Identification of the Waste Affecting
the Productivity of the Companies of
the Metalworking Sector of
the Department of Atlántico, Colombia

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Abstract
This paper presents the results of a research project that consisted of an analysis of the productive systems of companies in the metalworking sector of the Department of Atlántico to identify the wastes that are present in them and that prevent them from being more productive. The waste was classified based on those proposed by the Japanese in what is now known as Lean Manufacturing.

Keywords: Metalworking Sector, Productivity, Waste, Lean Manufacturing
1 Introduction

According to information published by ProBarranquilla\(^1\), the Metalworking sector is the second largest exporter in the department of Atlántico, after the chemical products sector, with the port of Barranquilla, the number one port for steel handling and the largest multipurpose port in the Colombian Caribbean region, where 60\% of the metal used in Barranquilla and 40\% of the steel used in the country is located. He also assures that companies such as ThyssenKrupp, Ternium, CSP Steel, Triple S, among others, are just a few examples of foreign companies based in the Atlantic for the development of their business activities; data backed by the investment captured in the department since 2008, around $283 million dollars and the generation of 980 direct jobs. He also notes that the metalworking industry represents one of the main sectors of Barranquilla and the Atlantic, represented by the presence of more than 400 companies in the industry, including manufacturers and distributors. In addition, it says that the Atlantic currently has a per capita steel consumption of 125 kg, which is almost double the national consumption per capita (68 kg). This translates into a high volume of demand as predicted for 2020 where it will be 5 million tons for the construction of 4G tracks and furniture projects. Finally, it emphasizes that the sector is one of the largest generators of employment, with a large amount of human resources trained thanks to the different professional and technical education entities.

The importance of this sector for the economy of the Department of Atlántico, inspired this research work, with the aim of contributing to the improvement of the productivity of the companies belonging to this sector. For them it was decided to use the philosophy of continuous improvement called Lean Manufacturing because it offers a series of practical and efficient tools to achieve this goal.

2. Theoretical Framework and State of the Art\(^2\)

The term "Lean" was coined by a study group from the Massachusetts Institute of Technology to analyze the manufacturing methods of automotive companies worldwide. The group highlighted the manufacturing advantages of the best-in-class manufacturer (the Japanese automotive company Toyota) and called the group of methods it had used since the 1960s'Lean Manufacturing', which was

\(^1\) http://www.probarranquilla.org/index.php?lang=es&opc=5

\(^2\) Taken from "Application Of Lean Manufacturing Tools For The Improvement Of The Value Chain Of An Office Chair Production Line" Magazine Dimensión Empresarial. - Vol. 11 No. 1, January - June 2013, pp. 127-130
subsequently refined in the 1970s with the participation of Taiichi Onho and Shigeo Shingo, in order to minimize the use of resources throughout the company to achieve customer satisfaction, reflected in timely deliveries of the variety of products requested and with a tendency to zero defects. This study shows that Lean Manufacturing uses less of everything in the plant, less human effort, less investment in materials and tooling inventories, less space and less engineering hours to develop a new product [1]. In Lean Manufacturing, the compromise between productivity, investment, quality and product mix or variety has been eliminated. As examples, during the 1980s Sony in Japan introduced more than 200 walk-man models and the Japanese company Seiko introduced one watch per working day [2]. In Mexico, progress has been made in Lean Manufacturing. In[3], the Lean Manufacturing and Six Sigma methodologies are explained, and experiences are shared in some manufacturing companies and the results of the IV Annual Census of Manufacturing in the NAFTA countries and Australia developed by the North American magazine Industry Week, where lean manufacturing practices were observed in a sample of 108 respondents with 17 cell manufacturing, 14 with rapid changes and Kanban; and 21 with continuous flow production[4]. It should be noted that within the concept of Lean Manufacturing several tools have been created such as 5s, SMED, Kanban, Kaizen etc., and each of them has its own way of being applied. At[5] it is ensured that the diverse methods of Lean Manufacturing require the leadership and commitment of senior management in companies and much emphasis on the development of teamwork, including personal development. This methodology can be applied to micro and small enterprises, with changes in culture and management styles. Therefore, the main benefit of using Lean Manufacturing methods is the "thinning" of the company, making it much more flexible and operating with minimal resources for manufacturing, achieving competitive advantages in speed of response, reduced costs, which satisfies the customer and can reduce the stress on managers and employees.

In Colombia, studies have also been carried out on Lean Manufacturing and one of them was carried out by the American Mattress Company, which consists of the design of a model for the application of lean manufacturing tools from the development and improvement of quality in the production system, in which the following results were obtained[6]:

- The people of the organization should recognize the implementation of manufacturing tools as a process of continuous improvement, so there should be a person in charge at each stage and control mechanisms.
All the assessments and calculations carried out in the project must be reviewed periodically and adjusted in accordance with the changes and modifications that occur in reality, so that the model can be developed in different real scenarios.

Other advances in this area can be found in [7], in which conclusions such as the following can be found:

- The lean production system is strongly associated with common sense and therefore its implementation requires adequate preparation in the organizational culture, where all, managers and employees are committed to changing their traditional ways of thinking and working.

- The focus of the system is the elimination of all kinds of waste (or molt).

- In order to implement this system in Colombian companies, the commitment of senior management is crucial. With a good dose of common sense and sufficient economic resources to invest in technology and training, this type of project can be supported.

Also, in [8] the following is concluded:

- Slim control policies are useful tools for productive system performance. The major advantages of implementing the pull system include reduced cycle time, and economic flexibility.

- While kanban systems maintain rigid control of WIP through the use of individual cards at each workstation, CONWIP systems are easier to run and adjust.

Toyota, with the support of Taichi Ohno and Shingo Shingeo, introduced a system to reduce or eliminate waste or activities that do not add value to the process [9]. They claim that lean manufacturing has been described as a philosophy that seeks to eliminate "waste or muda" by aligning processes in a continuous flow, and using resources to solve problems in a continuous process. So "mote" means "loss or waste", specifically any human activity that absorbs resources but does not create value, within this framework the value corresponds to what the customer defines as such. Thus waste, in this context, is any misuse of the resources and/or possibilities of the companies. So many hours of work are wasted due to inefficient scheduling and planning of tasks, as well as wasted possibilities of winning new markets due to lack of quality products or excessive costs [10].
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Seedlings are classified into the following categories: overproduction, inventory, defects, unnecessary movements, over-processing, waiting and transport[11]. Finally, in their article, Cabarcas and Wilches[12] note that the implementation of manufacturing problem-solving alternatives based on the Lean philosophy is relatively simple and generally technically and economically feasible. This further motivated the realization of the work that resulted in the present article.

3. Results and Conclusions

The present work has used as main input the observations made in various companies of the metallurgical sector of the Department of Atlántico. Although they are companies with great differences in their products and processes, even in their size and organization, many similarities can be found in terms of the waste that occurs in their manufacturing processes. For example, large companies that continuously produce their products using large, sophisticated equipment usually have problems with long set-up times (many hours, even days), which forces them to fall into overproduction, generating excess final product that must be transported and stored. These products being heavy and large, they require large storage spaces and specialized equipment to be transported. In addition to overproduction, there are also transport changes and, in most cases, delays or downtime, as material handling equipment is scarce, moving slowly and sometimes having to wait until they are free to continue with the process. This waste usually occurs because the equipment preparation process is not properly organized and because the tools and elements necessary to perform the procedure are not organized. This causes many activities that may be external to be performed internally (i.e., with the machine stopped) delaying changes. This requires overproduction to increase the efficiency of the machines and to reduce unit costs. To reduce this problem, we find that slender manufacturing tools such as 5’s and SMED are easy, economical and practical to implement, but they generate very good positive results, reducing set-up times by up to 40%, increasing equipment availability, making processes more flexible and improving the productivity of production lines.

With these improvements, production lots can be reduced, reducing transportation and storage needs, which also contributes to increased availability of material handling equipment and space utilization. In addition, it was found that the activities where the human resource is involved are not completely standardized, but that the experience and expertise of the operator is left to comply with the quality
characteristics of the products or at least the operation they perform. This usually leads to the generation of defects, some of which can be reprocessed and some of which cannot. Reprocessing increases operational costs, decreases operator productivity, reduces the availability and productivity of the equipment involved and delays the flow of materials into the production system. And defects that cannot be reprocessed generate waste of raw material, which in this type of company is expensive due to the materials used (metals). To reduce this type of mudas or waste, the use of Pokayokes is recommended, so that the quality of the product or the operation does not depend on the expertise of the operator. This also helps to reduce activities such as measurements that do not add value to the product. In addition, it is suggested to standardize procedures, but not without first reviewing them and applying the basic principles of movement economics to make them more efficient.

Another aspect found in the workers' workplaces is the lack of organization of their elements or work tools. This forces them to make unnecessary movements that tire them out, expose them to health problems and reduce their productivity. In addition to making it difficult to control the inventory of these tools that are part of the companies' investments. Likewise, it was observed that many times workers do not have a specific place for temporary storage of the products in process that they handle, forcing them to leave them anywhere in the work or transit area of other workers, making them make unnecessary movements when they walk, traveling longer distances, increasing their walking time (which does not add value), fatiguing them more and reducing their productivity, and exposing them to physical risks. To reduce this type of situation, it is recommended that the tool 5's be implemented in all areas of work.

Finally, many occupational health and safety situations were observed that can affect the flow of materials in a manufacturing process. In companies in the metal-mechanical sector, due to the materials used and the size of the products, there are always physical risks for operators such as tripping and falling, blows, etc. However, poor electrical installations and misplaced cables can also lead to electrical accidents that endanger the integrity of workers. This is not part of the present investigation, but the presence of accidents or illnesses among workers reduces the production capacity of the productive system and can increase costs, which affects the productivity of companies.
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References


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