IMPLEMENTATION OF LEAN MANUFACTURING IN FISH CANNING COMPANY: A CASE STUDY OF A CANNED SARDINES PRODUCTION COMPANY IN MOROCCO

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A B S T R A C T

Lean is a powerful tool, which can bring significant benefit to manufacturing industries by creating value through reduction of waste. Although the lean concept has become very popular in mass production industries such as the automotive industry, more recently the concept has been adopted in different batch processing industries and service sectors. The application of lean tools into the food processing industry has not received the same level of attention compared to the traditional manufacturing industries. The paper discusses how the lean concept could be applied to a fish manufacturing company. The paper first presents the lean concept tools. The empirical section discusses how a case company, operating as a contract manufacturer in the food industry, has applied the lean production concept and tools. In the case study, three analysis tools are examined and the structures of demand chains of different customers are presented. The delivery times will decrease and more flexibility will be needed from the contract manufacturer. The case study shows that much movement is possible toward the lean supply chain and partnership-based cooperation. By implementing the lean concept, food companies can increase customer value through cost reduction or through provision of additional value-enhanced services.

K E Y W O R D S

Lean, Lean manufacturing, canned fish, optimization

A R T I C L E I N F O

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1. Introduction

This paper focuses on improved understanding of the development of supply-chain management in a food chain with a special reference to the lean production concept. Womack and Jones (1996) defined a vision of the future organizational model of manufacturing, the lean enterprise, as a group of individuals, functions, and legally separate but operationally synchronized companies. This vision of the modern production paradigm was described by Henry Ford in the early 1900s, and his writings were later the basis for the Japanese production philosophy. The new manufacturing paradigm, the lean management concept that places emphasis on outsourcing, cooperation, networking, and agility (e.g. Womack, Jones, and Roos 1990), was developed in the automobile industry and has been widely adopted in engineering-oriented and assembly industries. So far, little has been written about the applicability of the concept to the food industry.

This paper presents the lean production concept tools that are used to analyze and develop production. The empirical illustration shows how a case company, operating as a contract manufacturer of leading private-label products in the food industry, has applied the lean production concept and tools.

A change occurred in the relationship between manufacturers and distributor organizations in the 1980s and 1990s. Within a number of product markets, both food and non-food, distributors launched their own products that inevitably forced manufacturing companies to compete with the owner of the shelf space, in addition to traditional competition with other manufacturers (Håkansson 2000). Store chains and their brands have increased their market share in Europe and the USA. In Finland, the share for store brands is about 20 percent. In other European countries the shares exceed the share of store brands in Finland—e.g., 41 percent in England and 35 percent in Germany. The manufacturing of store brands—i.e., private-label products—is more commonly assigned to small and medium-sized manufacturers that specialize in particular product lines and concentrate on producing store brands (Private Label Manufacturers Association 2005). These companies are called contract manufacturers or subcontractors. The reasons for outsourcing include lack of inhouse capacity, need for expertise in technology, financing (e.g., cost-cutting), union avoidance, product life-cycle (outsourcing of old designs), and organizational changes in operations (Webster and Beach 1999). According to Dolan and Meredith (2001), there are three reasons why so many manufacturers have outsourced their products:

1) Money is in the brands, not in the machinery—i.e., the intangible assets are more valuable than tangibles;
2) Globalization, which implies that production is easy to transfer to countries with low labor costs; and
3) Only the biggest companies can fully utilize the capacity of their own factories. In other words, contract manufacturers are able to obtain economies of scale in their factories.
The role of the customer company and contract manufacturers varies within the food supply chain. The main responsibilities of a contract manufacturer are product planning, sourcing and allocating materials, preparing and maintaining manufacturing operations, and product manufacturing. The customer company should provide the product label, manage the supply chain, and arrange marketing and after-the-sale service.

2. Lean Production

The Lean Production concept, introduced by Womack, Jones, and Roos (1990) based on a comparative study in the automobile industry from Japanese and other parts of the world, could be seen as a quantification of earlier “world class” and just-in-time (JIT) manufacturing studies (Schonberger 1982; Monden 1983; Shingo 1981, 1985). Womack, Jones, and Roos (1990) described the supply co-ordination system from the Japanese point of view. Lamming (1993) developed the concept of the Lean Supply Model, describing supply-chain management practices within lean production. The origins of lean thinking can be found on the shop-floors of Japanese manufacturers. In particular, the early work of Toyota has been highlighted. Lean production was first defined by Womack, Jones, and Roos (1990) as a system that create outputs using less of every input, similar to the traditional mass-production system but offering an increased choice for the end user. This definition of lean production was based on the concept of waste (“muda”) introduced by the Toyota Production System (Shingo 1981). Waste means non-value-adding activities that, in the eyes of final customer, do not make a product or service more valuable (Hines and Taylor 2000). The main pillars of lean production are management of processes and the integrated logistics flow; management of relationships with employees, teams, and suppliers; and management of the change from traditional mass production (Hines 1994). After 1990, lean production focused away from the shop floor. The value-stream concept evolved and was able to extend beyond manufacturing to the single company stretching from customer needs right back to raw-material sources. Womack and Jones (1996) crystallized Value as the first principle of lean thinking. They define the Lean Enterprise as a “group of individuals, functions and legally separate but operationally synchronized companies. The notion of value stream defines the lean enterprise.” As such, lean had moved away from a merely “shop-floor-focus” on waste and cost reduction to an approach that sought to enhance value (or perceived value) to a customer by adding product or service features while removing wasteful activities (Hines et al. 2002).

The mechanism of a lean enterprise is defined as a conference of all firms along the stream, assisted by technical staff from “lean functions” in the participating firms, to periodically conduct rapid analyses and then take improvement actions. Womack and Jones (1996) also note that someone must be the leader of the lean enterprise and argue that the firm bringing all of the designs and components together into the complete product should be the leader. However, the participants must treat each other as equals and the lean system must be transparent (i.e., participating firms should have the right to examine every activity in every firm relevant to the value stream as a part of the joint search for waste.). Womack and Jones (1994, 1996) also highlight the fact that
a single company will participate in multiple, competing streams with different upstream and downstream partners in order to learn from companies that think in different ways. This is a key to continuous improvement. The purpose of the firm itself as a part of the lean enterprise is to be the link between streams. The links are the means to make maximum use of technologies and capabilities accumulated by the firm’s technical functions. They also provide the means for shifting resources between value streams.

3. Case Company

The case company was founded in the early 2010s, based on production of canned fish. It then shifted its focus into the European market; the case company had been certified HACCP (Hazard analysis, critical control points) IFS Food Version 6 (International featured standard) and BRC Food Version 6 (British retail consortium). Although the employees’ general level of education is not high, the case company still decided to implement some lean projects in order to reduce its operational cost, to improve its financial performance and to better face an increasingly competitive market situation. A Lean committee was established to facilitate the implementation process, including building infrastructure, proposing and selecting projects, tollgate review and decisions related to rewards. As there were many aspects to be improved, the projects were first prioritized systematically and two projects were selected in the first year. Champions, usually the leaders of all the departments and supporting units, were then in charge of monitoring progress and ensuring the success of each selected project. Every year, all the champions had to propose some candidate projects according to their department’s KPI (key performance index) and submit them to the committee to be approved. Several important issues, such as improving customer satisfaction, lowering product defect rates, reducing recruit cycle time and shortening new product development time were discussed in the committee. Every possible alternative was prioritized by using the C&E (cause and effect) matrix. Criteria being considered to select the most critical projects included the effects on KPI, impact on customers, data accessibility, project hard savings and the time needed to reach the improvement goal. Among all these candidate projects, lowering product defect rates was considered the most critical, as it is highly correlated to KPI and customer impact.
4. Methodology

First, a lean team was formed with the people from different departments in the company, who were knowledgeable and experienced about the products, processes, equipment, and planning. Lean team leader collected the production data and generated the process map by studying each stage of the manufacturing processes with the help from the team members. Strategic areas for implementing lean tools were identified based on the data and observation. Among many issues related to
manufacturing, high waste in raw materials and motion, high consumption of water, electricity and liquid nitrogen, lack of 5S and Total Productive Maintenance (TPM) in practice, high machine downtime during changeover and lack of communications between departments were considered for investigation. Five Key Performance Indicators (KPIs) were identified: Safety, Quality, Volume and delivery, Cost, People and Morale, and Environment. The lean projects strongly relevant to the KPI of the company were carefully and systematically selected and implemented in order to achieve immediate tangible benefits with minimum investment. A data collection procedure and structured problem solving technique were established. Boards were displayed in the shop floor to communicate action lists and control charts. The progress of lean implementation was regularly reviewed in senior management meetings as well.

5. Results of Lean Implementation

Although a number of lean techniques were applied in the production, packaging and warehouse areas, in this paper the results were presented based on mainly four lean principles: Waste reduction, 5S, Single Minute Exchange of Dies (SMED), and Overall Equipment Effectiveness (OEE).

5.1 Waste Reduction

Data collection on food waste over a six-month period indicated that Interim storage of cooked fish dewatering over 2 hours, No qualification of the workforce, Incorrect exploitation of equipment, Lack of manpower, Insufficient space to work the cooked fish, Poor filling before cooking grids Lack of supervision, Fish small mold causing duplication of work, and insufficient Storage capacity of refrigeration room represent the high waste areas (Fig. 2). Waste was generated in the cooling process more frequently than the other areas in production. With the application of good practices, the daily due to No qualification of the workforce, incorrect exploitation of equipment and Lack of manpower were drastically reduced.

Table 1: Data collected to make the pareto chart

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Relative frequency</th>
<th>Cumulative frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interim storage of cooked fish dewatering over 2 hours</td>
<td>36</td>
<td>35.78</td>
<td>35.78</td>
</tr>
<tr>
<td>No qualification of the workforce</td>
<td>24</td>
<td>23.85</td>
<td>59.64</td>
</tr>
<tr>
<td>Incorrect exploitation of equipment</td>
<td>12</td>
<td>11.93</td>
<td>71.56</td>
</tr>
<tr>
<td>Lack of manpower</td>
<td>9.5</td>
<td>9.44</td>
<td>81.01</td>
</tr>
<tr>
<td>Insufficient space to work the cooked fish</td>
<td>7.9</td>
<td>7.85</td>
<td>88.86</td>
</tr>
<tr>
<td>Poor filling before cooking grids</td>
<td>7.8</td>
<td>7.75</td>
<td>96.61</td>
</tr>
<tr>
<td>Lack of supervision</td>
<td>2.4</td>
<td>2.39</td>
<td>99</td>
</tr>
<tr>
<td>Fish small mold causing duplication of work</td>
<td>1</td>
<td>0.99</td>
<td>99.99</td>
</tr>
<tr>
<td>insufficient Storage capacity of refrigeration room</td>
<td>0.01</td>
<td>0.01</td>
<td>100</td>
</tr>
</tbody>
</table>
5.2 5S

The housekeeping tool 5S has been implemented in the daily routines across the entire site from production to office space to improve the organization of production. 5S areas of responsibilities were distributed among the employees to own the process. Single point lessons were learnt from each activity and 5S audits were carried out regularly to generate 5S score point. New 5S audit boards for production, packing, warehouse, and office were put in the shop floor to communicate the activities and scores. Although, the initial score was low (between 30 and 40), gradually the score was improved as shown in the data collected for six months. Dramatic improvements were achieved in housekeeping and cleanliness, which was absolutely essential in food manufacturing. Furthermore, 5S activities generated standard operating procedure, reduced the time searching for tools, improved 5S awareness, and increased employee motivation through ownership.

5.3 Single Minute Exchange of Die

African food manufacturing industries are characterized by wide range of product mix, frequent changeover in the production line and shorter production runs. In some food processing operations such as in this case company, one product does not run through a particular production line everyday rather multiple products are manufactured even in a single day. This shorter production run means frequent changeover, which leads to increased machine down-time and labor hours. Single Minute Exchange of Die (SMED) is a lean tool, which can dramatically reduce the changeover or set-up time. Set-up time is defined as the time between the last good piece off the current run and the first good piece off the next run. Several SMED activities were carried out at the packing and forming areas. Using Video analysis and reviewing the process, the changeover time in
the forming machine was significantly reduced. By working as a team in a Formula 1 pit stop style, the operations of cleaning with hot water, standardizing equipment position in the line and standardizing changeover procedure reduced the changeover time resulting in better production capability, flexibility, and production efficiency.

6. Discussions

In this study, the lean tools have not only been implemented but also the tangible benefits to the company have been measured in each case. Although a significant waste of expensive raw materials was eliminated in the mixing area, it was difficult to estimate in terms cost saving. However, the activity surely contributed to the improvement in process yield. The elimination of waste not only helped the company financially, but also brought considerable environmental benefit, reducing the company’s carbon footprint. Whist the exact changes in environmental impact are yet to be fully determined, it is clear that these changes are very much in the spirit of the company’s long-term mission. It should be emphasized here that financial benefits were achieved with a minimum amount of investment, which could be paid back in a short time in most cases within a year. It has been demonstrated earlier that simple changes to the machines (cutting and seaming) saved a lot of waste in oil and fish. Therefore, working closely with the equipment manufacturers could be a way forward in order to improve the machine design for reducing waste, easy maintenance and quick changeover. Although the general shop floor workers were not familiar with the concept of lean manufacturing, they quickly learned it through a structured training program and hands on practical work in the team. This created a learning environment through team working and a continuous improvement culture in the company by involving everybody from operator to senior management. This also generated friendly competition between shifts resulting in improved production efficiency. Finally, the establishment of continuous improvement team in the company ensured that a long-term improvement plan was in place for sustaining the lean program and the quest for continuous improvement was carried on.

The biggest challenges in implementing the lean were the resistance to change from the operators and personnel changes in production management. The implementation of lean manufacturing does not happen overnight; it needs time, stamina, better communication and support from the top management to make the changes a reality. As the competition is rising continuously, it is absolutely vital to accomplish and sustain the incremental changes towards achieving the long term stability and competitiveness in the business.

7. Conclusions

This case study clearly demonstrates that it is feasible to apply lean principles in a fish canning company. The systematic application of lean tools has started with the waste elimination in different process steps of the manufacturing cycle across different product
range. Waste reduction in Interim storage of cooked fish dewatering over 2 hours, No qualification of the workforce, incorrect exploitation of equipment, Lack of manpower Insufficient space to work the cooked fish, Poor filling before cooking grids, Lack of supervision and Fish small mold causing duplication of work has resulted significant cost savings for the company and created more value for the customers. The introduction of 5S across the whole factory including office areas has led to a more organized, clean and safer production area and also increased efficiency due to motivated operators and shorter time for searching tools. The SMED activities have increased the opportunities for set-up time reduction leading to quick changeover and shorter lead times. In summary, the lean activities can facilitate the food company to be competitive in the market by reducing cost, improving productivity, teamwork, and consistency of product quality.

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References


• Zu X, Fredendall LD, Douglas TJ (2008). The evolving theory of quality management:

• Anon (2013) Food processing and manufacturing efficiency-competition for collaborative R&D Funding, 2012

• Schmidt CJ (2013) Getting the fat out of food manufacturing-a practical approach to lean manufacturing in the food industry, 2010 EnteGreat, Inc.

• Beal D (2009) The ABCs of good food manufacturing. Food Safety Magazine, August/September
• Anon (2010) Value of food and drink manufacturing to the UK. Institute for Manufacturing, University of Cambridge, UK