INTERDEPARTMENTAL POSTGRADUATE PROGRAM IN BUSINESS ADMINISTRATION (MBA)

Master Thesis

MINIMIZATION OF WASTE IN THE FOOD INDUSTRY BY APPLYING LEAN PRODUCTION PRACTICES

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Minimization of Waste in the Food Industry by Applying Lean Production Practices

Purpose of Thesis

The Lean adoption in the food industry has been researched through surveys and case studies, the results of which vary in terms of the degree of Lean implementation and the Lean practices applied. The purpose of this thesis is to reveal the wastes that exist in the production process by investigating the case of a Greek food industry, and then propose the appropriate Lean practices in order to alleviate their impact.

Research Questions

1. Can Lean Production be applied to minimize waste in the food industry?
2. Can the Value Stream Mapping tool be utilized to improve Lead Time and Work in Progress in the food industry?
3. Which are the most applicable Lean Tools in the food industry?

Literature Review

Extensive literature review was conducted on the following topics

Lean Principles	The Eight Types of Waste	Identification of Waste	Waste Elimination
• Define Value • Identify the Value Stream • Make the Value Flow • Implement Pull-based Production • Strive for Perfection	• Overproduction • Waiting • Transportation • Unnecessary Motion • Inappropriate Processing • Unnecessary Inventories • Defects • People Underutilization	• Value Stream Mapping	• 5S • TPM • SMED • Kaizen • JIT - Kanban

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Research Framework

Lean Production in the Greek Food Industry

- In Greece, there is lack of a substantial number of articles regarding Lean adoption. The case study that Psomas, Antony and Bouranta conducted in 2018 on 9 Food SMEs was – to their knowledge – the first attempt to focus on Lean application in Greece. They concluded that Greek Food SMEs apply Lean to a higher extent than similar companies in Europe.

The Unique Features of the Food Industry

- Limited Shelf Life
- Multiple & Diverse Raw Materials
- Seasonality
- Food Safety
- Quality Assurance

The Degree of Lean Implementation in the Food Industry

- Contradictory results have emerged from academic research in terms of the degree of implementation and of the Lean tools' application.

Barriers to Lean Implementation in the Food Industry

- Extended Cleaning Times
- Long Product Changeover Time
- Product Perishability
- Low Resources Availability
- Employees' Lack of Education and Low Engagement
- Fluctuations in Demand
- Quality Assurance Demands
- Food Quality Regulations

Recapitulation of Literature Review

The Literature Review of articles on Value Stream Mapping concluded that this Lean tool is utilized to identify wastes in the food industry, to reduce Lead time, and to improve production efficiency especially when applied in combination with other Lean tools.

The Lean adoption in the food industry with its unique characteristics was reviewed through significant articles and contradictory results have emerged in terms of the degree of implementation and of the Lean tools' application. The present thesis also attempts to investigate the applicability of Lean tools in the food industry.

In order to fulfill the purpose of this research the following three research questions will be investigated:

- Can Lean Production be applied to minimize waste in the food industry?
- Can the VSM tool be utilized to improve Lead Time and Work in Progress in the food industry?
- Which are the most applicable Lean Tools in the food industry?

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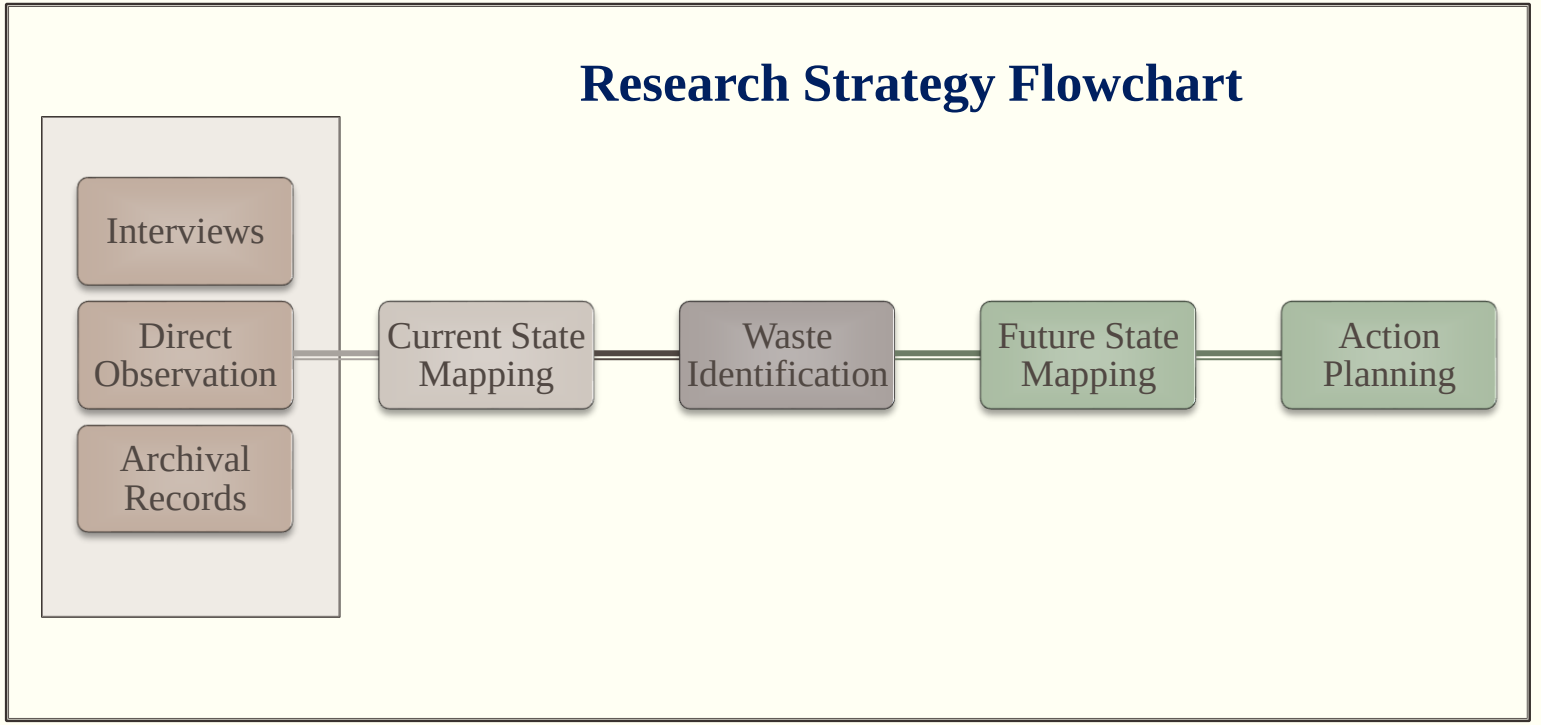
Methodology

This thesis studies the case of a Greek Food Industry following the Action Research methodology. It was selected over the standard case study methodology due to the fact that the author gets involved in the process and proposes solutions. A specific product family is examined towards waste identification and minimization.



Methodology

The research strategy in more detail

Data is collected by direct observation, interviews, and archival records.

VSM is applied and the current state map is created.

Analysis of data provided by the current state map which enables the identification of wastes.

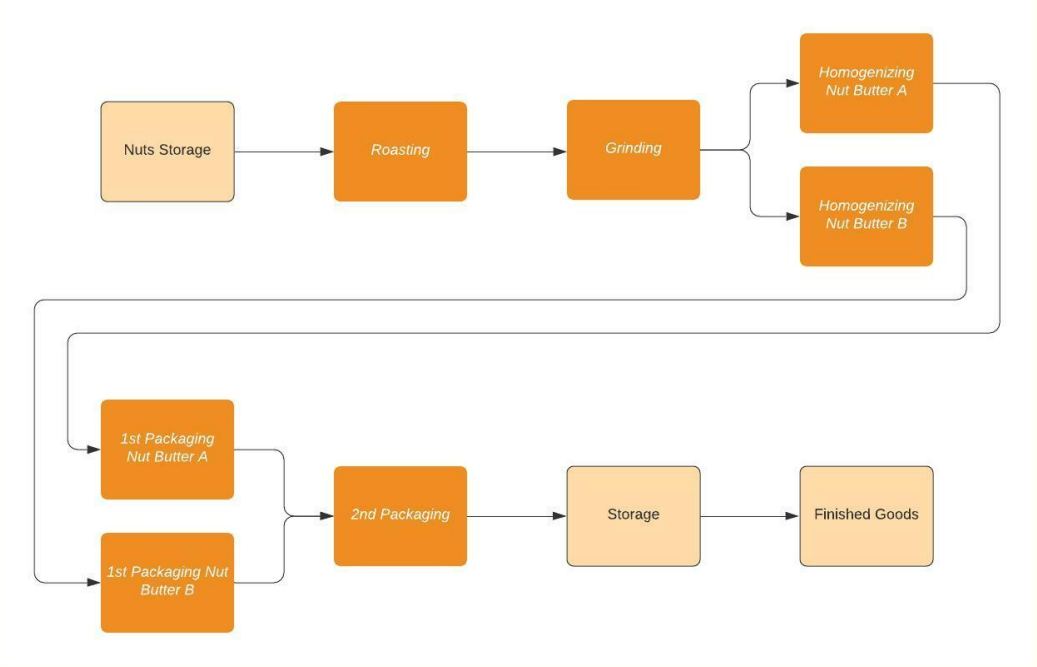
The future state map is created including all the possible improvements.

An action plan is proposed to the case company in order to reach the future state

Methodology

The Case Company

- The company is situated in Northern Greece, employs approximately 350 people, and has an annual turnover of about €80 million. The firm specializes in seed pastes, nut butters, wafers and confectionery, and holds a strong position in the domestic market. The products under consideration are within the Nut Butters family the production process of which is shown in the next figure.



Flow Diagram of the Production Process
Source: Own compilation

Methodology

Data Gathering

- The author obtains data by as many sources as possible in order to increase the validity of this study. The main data gathering method is direct observation which in combination with semi-structured interviews provides the majority of information necessary for the VSM application. Archival records are utilized to obtain historical data; however, they are used in certain cases only.

DATA RETRIEVED	DATA GATHERING METHOD	DIRECT OBSERVATION	INTERVIEWS					ARCHIVAL RECORDS
			Sales Manager	Procurement Manager	Production Manager	Operators	Technician	
Customer orders frequency			■					
Customer orders quantities			■					
Customer deliveries frequency		■	■		■			
Customer deliveries quantities		■	■		■			
Production schedulling		■			■	■		
Inventories - WIP		■			■			
Cycle times		■			■	■		
Changeover times		■			■	■	■	■
Available times		■			■			
Number of operators		■			■	■		
Equipment uptime					■	■	■	■
Raw material orders frequency				■				
Raw material orders quantities				■				
Raw material deliveries frequency				■	■			
Raw material deliveries quantities		■		■	■	■		

Data Gathering
Source: Own compilation

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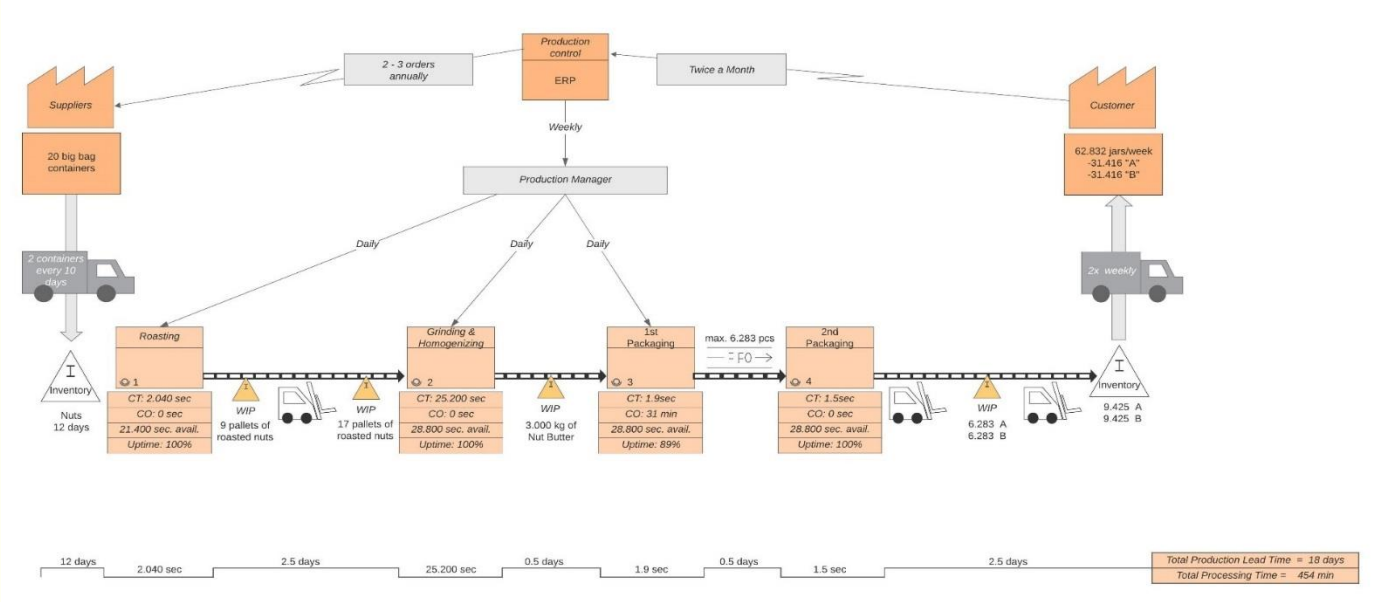
Methodology

Current State Mapping

- The Value Stream Mapping tool utilizes the data gathered to depict in the current state map material and information flows, process details, supplier and customer information, and the total processing time and total production Lead Time.



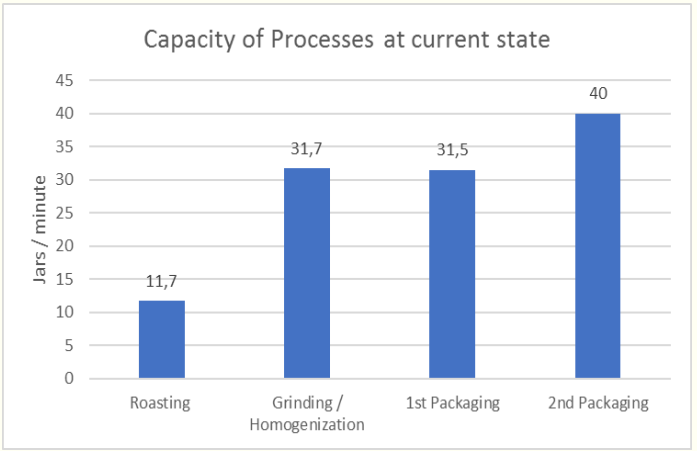
Current State Map of Nut Butter Products A & B
Source: Own compilation

Minimization of Waste in the Food Industry by Applying Lean Production Practices

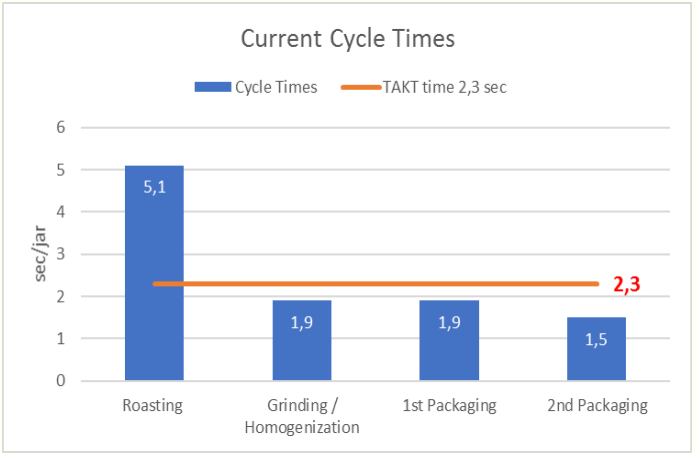
Methodology

Waste Identification

The identifiable wastes in the current state of the given process are unnecessary inventories, waiting and transportation; however, the batch and push production indicates also the existence of the waste of overproduction which in turn affects all other types of wastes. The current state map also reveals that the bottleneck in the process is the roasting step.



Capacity for All Production Steps at Current State
Source: Own compilation



Current Cycle Times
Source: Own compilation

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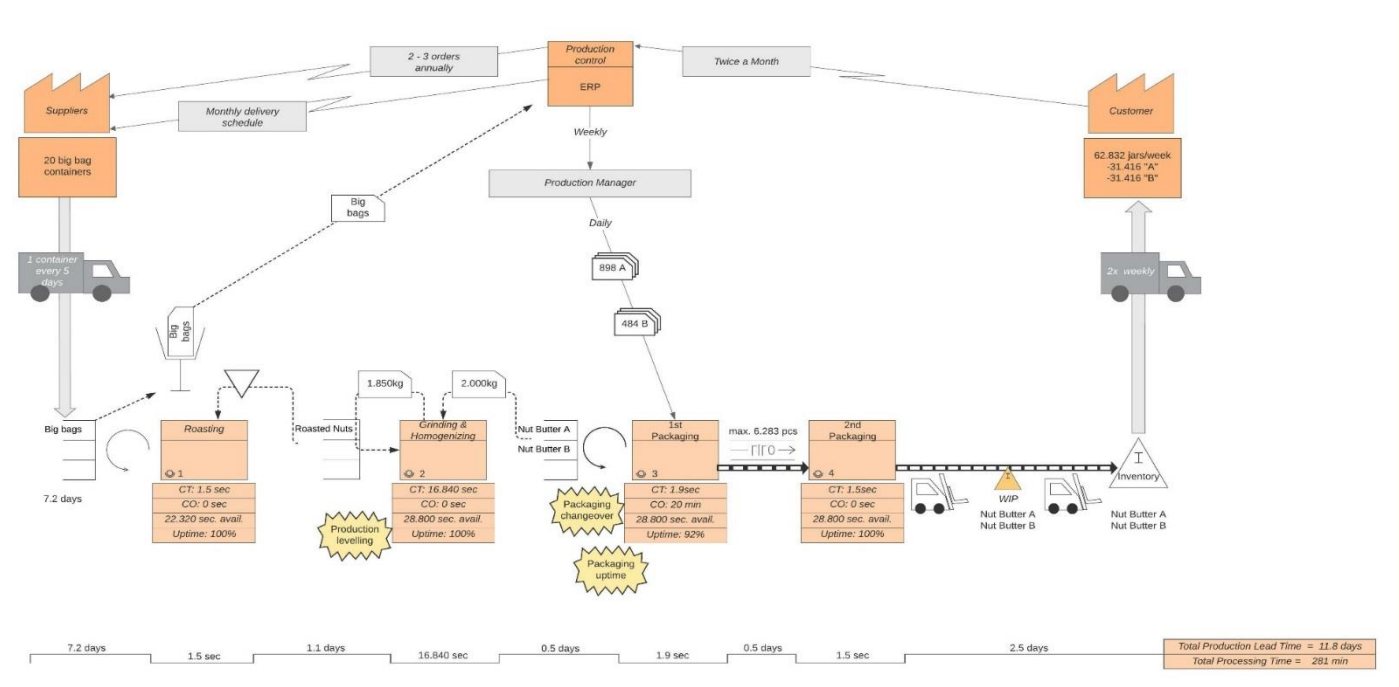
Results



Future State Map of Nut Butter Products A & B
Source: Own compilation

Future State Mapping

- After the identification of Waste, the Value Stream Mapping tool is applied again to depict the future state map. This map visualizes many changes such as the installation of a new Roaster, the layout change of the roasting step, the introduction of three pull-based supermarket systems, the reduction of the raw material inventory, and of the WIP quantity after the Roaster. Furthermore, it includes the new production data of the roasting step that will operate in one shift with one operator.

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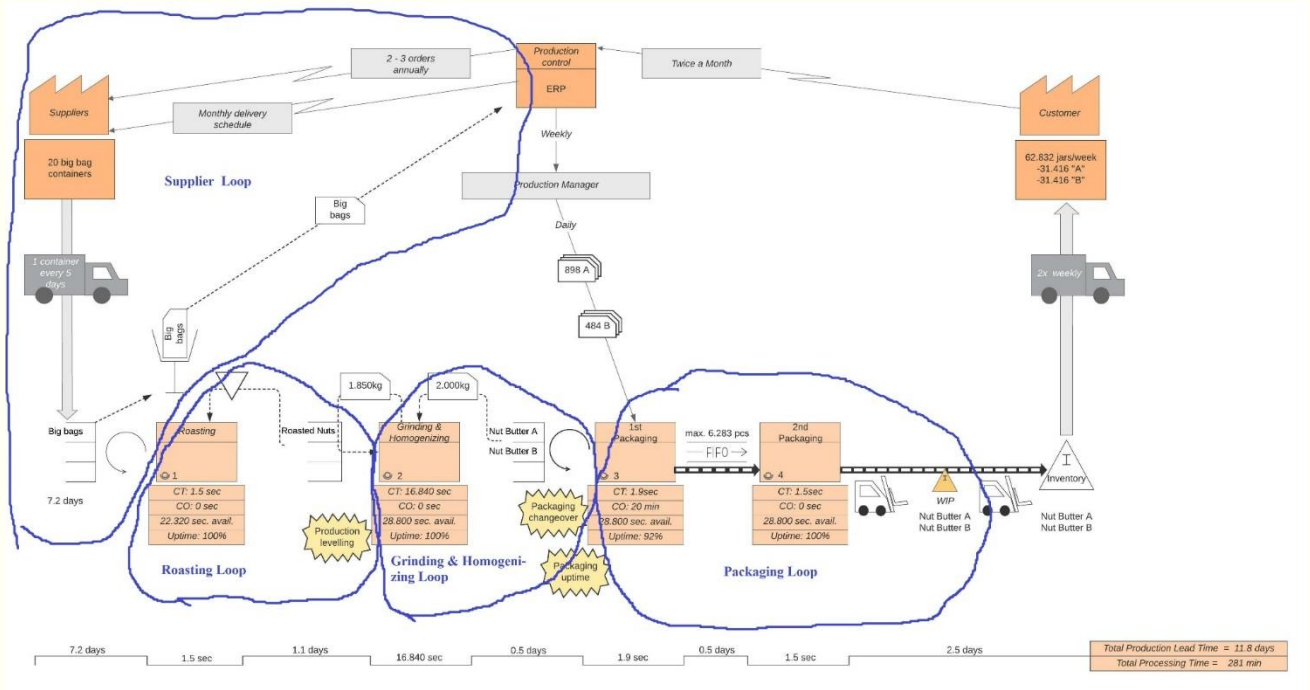
Results



Value Stream Loops
Source: Own compilation

Action Planning

- The use of VSM and the creation of the current and future state maps are followed by the setting up of an Action Plan. The future state map is divided into loops as shown in the figure: the pacemaker loop, the grinding and homogenizing loop, the roasting loop, and the raw material suppliers' loop. The action plan includes improvements in every loop; these improvements encompass the appropriate Lean tools in order to reach the improved future state.

Conclusions

Answering The Research Questions

Can Lean Production be applied to minimize waste in the food industry?

- VSM, with the visualization of the current state, identified the existence of unnecessary inventories and the waiting, transportation, and overproduction waste in the system. Then, the consequent analysis led to the future state map and to the action plan proposed to the company that encompassed Lean practices able to tackle these types of waste. In conclusion, Lean Production can be applied to minimize waste in the food industry.

Can the VSM tool be utilized to improve Lead Time and Work in Progress in the food industry?

- The analysis of the current state map and the visualization of the future state with the relevant proposed improvements can bring a reduction on the Lead Time and WIP of 34,5% and 30,2% respectively. The fact that these KPIs are greatly benefitted by the utilization of VSM effectively answers the second research question.

Which are the most applicable Lean tools in the food industry?

- This research concluded, through the action plan proposed to the case company, that the most appropriate Lean tools to tackle the wastes in the process and bring the case company to the future state are VSM, pull-based production system (Kanban), SMED, multi-functional employees, standardization (5S bundle), autonomous maintenance (TPM bundle), product leveling, layout change, and supplier involvement.

Conclusions

Limitation of Research

- The first limitation concerns the research methodology; Action Research compared with other approaches to research is an imprecise, uncertain and sometimes unstable activity. This study attempts to alleviate this problem by the method of triangulation in data gathering.
- This thesis applies VSM as a starting point. This means that the results are not comparable to the results that would emerge from other similar food industries that follow different paths in implementing Lean.
- A generalization attempt of the conclusions to food industries that differ in their operation from the case company would possibly have a poor outcome.
- The proposed improvements potential is not verified, since the implementation action plan which could validate those improvements is scheduled in a timeframe out of the one of the present thesis.

Future Research

- Future research could follow the implementation of the action plan's activities attempting to validate the proposed Lean practices.
- A multiple case study could take place at food industries to assess the applicability of VSM as a basis for Lean adoption. Should such research take place at food industries in different countries would bring interesting results in terms of generalization and validity.
- A case study or action research could be conducted in a food industry, similar in operation to the one of this thesis, starting out their Lean Journey by beginning with Lean tools other than VSM.
- A survey could take place aiming to compare the types of waste that exist in food industries of different sub-sectors and in different countries.