Study of the Application of Lean Manufacturing Techniques in Medellin Baking Industry

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Abstract
The bakery industry in Medellin has an important economic and social significance , most of the companies are small, with high levels of informality, low added value and low productivity, this work is looking for evaluate the level of implementation of Lean Manufacturing techniques in this kind of industries.

Keywords. Baking Industry, lean manufacturing, Improvement

Introduction

The food and beverage industry represents more than 20% of the total domestic industry. It is composed of sectors such as meat and fish, oils and fats, dairy, bakery and milling industry, coffee products, sugar, cocoa and its products, and alcoholic and non-alcoholic beverages. In Antioquia, the sectors that have contributed the most to growth in 2010 and 2011 were automotive industry, food and chemical substances.

This research focuses on the micro and small enterprises (MSEs) of food industry in Medellin. Especially in the production of bakery products, due to the high participation of this sector in the city economy.According to statistics from Medellin Chamber of Commerce to December 2013, from the registered companies, 96.84% correspond to MSEs, 92458 of the 92475 companies in the city.

The research objective is evaluating the status of the actions implementation of continuous improvement, associated to Lean tools and techniques: Poka Yoke, SMED, Maintenance, 5S, Kaizen, just in time, Visual factory and Six Sigma, in the food industry, in Medellin micro and small enterprises; through diagnosis and monitoring instruments that will enable organizations to have a guide to improve their current productivity conditions.

Project Development

Micro, small and medium-sized enterprises (MSME), are a fundamental component for the business network in Latin America. Its importance appears in various forms in each country and region, such as participation in the total number of enterprises or in job creations, and even in the participation in the product. In Colombia, MSMEs correspond to 98.7% of the total number of registered companies.

The contribution of these Latin American organizations and European countries is observed: Latin American ones contribute approximately 30% of the gross domestic product (GDP), while in the European ones approximately 60% of the production is generated by MSMEs. The high contribution to the employment combined with the low contribution to the production that characterizes the MSMEs in Latin America is reflection of the heterogeneous productive structure, specialization in products with low added value and their reduced participation in exports, less than 5% in most countries. The result is that the gap of productivity between the European and Latin American countries tends to persist in time.

Taking as a referent a research conducted at national level, Arrieta, Muñoz, Salcedo & Sossa (2011), it was identified that the sectors with a greater implementation of the Lean Manufacturing tools in recent years were: others with 21%, automotive and metalworking with 20% and food with 16%. Additionally, the sectors that less implemented these tools were: textile with 9% and glass and ceramics industries with 7%.

Lean Manufacturing or also known as LEAN has become one of the most popular paradigms of elimination of waste in the industrial sector and services, with great benefits in their practice, in the improvement of the quality and organizational productivity. Lean Manufacturing is based on the reduction of waste and in the quality of the products through the commitment of each of the members of the organization, as well as a strong focus on participation in the tasks. With these principles, the performance translates into higher productivity, less invested time, higher quality, customer satisfaction, increase in sales and, consequently, profits.

According to statistics from the Medellin Chamber of Commerce, the sector is composed by 1636 micro and small enterprises, of which 49% correspond to bakery product manufacturing.

Methodology

To reach the specific objectives and the research questions proposed in the project, to be carried out in the Food sector, the following methodology was developed:
1. Evaluate the Lean Manufacturing tools that currently are used by MSMEs in the bakery product sector.

To develop this objective, a questionnaire was applied to bosses or persons in charge of directing the production in each bakery. The questionnaire has 55 questions; the variables or testing criteria are:

Poka Yoke: Flawless quality, TPM: Total Productive Maintenance, Kaizen: Continuous improvement, Visual Factory, SMED: Enrollment of reference, VSM: Generation of value, 5S: Workplace organization, SPC: Statistical Process Control, JIT: Production workflow and MGT: Management.

The sample was calculated based on the size of the finite population, provided by Medellin Chamber of Commerce= 797, p= 0.5, assuming that 50% of the organizations use Lean tools and techniques q= 0.5, assuming that 50% of the organizations DO NOT use Lean tools and techniques z= 95% true value and e = 10% margin of error, gave as n= sample size= 86 Micro and small enterprises (MSEs).

This instrument was validated in 5 bakeries in order to make the relevant settings to the questions and answers, so that facilitate their subsequent application.

2. Characterize the Food sector in the terms of good practices that are applied, related to Lean techniques and tools, object of study.

The questionnaire was applied in the sample, enquiring each item of analysis; subsequently, it was tabulated and the information was analyzed, establishing a classification, by Qualification or development of Lean practices (with a rating scale of 1 to 5) and Factor of Positioning of the organization (with a weight of - 100 to + 100%).
This classification allowed segmenting the organizations, in 4 quadrants or sectors: I: Productive Organizations, II: Basic, III: Vulnerable, including the Backward ones, IV: Promising Organizations. This organization or distribution is based on the study conducted by Seibel, (2004) and Arrieta (2011). Each quadrant is defined:

Quadrant I - Productive: the company located in this sector, is the one that has in the development of Lean practices, as in the Factor of Positioning or performance, a note of 3.0 and percentages higher than 60% (minimum expected). The company that belong to the area of World Class is the one that in its Factor of Positioning and Qualification or development of Lean practices, has percentages higher than 80%.This means that it has an operational excellence and has very favorable conditions to compete in international markets.

Quadrant II - Basic: are the companies that have Factor of Positioning between 60% and 100%, and development of Lean practices between 1.0 and 3.0.In these cases, the issue that must be taken into account is the little fortress in the implementation of process improvement techniques.

Quadrant III - Vulnerable: are the companies that have up to 60% or 3.0, in performance or positioning and development of Lean practices. These types of companies have implemented some improvement techniques. Within this sector, the critical ones or the area of Backward ones

are included, they are between -80% and 0%. They require the greatest investment to change and improve all their processes.

Quadrant IV - Promising: are the companies that present a Development of Lean practices higher than 3.0 and a Factor of Positioning below the expected minimum, 60%.These figures indicate that the company is working and implementing improvement techniques. In this case the performance results are not yet the most satisfactory, or they have not been started to evaluate deeply yet.

To complement the information collected with the previous instrument, a survey was carried out to the organization's people in charge or managers, with the following items of analysis: Type of company, Number of employees, Employees' education level, Education level of people in charge of the bakery, Type of distribution, Certified in high quality, and Weekly sales.

3. Establish recommendations for the Lean Manufacturing implementation in the sector Based on the information collected above, the most critical testing variables of each sector were selected and actions to improve their production and administrative processes were proposed, in order to move to better sectors and thus increase the business and the sector productivity and competitiveness.

Results

Lean Manufacturing tools that are currently used by MSEs in the bakery product sector:
The average of companies are in a Qualification or Development of the Lean practices, in 2.98 close to the expected minimum value of 3.0; becoming a Factor of Positioning of 21.8%, well below the 60% (expected minimum value). This means that there is some progress in the implementation or development of Lean practices, although it is not enough to generate value to the sector.

Once the quadrants by Factor of Positioning and development of Lean practices were established, the results of each of the 86 studied bakeries were located, allowing knowing how many and which were in each quadrant:

Quadrant I - Productive: 13 of 86 companies, corresponding to 15.12% of the total. None of the organizations was located in the World Class area. This is the Sector in which the fewest number of companies were located.

Quadrant II: not applicable, due to the average qualification of 3.0 that the organizations had.

Quadrant III - Vulnerable: 44 of 86 companies (51.16% of the total). Most of the companies were located in this sector, with 21 of them (47.73%), in the area of the Critical or

Backward ones, because of their rating lower than 2.5 or 50% of Positioning, as a cause of their zero or minimal application of Lean practices.

Quadrant IV - Promising: 19 of 86 companies, which belong to the 33.72% of the studied total. It is the second sector with the largest number of located organizations.

The previous data are the result of the particular behavior in the bakeries in the implementation or development of each of the Lean practices or analyzed factors. Being VSM practices (this due to the lack of knowledge of the concept and therefore the importance of it inside the organization), JIT (there is not an U plant distribution and equipment that facilitate the production in small batches, devices between workstations to control transport and production, balancing lines for the order assignment, deliveries in small quantities several times a day by both external and internal suppliers) and Management (lack of training of employees, knowledge of the production capacity, organizational structure, participation of employees in the business decision making), in that order, are the critical points.

Figure 1 shows the companies combination in every quadrant, according to the Development of the practices Lean and Positioning Factor (FP)
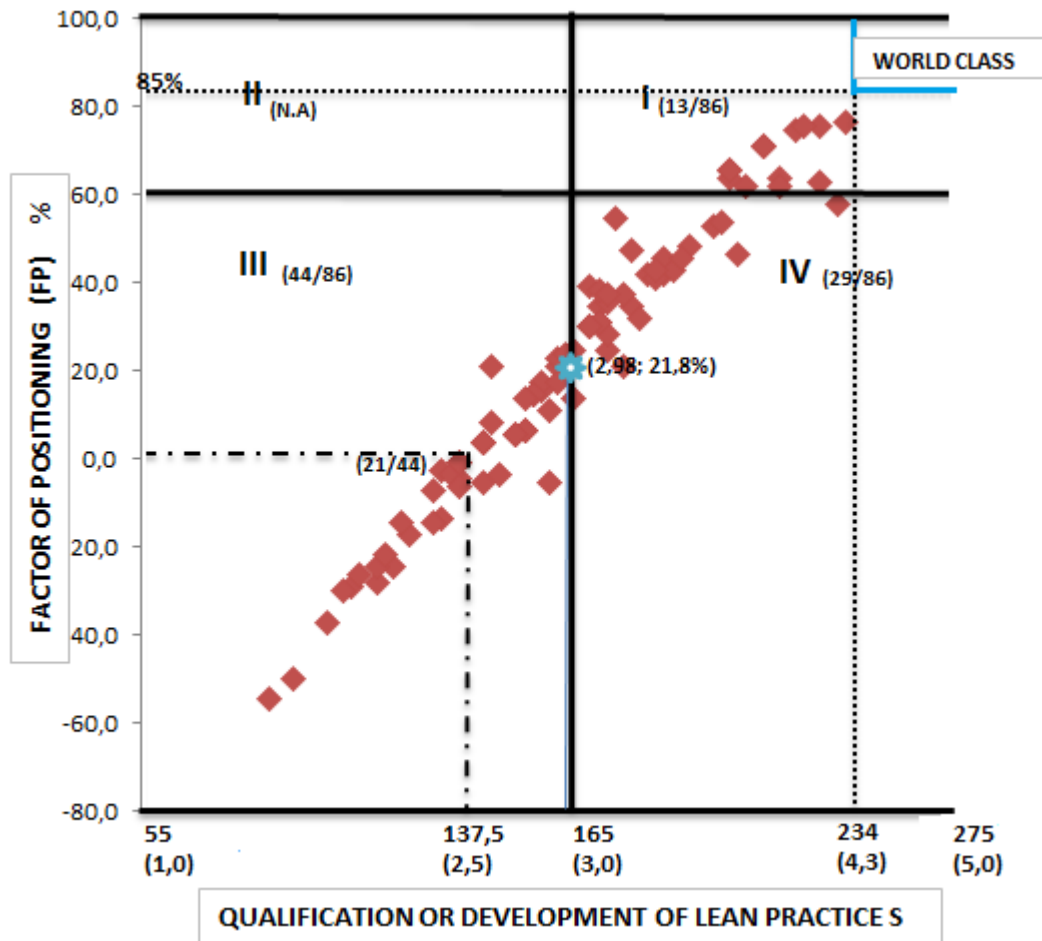
Figure 1. Classification of baking industry for quadrants and average general note

This factor allows knowing, the degree of implementation of tools and skills Lean. It is calculated by base in the note or qualification: 1,3 or 5, from the response to every question of the questionnaire. This factor grants a qualification of-100 % up to 100 %. A negative result, it means that the organization has big deficiencies in the implementation. A positive result shows the advance that the organization has realized. To major it is the average note of the qualification of the indicators, major and positive, is the result of the FP.

The positioning factor (FP) is calculated by the following formula, determined by Marin (2000):

$$FP= \frac{1*(No.Indicators=5) + 0,5*(No.Indicators=3) -1*(No.Indicators=1)}{(Total\ No.\ Indicators)}$$

- Characterize the food sector in the terms of good practices that are applied, related to the Lean techniques and tools, object of study:
  The data from the questionnaire and the survey tabulation were considered.

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It is taken as a reference, the characteristics of the organizations that make up the Quadrant I, known as Productive, corresponding to 15.12% of the applied sample (13 of 86 organizations), they are characterized by having high level in the implementation of the Lean techniques or tools.

The outstanding Lean techniques or practices are: Poka Yoke, Kaizen, Visual Factory and the most relevant characteristics or features are:

- The company knows the defects and faults in the processes.
- The number of suggestions that are received annually per worker is known. A system of motivation and compensation to the most profitable suggestions is implemented.
- There are visual indicators available to all employees and show the organization performance and actions are taken based on these.

Other features that will facilitate their understanding and the establishment of improvements for the other quadrants that are in the process of increasing their productivity and getting to become World Class are:

- 75% of the managers have university studies, allowing the Management to have a bigger and better view of the organization and its environment, as well as knowledge of new management models. Regarding the staff education, 43% has high school or technical – technological studies, which facilitates the assimilation of changes, gestation of new ideas and achievement-oriented attitude.
- Most of the organizations (69%) have regional distribution to supermarkets and some chain stores. This is a response to the organizational vision, the environment knowledge and the management performed by the directives.
- The technology, associated with the production process, has an antiquity between 2 and 8 years in 23% of the bakeries. Having these updated equipment and machines, dynamizes the production process.

Conclusions

Lean Manufacturing it is the philosophy of zero waste or "Muda", which is key for the increase of the productivity organizacional. This research shows that in average, the sector is below the awaited minimum; this means that there is some progress in the implementation or development of Lean practices, although it is not enough to generate value to the sector.

The skills or practices Lean implemented and in that degree, for the organizations of the sector of products of bakery, being outlined positively Poka Yoke and 5S, which must continue being strengthened to assure major impact in the organizations and to manage to be catalogued as World Class. Some critical practices are: VSM, JIT and Management.

After identifying the general situation of the sector, it was proceeded to investigate in detail of every quadrant, in order to know it better. There were identified the causative aspects of

this result, to propose actions of improvement; the characteristics of the organizations of the Quadrant I, for productive behavior, it was the base of study; with implementation of techniques or practices: Poka Yoke, Kaizen, Visual factory. Some characteristics of these organizations are: The Company knows the faults of the processes, has system of suggestions, visual indicators that show the performance of the organization and the employees are qualified in tools Lean.

The recommendations appeared in order to change the conditions of the organizations of a condition or quadrant to other one, as a process of constant improvement. The Lean practices were selected for the general improvement, of the sector: VSM (Generation of Value), JIT (Flow of Production) and ADMIN (Administration). In agreement to this, they propose specific plans of implementation. It is important to highlight the need to integrate: Culture - Structure and Action of improvement.

Some of the improvement actions or recommendations for each of these companies to enhance the implementation of Lean Manufacturing are: Standardize and document processes, use devices (kanban cards), manage production (plan, schedule, execute and control), train the employee to work under the premise of search and eliminate the 7 wastes and to work at any of the stations or operations in the plant.

Recommendations

From these research findings, more detailed works of each of the quadrants or sectors found in this study can be established and directed. Especially Quadrant I, Productive, so that evaluates specifically each of the characteristics of productive and administrative processes that enable organizations to be a part of this sector, involving other testing variables such as information and communication systems as a support to the decision making to be more effective and real.

Also, studies about implementation of the improvement plan suggested according to the PMI guidelines can be carried out, allowing monitoring the progress in the productive and administrative improvement processes, contemplating a measurement system and Lean indicators.

Another way of taking advantage of this research is to do an evaluation of the relation that exists between the competitive priorities defined by the organization and the development of the Lean practices, so that it is established if the development of these, contribute to the achievement of the organization strategic objectives and consequently, its vision, increasing the sector competitiveness.

Finally, it is suggested to apply this methodology in administrative processes, Office Lean, that support the productive processes and thus to show the integrality of the organizational system.

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