

Lean manufacturing application in the frozen goods industry

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ABSTRACT

The long-standing producer's market, in which the selling price was the sum of costs and desired profit, has been transformed by globalization into a buyer's market, where profit is the difference between the realized selling price and the production costs. Therefore, every company must approach the reduction of operating costs and the optimal use of the resources at its disposal. Lean thinking can help companies in reducing business costs and increasing productivity. Lean companies can improve their processes and increase their competitiveness in the market. The paper aims to present lean thinking implementation in manufacturing companies to improve procedures and increase competitiveness. Based on proposed improvements to business processes, Frozen Ltd. saved time and costs, making it more competitive in the market and confirming the hypothesis that the lean methodology can help a company perform its business processes better. The company needs to continue with its efforts to use lean since this is not a single event but a journey.

1. Introduction

Throughout history, companies tried to be competitive in the market using different strategies and business models. One of the essential characteristics of the worldwide economy is the extremely swift shifts imposed by the wealthiest countries, and the less developed countries follow them "in step". Changes in the global markets, advancements in technologies in all areas, new competitors, increased demand of buyers, and new requirements and limitations of target markets influence a new style of managing business systems, where management must find practical and quick solutions. Only companies that constantly enhance their businesses and stay ahead of the competition have an opportunity to maintain and improve their business and market position (Piškor & Kondić, 2010). The goal of every company is apparent: to live and succeed, which means producing what the market wants, with affordable-market prices and high quality, and required delivery times, while continuously satisfying the customer and other interested parties. One of the possible tools and/or approaches is lean thinking. Lee-Mortimer (2006) concluded that knowing the distinctions between traditional and lean manufacturing (thinking) is essential for companies before they decide to implement lean.

The paper aims to present lean thinking applications in manufacturing to improve a company's procedures and increase competitiveness. The first part of the paper presents the lean thinking approach to improving a company's operations. The second empirical part presents the application of the lean approach in a manufacturing company in Croatia. The third and final part of the paper provides conclusions and recommendations for further research.

2. Literature Review

Lean thinking-LT and lean manufacturing-LM represent an improved Toyota production system-TPS which was used in Japan in

the 1950s. The TPS was founded on the desire for product organization in an uninterrupted flow and was not influenced by the long production flows to achieve efficiency (Melton, 2005). LT is a collection of different methods and philosophies for generating maximum user value through waste reduction (Womack & Fitzpatrick, 1999; Womack & Jones, 2003). It pursues to change the company's values and philosophy fundamentally, ultimately changing its culture and behavior (Smith et al., 2012). LM is usually connected with big companies' projects to stay competitive in the market (Rajenthirakumar & Thyla, 2011), and as a result, companies that implement LT become increasingly competitive (Bhasin, 2011).

For LT implementation, the company needs to meet five principles of LT (value, flow, value flow, retreat, and perfection) (Womack & Jones, 2003) as follows: a) identify the value for the end-user; b) define value flow as a set of specific activities essential to carry a product through an internal value chain; c) flow denotes the value creation steps; d) withdrawal is planned; and e) perfection denotes constant efforts to advance the process. Those five principles can be presented graphically. (Figure 1)

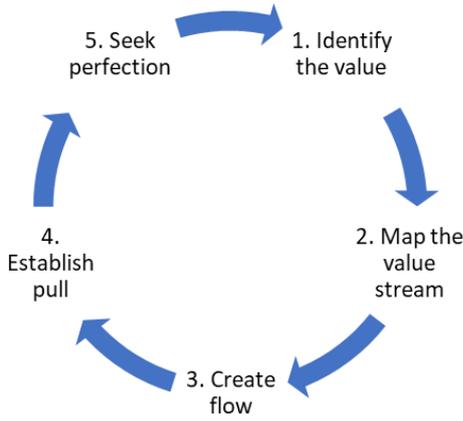
Additionally, to use LT tools and methods, a change in work environments is needed, as a readiness to adjust approaches and mentalities and a forward-looking attitude to new technologies for waste reduction (Bittencourt et al., 2019).

Researchers (Vinodh et al., 2010; Marques et al., 2018) defined LM as a continuous improvement system for the integration of daily work in the production and delivery of products, services, and information with the main aim of waste identification that influences the production flow, quality, delivery times, and cost. Researchers (Santos et al., 2017; Carvalho et al., 2018) define LM as integrating socio-technical systems to remove waste by minimizing and reducing the variability of suppliers and customers. This definition states and confirms the research (Womack & Jones, 2003; Doiro et al., 2017) that wastes in production

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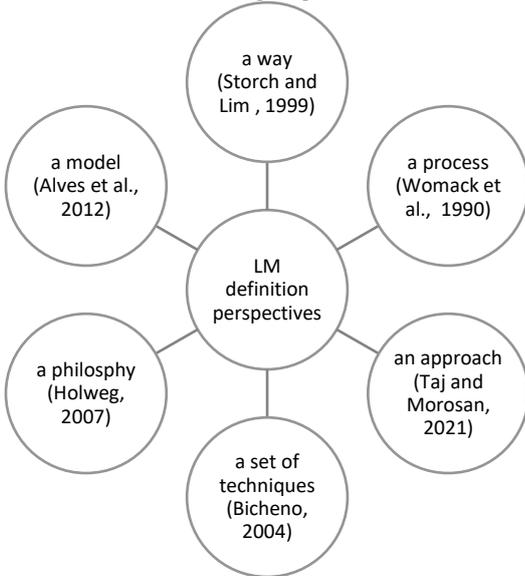
Figure 1: Five principles of lean thinking



Source: Karuppan et al., 2016: 201

include unnecessary transport, inventory, defects, waiting, over-production, movements, and overprocessing. In other words, the foundation of the LM is focused on designing actions that provide value to the buyer, methodical detection, waste removal, and continuous improvement of the production environment for productivity increase (Erceg & Dotlić, 2014). Due to the many studies, different researchers defined LM, which can be seen from different perspectives. (Figure 2)

Figure 2: Different LM definition perspectives



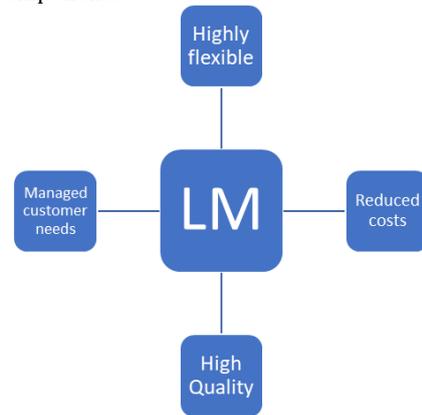
Source: author

Implementing LM enhances the production process and boosts the employee's job satisfaction (Sing et al., 2020). LM represents the company's methodology to reduce waste in its manufacturing processes (Kumar et al., 2022). The base is in minimalizing product costs in the production process, whether in the design or manufacturing phase (Womack & Fitzpatrick, 1999; Womack & Jones, 2003; Alavi, 2003). For LM implementation, companies must utilize a methodology with critical elements such as operations (Troncoso, 2018) and integrated management systems (Jimenez et al., 2018) dedicated to improving their performance. LM was initially developed for the auto industry. It is now widely used in different engineering and assembly industries, but there are not many studies about its implementation in the food industry (Jimenez et al., 2019).

Previous studies found successful LM implementation in among other banks (Hidayati et al., 2019), the building sector (Li et al., 2020), the health sector (Erceg et al., 2020), pharmaceuticals (Sieckmann, 2018), shipbuilding (Storch and Lim, 1999; Sharma and Gandhi, 2017), and in high education institutions (Balzer et al., 2016). LM can be used in all companies, no matter if they are public or private (Samuel et al., 2015), no matter their size (Hu et al., 2015), and in all aspects of their operations (Zhu et al., 2018). Companies implementing LM have become increasingly competitive (Bhasin, 2011). Research has shown that if a company implements LM, it has three times greater chances of becoming a leader in its industrial sector (Hertzler, 2013). In their discussion on LM, researchers (Slack et al., 2019) conclude that LM endeavors to meet immediate market demand with demanded quality and without waste. In other words, the product and service flow consistently deliver what the buyer wants (level of quality) when needed, in the required quantities, where it is needed, and with the lowest cost.

LM is a popular and valuable tool for most production and service companies to fight activities that do not bring value to the final customer (Nandakumar et al., 2020). The main reason for companies to implement LM is to gain and keep market competitiveness and improve product productivity and quality (Palange & Dhattrak, 2021). The main components of the LM are shown in Figure 3.

Figure 3: LM components



Source: adapted from Kumar et al., 2022

LM tools are valuable in every situation where there is a correct tool selection, genuine collected data, and employees with a positive attitude to draw out and recognize the necessary changes in their working culture and methods, which will result in an improved working environment (Kolla et al., 2019). Some of the LM tools are shown in Figure 4.

Figure 4: Various tools in LM

Optimized Layout	Poka Yoke	Kaizen	5S
VSM - Value Stream Mapping	Pull / Kanban	Ishikawa diagram	Preventive maintenance
Quality circle / Brainstorming	Single minute exchange die	DMAIC	FMEA

Source: adapted from Palange and Dhattrak, 2021

LM can be seen as a strategy for investing less in the production inputs and receiving increased productivity and product quality as outputs with better customer relationships and after-sales services (Bayou & Korvin, 2008). Researchers concluded that the techniques and tools used for LM have a goal of eliminating waste (Gamage et al., 2016; Nawansir et al., 2016) and all activities that do not add value to the process (production or service) in all stages of manufacturing companies (Yang et al., 2011; Jasti & Kodali, 2016) and the supply chain (Gamage et al., 2016; Pullan et al., 2013). LM aims to secure excellent value for customers through holistic process optimization in the whole organization and the organization's supply chain (Hu et al., 2015). Another study (Žvorc, 2013) points out that lean companies are focused on (i) the customer because goals and strategies are outlined based on his/her wishes; (ii) continuous changes and process improvements; (iii) towards spotting problems and solving them permanently (iv) innovation; (v) shaping the organizational structure determined during customer value; (vi) the standardization of work. Reaching LM is an ongoing journey, not just a single event with a destination (Womack and Jones, 2003; Bicheno, 2004). Therefore, the last step in reaching LM is constantly improving to achieve perfection. Companies must constantly evaluate the value they provide to their buyers and improve the processes to lower the time and effort involved, space used, cost level, and errors (Erceg et al., 2020).

3. Research methodology

Information and data for the research in this paper were collected and analyzed to propose process improvement based on LM tools. The primary LM tool used for the research was value stream mapping (VSM). In the research, a value stream is defined as a set of specific activities needed to take products through the business' three crucial management duties: problem solving, information management, and physical transformation (Sundar et al., 2014). VSM maps all material and information flow needed for activities coordination of all parties. VSM starts with mapping the status of the material flow and activities during the processes (Palange & Dhattrak, 2021). Its visual representation helps identify value-adding and non-value activities (Rother & Schock, 1999). Furthermore, the simulation model can evaluate the improved activities before implementation (Abdulmalek & Rajgopal, 2007). McDonald et al. (2002) state that a simulation tool in VSM is necessary to predict the level throughout.

Process flow mapping and time-value mapping (Melton, 2005) were used for research conducted to record results in this paper and to test the hypothesis that the lean methodology helps the company in becoming better at performing its business processes.

4. Results and discussions

Production company Frozen Ltd. produces, sells, and distributes frozen food and ice cream. It sells its products in the retail, wholesale, and HoReCa channels. The company has more than 800 employees and an annual turnover of more than 100 million EUR. The company sells its products by receiving customer orders through different trade channels. Orders are then commissioned within 48 hours and delivered with their transport to the points of sale. At sales points in the stores with a usable area of less than 200 m², in restaurants and coffee bars from the HoReCa channel, sales are made directly from company trucks according to the available assortment and quantities in the truck on that day. The trucks are driven by employees classified as driver-salesman who have an additional team member (assistant stacker) on the truck. The structure of their monthly earnings is a combination of a fixed part of the income with an incentive supplement in the form of a percentage of the sales revenue. In addition to sales tasks, the drivers salesmen are responsible for taking

taking care of the inventory on the truck, replenishing the inventory, administration related to the delivery of delivery notes, delivery of cash payments from customers, and preparation of documentation for tomorrow's daily tour route. Their daily activities are shown in Table 1 as a percentage of working days.

Table 1. Working day activities of driver-salesman before LM implementation

Warehouse	Administration	Distribution	Sales	Total
25%	10%	30%	35%	100%

Sales account for only 30% of daily activities, making it impossible for employees to be productive. This paper analyzes only part of the Frozen Ltd. sales process. It examines sales at the sales points in the store channel (stores with less than 200 m² usable areas) and the HoReCa channel (restaurants and coffee bars). The driver-salesman daily visit structure to the sales point is shown in Tables 2 and 3.

In previous tables, one can see that there are waste activities driver-salesman can, with an average duration of the sales process of 25 minutes, visit only 8 to 10 sales points per day to sell and deliver goods. After analyzing the previously presented process within the company, a process of reorganizing sales and distribution in the company started by applying the Kaizen principles:

1. Identification of the problems: Combining the functions of the driver, delivery person, storekeeper, and seller in one driver-salesman does not achieve the desired results in sales or distribution. There is not even an answer to the growing number of sales points in the growing range of products.

2. Analyzing current processes: Insufficient results were detected in sales, the number of daily deliveries, the physical load of drivers, and safety at work due to overload.

3. Creation of solutions: The need to separate the process of storing and loading goods from sales and distribution operations is determined. The working place driver-salesman is terminated, and three new positions are created: sales representative, driver-delivery man, and assistant warehouse worker (Table 4). Workers employed as the assistant stacker on a truck are reassigned to an assistant warehouse worker position. On the wave of computerization, the company invests in acquiring software solutions for sales support, warehouse inventory management, electronic delivery of orders, and transport management systems.

4. Testing of the solution: A pilot project was organized for a trial period of 60 days. Two working specifications covering two workplaces are defined: sales representative and delivery driver. The dynamics of the process are defined in such a way that the sales representative visits the customers according to a predefined schedule of visits, takes orders through a personal digital assistant (PDA), and sends them electronically. The total ordered quantities are cumulated and placed in the warehouse at the end of each working day. During the night shift, total quantities of products are ordered and loaded onto trucks. In the morning, the driver picks up a handheld device loaded with information about delivery locations and delivers according to the most economical tour schedule defined by the transportation management system. When delivering the goods, the driver prints the shipping slips in 3 copies on each truck's portable dot matrix printer.

5. Measurement and analysis of the results: After a 60-day trial period, an increase in daily orders from 12 to an average of 30 orders per day was determined, and the same number of deliveries to sales points.

6. Standardization of solutions: Solutions from the trial period are permanently adopted along with standardization of new processes, education, and familiarization of all organization members with new standards to avoid process delays.

Table 2. Structure of sales tour of the driver-salesman in minutes before LM implementation

Step	Activity	Time	Activity type	Waste type
1	Getting orders	3 min	Value	
2	Checking the customer's internal creditworthiness	1 min	Value	
3	Agreement on terms of delivery and payment	1 min	Waste	Waiting
4	Order preparation with an assistant stacker on the truck	5 min	Value	
5	Order correction with the customer based on available stock	1 min	Waste	Overprocessing
6	Manual printing of the delivery notes in three copies	3 min	Value	
7	Unloading the order at the point of sale	1 min	Value	
8	Control of conformity of ordered and delivered goods	2 min	Value	
9	Verification of documentation	1 min	Value	
10	Acceptance of the return of goods due to damage or expiration date	2 min	Waste	Overprocessing
11	Printing of documentation for the return of goods in three copies	3 min	Waste	Overprocessing
12	Storage of returns in truck	1 min	Waste	Overprocessing
13	Preparing the cart for delivery	1 min	Value	
14	Closing the storage area of the truck	1 min	Value	
Total time		25 min		

Table 3. Structure of daily activities of the driver-salesman in minutes before LM implementation

Step	Activity	Time	Activity type	Waste type
1	Receiving a daily activity schedule from the transport officer	5 min	Waste	Unnecessary movements
2	Visual inspection of the truck's condition	2 min	Value	
3	Control of ordered goods to replenish truck stock	30 min	Value	
4	Correction of documentation due to deficiencies in the preparation of ordered quantities	8 min	Waste	Defects
5	Replenishment of the truck with the ordered quantities	45 min	Value	
6	Driving along the agreed route - total time spent in active driving	180 min	Value	
7	Ordering process - total daily time spent in the sales process	210 min	Value	
8	Daily fuel tanking	15 min	Waste	Overprocessing
9	Daily rest	45 min	Value	
10	Handing over cash from cash sales to the cashier	15 min	Value	
11	Submission of documentation to the administrator and deregistration of sold items	15 min	Value	
12	Creation of a template of the required quantities to replenish the truck	30 min	Value	
Total time		600 min		

Table 4. LM workplaces optimization

Old working place - termination	New working place - establishment
Driver – salesman	Sales representative Delivery driver
Assistant stacker on truck	Assistant warehouse worker

An analysis of the company's sales and logistics distribution processes was carried out, neuralgic points were defined, and steps were proposed that are believed to improve the process. The 5S tool was used to analyze each procedure within an individual process, eliminating waste in the process. In the distributive part of the process, the method of stacking goods is standardized. This was done with the presence of Kanban elements that refer to the markings of storage slots inside the truck and the marking of the assortment and storage space with colors (frozen vegetables are green, fish are blue, family ice cream is orange, impulse ice cream is yellow, dough is brown). The company invested in acquiring programs for sales support, warehouse inventory management, electronic delivery of orders, and transport management systems. Actions related to the daily organization of drivers' and sales representatives' activities are avoided by automated processing and preparation by sales managers and dispatchers. Since the credit checks and payment terms are predefined by the sales support tool, there is no need to conduct these activities. Correction of the order with the customer by the driver based on the available stock is no longer necessary since the sales representative has information about the availability of the goods in the PDA and the goods assembled and ordered the day before being delivered. The time needed to print orders in 3 copies is reduced to the time needed to print delivery notes. It does not represent a waste of time because the ordered goods are prepared simultaneously according to the order. The return policy for damaged or expired goods is changed so that Frozen Ltd. no longer physically accepts the return but approves a 50% reduction in the deadline, with the possibility of a complete write-off of the goods in case they are not sold by the legal deadline. Drivers are no longer required to fill up with fuel daily, and the transport management

system controls potential fraud in the consumer segment. After the changes, the new, improved value stream is shown in Tables 5 and 6.

In the sales channel, separating the sales process through the new position of sales representative resulted in increased productivity in the form of an increase in the share of working time spent in sales activities from 35% to 63% of daily work activities. The number of daily orders of the sales representative grew from 12 to 35, which is 150%. In the distribution channel, the exemption of drivers from obligations related to sales activities significantly increases productivity in the distribution process. The share of distribution activities in the daily working activities has increased from 35% to 50%. The number of daily deliveries increased from 12 to 30, which is an increase of 150%. Although the different working place was established, there are still savings in the time needed for one visit (from 25 to 11 minutes per salesman and a total of 11 minutes for delivery).

As a result of LM implementation, the company Frozen Ltd. improved the sales-distribution process through productivity growth. The observed changes represent an opportunity to improve the selection process during employment since the separation of competencies enables selection according to the narrower specialization and skills required by each of the separated workplaces. Additionally, these changes help companies increase their market reputation by improving corporate culture (Esenyel, 2020) since the LM influences the company culture and the worker's approach toward it (Erceg & Dotlić, 2014). Changes resulting from the LM implementation in Frozen Ltd. and the investments in IT positively impact the growth of the company's business operations. These investments in IT (i.e., sales support, warehouse management) impact sales increase as seen in previous research (Işık, 2013), and their impact is higher when combined with LM implementation, as was the case in Frozen Ltd.

Table 5. Structure of activities of the sales representative in minutes after LM implementation

Step	Activity	Time	Activity type	Waste type
1	Visual control of the point of sale, stacking, and replenishment	5 min	Value	
2	Receiving the order	5 min	Value	
3	Creation of an order for the approval of damaged/goods before the deadline	1 min	Value	
Total time		11 min		

Table 6. Structure of sales representatives' daily activities

Administration	Driving	Sales	Total
2%	35%	63%	100%

Drivers spend 50% of their daily working time in the delivery process, 35% in active driving, 5% of their working time in mandatory rest, and 10% in administrative work. The number of deliveries to sales points increased from 12 to an average of 30 deliveries per day (a 150% increase). After the implemented changes, the new, improved value stream is shown in Tables 7 and 8.

Table 7. Structure of activities of the driver in minutes after LM implementation

Step	Activity	Time	Activity type	Waste type
1	Preparation of goods for delivery to the point of sale	5 min	Value	
2	Control of delivered goods with the customer	3 min	Value	
3	Printing of delivery notes	1 min	Value	
4	Preparing the cart for delivery	1 min	Value	
5	Closing the storage area of the truck	1 min	Value	
Total time		11 min		

Table 8. Structure of drivers' daily activities

Administration	Driving	Distribution	Obligatory rest	Total
10%	35%	50%	5%	100%

5. Conclusion

The significance of the LT and LM has been shown and proved in different academic and professional studies worldwide. This has been the case in both production and the service sector, whether private or public. LM can be applied in all processes in all industries. The main challenge is whether the company implementing LM knows its processes, what buyers perceive as a value, how the company operates, and what needs improvement. Companies have several different LM tools that can be used during this process. The tool they will use mainly answers their needs and potential knowledge regarding using it. Reaching LM is an ongoing journey, not just a single event with a destination; thus, companies need to keep working toward improving their processes.

The application of LM was presented in a Croatian frozen goods manufacturing company. For the implementation of the LM, the company applied LM tools and analyzed every process within the sales and distribution department in detail. By applying LM principles, redundant processes are eliminated, and because of the LM implementation, the company decided to separate the driver and sales representative functions. The LM application showed significant improvement and gave company savings and better workforce utilization, resulting in better sales results. These results showed that LM could help the company adapt to market changes, gaining and/or increasing competitiveness in the market. Therefore, the company should continue with its efforts in implementing LM in other business processes based on the results of improved sales and distribution processes. Research results confirm previous studies (i.e., Alves et al., 2012; Hidayati et al., 2019; Palange & Dhatrak, 2021) conclusion that LM can significantly improve business processes and increase competitiveness in the market in increasingly challenging environments.

Further research on LM in Croatia is more than needed not only in manufacturing companies but also in the service sector. Additionally, conducting another research on the company in five years is recommended to review its improvements, check if the company has used LM in other parts (i.e., production), and see if there are additional benefits of LM.

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