

# **Model of Integration of Lean Tools and Knowledge Management to improve the production process in a Metal-mechanic company**

**Gianella Damacén**

Department of Business Management Engineering  
Universidad Peruana de Ciencias Aplicadas  
Lima, Perú  
[giane.damacen@gmail.com](mailto:giane.damacen@gmail.com)

## **Abstract**

In the new context of globalization, large manufacturing companies are forced to improve their production processes, so they need to design and apply methodologies that align with this trend. However, these practices are not applied in SMEs with similar problems, which mainly influence the timely delivery of their products and especially in the metal mechanic sector.

Therefore, this article proposes the design of an integration model of Lean Tools and Knowledge Management, whose methodology is composed of 4 phases; in phase 0, the awareness and analysis of the current situation is carried out, in the first phase knowledge management is applied (design, development, implementation and sustainability), in phase 2, the Lean tools are implemented, initiating the application of the 5's, followed by standardized work and then by Total Productive Maintenance; finally in phase 3, the analysis and control of the results obtained. The model was validated in a metal-mechanic SME in Peru where an increase in production of 20% was obtained, an improvement of 30% in the training and training of the person and a 14% improvement in the overall efficiency of the team.

## **Keywords**

Small and medium enterprises, knowledge management, lean manufacturing, metal-mechanic.

## **1. Introduction**

The large companies in the manufacturing sector have continuous problems in their production process, due to this, they believe in the need to be sustainable and sensitive to the demands of the market. These manufacturing companies make such improvements in order to create more value for customers, increase their performance and lower their costs.

Small and medium-sized companies are not unaware of these problems; however, very few of them implement improvement tools or methodologies, although they are prominent among all organizations, since they play an important role in the manufacture of products and services acquired by society and large companies [1].

That is why SMEs are considered as the basis of economic growth in a country. In Peru, these companies represent more than 90% of the total [2]; however, they have a higher rate of problems in their production processes compared to large companies.

Despite the flexibility of SMEs, in the case of companies in the metal-mechanic sector, these problems are manifested as follows: disorderly environment, low quality, defective parts, reprocessing and stock breakage that generate low productivity [3]. Likewise, the lack of knowledge in the collaborators both in the production processes and in the application of improvement methodologies also cause the aforementioned problems.

For this reason, SMEs currently show great interest in issues of Continuous Improvement and the creation of Knowledge. A series of studies indicate that a modern methodology for the improvement of the aforementioned problems is the Lean Manufacturing, these studies indicate that their implementation

improves the productivity and performance of the company [1]. However, after the research carried out, it is reported that there are not many studies that apply an improvement focused on a metal-mechanic SME that solves all the problems as a whole. This article proposes a model of integration of Lean Tools and Knowledge Management, in order to solve problems in production processes.

The proposed model is composed of 4 phases: in phase 0, the awareness and analysis of the current situation is carried out; in phase 1, knowledge management is applied, which will serve as a basis for the application of the model, in the Phase 2 Lean tools are implemented, starting with the application of the 5's, followed by standardized work then by Total Productive Maintenance, finally in phase 3 the analysis and control of the results obtained is carried out.

. This model was validated in an SME in the metalworking sector of Peru, obtaining as a result an increase in production of 20%, improvement of 30% in training and personnel training and a 14% improvement in the overall efficiency of the equipment.

## 2. State of Art

In this section we present findings from the literature of authors who, having similar problems to the present article, used different models that helped them to solve it. (View table 1).

Table 1: Analysis of models

<b>AUTOR</b>	<b>APORTE</b>
Dombrowski , Mielke & Enge (2012) [4]	Study on the integration of knowledge management in the implementation of Lean tools, description of knowledge flows to determine the most appropriate method.
Bartz, Mairesse & Barth Bartz (2013) [5]	It is a model for the application of total productive maintenance (TPM), in which the steps are presented and a list of activities that must be carried out in order to obtain positive results, as well as the case under study.
Matt & Rauch (2013) [6]	A preliminary study was made of the existing Lean methods for application to an SME. This research was complemented with a case study to an industrial SME, after the implementation the company had a productivity improvement of 18% on average.
Hernandez, Camargo & Martinez (2014) [1]	It is a model of the 5'S methodology applied to a manufacturing SME, additionally they made measurements to measure the performance of the implementation. The results indicate that this tool increases productivity and quality.
Osterman & Fundin (2014) [7]	Theoretical model that demonstrates the relationship of standardized work and problem solving, also demonstrates the key factors for its implementation.
Marulanda, M. Lopez & F. Lopez (2016) [8]	Knowledge management evaluation model focused on SMEs, in which it is determined that culture positively influences competences for the development of knowledge management.
Morales & Silva (2017) [9]	Total Productive Maintenance Model (TPM), which begins with the theoretical preparation for the workers, followed by the application of the 5s as the basis of the model, then the development of the selected pillars.
Cerchione & Esposito (2017) [10]	Empirical study about the knowledge management tools that are used by PYMES, where e obtained as a result that traditional techniques are more adaptable and generate greater benefits to this type of companies.

[4], [7], [8], [9] and [10], are based on a theoretical framework, but are not applied to a case study. However, the rest of the models were validated in companies and their effectiveness was confirmed. On the other hand, in [5] and [6] the Total Productive Maintenance (TPM) is explained as a tool that reduces costs in machines that were not planned and improves their performance and performance. In the same way, in [1] the 5's are explained as the basis for the implementation of any other Lean tool, it also states that it helps to standardize the processes, keep the area clean and tidy, and increases the productivity of the company. In [4] and [10] they explain the importance of integrating knowledge management with the Lean Tools and their great impact and importance in organizations. In addition, this tool helps to develop in a better way the capacities of workers for their performance in the company.

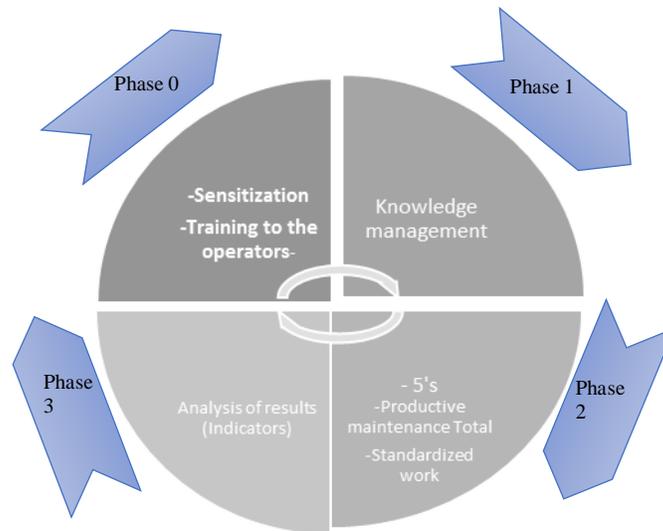
### **3. Contribution**

This section of the article will describe the proposed model, the components and a brief implementation guide.

#### **3.1. Idea of the Contribution**

The proposed model aims to improve the production process based on the application of Lean tools with the integration of Knowledge Management. (View figure No. 1).

Figure 1: Proposed model



#### **3.2. Description**

The model is made up of 4 phases, where knowledge management will be the basis of the entire implementation. In phase 0, the management will be sensitized and the general topics of the tools will be trained, in phase 1 the 5'S will be applied, then in phase 2 the standardized work and Total Productive Maintenance will be implemented, and finally, in phase 3, the results will be analyzed using indicators.

#### **3.3. Support**

Globalization leads companies to constantly modify their practices and ways to make any improvement. Because the human factor represents the engine of innovation in companies and a motivated staff generates an exceptional work environment and an improvement in their productivity. Therefore, the novelty of the proposed model has as an innovative contribution to knowledge management.

### **3.4. Components of the Model**

#### **3.4.1. Sensitization and training:**

In this stage, the management will be sensitized so that they can commit to applying the model. Likewise, workers will be trained, since many of the workers do not know how the tools will be implemented, so the following points will be met:

- In this phase performs training for operators, which will present basic definitions of tools and case studies to better understand the methodology and the benefits.
- Then an analysis of the current state of the company will be made, to be later compared with the new results.
- Operators will be presented with the schedule of activities so that they are informed in advance of the tasks they will perform during the implementation period.

#### **3.4.2. Knowledge Management**

This component is the main one of the model, since knowledge is a fundamental piece for the application of new methodologies in the organization. The purpose is to acquire the knowledge that is transferred to the entire organization.

For the correct application of knowledge management, the following steps should be followed:

- Analysis of the current state
- Identify the required knowledge
- Create knowledge
- Store and register knowledge
- Share and spread knowledge
- Uses knowledge in the process

#### **3.4.3. 5's**

This component of the 5 model is in the support tools, followed by the rest of the tools. The objective of its application is to maintain an orderly and clean work environment. This tool has 5 steps, which are the following: classify, order, clean, standardize and maintain discipline.

- First, the team of 5 must be formed, to then implement the 5 corresponding steps
- Sort, at this point will separate the necessary objects from the unnecessary. To do this, we will use color tools as follows: red (unnecessary), green (necessary) and yellow (necessary but for other areas).
- Order, use tools to order tools and supplies, for example tables with shapes of objects for proper organization.
- Clean, a cleaning plan will be implemented in which a responsible person will be appointed by area to comply with the plan.
- Standardize, similar to the previous step, in this step a standardization plan will be incorporated, which will have as criteria the 3 previous steps and the time that each of them should last.
- Discipline, in this step first an assessment of the compliance of all the S will be made, for this a final meeting will be held in which the results obtained will be presented throughout the implementation of this tool and will indicate the aspects that have to be improved.

### **3.4.4. Standardized work**

For the implementation of this component, we have to follow the following steps:

- Observe and analyze the current way of working
- Conduct time studies
- Identify and eliminate waste, this has already been done in the implementation of the 5's, but a verification of it will be made.
- Develop and store the work sequence.
- Test and implement the new processes.

### **3.4.4. Total Productive Maintenance (TPM)**

The purpose of the TPM is to avoid or reduce downtime of unscheduled machines and improve their performance.

The tool has 8 pillars; however, for the proposed model, 1 of them will be applied, which is autonomous maintenance.

For which the following order of implementation will be followed:

- Evaluate the current state of the machines
- Select machine for the pilot
- Dissemination campaign and tool training
- Initial meeting, where the specifications and activities that will be carried out for the implementation will be explained, where the management will also announce its commitment.
- Creation of the TPM committee
- Autonomous maintenance pillar implementation design.
- Analysis of maintenance results.

### **3.5. Benchmarking**

To demonstrate the validity of the model, a comparison of different models was made, in order to demonstrate that the proposed one is better than the previous ones and will help to obtain better results than the rest. (View Table 2)

Table 2: Benchmarking Model

CRITERIA	M1	M2	M 3	M4	Proposed M
cost	YES	YES	YES	YES	YES
Ease of Implementation	YES	DO NO T	DO NO T	YES	YES
Total Scope Improvement	DO NO T	DO NO T	DO NO T	YES	YES
Feasibility of implementation	DO NO T	YES	DO NO T	DO NO T	YES

## **4. Validation**

To validate the proposed model was applied in a small company that manufactures machines metalworking industry bakeries in the city of Lima, Peru; and it has been on the market about 20 years. The company manufactures various products, such as ovens, mixers, blenders, tables and cars. However, in recent years the company has a problem, which is the delay in delivery of the final product, which product has the greatest delay is the oven.

The company has 14 employees, but implementation will only be part of the team 9 workers who are part of the production of ovens.

#### **4.1. phase 0**

At the beginning of the implementation it was done by first raising the policy of the company, through information and presentation of success stories of the tools that are within the model, so that they show commitment and give their approval.

After the approval of the board a general survey was conducted operators of the production area as a contextualization of the proposal where the following results were obtained:

- ✓ All workers are men
- ✓ The age of workers is in the range of 30 - 39 years
- ✓ 77% have from 1 to 3 years working in the company
- ✓ 9 of the 13 workers employed in the production area involved in manufacturing ovens.

#### **4.2. Phase 1**

##### **4.2.1. Knowledge Management**

###### **4.2.1.1. Model design Knowledge Management**

As a first step in implementing knowledge management in the enterprise development project objectives, the commitment of the company, and the team will participate in the project will be presented.

Goals:

- ✓ Documented and distributed manuals
- ✓ Developing knowledge workers with regard to Lean Tools.

Team: The project team consists of 9 people who are organized in the following ways: head of production area, a facilitator and operators.

###### **4.2.1.2. Assessment**

At this point a detailed current state of the tool analysis for this survey in which the following main results obtained was performed:

- ✓ All said they have no recourse in the company where they can turn for information on the manufacturing process indicate that there are no manuals.
- ✓ Approximately 90% of the workers indicated as most important concept reducing the time of their task.
- ✓ 100% of the operators know the Lean Manufacturing methodology or some other process improvement methodology.
- ✓ All agreed that an improvement in knowledge acquisition will improve the performance of their activities.

###### **4.2.1.3. Development**

At this point of knowledge management tools to be used for the implementation of knowledge management, having the following core activities are defined:

- a. Identify knowledge
- b. Knowledge Creation
- c. Storage Knowledge
- d. Sharing knowledge
- e. Use knowledge

And the tools that most resemble the needs of the company are as follows:

- a. Brainstorming
- b. workshops
- c. manuals

#### **4.2.1.4. GC implementation**

Implementing Knowledge Management began as follows:

- Brainstorming: This tool helps identify the knowledge that the company needed in the production area, this tool was applied in a 1 hour meeting with all employees of the production process furnaces.
- Workshops: The workshops were held for a week (5 sessions) and each lasted half an hour.
- Manuals: Manuals process specifications were developed and distributed to operators for the proper development of the manufacturing process.

### **4.3. Phase 2**

#### **4.3.1. Metodología 5's**

As a first step of applying tool 5's an analysis of the current situation was conducted, which was assessed every stage of the tool.

Assessment qualification at the beginning of the company Panalin resulted in 20 points out of a maximum total of 100 points.

Followed it, it was correctly applied each of the 5 steps of the tool.

#### **4.3.2. Total Productive Maintenance:**

Before applying this tool the overall equipment effectiveness (OEE) of the current situation, which resulted in 72%, this is the OEE of the machine that presents major problems was calculated. He then worked with the committee already established initially, who showed commitment and responsibility.

For the implementation of TPM developed the pillar of Autonomous Maintenance, in order to promote the commitment of operators with machines and have a plan of maintenance and lubrication.

#### **4.3.3. Standardized work**

This tool analyzed the current process as well as the tak time and cycle time.

A new DOP was presented with the new production process and the manual manufacturing Horn.

### **5. results**

After implementation resulted in a neat and clean environment, as can be seen in Figure No. 3. In addition, evaluation of the 5's which was at first and was obtained as a final result in improved performance was performed again at the end of the application 85 points thus demonstrated a great improvement in the aspect of the working environment and get .

As a result of the application of TPM improving the overall efficiency of the team, which was an improvement of 14% had, and its current level of 86% efficiency. (View Figure 4)

Figure 3: Company pictures

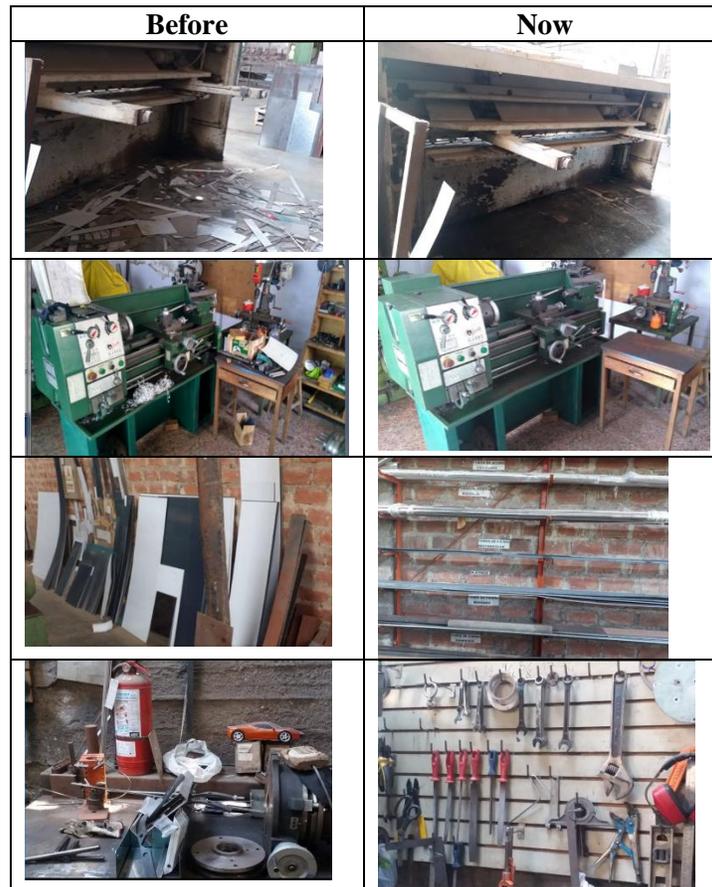
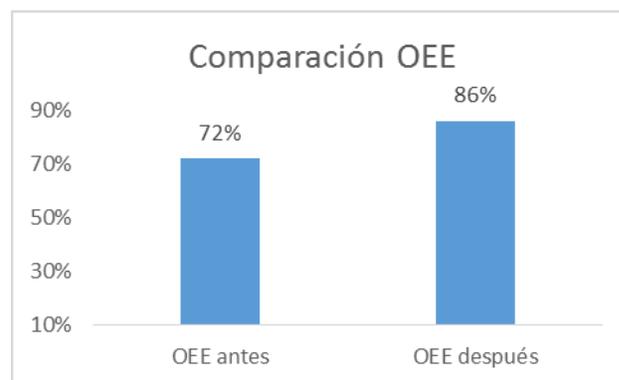


Figure 4: Comparison OEE



Likewise, they used to analyze said results obtained after application of the proposed model. The indicated show great improvement, especially in the main problem of the company, which is the timely delivery of furnaces. (View Table 3)

Figure 4: Indicators

<b>INDICATORS</b>	<b>BEFORE</b>	<b>NOW</b>
% Time delivery	<b>58%</b>	<b>72%</b>
% Reprocessed parts	<b>15.45%</b>	<b>9.5%</b>
% Level knowledge workers	<b>35%</b>	<b>65%</b>
% Total Productivity	<b>0.0000416</b>	<b>0.000052</b>

## 6. Conclusions

The model applied had positive consequences for the company, because it added to its processes tools that helped improve the performance of the company, where the innovative contribution of the model was Knowledge Management because it allowed us to analyze the entire production process and employee training for the correct application of Lean tools.

The application of the 5's allowed to have a suitable environment for workers and prepared the company for the implementation of the following tools.

It was also shown that the application of the TPM pillar had positive results where OEE had an improvement of 72% to 86%. Likewise, indicators were developed to demonstrate the improvement in the company, the main indicator is the% on-time delivery which increased 14%.

Finally, concluding with the validation of the model could get a nice and clean environment, operators were more reasons and engaged in productive processes since they had more knowledge of it.

## 7. Acknowledgements

First of all, I thank my professor Pedro Chavez for giving me the knowledge and tools required to develop this research article. I am also grateful to the Panalin Company and its operators for having given me support in all that was required and for allowing me to apply the proposed model in the company's production process.

## 8. Biographies

Gianella Damacén is a student of the Business Management Engineering Program at the Universidad Peruana de Ciencias Aplicadas (UPC). She has completed a course on Organizational Management aimed at innovation at the Universidad Pontificia Bolivariana de Medellín. She currently works in a company in the financial sector where she realizes his pre-professional practices.

## 9. References

- [1] Camargo & Martinez (2014), 5S impact on productivity, quality, work environment and Safety Rubber Company metal- Hernandez,
- [2] Zambaldi (2013) - Percepção A Respeito Do Desenvolvimento Sustentável Das MPen No Peru, 53 (3), p. 290-302
- [3] Blumea, Kurlea, Herrmanna, Thiedea (2017), Toolbox for Increasing Efficiency in the European Resource Mechanic Metal Industry, 61, p. 40-45.
- [4] Dombrowski, Mielke & Enge, (2012), Knowledge Management in Lean Production Systems, Vol. 47
- [5] Bartz, Bartz Mairesse & Barth (2013), Industrial Improvement of Performance with TPM implementation
- [6] Matt & Rauch, (2013), Implementation of Lean Production Small Sized Enterprises in, vol 27 (6), p. 3-10.

- [7] Osterman & Fundin, (2014), Exploring Approaches to Measure how Lean Process. Vol 15 (2), p. 8-15.
- [8] Marulanda, M. & F. Lopez Lopez (2016), Organizational Culture and Skills for Knowledge Management in Small and Medium Enterprises (SMEs) in Colombia. Vol 27 (6), pp. 3 - 10.
- [9] Morales & Silva (2017), Total Productive Maintenance (TPM) as a tool for Improving the productivity. Vol 6, p 150-163.
- [10] Cerchione & Esposito, (2017, Using knowledge management systems: A taxonomy of SME strategies, vol 37 p 1551-1562..