

## The maintenance management for lean organization

### *Managementul mentenanței pentru organizațiile lean*

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#### **Abstract**

*The goal of lean maintenance approach is to maintain organization international competitiveness. In the spirit of continuously improvement, in the paper it is shown how by adjusting some Lean manufacturing specific techniques for Total Productive Maintenance (TPM) system, was born new maintenance system named Lean TPM. This is a systemic approach with three techniques, which don't exclude specific techniques of TPM pillars, but complete them: the 7Ss as a critical first step in any improvement program; instantaneous maintenance; improvement setup operations. In the spirit of Lean principle, Lean TPM adjusts overall equipment effectiveness concept for all supply-chain from supplier to customer. Maintaining equipment in its optimal state and continually improving its productivity is the whole strategy behind Lean TPM.*

**Keywords:** Kaizen;, management; maintenance; lean manufacturing.

#### **Rezumat**

*Scopul abordării mentenanței lean este menținerea competitivității internaționale a organizației. În spiritul îmbunătățirii continue, în acest articol se arată cum prin adaptarea unor tehnici specifice sistemului de fabricație Lean pentru sistemul TPM, s-a născut noul sistem de mentenanță denumit Lean TPM. Acesta reprezintă o abordare sistemică cu trei tehnici, care nu exclud tehnicile specifice pilonilor TPM, ci le completează: 7S ca un pas critic în orice îmbunătățire; mentenanța instantanee; îmbunătățirea operațiilor de reglare a echipamentelor. În spiritul principiilor Lean, sistemul Lean TPM adaptează conceptul de eficiență globală a echipamentului pentru întregul lanț logistic de la furnizor la client. Menținerea echipamentelor într-o stare optimă și îmbunătățirea continuă a productivității este o strategie completă ce se află în spatele sistemului Lean TPM.*

**Cuvinte-cheie:** îmbunătățire continuă; management; mentenanță; fabricația lean.

**JEL Classification:** L10, L20, M10

## Introduction

In today's business environment companies have in their view every possible advantage. In the first decade of the 2000's, many firms directed their attention towards the optimization of their actives. Because firms realize that most of them don't have actives or "hidden" processes, they must be more effective than their competitors in the usage of actives and processes. This competitive attention virtually implicates all the parts of the organization with impact on the effectiveness of actives (Badea & Burdus, 2009). The area where the firm has the greatest impact is the maintenance department and those responsible with maintenance. Because maintenance has great impact on the status and capacity of actives, firms search for the best method for maintenance management.

How did Total Productive Maintenance (TPM) evolve? What hurried its development? TPM has its origins in Japan, as a strategy conceived to support the Total Quality Management strategy. Japanese realized that firms can't produce goods of consistent quality with low equipment maintenance.

TPM started its existence in the 50's, their main objective being preventive maintenance. When a new tool was set, the purpose was to apply the preventive maintenance recommended by its manufacturer. Emphasis was put on equipment that worked according to manufacturer's specifications without deteriorating. In the same period of time a team of researchers was founded, which later went under the name of "Japanese Industrial Preventive Maintenance" (JIPM).

In the 60's TPM focused on productive maintenance, admitting the importance of liability, maintenance and economical efficiency regarding the factory's project. This task manifested itself by applying the information gathered in the 50's about project equipment, its procurement and equipment stages management. JIPM was naming companies that excelled in maintenance activities for a prize, in the late 60's.

Then, in the 70's, TPM evolved into a strategy that focused on productive maintenance (PM) efficiency with the help of a comprehensive system based on individual respect and total involvement of employees. In this period the word "Total" was added to PM. In the middle 70's, Japanese started teaching internationally TPM strategies and were recognized for their results. This process was an evolutionist one, which needed time, the cause being not the technical difficulties on producing results but the efforts brought to change organization culture in such a way that the "Total" concept could be highlighted. Interest towards TPM is accentuated these days. This interest helps companies enhance the value of their goods.

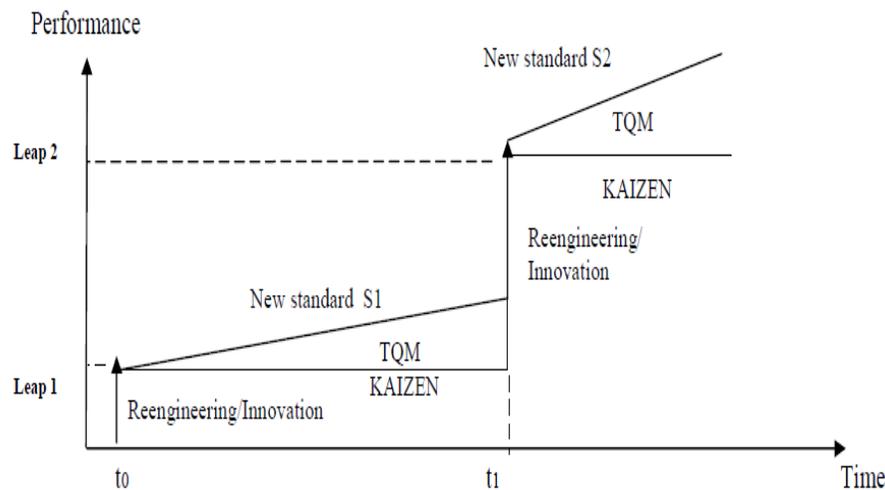
### The impact of Kaizen strategy

The perspective on generalization of advanced production systems that uses modern managerial methods for fabrication processes imposes new exigencies on continuous quality improvement for production and products in contemporary firms. So, reaching high quality standards becomes the first objective that conditions good development for any activity. The importance given to the elaboration process and the quality of the implementation strategy is, in this context, more than obvious. Structurally integrated in the firm's global strategy, quality strategy assures effect on future performances of the firm, construction possibilities, exploitation of competition advantages and finding of behavioral procedures on different markets.

Recent history of quality management (80's-90's) marks the growth of concerns regarding substantiation of integrating strategies, quality functional. Continuous improvement strategy known under the Japanese name of Kaizen represents an integrator strategy that appoints graduate and continuous improvement of management, firm activities and quality, productivity and competitive parameters with direct participation from the entire staff. Seen by a group of authors as the most important concept of Japanese management, the term Kaizen is owed, in its original form, to the Japanese specialist Masaaki Imai. This is the results of its efforts to investigate the causes of Japanese competitive environment. Masaaki Imai elaborated an extremely original and valuable work that he called "Kaizen -the key to Japanese competitive environment". In his opinion Kaizen can be seen as an umbrella that gathers an ensemble of managerial practices and typical Japanese concepts as: total quality control, the "no defects" principle, just-in-time, quality circles, orientation towards costumers, productive maintenance (Masaaki, 1997).

In its usual accept on Kaizen is the result of a three-dimensional approach. First of all it is an integrated global strategy oriented towards continuous improvement of all the firm's activities in a participative manner. On a pragmatic level Kaizen is implemented under the form of a current managerial practice founded on the grounds of graduate improvement principle trough "small steps strategy" (Naftanaila & Brudaru, 2009).

The third face of Kaizen is its interpretation as a result of typical Japanese mentality that places in the first row the human factor with its grounding, its experience, its endowment and motivation oriented towards the strategic objective of uninterrupted progress (Hobbs, 2004). Success awareness, consecrated by Kaizen's promoters requires strategy knowledge and characteristics familiarization for contemporary methods for production process. The Kaizen strategy is presented in Figure 1.



**Figure 1 Kaizen strategy and innovation**

TPM is a global administration technique, integrating equipments, aiming towards the growth of usage extent and life expectancy of machineries, with the participation of all workers. The principles of this method were brought to light for the first time in Japan in the 80's as a result of researches made by a team of specialists from The Japanese Institute for Industrial Maintenance. TPM "includes more than the simple maintenance function, because we are talking about a global management technique where all the workers must contribute". The term "total" which is included in the name of TPM method has three meanings that accentuate the main features of this kind of maintenance: total efficiency, meaning that the goal of TPM is achievement of economical efficiency or firm profitability; a total maintenance system that includes flaws prevention, corrective maintenance and preventive maintenance; total involvement of personnel that has in view autonomic maintenance made by workers that exploit machineries.

The first step in applying TPM is production loss and waste analysis, classified in six distinct categories: accidental flaws, adjusting machineries for fabrication series change and devices replacement, short term stops for maintenance reasons (cleaning, removal of an improper product, equipment supply), work speed reduction, removal of rejected products (generated by products that aren't built according to quality standards for starting the equipment). Obviously, applying TPM implies investigation of practical means of maintenance loss reduction regardless of their category. For example, the time lost in accidental flaws must be eliminated by implementing auto-maintenance, just like the time for adjusting equipment can be reduced by applying the Single Minute Exchange of Die (SMED) method (Wireman, 2004).

### **The impact of maintenance strategy**

The purpose of every company is to increase its profit. This fact is true regardless of the nature of the company. A complete strategy of maintenance/management of assets will increase profits by two main ways: reducing expenses and increasing capacity.

Have in mind that one third of all maintenance expenses are wasted because of inefficient maintenance resources. Two main divisions of maintenance costs are work and materials. When you improve an organization with reactive maintenance, they are immediately reduced. You need time to evaluate total reductions because transforming an organization with reactive maintenance into a proactive one, even when the best of decisions are taken, it can take from 3 to 5 years. Transition by itself, technically speaking, can be a not so difficult one; in change, you need time to change the culture or the corporation model from a negative one when regarding maintenance function into one that really treats maintenance like a central process of the business.

Maintenance contracting will present similar reductions because maintenance contractors use such work and maintenance materials. Economies won't be that big because maintenance contractors are usually more expensive than reactive maintenance in one's organization.

The true contribution of maintenance to the profit is small in comparison to reductions made by capacity increase (availability) and efficiency through active maintenance. For example, in some companies, dead points of equipment have an average of 10-20 percents, even more. The equipment, that doesn't work when it should, restricts the volume of products delivered on the market. Some companies went to buying spare or redundant equipment to compensate dead points. These expenses have a negative impact in net cushioning of assets, decreasing the investment's appreciation of the company on the market. The true cost of dead points is money loss in products sale that isn't done in time. This cost is far greater than basic costs mentioned earlier, the majority of financial departments using a compromise value. A company should understand this cost in order to make good decisions regarding assets and the way they are used.

Then, maintenance dates with financial dates, the cause of the efficiency problem searched can be solved. If the organization focuses on maintenance, then it is possible for this business process to contribute to the firm's profitability. It needs though the cooperation concentration of all departments and organization functions to be successful.

### Developing Lean TPM system

The objective of innovative approach regarding Lean TPM is to keep the company's competitively. Japanese know-how thought the world how to produce cheap goods by reforming the fabrication process and using workers in a more efficient way.

Reforming an existent system means rejecting the present state and presenting its weaknesses. If we don't present these weaknesses, we will be incapable to improve the way we do things (Sekine, 1998). This improvement idea leads to the three things that innovative approach brings to Lean TPM in comparison to the present understanding of TPM:

- the 7Ss: strategy; structure; systems; style; skills; staff; and shared values;
- instantaneous maintenance;
- improvement of installation operations.

The main objective of the 7Ss system is to grow the value added to each worker. To grow the added value, we must create ordered and well adjusted production lines based on the principles of the 7S's: organization and order. Above all these two S's bring to the factory standard positions and acknowledgement. Focus on the first two S's brings a new perspective on understanding the 7S's. Operators ask maintenance technicians every time equipment beaks down. Technicians come and fix the equipment while operators take a break. This scenario divides work force in two kinds of persons: the ones that make the equipment break down and those that fix it. It's almost like cartoons. The solution for this loss is instantaneous maintenance. Instantaneous maintenance is a technology that allows fixing the equipment to its initial state in three minutes since its break down. It's important that the operators achieve qualities necessary for instantaneous maintenance. If we are attentive in implementing, this will lead, in a natural manner, to improvements in daily inspections and maintenance and improvement of planned maintenance. It should save the company's money because you won't depend on the equipments manufacturers to do maintenance and repair.

Improving adjustment means reducing operations for production lines adaptation to one single step or even their elimination. Factories that implement it correctly can eliminate the problem of minor stops likewise checking and regulating after the adaptation of the production line. This new innovative approach of Lean TPM is built on the same three pylons, as other methods that identify the seven types of losses connected to total productive maintenance. Most of the losses in the factory come from inappropriate implementation of TPM as is shown in Table 1 (Levitt, 2005). The first basic source for this type of wasted efforts is equipment installation without correlating with production volume. This thing means that, for example, more small lots on specialized machinery and large lots in processing centers.

**Seven types of waste****Table 1**

No	Types of waste
1	Minor, medium and major interuptments.
2	Interminable adjusting time.
3	Manual remodeling, defects, defective products.
4	Planned dead points.
5	Incomplete application of 2S's.
6	Over-production caused by large equipments.
7	Equipment problems at the beginning of production.

For a large number of companies, TPM means rather creating graphics for visitors to see than using them for management. Some companies post a lot of graphics of improvement development, but as a result real performances don't always improve. A key element that is missing is an ideas exchange between the people that develop and project machineries and the people that use those equipments. When this communication link will be established, equipment problems in the beginning of production will be solved.

**The benefits of 7Ss**

A way to improve precision for the entire production and maintenance work in the factory is to give people an extremely organized work environment where a big part of their work is controlled visually. The visual workplace is an ideal one with no defects and no anomalies.

The first step in creating a visual workplace is the 7S organization. A visual workplace is capable to assure the following benefits: there is nothing extra or necessary; storing areas are clearly defined; there is a place for every object and everything is in its place; the workplace is kept clean; objects, information, plans and processes are immediately recognizable; it is easy to immediately distinguish what is normal and what is not; birocracy is simplified and minimalised; rests and abnormities are immediately recognized by anyone; product flux, deviations from standards and everything that is or takes place in the work field is visible at one gleans; standard procedures are easy to understand; quality is raised; productivity is raised (Taiichi, 1988).

Three steps must be followed in order to be successful in this approach. First of all, the top managers must act in the same direction. If they hope to reach the objectives of the 2S's of organization and order, managers must primarily give a good example. Otherwise, they can talk as long as they want, but employees won't listen.

### **Some aspects of instantaneous maintenance**

Different types of problems can appear regarding equipment, machinery, factory appliances:

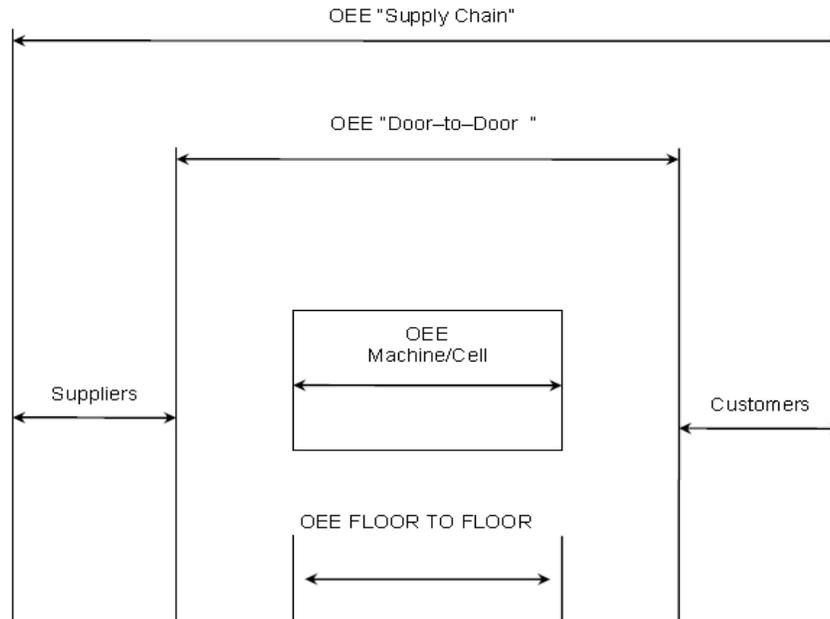
1. Minor unplanned stops.
2. Medium unplanned stops and major stops that stop production.
3. Losses caused by pre-set stops, components replacement or improper adjustments during preparation of the production line.
4. Mechanical stops when blades are replaced.
5. Loss caused by redoing the work, defects caused by variations in the quality of components and materials received from exterior suppliers.
6. Loss caused by machinery and equipments and machineries that are stopped because of components consumption.
7. Losses caused by production lines interrupt while the employee is absent.

One might also talk about planned stops, but this is tied to what happens between placing the order and manufacturing the product. The seven types of losses enumerated are significant, but in the TPM point of view, the most important one is regarding defects caused by equipment problems.

A well done preparation can prove Lean TPM efficiency. In other words, if the preparation is made correctly, the work is 80% done. Lean TPM also follows this principle. If the attention is paid to the way a factory activates, one could see how strong is the Lean TPM effect, and one could determine the level of TPM implementation in the company. It is not exaggerated to say that half of preparation problems are caused by unorganized proceedings. Any machinery should have standards for positioning and adjusting. In any case, even when such standards are established, these are changed during processing, causing minor interruptions.

### **Lean TPM measurement system**

One furthered aspect of the Lean TPM approach is the very powerful measurement system. At the basic level there is the analysis and trend information that relates to a single asset or cell. This has been referred to as the Overall Equipment Effectiveness (OEE) measure or the "floor to floor" level of analysis. This aspect of Lean TPM measure shows how well the machine/cell is managed. Hence, the "door to door" measure includes these linkages. Finally, the highest level of control and the level at which manufacturing can be exploited, as a means competitive advantages is the supply chain OEE (McCarthy & Rich, 2004). These are interrelated measures, giving different level of management analysis and trend information, covering the entire production system. Lean TPM measurement system is presented in Figure 2.



**Figure 2 Lean TPM measurement system**

The measurement system therefore allows for proper navigation of the firm starting with the optimisation of individual assets, optimisation of the chain of assets in the factory that form the production sequence and finally the overall performance of the firm and its selected supply chain design .

### Conclusion

Reforming an existent system means rejecting the actual state and exposing its weaknesses. If weaknesses are not discussed, it will not be possible the improvement way of doing things. This improvement idea leads to the three things that innovative approach brings to TPM in comparison to the actual understanding of the Lean TPM system: 7S, instantaneous maintenance, improved installation and adjusting operations. This innovative approach of Lean TPM is built on these three pylons, as in other methods that identify the seven types of losses connected to total productive maintenance. Lean TPM adds a precision and ability to reduce cost whilst reinforcing the drive for improved quality and delivery reliability. Moving from the "pain" of traditional "fix it" type operation to the motivational "pleasure" of working as part of a winning team, in control and growing in capability is an experience many retired operators and maintainers will have thought impossible.

The majority of losses in the factory come from incomplete implementation of Lean TPM.

Total Quality Management (TQM) and Lean Manufacturing will quickly discover that these programs will not have the desired effect without full use of these standards and the aim to be competitive in a global marketplace cannot be achieved.

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