing Fair 2016, it is concluded that the focus the last years was mainly on the quality of the products instead of the process. A change to process management is wished. Because the Finnish construction industry became more specialized over the years in the quality of the product timber and how to build with it, a high level of quality can be expected, and research for improvement could better focus on other areas. However, there is much to gain in the field of project management. After different researches it is concluded that at its worst one third of the used time on the building site is wasted time, time when there is no value added to the building. This must be reduced.

This report answers on the question how building processes in Finland could be improved with an innovation that is proven to be profitable in The Netherlands by focusing on process control.

Because the Housing Fair is all about innovations, and the study of the writers is construction management, an innovation in the field of management is wished. A good development introduced in The Netherlands is called LEAN. LEAN is a method to reduce wastes and to improve the project management. This method was found by Toyota. This method is chosen because it is a well-known strategy which is proven to be profitable, also in the building industry. There are different tools to imply this method in practice. This report contains tools that are useful to improve building processes in the starting phase of using a LEAN method. Because that is how the situation in Finland is at the moment.

The tools that are recommended to the Finnish construction industry are divided into short- and long-term tools. The short-term tools recommendations could be easily and directly implemented by the company and the long-term tools require more study and practice.

The subjects that are mentioned in the report to implement LEAN are the 5-s method, how to share information, the necessary meetings and the pull planning. This has some influence on the contract and the mentality of the employees, therefore there is also a part written about how to cope with this.

The results of implementing LEAN can be very positive. It is possible to decrease the costs, it gives peace on the building site, the cooperation with the sub-contractors will be more loyal, the construction time will be shorter and it provides predictability.

This report answers as followed the main question: The use of LEAN is an identified difference and can mean an innovation for Finnish companies in general to influence process control. The influence on process control is possible on the short- and long term.

Because the writers have no experience in the Finnish building industry, a basic study about different construction subject was required. Besides that, there is no method found to compare the building industries of two countries or to gain general information of a country, a method for this has been created. The most interesting differences are mentioned in section 2.2 and the rest of this method can be found in Attachment A.

Besides this report there were other interesting subjects found. Because the writers are coming from The Netherlands and there is concluded that it could be interesting for Dutch construction companies how the Finnish construction companies cope with cold weather conditions. Finnish companies are specialized in this field. Therefor this subject is also attached.

June 16, 2015
## List of definitions

<table>
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<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td><strong>5-s method</strong></td>
<td>Name of a workplace organization method that uses a list of five words: sort, systematic arrangement, shine, standardize and sustain. It describes how to organize a work space for efficiency and effectiveness.</td>
</tr>
<tr>
<td><strong>ActiveCollab</strong></td>
<td>Online platform where parties can share their information which is needed for a project.</td>
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<td><strong>Asuntomessut</strong></td>
<td>Finnish name for Housing Fair.</td>
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<tr>
<td><strong>Bearing capacity</strong></td>
<td>Capacity of soil to support the loads applied to the ground.</td>
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<tr>
<td><strong>Beaufort scale</strong></td>
<td>Measure of wind speed.</td>
</tr>
<tr>
<td><strong>Coarse-grained soil</strong></td>
<td>Soil in which gravel and sand predominate, soils that are least affected by moisture.</td>
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<tr>
<td><strong>Contractor</strong></td>
<td>Organization or individual that contracts with another organization or individual for the construction of a building.</td>
</tr>
<tr>
<td><strong>Demand conditions</strong></td>
<td>Conditions that can help companies create competitive advantages.</td>
</tr>
<tr>
<td><strong>Diamond model</strong></td>
<td>Economic model developed by Michael Porter, theory of why particular industries become competitive in particular locations.</td>
</tr>
<tr>
<td><strong>Factor conditions</strong></td>
<td>Human resources, physical resources, knowledge resources, capital resources and infrastructure.</td>
</tr>
<tr>
<td><strong>Failure costs</strong></td>
<td>Costs that are caused by products or services not conforming to requirements or the needs of the customer. Examples: rework, shortages, re-designing or delays.</td>
</tr>
<tr>
<td><strong>Firm strategy</strong></td>
<td>The way in which companies are created, set goals and are managed is important for success.</td>
</tr>
<tr>
<td><strong>Formwork</strong></td>
<td>Temporary of permanent molds into which concrete or similar materials are poured.</td>
</tr>
<tr>
<td><strong>GMP</strong></td>
<td>Guaranteed Maximum Price, contract is a cost-type contract where contractor is compensated for actual costs incurred plus a fixed fee subject to a ceiling price.</td>
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<tr>
<td><strong>IPD</strong></td>
<td>Integrated Project Delivery, joint project control by owner and key designers and builders.</td>
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<tr>
<td><strong>JIT</strong></td>
<td>Just In Time, logistical method to increase efficiency and decrease waste by receiving goods only when needed in the building process.</td>
</tr>
<tr>
<td><strong>Laminated log</strong></td>
<td>Log that exists out of four or more layers glued together.</td>
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<tr>
<td><strong>LEAN</strong></td>
<td>Management philosophy focused on realizing customer value with as less waste as possible.</td>
</tr>
<tr>
<td><strong>LEAN tools</strong></td>
<td>Tools that can be used to imply LEAN Examples: 5S-method and JIT.</td>
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<tr>
<td><strong>Outcrop</strong></td>
<td>Visible exposure of bedrock on the Earth surface.</td>
</tr>
<tr>
<td><strong>Plywood</strong></td>
<td>Sheet material manufactured from thin layers or plies of wood veneer that are glued together.</td>
</tr>
<tr>
<td><strong>Precast</strong></td>
<td>Prefabricated.</td>
</tr>
<tr>
<td><strong>Pull-planning</strong></td>
<td>Planning the implementation phase in concert with all construction parties.</td>
</tr>
<tr>
<td><strong>Rc-value</strong></td>
<td>Value of thermal resistance used in construction industry.</td>
</tr>
<tr>
<td><strong>Slab-on-ground-structure</strong></td>
<td>Structure where the ground structure is in contact with warm and moist drainage and fill soil layers.</td>
</tr>
<tr>
<td><strong>Stratification</strong></td>
<td>Layering of rocks.</td>
</tr>
<tr>
<td><strong>Sub-contractor</strong></td>
<td>An individual or business that signs a contract to perform part or all of the obligations of another’s contract.</td>
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TQC
Total Quality Control, application of quality management principles from design to delivery instead of confining them only to production activities

VAT
Value-added tax, a form of consumption tax

Wind chill
Perceived decrease in air temperature felt by the body on exposed skin due to the flow of air
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1 Introduction
1.1 Occasion
In 2016 during one month Seinäjoki has the honor to host the Housing Fair Finland in their city. During this fair it is all about improving the quality of housing and living conditions in Finland. Producers and consumers are brought together to see the latest research in construction and housing related issues. This research has led to two important products. On the one hand they have produced practical applications of innovative ideas in the field of construction. On the other hand they have produced concrete visions of excellence in living and housing standards within the housing industry. This means that during the fair designers and builders have the opportunity to try out innovative ideas in practice.

Asuntomessut, sd
An important issue that could be recognized immediately is the main focus of this Housing Fair: the end product. However, in recent years the focus displaced from product to process. This means that there is no longer focused on “what” is realized, but also “how” it is realized. Especially in the field of management this is an interesting development. Due to own experiences by focusing on the “how”, this report will be about managing a building process to accomplish an end product in a more profitable way.

So this report is based on improving the current way of project management of the Finnish construction companies in general because they are the visitors of the Housing Fair 2016. The reason to choose for construction management is simple. First of all, the quality of Finnish building has a direct relationship with building log houses or at least building with timber. Since many years this has been the number one building method in Finland. So to write about the quality of their products would be insulting and seen as useless. Therefore the focus of this report is on the building process. By introducing a new management method, Finnish construction companies should be able to work in a more profitable way. Besides describing how to focus more on the process there will also be described Finnish construction in general. This part is based on desk and field research. In the end of 2014 different companies, or families by their own, started to build the houses at the location where the Housing Fair in 2016 will take place. The field research is a result of cooperation with two construction companies: Hartman Oy and Omatalo. These companies will be building specifically for the Housing Fair 2016. Their projects are representative for the Finnish construction industry in general.

The field research is based on the houses each company will build. The first project is a three story house developed by Hartman Oy. This project is built the traditional way: a timber structure placed on a concrete foundation. Omatalo have built their house with precast timber elements. They started and ended with the foundation before the winter of 2014. The 1st of April they started to build with the precast elements. They erected the complete hull in only 4 days. The house has two stories. Right next to the house there is a garage that is made also in a traditional way. This garage was finished before the winter started. Omatalo has a large market share in the prefab Finnish construction industry. The projects are shown on the next two pages.

Figure 1.1: Overview of the main purpose of the report
Project Hartman Housing Fair 2016

Figure 1.2: First floor

Figure 1.3: Views

Figure 1.4: Second floor

Figure 1.5: The log structure

Figure 1.6: The house in a further stage.
Project Omatalo Housing Fair 2016

Figure 1.7: First floor

Figure 1.8: Views

Figure 1.9: Second floor

Figure 1.10: Omatalo, in front the garage with the house.
1.2 Problem statement and main question

As described in chapter 1.1 there are many possible opportunities for this thesis. The reason there is chosen for improvement of Finnish building processes is a simple one: own experiences during the study Construction Management, where internships are included. During studying and fulfilling the internships, building process became more and more important. Different strategies were shown and implemented in projects. Results were promising and high profits were reached (mainly in money and time). (Klokbouw, 2013) (Bouwgroep, 2013) This thesis focuses on how it might be possible to bring the same process improvements, which are used in The Netherlands, to Finland. The two companies Hartman Oy and Omatalo are in the first place the two cases where building processes are tried to be improved. The Housing Fair gave the opportunity to advise different construction companies in Finland to use a different strategy in the building management during their implementation phase, which leads to improvement of their building process. The problem and main question are based on the idea that Finnish and Dutch construction companies currently have different building processes. By taking a look at these differences, the Finnish construction companies might work faster in less time with maybe less money without affecting their already guaranteed quality. This report contains different strategies based on LEAN management. LEAN is chosen because it has shown that this is a profitable method in the building industry. With this strategy they actually could make money and save time. It could be about their current working methods or other factors. Hopefully the Finnish companies will see the opportunity to use this LEAN strategy. The Housing Fair and in particular the two companies gives the chance to do research about the building processes in Finland. This report does not focus on actual construction faults or other issues that deviate from Finnish building standards but it focuses on the possibility to improve building processes.

The main question:

How could the widely applied new method in Dutch building processes, LEAN management, lead to the suggestion of a possible innovation for Finnish construction companies to their current building process by focusing on the process control?
1.3 Goal of the research

The problem statement described the many opportunities for this report. To keep this thesis structured and organized there will be mentioned here what the main goal is and what the additional goals will be. As shown in this report’s title building process improvement is the main subject. Trying to improve the building process of the two Finnish companies is the main goal. The improvement is based on LEAN management as therefor the biggest part of this report is about that. There will be desk and field research to get to know the current building processes of both companies and for Finland in general. The two companies must lead to at least one interesting case where one of the LEAN tools will be tested. The outcome will be discussed with an expert for the Seinäjoki University to see if our conclusion does not contain strange deviations before it is handed over to the companies. Besides the companies the results will also be offered to the Housing Fair to advise all other construction companies in Finland about process innovation. However, other goals are also included in this report. These goals are outcomes of the given fact that two countries are involved. Two different countries often means two different cultures, circumstances and behaviors. Attached to this report are the main differences of the building cultures of The Netherlands and Finland. Also attached are some recommendations for Dutch companies. These recommendations are based on own experiences during field research in Finland.

The goals which are mentioned above have led to the following research issues and structure of this report.

1.3.1 Research issues

With this research proposal the subjects are limited. These two questions need to be answered to answer the main question.

1. How is building project management in Finland arranged and what could we propose?
   a. How do they control their building project?
   b. Which method is a good proposal for the Finnish building industry?

2. In what way can LEAN be a value to the Finnish construction companies?
   a. What is LEAN?
   b. Are Finnish companies familiar with LEAN?
   c. How could we convince them that LEAN is a good development in the building management?
   d. Which developments are taking place?
   e. Is LEAN a good development in The Netherlands?
   f. On which phases of the project management are the opportunities to imply LEAN?
   g. What are the practical opportunities to implement LEAN?
   h. Is the recommendation based on LEAN valuable for the Housing Fair 2016?

1.3.2 Structure of report

The first chapter is about the current building process in The Netherlands and in Finland. This is a theoretical part about project management that includes desk research and information gained from own experiences.

The following chapter will be about how to improve the building process with LEAN. This part contains a theory part and a practice part. In the theory part LEAN will be explained and introduced, what it means in Finland thus far and with which tools the building process could be improved. Then the practice part is the part where one of the tools is being tested and the results are shown.

The next chapter contains the conclusions. The main questions will be answered and conclusions of the research are given. The conclusions are divided into short-term and long-term adjustments.

The last chapter of this report is the recommendations. In this chapter the issues that could not be researched due to the limitations of this thesis are mentioned.
This report contains attachments which have interesting facts and experiences about the Finnish building culture. These are placed in the attachments because they do not make a contribution to the main goal of this report: improvement of building processes in Finland but were necessary to create the main goal. The following items can be found in the attachments:

- Attachment A starts with a method how to compare two different construction industries. The second part of attachment A contains differences and similarities between the two countries in the construction industry. The previous method is applied to this part. This part is to gain general information about the construction industry of the two countries (Finland and The Netherlands). This will be general information that contains only the important things of the housing construction industry. The function of this chapter is to introduce the different audiences with information that is necessary for the rest of this report.
- Attachment B and C is about the innovation LEAN applied to the two construction companies Hartman Oy and Omatalo followed by attachment D that includes the interviews.
- Attachment E is about how to cope with cold weather circumstances. This attachment is mainly for Dutch construction companies because Finland is used to handle the cold weather circumstances very well. This part has no addition to the main goal of this report.
- Attachment F is an addition to the LEAN chapter because this attachment shows the differences between a normal contract and a LEAN contract.
- Attachment G, how to convince the employees to work with LEAN is also an addition to LEAN.
- Attachment H shows the normal planning of Hartman Oy about the project. This is an addition for chapter 2, project management.

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<thead>
<tr>
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<th>Sub goals</th>
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<tr>
<td>Improvement on the field of process control for the Finnish building companies in general</td>
<td>Improvement on the field of process control for the building companies Hartman Oy and Omatalo, who are building on the Housing Fair 2016</td>
</tr>
<tr>
<td>Improvement for the Dutch building companies in general how to cope with cold weather conditions on a building project</td>
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Table 1.1: Overview of the main- and sub goals
1.4 Value of thesis

There are a lot of interesting opportunities given for writing this thesis. The two companies, the Housing Fair 2016, the differences in building between The Netherlands and Finland have given the possibility to have different goals. Two issues were important for choosing these goals. First of all there are the construction differences between the countries which will make and give an extended introduction to this report, this can be found in attachment A and a summary from the most important differences in chapter 2. Besides this, and this is the second issue, there is the help of two companies which are earlier mentioned. To return this favor an innovative idea will be described and offered to both companies which will have a direct relation to the innovation for the Finnish construction companies in general, this will be a sub goal. The issues are the reason this report has different goals. The main goal is to first investigate and write a part about the differences in building, during implementation, between Finland and The Netherlands followed by an innovation for the project management with a method called ‘LEAN’ for Finnish building companies in general. The fact that in this report is chosen for LEAN is because of our own experience with this method. It has proven that this method is an enhancing development. It should be very interesting because the two countries show some interesting similarities and of course differences. The second part of the report contains recommendations for Finnish construction companies in general based on LEAN management; this has a direct relation with the first part.

By doing the research it has proven that there are also interesting recommendations for the Dutch companies in the field of weather circumstances. These recommendations for The Netherlands are attached to this report because this is not part of the main goal. To reach a bigger audience this part is substantiated with a video on YouTube.

As earlier mentioned a sub-goal is to write two different reports for two different companies, also attached. One of these reports (attachment B) is based on a working method used by Hartman Oy. This is a more or less traditional working method with timber. The other report (attachment C) is for Omatalo, it shows a working method based on big elements arriving on the building site and placed immediately on the right spot. Both reports contain observations and recommendations in the field of LEAN. These reports are a follow-up of the main report but only focused on the specific companies.

The report needs to be of value for the Housing Fair 2016 and therefore for the Finnish building companies in general. The sub-goals are for the two companies Hartman Oy and Omatalo and for Dutch building companies in general. Because it has a value for the Finnish construction companies in general and made by students from another country it has indirectly also a value for the Seinäjoen University of Applied Sciences and Avans University of Applied Sciences. To make it clear, table 1.2 shows an overview of the value of the thesis.

<table>
<thead>
<tr>
<th>Main goal is to create a value for:</th>
<th>Sub goal is to create a value for:</th>
<th>An indirect goal is to create a value for:</th>
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<tbody>
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<td>Finnish construction companies in general</td>
<td>Omatalo</td>
<td>Avans University</td>
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<td>Hartman Oy</td>
<td>University of Seinäjoki</td>
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<tr>
<td>Dutch building companies in general</td>
<td>Ourselves</td>
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Table 1.2: Overview of the value for different parties
1.5 Process

The research will be based on the fact that there are interesting differences and opportunities. First of all there is the difference in building project management. In The Netherlands almost all of the bigger construction companies are working or trying to work with a so-called LEAN method (B.V., 2014) (Beckers, 2014) (BAM, sd) (Vermeer, sd) (Vries, 2015), the most Finnish construction companies are not really familiar with this method yet. So how to convince the Finnish construction companies to apply or use some parts of this more efficient type of management will be a challenge. To be able to offer the companies innovations and improvements the process needs to be controlled, from research design to the final report, by using LEAN. Toyota was the first company that used this method. They were able to improve the process continuously with one focus: the customer. LEAN has a direct relationship with the project management.

As earlier described there are other interesting things about comparing two countries besides the main goal. Delay caused by the weather is an important issue in the Dutch building culture. Rain, frost, temperature are factors that causes a lot of delays. For example if the wind-chill in The Netherlands is minus 6 degrees Celsius work may be stopped or if the roads are not possible because of snow work may also be stopped. These are factors that are not an issue in Finland. So how is it possible that the differences are so big on this subject? This subject will be discussed in the attachment.

1.6 Research Method

The goal of this research is to explore the building culture of The Netherlands and Finland, there has to be searched for possible connections and/or statements. This research contains desk research and field research. For the desk research all available information out of study books, internet and other useful sources like newspapers, essays, article’s, scientific documents etc. will be used. There is access to the university’s library and therefore also to the complete online database.

All the information found within these sources has to be analyzed and organized in a way that they are useful for this research. With the field research new information can be found on the building site and two companies. Both companies, Omatalo and Hartman Oy, who are building on the Housing Fair 2016 and represented the Finnish construction in general, can be watched during construction. Their progress on the building site will be analyzed. The way they build and how they work with their partners will lead to new information. Besides the observation on the building site there will be a few interviews with the managers of both companies. Another way to gain new information is with the help of a teacher, who teaches log constructions, and the head of the technology department, both from Seinäjoki University of Applied Sciences. Besides gaining this information they are able to translate Finnish phrases into English or the other way around and consider if our recommendations are executable.
Desk research
Most parts of the report’s second chapter is based on desk research. The sources are carefully sorted and picked by their reliability. Chapter 2.2 and Attachment A, the introducing and comparing of the two countries on different building aspects, is completely based on desk research. The project management of the two companies is compared with the general way of project management in Finland in chapter two and the general way is based on desk research. Also the recommended tools, the background of lean and the developments of lean are based on desk research. As mentioned before, the university’s library gives us all the right sources to find this information.

Field research
The parts of the second chapter which are not included in the desk research are based on project management observations on the building site are essential for this part because of the meetings with the project managers and more important to see them working and building the houses during the complete implementation phase. The second part of the chapter about lean is also based on this field research, but the information comes from personal experiences during internships.

The interviews contain open questions because the project manager can answer the questions with more information about the subject. The disadvantage of these open questions is that the person can interpret it on their own way. Unfortunately this was experienced during the interviews.

The other way, to convince the construction companies to apply the given recommendations, we want to avoid the communication barrier by making an easy script how to apply the lean management. This will be in Finnish and English. The script is attached too.

In every chapter will be indicated where the information is coming from, and it will be clear if the information came from desk- or field research.
2 Project Management
2.1 Introduction
In this section there is a summary written about the differences between the two countries. This part is a small introduction of the report, to introduce the building industries of the two countries. After this the project management of the two companies is described. The description is divided in the organization in general and the three phases: preparation, implementation and completion. The project managers of the construction companies Hartman Oy and Omatalo have given the visions of the companies and their current management methods as input for this report. This chapter will be used as introduction to an innovative idea that is being used in the Dutch building industry called LEAN. As earlier mentioned this report is about the process improvement in the Finnish building industry.

2.2 Differences and similarities between Finnish and Dutch building industry
In Finland they have to cope with lower temperatures than in The Netherlands and they have their methods to be able to continue their work in the winter. The soil in Finland is partly clay ground, outcrop and in the Northern part rocks. In The Netherlands the soil exists mostly out of sand and (river and sea) clay. The terms of payment are quite the same between the countries and to transport material in Finland they need to travel a lot more kilometers than in The Netherlands. Working conditions are more or less the same for workers of both countries. Working hours for one week are the same but when people are sick the conditions in The Netherlands are a little bit better, you will receive a higher allowance for a longer time. The number of paid holidays is for Finland and The Netherlands both between 25 and 30 days. The biggest difference of working conditions is between the working fathers. In Finland they have much more days for child care than in The Netherlands, especially during and after the pregnancy.

The usual building method in Finland involves timber, for the smaller or older companies it is normal that they still use the traditional way of building. The younger or innovative companies are using more often the precast method with timber. In The Netherlands bricks and sand-lime are the oldest way of building structures. Nowadays concrete is almost the most important construction material. The most common building methods are precast elements and still the traditional way of building with bricks. An extended version is written in attachment A with a method to compare two countries on the field of construction.

2.3 Project management and building process Hartman Oy and Omatalo

2.3.1 Introduction
In this chapter information will be given about the project management of the Finnish building companies Hartman Oy and Omatalo. This is necessary for the rest of this report, especially for the recommendations and conclusions. The information comes from field research on the building site and the interviews with the managers of the companies. The function of the general sources in this chapter is to strengthen the information based on the field research.

2.3.2 Organization
Hartman Oy is a company with 250 employees. It is a company with several subsidiaries. One of them is the building company Hartman Rauto Ltd. They have more than 100 projects nowadays realized by 3 architects, 3 construction engineers, 5 project managers and 1 interior designer working for Hartman Koti Hem. For one project they need 5 officers and 10-15 workers/subcontractors. For all the physical work they use subcontractors.

Omatalo is a company with ca. 90 employees. This company has in the winter ca. 5-10 projects and in the summer ca. 20-30 projects.
This biggest project is 44 houses. They use subcontractors for transport, part of planning and the erection on the building site.

The Finnish organization of a building project during implementation and preparation is very similar to most Dutch building companies, for one project they use one architect, one construction engineer, one project manager, a calculator and a planner. One difference is that, at Omatalo and Hartman Oy, the architect and the construction engineer work for the contractor because mostly in The Netherlands the architect and the construction engineer are hired from different companies. That Hartman and Omatalo have its own architect and construction engineer is not very common in the organization of building projects in Finland. After desk research, the conclusion is that most Finnish contractors do not have their own architect or construction engineer. (Ministry of Employment and the Economy, 2013)

Another difference in the building industry in Finland is that the client sometimes builds his own house, so the construction company only sells the plans and the building materials. This means that contractors could have less bigger projects. This was also the case at some of the projects at the Housing Fair

2.3.3 Preparation
The duration of the preparatory phase (initiative, definition and design) is for Hartman’s project on the Housing Fair 10 weeks. During these weeks the project specifications are being formed, the building permit is arranged and also the designs (structural, HVAC, interior, etc.) are created. The cooperation between the subcontractor and Hartman is based on agreed contracts. The number of meetings depends on whether it is necessary. The way they share their drawings, planning etc. is by post or by email.

The meetings at Omatalo also depend on when it is necessary. Sometimes they only sell the plan and the materials and the client starts to build his own house. When they built the house with the help of sub-contractors they also share their drawings and documents by post and/or by email.

2.3.4 Implementation
Hartman is used to sub-contract all the physical work of a project. Normally the payments of the sub-contractor by Hartman are according to an agreed contract but sometimes they pay the subcontractor per hour. That depends on the project, if it is complicated or if it is cheaper to pay per hour. Omatalo is used to sub-contractors, besides the physical work on the building site, also partly their planning is being outsourced. The payments by Omatalo are usually done after the work is completely finished. They are used to normal contracts and paying per the hour is not common.

Hartman works with a traditional overall planning. The weeks they spent on the project without holidays is 70 weeks (85 weeks with holidays). 70 weeks seems a little bit long for a two story house with a total floor area of 206 square meters. The duration of this project is mainly caused by the time they planned for the structure, approximately three and a half months. Besides that, the internal work has the duration of 5 months. The planning of both projects has also led to the decision of focusing on the aspect time. With the LEAN method it will be most likely that the lead time of both projects can be decreased significantly with some small and easy changes. The possible profits in the planning of Omatalo are probably to be found in the finishing phase of the project. Because for the structure of the house they use precast elements and they are able to build the structure in only 4 days.
2.3.5 Completion
According to the planning of Hartman they need approximately 10 weeks for the completion of their project. During these weeks finishing and receiving are the two proceedings which are planned. Completion is the act whereby one party which has adopted a work, being the contractor, this work if done stamped and that work then transfers to the principal who then accepts that work. The consideration is the (final) redeem the financial covenants under the (limited) conditions prevailing at that time. (Burgelijk Wetboek, 2010) This applies to both countries and is based on the desk research in The Netherlands (Burgelijk Wetboek, 2010) compared to the given answers by Omatalo and Hartman Oy.

2.4 Conclusion
This project is about improving of the process, to introduce this report a summary of the most important differences and similarities is given. The project management of the Finnish companies is comparable to traditional Dutch construction companies. The preparation with the costumer is without involving the subcontractors. In The Netherlands the project management is having a revolution, some companies still have the traditional management method, but some of the construction companies are changing (or trying to change) to the LEAN management method and a few companies are already well known with the LEAN-management.

Chapter 2 answers the first sub-question ‘How is building project management in Finland arranged and what could we propose? This chapter is based on the two companies that were examined. Based on the company types, their working methods and current building projects they are comparable to the Finnish construction industry in general.
3 The innovation LEAN
3.1 Introduction
This chapter has two parts, a theoretical and a practical part. In the previous chapters there is chosen for an improvement in the field of management. After describing the current way of project management in Finland in the previous chapter, a method to improve the management is ‘LEAN’, this will be explained in general and will be the innovation as described in the main question. This method is chosen because this is a well-known strategy which is proven to be profitable. The first part, the theoretical part, contains basic concepts (which are the first used concepts in LEAN management) followed by the used techniques, the biggest benefits (where also the introduction of LEAN in the construction industry will be mentioned) and how much waste could be avoid with the implementation of LEAN. Next, the connection to the Finnish building industry and the developments so far in this country are shown. In the next part there will be proven that this management method has benefits in The Netherlands and there will be shown that construction companies will have more profitable projects by using LEAN.
The second part is information gained from field research about the planning.

3.2 Theoretical

3.2.1 LEAN

Basis concepts of LEAN management
Japanese company Toyota is where LEAN management is originated. Toyota wanted to improve their delivery method together with the quality of their products to have a leading position in the world. To accomplish this, in the 1970’s they invented the application of LEAN production. LEAN production is a technology based on production management which leads to reduction of useless time, time during task switching, bad quality of unqualified suppliers, inventory, low-quality performance and the cycle of designing and developing products. This kind of production influences people’s way of life and humanity in general because of its mass production.
American engineer John Krafck and his team of researcher were the first to use the name LEAN after doing research to the production method of Toyota. He wrote an article named ‘Triumph of the LEAN Production System’. This article was based on investigating Toyota’s way of organization management which was back then, and nowadays, the most suitable way of manufacturing. (Wang, 2014)

A new production philosophy
As mentioned above Toyota’s main idea was to eliminate inventory and other waste by dividing production into smaller lots, reducing the set-up times, co-operation with the suppliers and also other techniques.
American consultants like Feigenbaum, Juran and Deming were guiding the Japanese industry on quality issues. The statistical method that led to assured quality made place for a broader approach which included quality circles and different tools company-wide developments.
A long process of trial and error by industrial engineers was preliminary to developing those ideas. However, at that time a wider presentation of the new ideas were not seen necessarily to the West (America and Europe). That led to limited understanding and information of this new approach until the beginning of the 1980’s. But around 1975 the automobile industry started to get to know more about the ideas.

Main techniques
There are a couple of factors which make it difficult to present a specific overview of all the ideas of this new production philosophy. First of all the field is relatively young and therefore constantly evolving. A second factor is the appearance of new concepts and
at the same time the changing of older concepts. And another factor is that sometimes the same concept is being used to refer to the same phenomenon but on different levels of abstraction so it is not clear where to place the boundaries between concepts which are related.

Due to above mentioned factors there is chosen for two techniques as an overview of the main techniques because these techniques are the very first basics of LEAN management (Gort, 2015). These techniques will be: Just In Time (JIT) and Total Quality Control (TQC). The two concepts will be explained shortly because they are mentioned to show the history of LEAN management. After the explanation there will be mentioned newer concepts, which have a relation to the construction industry, which are outgrowths of JIT and TQC. These are outgrowths are worth mentioning because they show that the application of the original ideas has extended beyond just production.

Just In Time:
Ohno and Shingo were the initiators at Toyota for starting at this point of the new production technique. The most important issue in their approach was the reduction and elimination of inventories. This reduction of course led to other techniques necessary to cope with fewer inventories: co-operation with the supplier, set-up time reduction, reduction size of the production lots and reconfiguration of the layout. Another production type was introduced: production based on actual demand and not based on predictions.

Total Quality Control:
Using statistical methods for inspection of materials and products was the starting point to controlling the quality. The movement in quality evolved from solitary inspection to a total quality control. Three extensions together are being referred to by the word total:
- Expanding quality control from production to all departments
- Expanding quality control from workers to management
- Expanding the notion of quality to cover all operations in the company (Shingo 1988)

The outgrows of JIT and TQC that will show a relation with the construction industry are explained below. They also have a connection with previous chapters where the process aspects are mentioned.

Employee involvement
The choice for employee involvement has several reasons. For a quick response to problems the authorization of workers is needed. Day-to-day observation and motivation of the work force is highly important for continuous improvement. This item is related to avoiding waste because teams that are multi-skilled are established for customer based production. (Liirrank & Kano 1989)

Continuous improvement
This item is has a connection with JIT and TQC and has become a theme on itself. The key idea is through small and slow improvements improving and maintaining of the working standards. The natural targets for continuous improvement are the wastes mentioned in JIT. (Senge 1990)

Time based competition
Time based completion is a generalization of JIT. It refers to compressing time in every part of the organization to reach competitive benefits. Shortening lead time (mentioned in previous chapter) will create benefits like decrease of the work that is not related to processing, decrease of inventory and it will lead to a more easily identification of problems.

Concurrent engineering
Primarily this concept is dealing with the design phase. Although this thesis focuses more on the implementation phase, concurrent engineering is worth mentioning. Due to own experiences this concept could be implied in other construction phase as well. The
idea is an improved process by upfront analysis, incorporating the restrictions of subsequent phases and the tightening of change control towards the end of the process. Three major objectives here are compression of process time, increasing the number of repetitions and reduction of changes.

Value based strategy
This strategy is all about customer-oriented value. It is a management method that increases value to the customer by continuous improvement. (Carothers & Adams 1991)

Introduction LEAN management to construction engineering
In 1992 a report was published named ‘Lauri Koskela Application of the New Production to Philosophy to Construction’. This was the first report based on LEAN thinking in construction engineering. It also was the first implementation of the manufacturing industry into the construction industry. A network of professionals and researchers in architecture, engineering and construction formed a year later a group that was called International Group of LEAN Construction. And in 1993 this team was brought together in Helsinki, Finland, for the first time. The four founders of this team have been coming together since every year and nowadays the formal meetings of the first years have turned into big conferences.

Connection to Construction
Traditional concept of construction
Now that we have seen what kind of problems exists in the production within the manufacturing industry, the interesting question is: do these problems also exist in construction? The first thing to do now is analyzing the traditional way of construction and find out what kind of problems the traditional concepts cause. The construction industry is obviously very old. Since there are buildings that were build way before there were scientific analyses. But the improvement methods and different initiatives to understand construction better are from after the Second World War. Some of those initiatives are the earlier named total quality management, computer integrated designing and building and industrialization. Also some techniques were control tools (common server, coding system, etc.) and project planning, productivity improvement methods and project success factors (deliver on time, meet quality requirements and team satisfaction).

Problems
To describe the caused problems by using concepts based on usual management, we can divide the problems into three groups: designing and engineering with a subsequent method, lack of quality considerations and segmented controls.

Subsequent method of designing and engineering
The idea is that the end result is being divided into temporally subsequent results. Every result is being executed by different specialists. The traditional way in construction is that a client first choses an architect, who designs and prepares all the specifications. After that the structural and mechanical designs are prepared and the construction is the responsibility of a contractor contracted by the client.

Lack of quality
It starts with the lack of making special efforts to eliminate defects and errors and reducing their impact. But finally it ends with thinking there is a fixed optimal level of quality. Especially in construction, where we are used to work projects and the process has only one run, it is difficult to make continuous improvement. And that leads to a more emphasized impact of the quality problems. The three characterizing quality problems in construction are:
- extravagant variability
- long time from detection to correction
- consideration of requirements of the customer are insufficient

Segmented controls
The problem with this issue is that often parts of a process are controlled and not the whole process. Usually the structure of the
organization is the reason, the hierarchy. A good example in construction can be found in material management. The preparation of a material flow is divided by tasks but each task is another person’s responsibility. The purchase of the materials is handled by a specialized department where the people only have eye for minimum costs for transportation and minimizing the total purchase. This all leads to a situation on the building site which is far from optimized. This situation is caused by the lack of space and attention for the materials and the work in progress which is required. Another problem is that the correction of errors is again too slow and there are too many handlings. (Koskela, 1992)

Waste and value loss in construction
A few examples for value loss in the building industry:

- **Transport:** the waste of carrying materials to a storage place and back to the building site
- **Overproduction:** to build an unnecessary part of the building or the production is in a wrong order.
- **Waiting:** at the building site for example if the subcontractor cannot start because he needs to wait for another party.
- **Unnecessary or poorly process:** waste, due to redo the work or picking up materials and / or equipment.
- **Storage:** Unnecessarily storage of materials
- **Defects:** Waste by defects in finished parts or correcting delivery points.
- **Movement:** Unnecessarily movement of the worker or construction equipment on the building site.
- **Unused knowledge:** Not using the available knowledge from the employees.

(Diekmann et al, 2004)

These value losses can be prevent if the company cares for a good organization. To communicate with all involved people in an early stage is very important.

3.2.2 The relationship between LEAN and Finland
A little more over 5 years ago Finland started with the application of LEAN in some projects. A LEAN institution called LCI Finland was founded in 2008. The members were LCI-USA, RAKLI – The Finnish Association of Building Owners and Construction Clients, RT – Confederation of Finnish Construction Industries and the University of Oulu. The R&D resources on LEAN in Finland were formed by the University of Oulu, Tampere University of Technology, Helsinki University of Technology, Technical Research Center of Finland VTT and consultants. Together with the financial support of Tekes (The Finnish Funding Agency for Technology and Innovation) and RYM Ltd [Built Environment Innovations] they could do research projects, enterprise projects and group projects.
A couple of projects with results are shown below. Two of the projects are highlighted and the results are given.

<table>
<thead>
<tr>
<th>Project</th>
<th>Year</th>
<th>Project type</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Alliance</td>
<td>2008</td>
<td>Research Group</td>
<td>The operational model for the procedures and ground rules of a construction procurement method based on partnership and risk sharing.</td>
</tr>
<tr>
<td>Reliability</td>
<td>2008-2010</td>
<td>Enterprise</td>
<td>Implement Last Planner System</td>
</tr>
<tr>
<td>Hospital District</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Tukefin           | 2008-2009  | Group        | Productivity  
Value adding, waste eliminating, innovativeness in supply chain  
better collaboration                                                                                                                    |
| LCI-Finland       | 2009       | Group        | LEAN Construction in Finnish, research agenda for 2010-2012                                                                                   |
| LCI-Finland       | 2010-2012  | Group        | LEAN Project Delivery System, Value Stream Mapping, Integrated teams and Commercial terms, employee empowerment                                 |
| Tukefin2          | 2010-2011  | Group        | Productivity  
Value adding, waste eliminating, innovativeness in supply chain  
better collaboration                                                                                                                    |
| Regional Development | 2010-      | Group        | Tampere University of Technology prepares the plan                                                                                              |

Table 3.1: LEAN projects in Finland
TUKEFIN Project
This group project was accomplished by 12 public owners, 7 contractors and 5 consulting engineering companies. Their goal was to improve productivity by adding the innovativeness of acquisitions and cooperation, eliminating waste from project deliveries and accelerating lead times of tasks and projects.

<table>
<thead>
<tr>
<th>Owner</th>
<th>General Contractor</th>
<th>Change in process</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finnish road Administration</td>
<td>Seppo Rantala</td>
<td>• Selection criteria -&gt; Price and Lead time&lt;br&gt;• Bonus/fine for Lead time&lt;br&gt;• Last planner system</td>
<td>Price 10% under budget&lt;br&gt;Lead time 30% under owners request</td>
</tr>
<tr>
<td>Finnish road Administration</td>
<td>Skanska Infra</td>
<td>• Early involvement&lt;br&gt;• Last planner system</td>
<td>6 months faster than owners request</td>
</tr>
<tr>
<td>Municipality Kerava</td>
<td>Destia</td>
<td>• Bonus: Lead time, safety and quality&lt;br&gt;• Last planner system</td>
<td>Lead time cut to half Variation increased</td>
</tr>
</tbody>
</table>

Table 3.2: Results TUKEFIN Project

The next companies want to import the developments of LEAN in Finland: Granlund, Consti, Fira, Lemminkäinen, Finse Transport Agency, Oulu University, Skanska, Talokeskus Yhtiöt, Sweco PM, Vianova, Vison en WSP.

3.2.3 Is LEAN a good development in the building management in The Netherlands?
The success of LEAN in the Dutch building sector will be explained. First has to be named again the important basic definition of LEAN: all the activities within an organization that lead to what a costumer has paid for has value and everything else, besides the necessary activities, is a waste of time and money.

Dutch construction companies believe that LEAN is exactly what the Dutch building sector needs. (Ede, 2015) More of ten percent of the turnover of a company is estimated to be failure costs. (Gort, 2015) Create more customer value, have fewer costs due to failure and have more satisfaction about work being done. Subcontractors and suppliers are no longer a third party but they become a partner. This means that not just the one with the lowest price gets to supply. Next example explains why. If suppliers are forced to sell without any profit they will disappear eventually because that is not a healthy way of running a company. You have to go to another, more expensive, supplier but one that survives because of that fact and that makes them an important partner on a longer term.
For a successful introduction of LEAN there are two cornerstones:
- Continuous improvements
- Respect for people

In LEAN is not only about more efficient company processes. LEAN is a philosophy focused on people and makes them central on the workplace, where the earlier mentioned value is being created, to be an integral part of the process of continuous improvements. This means that a LEAN organization would never fire employees because of efficiency reasons because the employees are forming the base to signaling and implementation of improvements. Construction companies in The Netherlands are all experiencing the same when do work with their biggest and best customers. With a relatively small effort people are being more enthusiastic and improvements are huge. But what does this mean in practice? LEAN starts from the very first moment that a potential customer contacts a company for an offer. The calculation section approaches the customer for more explicit information so that they could make a more valuable offer. After that the company will look at which method and implementation is more favorable. (Klokbouw, 2013) This actually is the beginning of the LEAN process: pro-active thinking.

Pro-active is important through the whole LEAN process. Think before acting and be convinced that an action taken means maximum value for everybody. And again the goal here is improving the efficiency, fewer costs because of failure and eventually satisfaction for both customer and contractor. This is where the Dutch construction companies can have their wished financial effect. Costs because of failure are usually a result of bad communication, bad preparation, apathetic attitude and not being fully involved. LEAN management always implies a tight schedule. Planning is really important. At the start of a project there is a Pull-planning. All the involved parties are present and everybody gets the chance to tell their wishes about the lead times of their own building part. After that together the gaps in the schedule are being pulled out and the building time comes closes to the wishes of the client. By putting all the facets of the different subcontractors together one recognizes in an early stadium to optimal situation for every party. But a pull-planning is leading and is stays leading. This means that forever reason possible one party cannot keep up to the schedule this will be noticeable for the entire building team. Together the team could look for a way to solve this without any failure costs. (Systeembouw, 2015)

Also ‘Arjan Walinga’ the policy officer from ‘Bouwend Nederland’ confirms that LEAN is a good development in The Netherlands. He said that it has proven itself in practice and that construction processes are running better. ‘Cor van Vliet’ manager of the building company Mulder Obdam said that for an early chain cooperation the failure costs are reducing. (obdam, 2011) ‘Cyril Mentink’ specialist in LEAN management and also financial and business consultant is also satisfied with the results of the development. "LEAN Construction leads to shorter lead times, lower failure costs and higher customer satisfaction. You will notice it in your margin “says Drs. Cyril Mentink. (Smit de Vries, sd) The article ‘slaat de LEAN bouwen-vermoeidheid toe?’ begins with the statement that the sub-contractors become tired from the paste of the stickers but that a lot of companies wants to change their management to LEAN management but that they only use some ‘tricks of it’. This article wants to confirm that this kind of companies needs to continue with the developments with LEAN. The companies which are really apply this LEAN strategy have impressive results. Construction times that are reduced by half of the time, with the same quality savings up to 25 percent of the budget, etc. (Kuijpers, 2015)
3.2.4 Tools

LEAN is introduced now by explaining what it means and what is could do to management and the process of a project. Besides that there is mentioned how profitable LEAN has been for Dutch companies and what companies are doing with it in The Netherlands. Also is mentioned how far LEAN is integrated in Finland. In this section there will be explained how the Finnish construction companies should imply LEAN with so-called LEAN –tools. Every tool has its own properties and the chosen tools are easy to implement. The choices are based on personal experience and also because of its specific properties for the application of companies which are starting to use LEAN. (Industries, 2013) There is complete toolbox with 25 possible tools. A LEAN tool is invented to create value and to reduce wastes. Beside the tools this report also contains some applications of LEAN, shown in the next section called practice. There are tools which are not mentioned here but further in this report, in chapter 5. The reason is that these tools require more experience and could be applied after the use of the tools which are mentioned in this chapter.

5-S Method

An important aspect of LEAN is a clear building site. The first tool that is described is the ‘5-S method’. This tool is chosen because with a few easy steps the effects on the building site can be huge and because of the personal experience. It reduces the waste of time.

The first important thing is that the people who are working on the building site make the decisions. The 5S’es apply to:

1. Sort
   Sort all the items on the workplace in order of the frequency in use. The items that often used can be placed within hand reach. This is important because it safes space, so it reduces problems and annoyances on the workplace. It also safes time because you are not wasting time to find something anymore. The building site will be clean and easy to work on.

2. Set in order
   This has a relation with the first point ‘sort’, because when you sort the materials you need to put it in order. Things that are being used often need to be on the front. The things that are needed sometimes can be put behind the first materials. Materials that are barely needed on the building site needs to be removed from the building site. It is important to label the places where the materials belong. So there is no miscommunication with the other colleagues. Also at this point you do not waste time by searching. There will be less time spend searching for materials and this will improve the safety on the building site as well. No unnecessary stuff is in the way anymore.

3. Shine
   To shine means to keep the building site clean and workable. After a day of work clean the workspace where you worked. If you do this every day it costs not much time and there will be no irritations anymore by your other colleagues the next day and everybody will enjoy their work more if the building site is clean.

4. Standardize
   Standardize everything. Make sure that everything will stay on the same place. If you want to change anything discuss it with other people on the building site before you change it.
5. Sustain

Make a habit of the taken procedures. When this will become a habit the method is going to save time and money and will motivate the people to keep improving this. The result will be a clean working place where people can work easily without irritations and it will also improve the communication. (EPA, 2015)

![5-S Method Circle](image)

Sharing information

A huge factor in waste in the construction industry is miscommunication. A common miscommunication is that for example the builder has the wrong drawings so he builds it the wrong way. An online platform where the parties can share the information about the project is a good method to prevent this. Most of the companies already have this platform but they use it only internally.

There are a lot of programs the parties might use to share their information. The top three, from an online platform on Hongkiat, is:

- ActiveCollab
- Assembla
- Basecamp

(Hongkiat, sd)

All of them are only working with an internet connection. However after reading the comments of the people who used these programs Assembla is very complicated and Basecamp is expensive compared to the other online programs.

The most people who are using ActiveCollab are satisfied with the program and are able to share large files very fast. It is also possible to try the program 30 days for free.
Meetings
The meetings in a project are an important issue for the LEAN method. Miscommunication often leads to failure costs so this must be reduced. Another purpose of the meetings is to let the personnel feel that they have a right to speak. The result is that they feel involved in the project. The next kinds of meetings are necessarily for clear communication.

The first meeting is before the start of the project that includes all the personnel and the management team to appoint the safety rules for the project. After the meeting, when they have explained all the rules, the employees sign an agreement that they will follow the principles of the safety routines.

Next is one (or more) meeting(s) with the contractor, subcontractors and the foremen. This will be about the pull planning, the sticky day. This meeting is further explained in the chapter of the practice part, 3.3.

Another meeting time is with the site manager, foremen of the contractor and the subcontractors. This will be informal and will take place weekly. In this meeting they discuss the issues of last week in the project and the progress.

The last kind of meeting is the daily meetings. This will take every day 5-10 minutes and the site manager or foremen will explain to the present construction workers what activities will be carried out that day. (Shakeri, 2015)

Preparation
As previously mentioned one (or more when necessary) meeting(s) is about the planning, the sticker day. First of all is a good preparation for this day is needed to achieve a planning that everyone will agree on. To prepare this day a few steps are described.

A few items are needed for this day:
- Broadsheets (to paste the stickers on)
- Stickers in different colors (to write the activities on)
- Markers
- Scissors and scotch tape (to make the planning official
- An available room to gather and where the construction personnel easily can come to see the planning, a construction trailer at the building site is a good example
- The information about the project, like the drawings, contracts of the subcontractors etc.

(Rekvel, 2014).

Implementation
The implementation of this tool will be shown in chapter 3.3, the practice part of LEAN of this report. One of the companies will serve as an example. Their planning will have small changes that will lead to a time profit of several weeks. After presenting the new planning to the company there will be a consultation in which the completion will be discussed. After this consultation the new planning could be an important recommendation for their future projects.

Pull planning
The last tool that this report is suggesting is the pull planning. The pull planning could be seen as an outgrowth of Just In Time. This tool demands a good preparation.
3.2.5 Terms

Contract
If a Finnish company decides to change their project management with LEAN, there will be consequences for the contract. In the table in attachment F, the differences between a design-build agreement and an agreement based on LEAN aspects are shown. (Timothy C. Becker, 2012)

Mentality
A barrier to imply the LEAN method in a company is the mentality of the personnel. (Omran, 2015) This problem can be solved to convince the personnel that the new way of project management is a good development. A way to convince the employees is written in attachment H.
3.3 Practice

This practice part will now show that the LEAN method could be very effective by making a few changes in the planning. The idea is that during this meeting different sub-contractors are able to tell how much time they for their work. But the most important thing is: are they able to work at the same time other sub-contractors are working. Next example will show what could be achieved in 5 minutes of discussion. The regular planning shows that for cladding and erection of the terraces and other non-complementary structures 7 weeks are planned. But the sub-contractor who is responsible for the terraces might not have to wait until the cladding is finished. It could be possible that the cladding could be finished at the places of the terraces. If this work could be done in one week the sub-contractor of the terraces can start two weeks earlier as shown in figure 3.2.

All work that is planned after this, and depends on it, can also start two weeks earlier.

The highest profit can be managed in the internal work phase. The planning shows that some proceedings have to wait for others to start. In most cases this is highly unnecessary. For example the start of screeding and painting does not have to wait until the inside boarding of the walls is completely finished. It seems that the boarding of the walls is important for this planning. All other proceedings are planned after this activity. A solution could be to that in consultation with that subcontractor a work scheme could be made so that at places where other sub-contractors can start their work the boarding will be done. This will lead to earlier starts of the wet rooms, placing kitchen and pantry furniture and also the fireplace. All these simple changes have led to a profit of three weeks, figure 3.3.
These two examples and another couple of small changes have been done in cooperation with an expert from Seinäjoki University and have led to a reduction of the construction time of 8 weeks.

The changes that have been done are now implied to the original planning of Hartman. But to really benefit from this new planning method a new kind of overall planning has to be made. This new kind of planning shows all the different parties and their proceedings, week numbers, dates and holidays.

<table>
<thead>
<tr>
<th>Week</th>
<th>Company</th>
<th>Operating</th>
<th>Activity</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
<th>Sun</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Building</td>
<td>Subcontractor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Roof</td>
<td>Subcontractor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Insulation + interior</td>
<td>Subcontractor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Windows + doors</td>
<td>Subcontractor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3.4: Format LEAN planning includes parties, proceedings etc.

This planning also contains unfilled boxes. These boxes are meant to be filled with a sticker by the specific sub-contractor. On this sticker are written which kinds of proceedings are being done and that moment. After a session all the stickers are being translated to an excel document to make sure the planned activities will stay at the right place.

Figure 3.5: LEAN planning after first session, all activities are planned in consent with all parties

**Results**

The results have been discussed with an expert from the Seinäjoki University before offering them to the companies and the Housing Fair. During this discussion no strange deviations were seen and therefore there can be concluded that the results are valuable to the Finnish construction companies.

The expected and possible results of the adjustments are:
- Shorter construction time
- Decreasing costs
- Peace on the building site
- Job satisfaction
- Predictability
- Problems solved before it is getting worst
- Loyal cooperation with the partners

The main results of implying all the tools are decreasing the building costs with a shorter construction time.
Besides the two main results there are a lot of more benefits.

Because of the 5-s method the building site is structured and tidy. It also gives the employees job satisfaction. Because if they improve their working method, more work can be done in less time with the same energy. They are also more involved in making decisions. Because the process becomes transparent and more predictable, there are less unexpected problems. The cooperation between the sub-contractors/partners becomes more loyal because there are more meetings and they are involved in an earlier stadium.
3.4 Conclusion

As shown in previous section the results are huge by only making relatively small changes to the planning. The only conclusion take can be made is that Finnish construction companies should start to use this method. The opinion of the university’s expert and given the fact that both companies already admitted that they are open for a new management strategy it should be a matter of time they will start to use the basics of LEAN management.

LEAN is an important development in management. This management method was introduced firstly in the automobile industry by Toyota. By introducing LEAN as a management method a new production philosophy was born. The goal was to eliminate inventory and other waste by dividing production into smaller parts. A couple of concepts were used to implement this method in the production phase. The main techniques that were used are Just In Time (JIT) and Total Quality Control (TQC). After a long process of trial and error these two ideas were enough developed that new techniques could advantage from them. Some so-called outgrowths are employee involvement, continuous improvement, time based competition, concurrent engineering and value based strategy. The two main techniques and these concepts are more familiar nowadays to people in the construction industry.

After explaining LEAN and describing in which way this method is applicable in building projects, the benefits are necessary to mention. The problems that were recognized in the manufacturing industry are partly the same as in the construction industry. Caused problems by using usual management methods are divided into three groups: designing and engineering by using a subsequent method, lack of quality and segmented controls. Overall these three groups have the same issue in common: the way of dealing with the process leads to mistakes because there is no integrated way of management. The most common waste and value losses in the building industry can be found in the following sections of process: transport, overproduction, waiting, unnecessary or poorly process, storage, defects, movement and unused knowledge. Based on personal experiences in the construction industry a couple of tools to cope with the problems are chosen. The first tool is the 5S-method. This method focuses on the building site and is chosen because of the easy way to translate this method into practice. The next tool is sharing information. This tool is used to handle the lack of integrated management. Sharing information in an earlier stadium with all the different parties together could solve problems. Some software programs are proposed. Meeting is the focus of the next tool. Communication is one of the most important things during a process. There is described what kind of meetings and how many are necessary to be sure the communication with all the parties is optimal. The last tool is the pull-planning. This planning gives every party the opportunity to work on an overall planning. They all have the possibility to plan their work with each other. The most important benefit here is that work can be done in shorter time. For the planning of Hartman this tool is used and the results are huge only by making some small changes. The application of these tools should be easily realizable in Finland because their project organization is comparable to The Netherlands. To introduce a new management method in a different country for different companies it is necessary to observe the current knowledge about that method. Finland started to use LEAN as a method in 2008. After 2008 it became more interesting by using it for more projects. Also universities and organizations started to do more research. One project called TUKEFIN, which included more projects, managed to get significant results. The total price under budget at least 10%, lead time of 30% less than the owner’s request and construction time 6 months faster than asked are examples which cannot be denied. Also the fact that in 2014 a big group of construction companies admitted they would like to import the developments of LEAN into their current working methods shows that LEAN could be very useful for future projects.
Also the research about LEAN in The Netherlands shows that by using some of the tools projects became more profitable. With these facts it becomes easier to convince other companies, no matter how small they might be, that using LEAN is profitable. For one company involved in this research the pull-planning tool has been used to show them that with small changes their leading time could be reduced by at least 10%. This chapter answered the sub-question in what way LEAN can be a value to the Finnish construction companies.
4 Conclusion
4.1 Answering the main and sub-questions

Main question:
How could the widely applied new method in Dutch building processes, LEAN management, lead to the suggestion of a possible innovation for Finnish construction companies to their current building process by focusing on the process control?

A lot of differences were observed by doing research on the two countries. First of all, there were differences between the aspects of quality and the building method. Finnish construction companies mainly build with timber and Dutch companies with concrete or lime-stones. However the Finnish companies are specialized in this method, they have decided not to do research on this aspect. There were also some differences in the organization between the two countries. Before a company is able to change this aspect, a lot of practice in LEAN is recommended. To come to results in a short time a change in the organization of a project is not wished. Because there were interesting developments in the field of project management in The Netherlands and on a smaller scale in Finland and because of the study and experience of the writers there is decided to do research on this part. The project management in Finland is mostly still traditional compared to The Netherlands, and there are more developments in The Netherlands to improve the management with a method called LEAN.

So there are changes in the field of project management for the Finnish construction companies with this innovative method. The innovation can improve the current project management of Finnish companies. For example by implementing the pull-planning, a few weeks of the total construction time can be deducted. Both companies are willing to look to this new innovation and might imply it in future projects. Especially Omatalo is willing to learn more about LEAN. More Finnish construction companies might benefit from the innovations shown in this report because it will be presented at the Housing Fair of 2016.

The use of LEAN is an identified difference and can mean an innovation for Finnish companies in general to influence process flows. The influence on the process flow is possible on the short- and long term. The Housing Fair should be an interesting place for this thesis to be spread out because many Finnish construction companies might consider the use of it in their own building process. Both companies have indicated that they would like this thesis to be presented by the writers at the Housing Fair.

4.2 Conclusion

First of all are the visitors of the Housing Fair open to a new project management strategy because they visit the Housing Fair to improve their current working methods. Also after desk research there can be concluded that the Finnish construction industry need a new and more efficient way of project management.

LEAN is a good method to improve the project management because it reduces waste and it improves the working process. It has been shown that it is a good development in different projects and it is applicable to all the construction companies, so also for Finnish construction companies.

After the field research there is much to be gained with the LEAN method. By implying some LEAN tools chosen by doing research and from personal experience in practice the process will be encouraged. The tools are also applicable for companies who are starting with the LEAN method.

The recommendation for Finnish construction companies is to change their strategy in the process. To be clear, only change the way to manage a project. The article ‘Granlund involved in the development of LEAN practices’ said that the construction industry is calling for changes; LEAN practices should be adopted in Finland. (Granlund, 2014) After different researches they concluded that at its worst one third of the used time on the building site is wasted time, time when there is no value added to the building. That is the main reason that the development ‘LEAN’ needs to be imported in Finland. In the past there are a lot of examples in Europe where the LEAN strategy works in the construction industry, for example in The
Netherlands. BIM manager Tero Järvinen said that LEAN will improve the efficiency of projects, the LEAN philosophy makes it possible to carry out projects more efficiently and with better quality; this does not mean that the schedules will become tighter, but instead work will be done in a timely manner so that the content matches the stage of the project. (Granlund, 2014)

Short-term adjustments
The short-term adjustments are easy to implement and the results are huge. These tools are suitable to begin with the LEAN philosophy.

5-S method
The first tool is the 5-s method. This method also improves the duration of the planning. This recommendation is made because it is easy to apply and it also improves the atmosphere on the building site. It prevents people from getting frustrated by all the actual waste. It is often seen that materials are still present on the building site while they will not be used again for construction.

Sharing information
Another tool for a short-term recommendation is the way of sharing information. This needs to be changed. The current way of sharing information is a common failure cost in the construction industry. There is a lot of miscommunication, for example builders which are working with old drawings, and that needs to be changed. That is why this is an important part, how to share the information with the sub-contractors.

The recommendations for the companies is, if it is possible, to create a shared folder with all their sub-contractors. In this case everybody will see and can find the most updated drawings which are being used on the building site. There are many ways to create a shared folder like this but a well-known program is ActiveCollab.

Long-term adjustments
The long-term adjustments provide more time to implement. To try these recommendations during one project is a good start. To know the benefits of the tools, it is important to analyze different factors. For example, how much time and money is reduced, what the reaction of the employees and the sub-contractors is, what the quality of the building is etc.

Cooperation between parties
The most important change in the management strategy is the cooperation between the customer and sub-contractors, they need to be included in the design and building process from the start. It is important to make this process watertight and transparent, so you are able to control the costs, the planning and the entire building process.

The cooperation between the contractor, subcontractor, owner and architect needs to take place in an earlier stadium because it is important that all the companies are familiar with the wishes of the customer in the first phase so they can make an exact list what their activities will be to give a certain value to the project. After the list they can start to make the planning together. This will happen during one or more meetings.

Pull planning
The most important tool to reduce the waste of time is the pull planning. The pull planning is mainly a method to shorten the construction period but it has more benefits.

At the practice part it was possible with some easy adjustment to shorten the planning of Hartman Oy with 8 weeks and is controlled by an expert.

All the short- and long-term tools have some consequences for the mentality and the contract.
5 Recommendations
5.1 Introduction
Due to limitations of the research some topics are not mentioned in this report. Although they are not mentioned further research is wished because of the value they have especially on a longer term. This chapter will describe those topics and it will show how cope with them.

5.2 Advanced tools
As mentioned before in this report the focus was specifically on tools for construction companies who have no experience in the LEAN-philosophy. Some tools provide more practice with LEAN and therefore more research is wished. How to organize a project and a project team using the LEAN philosophy could not be realized during the research and the writing of this report. The lack of time and insights in the projects and the companies has led to only the results which are mentioned in the previous chapter. It is recommended to use some tools which are more focused on the organization of a project. The tools which are recommended:

5.2.1 Tool 1 Value Stream Mapping
This tool is used to visually map the flow of the process of a project. It shows the current and the future state of processes in a way that highlights which opportunities could be improved more. This tool exposes waste in the current process and provides a roadmap for improvement through the future state.

5.2.2 Tool 2 SMART goals
The goals are Specific, Measurable, Attainable, Relevant and Time-Specific. It helps to ensure that goals are effective.

5.2.3 Tool 3 Continuous flow
This is project process where work-in-process smoothly flows through the end goal with minimal buffers between steps of the process. It eliminates many forms of waste such as inventory, waiting time or transport.

5.3 Monitoring of recommended tools
To have results the tools must be implied by the company into their project management. A kick-off project is the perfect way to start simple with one of the LEAN tools. But changing a project organization demands attention continuously. A kick-off project will show if tools have the wished results and if they have led decrease of waste causes.

5.4 Further research
This report could lead to three issues that might lead to further research. The first issue is the comparison between the building cultures between two different countries. This report has shown a method this was based on the limitations of this research. But further research will lead to a more accurate method.

The second issue is further research of the two building companies Hartman and Omatalo. Research must be done by a Finnish institution, for example Seinäjoki University, or a Finnish individual, possibly a Finnish student. This is because the language has been a major barrier. Lack of communication often led to limited gained information that must be available for further advice.

The third issue is based on all the Finnish companies who are not familiar with LEAN or at least have limited knowledge about this philosophy. Further research will lead to a much more extensive statement about how to change the organization of a project on a longer term.
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