



Process improvement methodologies: KAIZEN and Six Sigma

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1. Summary of key ideas

In this article, the basic characteristics of two of the most used methodologies for process improvement will be described, Kaizen and Lean Six Sigma. Both have as fundamental objective to achieve a lasting improvement of the company's results and to continuously improve the processes (the way of working). In both cases, the aim is to reduce waste and variability in each company process.

2. Introductory guide

There are many definitions of quality. According to ISO9000, "Quality is the degree to which a set of characteristics inherent to an object (product, service, process, person, organization, system or resource) that meets the requirements". Traditionally the search for quality improvement has focused on the context of tangible product characteristics in the manufacturing industry (conformity to specifications, suitability for intended use, value for the price paid, etc.), and on the analysis of intangible elements in the case of service industries. The definition of quality, therefore, arises from the construction of meaningful outcome measures that can be quantified and tested.

A continuous improvement system seeks the elimination or reduction of activities that do not add value and that add costs to the processes or services of the organization or company, and the continuous increase of quality and productivity, as well as user satisfaction. Continuous improvement is often related to a group of methodologies, such the Six Sigma or Kaizen methods. In the same way that the processes and activities of the companies must be improved continuously to preserve and improve their competitive advantages, the systems, methods and tools used for such improvement must also be improved in order to continue to be useful for the company's purposes. Preserving and enriching the philosophy of continuous improvement of the Kaizen system, instruments and tools are added to complement it and increase its capabilities to improve the levels of quality, cost and cycle times.

3. Objectives

In this document, the following learning objectives will be addressed:

- Remember, understand and apply the basic concepts related to quality.
- Remember, understand and apply the basic concepts related to the continuous improvement of processes and services.
- Remember, understand and apply the bases of the Kaizen methodology.
- Remember, understand and apply the bases of the Six Sigma methodology.

4. Process improvement methodologies

Next, the two methodologies that are currently widely used for process improvement will be described.

4.1 The Kaizen Methodology

The Kaizen philosophy is a methodology that is used on a daily basis for the continuous improvement of individuals and organizations. Kaizen is used to detect and solve problems in all areas of the organization, both those that directly affect the customer and those internal to the organization. Kaizen's priority is to review and optimize all the processes carried out in the organization through the elimination of waste (activities that do not add value).

Not only must products or services must be free of faults and errors when generated for external customers, but also for internal customers. What is more, these products and services must be generated according to specifications "the first time", i.e. neither reprocessing nor adjustments.

Although the term Kaizen is defined by Masaaki Imai in his two books on the subject as "improvement", it is a concept that still does not have a detailed explanation that allows us to know more clearly its theoretical content. From a first point of view, Kaizen can be understood as an organizational element in which employee participation has a direct impact on the improvement of work processes.

4.1.1 The ten Kaizen principles

There are 10 principles that mark and summarize the strategic lines of the Kaizen methodology:

- 1.- Focus on the customer satisfaction.**
- 2.- Continuous improvement.** Concentration is focused on improving tasks repeatedly.
- 3.- Openly acknowledge problems.** To maintain open communication within the organization.
- 4.- Promote openness.** The characteristic features of a Kaizen company are basically sharing, inter-functional communication, and visible leadership.
- 5.- Create work teams.** Teamwork are the building blocks of the corporate structure.
- 6.- Manage projects through cross-functional teams.** Participation of all departments and even external resources such as suppliers and customers.
- 7.- Encourage appropriate relationship processes.** Invest in training in interpersonal skills.
- 8.- Develop self-discipline.** It allows adapting to the situations that arise in daily life and to find well-being and comfort through the affirmation of his inner strength.
- 9.- Constant information to employees.** Keeping employees informed about the company from the induction and during the time they are employed.
- 10.- Encourage employee development.** Empowerment, since training people to acquire skills, give them responsibility in decision making.

4.1.2 The wastes in Kaizen

The Kaizen system of continuous improvement has as one of its fundamental pillars the continuous struggle in the elimination of waste and wastage (mudas). Therefore, the strategic decision to implement the kaizen methodology in the organization revolves around the detection, prevention and systematic elimination of the various types of waste and wastage that plague organizations. The seven fundamental wastes that every company must pursue and eliminate are described below (Figure 1):

1.- Overproduction. Can be caused by failures in sales forecasts, production at maximum capacity (higher utilization of fixed costs), achieving optimum production (lower total cost), etc.

2.- Excess inventory. Inputs, spare parts, products in process and inventory of finished products.

3.- Transportation. Waste linked to excesses in internal transportation, directly related to errors in the location of machines, and systemic relations between the various productive sectors.



Figure 1. The seven major wastes of Kaizen.

5.- Waiting. Mainly due to set-up times, times in which a part must wait for another part to continue processing, queuing time for processing, loss of time due to repair or maintenance work, waiting times for orders, waiting times for raw materials or inputs.

6.- Defects. Reparation and rejection of defective products. It must be added the losses generated by warranty expenses, technical services, product replacement, and loss of customers and sales.

7.- Over processing. Waste generated by errors in layout of the plant and its machinery, failures in production procedures, including failures in the design of products and services.

There are another new common wastes that currently have been identified in different organizations, such as energy waste, ineffective internal costs, failure analyzing customer needs, control supervising, etc.

4.1.3 The six phases for implementing the Kaizen philosophy

The implementation of kaizen is based on the Deming Cycle as a tool to achieve continuous improvement: PDCA (plan, do, check and act). These are the steps to follow to implement the kaizen philosophy in the organization:

1) Selection of the topic: it could be productivity (time improvement), quality (customer requirements) or safety (accident reduction).

2) Creation of a work team: the team should be multidisciplinary, so that all of them contribute with the knowledge and experience of their work area.

3) Data collection and analysis: it aims to determine the root causes to fix the problem. Different tools are used, such as Pareto diagrams, Ishikawa diagrams, flowcharts, histograms, scatter charts, etc.

Gembutsu Gemba is part of the data collection, consists of going to the area where the problem occurs and verifying the data obtained in the previous phase together with the people working in that area.

4) Action plan: it is necessary to take countermeasures for those problems that are critical for the improvement of the organization's process, which will be recorded in a plan that includes dates to implement them and those responsible for their execution.

5) Follow-up and evaluation of results: the team will keep track of the problem by means of charts and if necessary will perform the previous steps again for verification in the work area.

6) Standardization and expansion: after several months with good results, the problem is defined as being under control and recorded so that the changes introduced can be used later.

4.1.4 Examples of the Kaizen methodology

Examples of application based on the Kaizen philosophy could be the establishment of:

- Meetings of employees and bosses. A good example of Kaizen would be to establish regular meetings between employees and managers to analyze and resolve existing conflicts.
- Organization of work in groups: another of the Kaizen methodologies that can lead to success at work would be the organization of work in small groups that perform different tasks or projects, thus ensuring greater involvement of workers.
- Goal setting: the main highlight of the Kaizen philosophy is the establishment of a common goal, so that all workers join forces and strive to achieve it.

Particularizing on a practical example, for instance, in a furniture factory, an area leader decided to implement the Kaizen method to optimize the workspace.

- He made a request to the company's board of directors and thus succeeded in creating a work team with the heads of different areas.
- Together, they defined the objective of making the workspace more hygienic and organized during the workday. They sought to make a significant change in two months or less.
- They asked their colleagues for their opinions and at the same time took photographs of the state of the factory during a normal working day.
- They classified the levels of order and hygiene as "neat", "acceptable" and "not adequate".
- They generated organizational strategies for each workstation. With the help of a budget, they added utensils and shelves to maintain order.
- Over the course of 3 weeks, they documented and tracked the results obtained in each area. They optimized the processes that did not work and reinforced those that did.
- They documented the process to be followed at the workstations and took the results to the board of directors.

4.2 The Six Sigma methodology

Due to globalization, organizations in the industrial and commercial sector began to develop techniques to optimize processes and improve their competitiveness and productivity. This methodology, like Kaizen, also focuses on continuous improvement. Based on the statistical concepts of Shewart, Deming, Juran and Taguchi, Six Sigma provides short-term solutions to repetitive problems. It is composed of a robust design as well as establishing tolerances to define a standard and to know which products have or do not have enough quality to go to the market. In recent years, this methodology is being used in service sector organizations with very satisfactory results.

Six Sigma is a methodology based on five principles, those are: customer focus, processes focuses, methodology for the realization of projects, organizational structure and fight against variation.

The Six Sigma methodology focuses on the processes improvement focusing on the critical aspects for the customer. By measuring the different processes reducing the number of defects so that the production and/or service provision can continue in a normal way (under control).

From a statistical point of view six Sigma is a metric that allows you to measure and describe a process, product or service with extremely high process capability (99.9997% accuracy). Six Sigma means "six standard deviations from the mean", which mathematically translates to less than 3.4 defects per million opportunities (3.4 DPMO).

4.2.1 The levels of the Six Sigma

The classic organization of a Six Sigma Program in an organization consists of at least the following 5 profiles or levels of qualification on the methodology:

1.- Champion. Is the manager responsible for the program. Supervises and sponsors the Six Sigma Program. It does not need to be an expert in statistical tools, enough knowing the fundamental.

2.- Master Black Belt, MBB. Expert in advanced statistical and quality management tools. Is the mentor of the black belts. Coordinates the various improvement projects.

3.-Black Belt, BB (black belt). Specialist in advanced statistical tools and quality improvement tools. Responsible for a Six Sigma project. Usually is dedicated only to improvement projects.

4.- Green Belt, GB (green belt). Trained in basic statistical and problem solving tools. Performs "production" activities and may support the black belt in data collection, etc.

5.- Members of improvement teams. Personnel related to the process and assigned temporarily to projects and on a part-time basis.

To designation of each of these roles is accompanied by an intensive training program. Along with good training, possibly another cause that has facilitated the success of Six Sigma has been this hierarchy of improvement responsibilities. Nowadays, more belts are appearing (for example, yellow belts).

4.2.2 Six Sigma DMAIC/DFSS projects

There are two types of Six Sigma projects, DMAIC and DFSS projects. DMAIC projects are whose main objective is the improvement of existing processes, products and services. While DFSS projects are those applied to the creation of a new innovative project, product or service.

4.2.2.1 DMAIC Methodology

The application of Six Sigma to the improvement of processes is the most common and is usually known as DMAIC (Define, Measure, Analyze, Improve, Control). The DMAIC implementation has a clear relationship with the classic PDCA (Plan-Do-Check-Act) improvement cycle of Shewhart-Deming.

Define. The process to be improved must be defined in detail, defining their objectives and the existing constraints, arriving to an unambiguous definition of the requirements to be met (customer's expectations of the process). Requirements must be analyzed and hierarchized and also be measurable.

Measure. To identify the source of the problem as precisely as possible. This objective could not be achieved without data. Basically, there are two possible strategies, one taking data from the normal operation of the process and the other is to investigate the process behavior by varying the operating parameters of the process using statistical design of experiments (DOE) techniques.

Analyze. To identify the problem source as precisely as possible. The solution must be supported by data, being based on the application of the "scientific method" to reach conclusions. The statistical techniques to be used vary according to the cases, but in most cases it can be enough to use simple techniques of descriptive statistics (Exploratory Data Analysis) and regression analysis.

Improve. To demonstrate with data that the proposed solution solves the problem and represents an improvement, also use statistical tools. It involves the implementation of the "solution", verifying whether the results are better than the "old" ones and arriving at the final optimization.

Control. The objective of this phase is to ensure that the improvement is incorporated into normal operations. Without this phase, all of the above would be for nothing. Once this phase is completed, the project is closed and the improvements achieved are quantified.

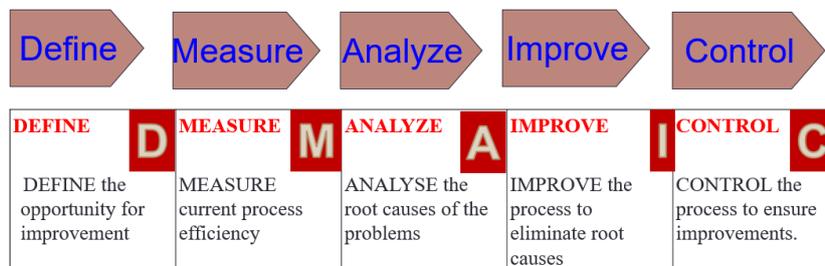


Figure 2. Steps of the DMAIC methodology.

4.2.2.2 DFSS projects

It is well known that there can be no good quality if there is no good design. The idea of DFSS (Design For Six Sigma) is to anticipate at the design stage in order to eliminate or neutralize the causes that can lead to nonconformities. However, DFSS does not reach a level of methodological detail comparable to DMAIC. Possibly because of the heterogeneity of situations that can be found under the word "design" (model of car, telephone, insurance policy or fire-fighting system). DMAOV is probably the most widespread and is an adaptation of DMAIC to a design process. For this reason, it works well when applied to the design of new processes.

- Define (D), the objective of the project is to set the guidelines to reach the purpose.
- Measure (M), to know what features should be differentiating from the rest, so that the customer's need is covered in a personalized and outstanding way.
- Analyze (A), it must be ensured that all components of the project team are going in the same direction, so the definition in more detail about the product continues.
- Optimize (O), the review of the product is carried out, detecting possible failures and giving them solution. Then a more uniform product is created, reducing the error rate or variability.
- Verify (V), the final approval and transmit the method of implementation of the product/service.

Other DFSS methodologies are the IDOV (Identify, Define, Optimize, Validate) or the DCCDI (Define, Customer, Concept, Design, Implementation), etc.

4.2.3 Examples of the Six Sigma methodology

Examples of typical six sigma projects in industry (plastic, automotive, pharmaceutical, packaging, chemical, etc.) could be to reduce machine downtime, to minimize welding defects of components, to minimize the variability of dynamic scales or to reduce the number of quality controls, among others.

Examples of typical six sigma projects for services companies (banks, administrative processes, hospitals, restaurants, etc.) could be to optimize the delivery time of offers, to minimize claim handling time, to maximize customer retention or to minimize costs associated with spare parts provisioning.

Application of the six sigma methodology to clean your garage. Suppose that you buy a new motorcycle and want to store it in your garage. Applying Lean methods or the DMAIC approach:

- Define: You need to make space in your garage. This means you will need to clean it out; just the garage and not the house, the scope of the project.
- Measure: Identify, collect and write down the data needed, calculating the square meters of the garage and the available area. You can set a target meters needed to park the motorcycle.
- Analyze: Identify what are the types and quantities of materials and storage spaces available.
- Improve: Organize your cleaning process. You can help yourself with the Kaizen methodology, eliminate useless material and, ultimately, install a new bin to minimize floor space.
- Control: Label storage locations and conduct weekly audits to ensure that things do not pile up.

5. Closure

The Kaizen method is a business management strategy that describes the improvement of organizational processes at all hierarchy levels of a company. Its objective is to implement improvements and reduce inefficiencies to build an efficient and productive environment that increases the competitiveness of companies.

The Six Sigma is a very effective methodology for the improvement of processes, products and services that bases decisions on statistical criteria. Its objective is the profit improvement. It uses statistical tool as major diagnosis and analysis tool. The successful application of these tools requires a mix of statistical-mathematical rigor and practicality. It is complementary and feeds positively with ISO 9000 and EFQM.

The application of Six Sigma to the improvement of processes is known as DMAIC (Define, Measure, Analyze, Improve, Control) methodology, these are the most usual 6σ projects.

The application of Six Sigma to the design phase of a new product or service is the DFSS (Design For Six Sigma). It does not reach a level of methodological detail comparable to DMAIC, since the word “design” covers very heterogeneity situations. There are several schools into DFSS methodology, being DMAOV probably the most widespread, it is an adaptation of DMAIC to a design process.

The major differences between Kaizen and Six Sigma are:

- Six Sigma uses technical data aimed at resolving product deviations and Kaizen focuses on improving the work environment, which has a positive impact on overall performance. Six Sigma uses statistics for corrections, and Kaizen uses emotions to solve employee problems. Six Sigma leans more toward standardization, and Kaizen believes in organization.
- Six Sigma is mainly used for innovative and radical continuous improvements, looking for solutions that address the causes of the problem to be addressed, while Kaizen, is more intended for daily continuous improvements and maintenance activities and sustainability of the standard processes, looking for adjustments and solutions to problems or deviations that may occur in the day to day.

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