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Aspects Regarding Continuous Improvement in Production Systems

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Abstract

Implementation of a modern management system covering all activities that occur within an organization must respond the major changes in the evolution of production systems, and feature flexibility, adaptability to market needs and company needs to increase competitive advantage. Implemented in many organizations, based on the evolution of the quality concept and aiming highlighting the human potential, currently Kaizen management is considered as the system that offers the most diverse range of tools for identification, analysis, evaluation and problem solving concerning eliminating waste and reducing costs through continuous improvement process. Through literature review, this paper presents the theoretical basis of the philosophy of Kaizen, Kaizen methods of implementing the principles in any organization and Lean Production tools and their application in order to increase performance of production systems. It will present the methodology of implementation of Kaizen major concepts, especially in the field of standardization and organization of Lean Production. By applying these principles are rethinking the system, control and improve processes on the value chain, without using sophisticated tools and technologies in solving problems.

Keywords

management, continuous improvement, Kaizen, production system

1. Introduction

The competitive environment compels increasingly companies to review, restructure and redirect the activities to achieve competitive advantage.

The business environment in Romania being in continuous development requires SMEs to continuously adapt to market demands, especially as Romania's accession to the European Union. The globalization of markets will increase competition. There is not a divine right to stay in business, therefore, small and medium enterprises in Romania, must realize that the solution of survival is competitiveness, improving SME productivity from productive and reduce costs in the production process are possible by applying Lean Manufacturing method. These characteristics are why companies, firms, organizations in the area of manufacturing and logistics planning, but also in economic and social fields, should know and apply new concepts that underpin the management of production and that means survival in a global market.

Today, organizations worldwide achieve remarkable results benefits by adopting the Kaizen philosophy, the mentality and specific methodologies. Widespread deployment of this philosophy among managers and customer successes of Kaizen Institute in more than 50 countries, confirms this [3]. Kaizen concept appearance, one of the key concepts of management benchmark is 1986, by publishing the book *Kaizen: The Key to the competitive success of Japan* (Masaaki Imai).

Kaizen (continuous improvement) is a philosophy based on working principles meant to continually improve in a company, in this case each job by eliminating waste, avoiding unproductive times, reduced waste and scrap, through organization, efficient use of premises and equipment of work through standardization and implementation by reducing production costs and making full use of working time [3]. Kaizen develop process oriented thinking, because, first, they must be improved to have better results. Aiming at a production process of a production line throughout is identified a lot of losses. Identify losses in the production flow does not mean their elimination. The challenge is to

continuously develop a method to identify and eliminate waste of any kind. The real positive results are to develop the process of identifying losses, meaning by this finding causes that generate them.

Lean is a management philosophy or a set of tools used depending on the scale, and the development strategy of the organization and the culture in which it applies. Because it is used as a management system is necessary for the organization to have reached the level of maturity at which continuous improvement has become part of the organizational culture.

Lean Manufacturing is an important method for manufacturing management, providing great results without the need for complicated systems, making it an appropriate method and system companies with limited resources. Lean or at minimal cost production is a philosophy that reduces the length of the customer order to delivery of the product by eliminating waste. Implementation of Lean principles has become a survival strategy in a production environment where cost reduction is a fact on the market [8].

Analyzing the literature [1, 3, 6, 9], it can be seen that most of the factories embraces the principles of Lean (Lean Manufacturing, Six Sigma, Total Quality Management - TQM, Theory of Constrains, Toyota Production System, Agile Manufacturing and other methodologies) for production processes (Fig. 1a). However, these companies usually fail to implement Lean in the rest of their organizations. Two-thirds of the factory has been limited progress in the implementation of their improvement approaches, with only 50 percent (median) of their employees fully engaged (Figure 1b). Even among the producers Lean, only 58 percent enjoy extensive or complete adoption of Lean, with only 60 percent of their employees fully engaged [9]. Regarding the document Lean processes for manufacturers, there are still a lot of opportunities to improve.

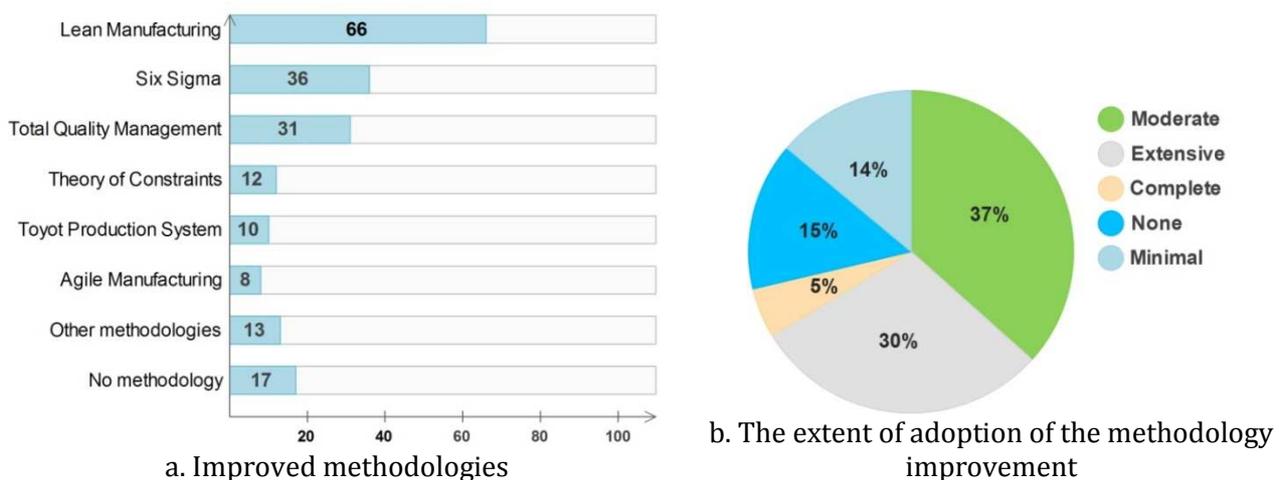


Fig. 1. The degree of implementation of Lean principles [9]

2. Modern Management Instruments

2.1. Lean production

Lean Manufacturing approach, as described by James P. Womack and Daniel T. Jones to guide managers in their attempt to introduce Lean principles in production, "Lean Thinking: Banish Waste and Create Wealth in Your Corporation" [8] means a process of thought and action in five steps, namely:

- Specifying the value for each product family in terms of the final customer;
- Identification of all components activities within value stream for each product family, eliminating as far as possible generating losses those activities;
- Ordering activities that create value in a sequence (stream) of steps clearly identified, so that the product reaches the end customer as continuously traversing a stream without many interruptions, stops and intermediate expectations;
- Once the value stream has been established and introduced, any internal or external client can apply the system of "pull" to "pull" the upstream product, the production flow;

- After the value has been specified, value-creating activities identified, the generating losses eliminated the flow of value established and inserted, you can move to the operational processes and the improvement of, until it achieves an optimal level in which is obtained the maximum of added value and most losses eliminated.

These considerations presented above constitutes the reason that companies, firms, organizations in the area of industrial manufacturing and logistics planning, and the economic and social field should know and apply Lean concepts that underlying production management and that means survival in a global market.

Lean Manufacturing operates based on a set of tools according to applied strategies, objectives and level of development of the company, being adapted to the specific activity.

The first step in implementing changes is the situation analysis, after which are defined objectives and outlines the solutions. Lean Tools are: Value Stream, 5S, Kaizen, TPM and Kanban.

The characteristics of these instruments possible to use after an assessment of the current situation and adaptation to the field of activity are [3, 8]:

- *Value Stream Mapping (VSM)*. Value stream map and drawing value stream map means plotting the flow of materials, people and information which lead to a product families.
- *Visual Management*. The set of methods and means used to facilitate the implementation of activities to highlight the losses to be eliminated. It includes visual presentation elements to be widely disseminated for the purposes of tasks, but also means visual inspection to facilitate decision-making in case of deviation from the normal situation.
- *5S Method*. "5S" is a methodology for organizing, cleaning and discipline at the workplace, with positive effects: increasing the safety and productivity of work, better conditions of maintenance, better quality. Includes: 1S (Seiri) Sorting and Filtering (Organization), 2S (Seiton) Stabilization (Order), 3S (Seiso) Brightness (Clean), 4 (Seiketsu) Standardization (Compliance), 5 (Shitsuke), support for change (Auto- discipline).
- *Kanban*. Production control back through cards, signs, containers, boxes, and buffer stocks, etc., which triggers the movement downstream process flow of products between workstations.
- *Kaizen*. Japanese term for "continuous improvement by involving all". It is a methodology of systematic teamwork to solve problems and implement solutions to improve.

2.2 Kaizen principles and instruments

Kaizen principles represent a basic tool of a performance management by improving productivity, quality and reduce costs, without making major investments in new technologies. Analyzing the literature [2, 4], concerning the successful implementation of performance management, Kaizen concept can be considered as an interrelation of several subsystems (Figure 2).

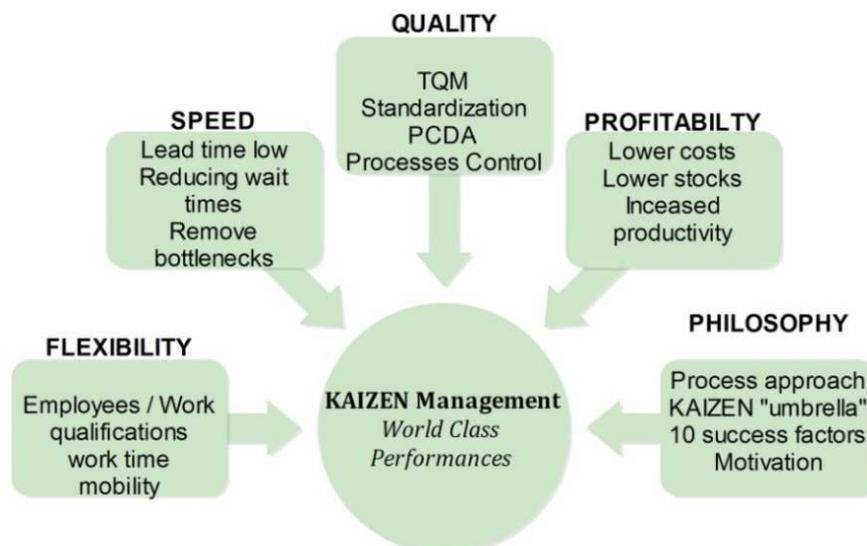


Fig. 2. Management Kaizen

Kaizen philosophy is a methodology to build a picture, an image of the reduction wastage. The first step in Kaizen process establishes in the PDCA (Planning - Run - Control - Action). This is the tool that ensures continuity in pursuing Kaizen strategy to maintain and improve standards [3]: *planning* refers to setting a target for improvement (Kaizen because it is a way of life, should be improved anything anywhere); *run* relates to implementing the plan; *control* means to determine whether the implementation is or not according to plan and how close they are to improve planned; *action* refers to performing and standardizing the new procedures to prevent recurrence of the original problem or establish new targets for further improvements. PDCA cycle revolves continuously or as soon as is an improvement, resulting status quo, becomes another target for improvement. PDCA means never being satisfied with the status quo.

PDCA initiation is performed by management by continuous setting of new goals. Considering that the beginning of any process is unstable, according to Kaizen strategy [3], before starting the PDCA cycle, any process must be stabilized through a process - cycle SDCA (Standardize-Run Controls-Action). PDCA relates to improved processes while SDCA to maintain and standardization.

2.3 Standardization in Kaizen

One of the basic tools for Kaizen continuous improvement of processes and activities of the organization is "standardization". Working with standards balances the processes and improves their quality and products. Standardization activity occurs cyclically improving it is endless. So after what the standard has been developed and improved, the new standard became the basis of subsequent improvements, and the cycle repeats. For the successful and effective standardization work should take account of a number of its main features [3]: standardization is the best and easiest way to work; it offers the best way to keep know-how and experience; provides the means to measure the performance; presents the relationship between cause and effect; provides the basis for maintenance and improvement; provide objectives and indicates training needs; provides basic courses; creates the basis for audit or diagnosis; provides a means to prevent recurrence of errors and minimizing variation.

By implementing a new system for standardizing a company will be able to implement Lean concept daily by using standards to control performance at all levels of the organization and create a foundation for all activities of continuous improvement.

Standardization work is an important component of the activities of Production Lean as it gives rhythm of production, helping to eliminate waste and improve standards through the establishment of specific procedures for each operator, located in a flow production and is based on three elements: time available of production which is the range at which the products must be made in a process so as to satisfy customer demand; exact sequence of operations which implements them the operator in the time available of production; the stock standard required for the production process to be conducted properly without interruption. To get a constant flow in production, should know that no matter who performs the work will get the same tact and will result in a constant cycle time, [7].

In view Kaizen [3], two major functions of management are emphasized: maintaining and improving. Maintaining includes specific activities aimed at maintaining operational standards, managerial and technological standards, through training and discipline and the improvement refers to activities of optimizing the current standards. The management should ensure the quality, cost and delivery time (QCD). For this, any company must be properly managed resources available locally: financial, material and human. Efficient management of resources requires standards. Standards are an important part of Kaizen and provide the basis of a performance management.

Kaizen procedure is a standardized format to record the kaizen activities undertaken by smaller groups such as quality circles. Kaizen standardized procedure includes the following steps [3]:

- Selecting the theme. The procedure starts with why he selected a topic;
- Understand the current situation and setting goals. Before starting a project, to be analyzed and understood the present conditions;
- Analysis of the data collected in order to identify causes;
- Establish measures to solve;

- Implement measures to solve;
- Confirmation of the effects of measures to solve;
- Establishing or revising standards to prevent recurrence;
- Revising the processes above and planning the next steps.

Currently has become almost a mandatory requirement for any company to apply for a national or international certification standards such as ISO 9000 or QS 9000 if it wants to stay in business and get the trust of major clients globally. These certification programs focus on standardization of key processes and continuous improvement. Kaizen applied correctly can improve quality, reduce costs considerably and can meet customer delivery requirements without investing too much or introduction of new technology.

Three Kaizen activities are important: *Standardization*, the *5S* and eliminate *Muda* (Japanese language loss) successfully contribute to QCD (quality, cost, delivery). Quality (Q), cost (C) and delivery (D) are regarded as the supreme goal of management.

2.4. The 5S method

5S is a method of continuous improvement and is done in 5 steps with their Japanese name (Fig. 3), [5]:

- SEIRI- distinction between necessary and unnecessary things at work;
- SEITON- orderly arrangement of all the items that remain after Seiri;
- SEISO- machines and working environment are kept clean;
- SEIKETSU - Extending the concept of cleanliness at your own job;
- SHITSUKE- Getting self-discipline and habit of engaging in the 5S by applying the standards.

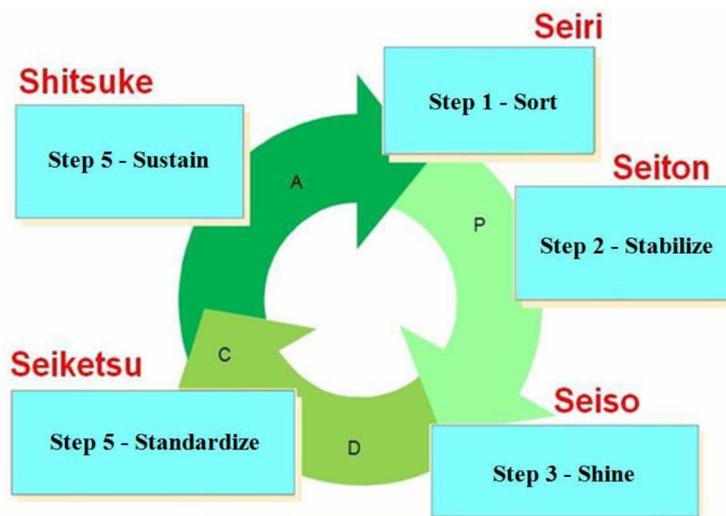


Fig. 3. Sequence of steps during 5S method [5]

The introduction of the 5S method must always start the first step. As a first step are defined the items that are needed at the workplace and to be removed from the workplace. In a second step defines the exact location of the items that were left in the workplace. In the third step they include actions that keep everything tidy and clean. One of the key objectives is to keep all cleaning equipment in such a state that they are always ready to use. The aim of the fourth step is to create a standardized arrangement of the workplace. The last step is focused on the constant use of 5S method and seeks to take root in the concept of working culture [5].

Implementation of 5S principle has the following objectives: productivity growth, reducing losses, increase safety in the workplace, form a solid basis for permanent development, increase the involvement and responsibility of employees at work and improve performance quality. This method can be applied both in the production department at every workstation and in the business office.

In the production system analyzed and identified the need to use the method in various areas of workspace.

3. Implementing a System of Continuous Improvement. Case Study

3.1. Lean production

Applying Lean principles [6] have been achieved these objectives: organization of production flow and rhythm setting manufacturing; reduce preparation time while increasing production flexibility, quality, efficiency and reducing total cost of production; continued development of the production flow; efficiency of the production process by reducing losses along the production system and their quantification; implementation of methods to measure system performance, knowing the characteristics of the system.

In step to achieve the value flow chart, it has been started from the ultimate consumer of the product, and the customer. It followed the production flow upstream identifying the main operations by passing raw material, from ordering and delivery in warehouse to customer requirements.

The necessary data mapping of model there were taken from the manufacturing system taking into account the actual processing every workstation, time auxiliary, necessary human resources and the waiting time from one post to another. It is essential to register and measure every variable that may occur in each sub-process of production. Also, they noted the trial records (time delays, stops, defects, absences etc.) impacting the performance of the production line.

After collecting the data and translate them into the current value stream map, it was passed to analyze these data and benchmarks for improvements to eliminate losses. After analyzing the information used were divided into three categories namely:

- operation with added value (e.g. Production operations) is any activity that increases the value or utility of the product, i.e. activities for which a customer is willing to pay;
- operation without added value but necessary (e.g. Transport control);
- loss (e.g. Handling or excessive waiting) is any activity that does not add value to the product, i.e. which increases product cost without adding value; these should be eliminated, streamlined, reduced or integrated.

During the observations made in the case study in the Division for processing workpieces type cylindrical parts were identified and the points for improvement in terms of cleanliness and keeping the order in the workplace. All this is illustrated in Figure 4.

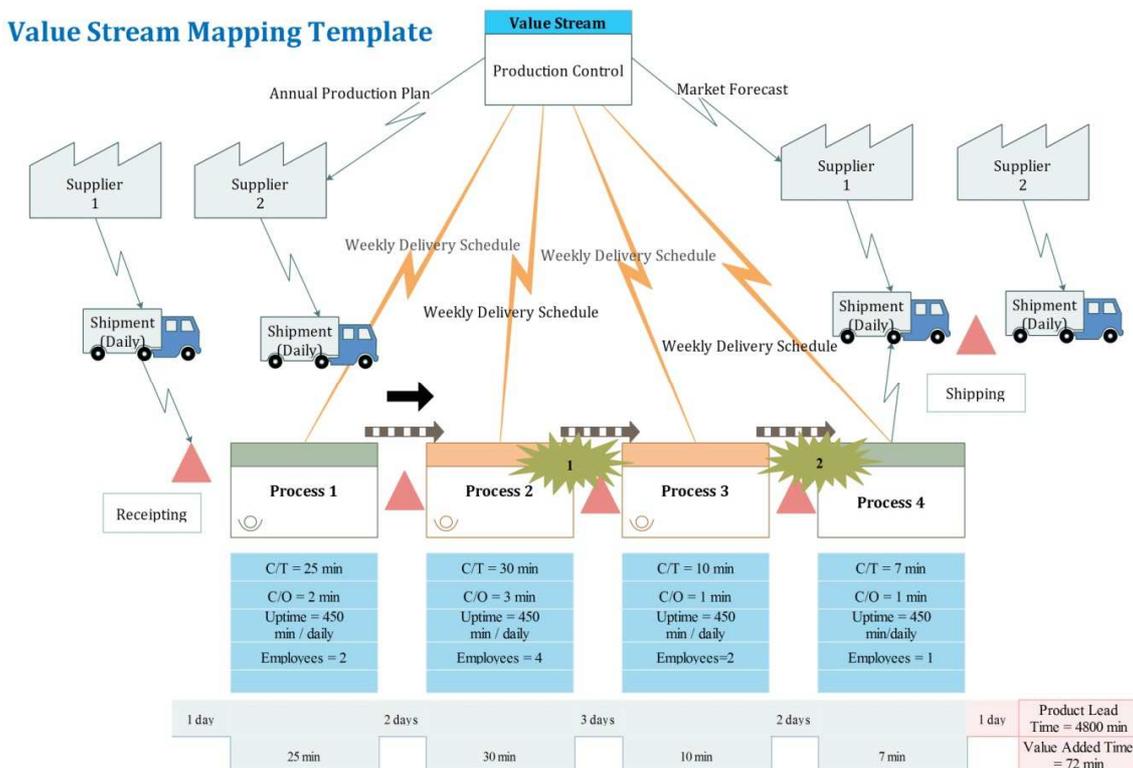


Fig. 4. Identifying the points with potential for improvement

Summarizing all results previously achieved for the production flow of the product under consideration, were able to determine the effects of Lean tools on the flow analyzed, effects that will translate into future value stream map (VSM). The effects of all proposals for improvement through Lean tools are identified in Table 1 and subsequently viewed in Figure 5.

Table 1. Effects obtained

Aim pursued	Expected outcome set out
Reduction of the distances	↘ 70 %
Increasing the share of value-added time	2,7 % ↗ 4,5 %
Reducing waiting time	↘ 58 %



Fig. 5. Analysis and operations phases of work

3.2. Implementation 5S Method

5S method is used in organizations to eliminate waste and to include standardization of processes to work through the stages described above. Action Plan for implementation consists of the following activities: site organization 5S, organization in line LINE system and analysis of changing assortment time (SMED - *Single Minute Exchange of Die*). Flow sheet of a manufacturing line must be in LINE without turning loops or additional adjustments. Any movement made up or over long distances represents MUDA (waste) of time, human resources, funds, additional expenses, and so on. The basic idea is that the manufacturing line operator must have on hand almost all the material resources, tools, accessories, control systems, clear work procedures which lead to reduced search times, transportation, physical and intellectual. The basic principle of a SMED is to reduce the share of internal operations, to turn external internal work to standardize the size, use of devices that facilitate preparation of parts of an equipment change. Those operations include activities to be carried out in parallel activities, to eliminate adjustments, to increase mechanization and automation and centralization of information. SMED it means possible to reduce bottlenecks in the process.

Case Study considered after applying the 5S method followed by SMED analysis in Figure 5 it shows the picture analysis and operations phases of work establish the type of activity (internal-external) needed versus disposal, merging activities, and so on. After applying, the 5S method workplace is organized and standardized.

After analyzing the activities carried out by operators and of the paths followed, the change process of the machine has been modified as the number of their activities towards reducing. The routes followed are much fewer staff and dividing their activities without overlaps and intersections during the change of line. In addition, it can be seen that by reorganizing of the workplace, the production flow has been greatly simplified, no longer turns, intersections, crowded spaces, stationary products and multiple manipulations. The technological flow is now more linear, directly and without physical effort increased from operators. Interventions control and machine settings are made in a natural order, documented and not chaotic at the discretion of operators.

The effects of the method pursued by implementing "5S" in the production department analyzed are summarized in Table 2.

By applying 5S method was obtained systematically organization, cleanliness and standardization work. This method can be extended to the organization of the workplace, protection and safety at work to eliminate work accidents.

Table 2. Effects of implementing the method "5S"

Actions	Effects
Effective waste storage	Good space organization and empowerment of the employees
Organizing workspace	Reducing the time needed to change the materials used and of the equipment
Removing objects obsolete	Efficient organization of workspace
Achieving bookmarks	Increased safety at work
Cleaning	Improvement of product quality and eliminating defects

4. Conclusions

Kaizen is a Japanese philosophy that focuses on continuous improvement in all aspects of life [3]. Applied in any company is obtained permanent improvement of the organization, starting with the staff, continuing with the processes and finishing with products and customer service. An essential element in the implementation and operation of Kaizen management is the "mentality". Through a better understanding of the essence of Kaizen concept, through proper training, practice and personal example can be drawn the expertise needed to implement and support its management system Kaizen. The key evolution lies in creating a simple system, easy to use and developed. Kaizen concept lies in the simplicity of nature to be a lifestyle, not just a way of working. Starting from this premise, in the present paper was required to achieve a modern approach to the study, using such solutions and Lean principles to organize a system of production and instruments Kaizen continuous improvement processes.

Optimization is performed based on modern principles of organization of production by applying specific tools of Lean and continues to develop the production flow by cutting out intermediary's production, reduce production costs, eliminate waste, increase productivity and flexibility, and last but not increasing competitiveness in all existing competitive environment.

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