Undertaking ~~Learning~~ Kaizen 2

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Undertaking Learning Kaizen 2

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PREFACE

The purpose of this book is to complete the contents of Undertaking Kaizen (2019) and, once again, to transmit what we believe to be the pillars for the application of KAIZEN, providing analytical and practical tools, and offering a clear view on how organizations can face the realities of production.

In these five chapters, we intend to help develop KAIZEN skills by means of practical instructions in the company, which consist in identifying opportunities for improvement, eliminating waste, establishing standards by consensus, defining and monitoring indicators —all this, in the context of continuous improvement.

Improvement entails analyzing, thinking, re-thinking, and, most of all: acting. Here, "acting" is understood to mean the performance of an action that makes a change and leads us to a new and better stage. The use of specific methodology ensures success and positive results. We can learn KAIZEN by considering certain concepts and, most of all, by putting them into practice through transformative tools and methodologies.

With these tools, we intend to help improve individual skills and we expect to contribute to the creation of a work environment full of communication, social integration, and better process development. Nevertheless, we believe this book will be useful to understand the mechanisms for detection, measurement, problem solving, prevention, and elimination of different types of waste in the systems and the processes of an organization. The results that can be achieved will have a powerful effect and give rise to a new way of working.

INTI - Management Technologies | MAR. 2021

NOTE ON LANGUAGE USE:

Taking into account that, today, INTI's Management Technology Network is composed of male (56%) and female (46%) consultants, and that the use of language should account for this composition, we decided to adopt a genre-based approach to writing. In the absence of an agreement on how to do it in Spanish, and for the purpose of avoiding discussions centered on the format, rather than the content of this book, we opted to use the feminine-generic form in chapters 1, 3, and 5, and the masculine-generic form in chapters 2 and 4. We hope that this approach contributes to raise awareness among the readers and to use the language more fairly and accurately throughout this book.

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CHAP. #1:
MANAGING CONTINUOUS IMPROVEMENT

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INTRODUCTION

It is impossible to talk about Kaizen without mentioning Continuous Improvement, as it is the core of this book and is present in each of the following chapters.

By way of a general overview, three aspects of Continuous Improvement can be set out: first, it aims at improving the products, processes, and services of an organization; second, it is based on the identification of production problems that are considered "opportunities for improvement"; and third, it is implemented to stabilize production processes through standardization of daily activities and operations, as well as to detect and eliminate any eventual deviation.

The trigger question is how to manage Continuous Improvement to achieve the two elements of this concept: to improve and continuously. Sometimes, organizations work in a continuous manner but, instead of carrying out improvements, they repeat errors that lead to production loss, product accumulation, and reprocessing; other times, they execute improvement processes that have a positive impact on product quality, lead time, work organization, but these are isolated and occasional actions performed by a sector or area that fail to consolidate as a substantial change.

A company where improvements are not isolated events, but part of the daily routine is a company that has internalized the concept of Continuous Improvement. In such daily routine, there are visible aspects as well as invisible or not immediately apparent aspects. The **visible** ones are tangible and easy to identify. These are the practices, the principles, and the tools. They provide evidence that Continuous Improvement is implemented. As to the **invisible** ones, even though they are not evident, they are equally important, since they are part of the structure that supports all improvements. These are the integration of improvement management and the development of habits —two essential elements for Continuous Improvement to become the basis of a corporate culture. The **invisible** aspects guarantee the internalization of Continuous Improvement in the organization, making it more sustainable over time and bringing long-term benefits.

1 .
Continuous Improvement

1.1. The Beginnings

In a globalized and a more and more competitive world, companies need to administer and manage actions that help them improve their business. Continuous Improvement includes concepts and practices that enable organizations to optimize processes and products, as well as increase profitability and market positioning.
Thus, Continuous Improvement is essential to reach total quality, internal competitiveness, and the comprehensive development of companies.
At an early stage, Quality and Continuous Improvement followed two similar paths, as explained below; however, the concept of Continuous Improvement spread all around the world.

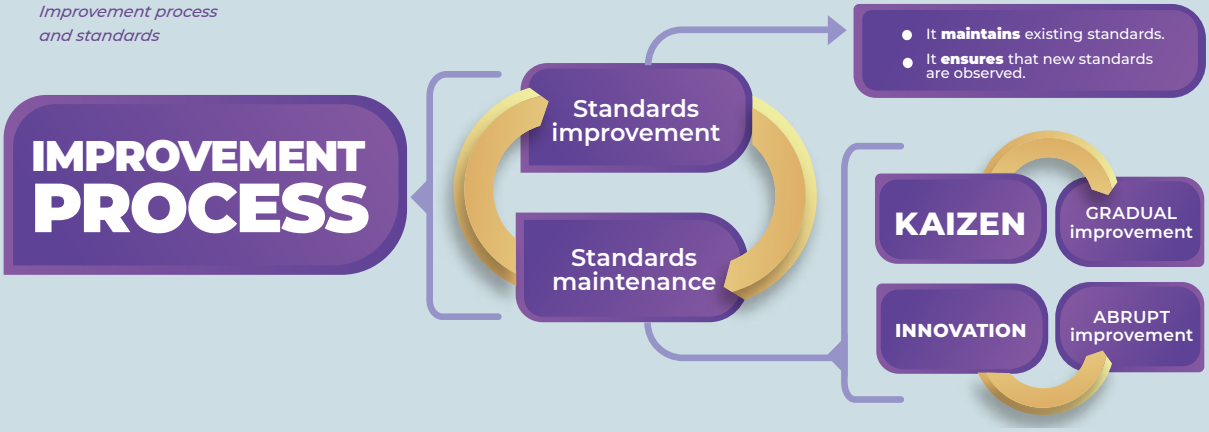
In the United States, during the 1930s, Walter A. Shewhart carried out important studies on statistical techniques to control processes and create methods for improvement, which were later perfected by Edwards Deming and other Japanese scientists and engineers (and named the Deming Cycle in Japan). The Deming Cycle is also known as the PDCA Cycle: Plan, Do, Check, and Act. After perfecting the method, Deming implemented many quality management systems and promoted them widely.
In the West, companies used to focus on the results and the efficiency of the processes.

In Japan, around 1950, Deming, acting as a consultant, trained statistics experts to improve product quality. In 1954, another consultant called Joseph Juran traveled throughout that country to introduce quality-management-related concepts, and the Japanese community applied those concepts to the management of their companies. New tools followed, which represented a qualitative improvement in Statistical Quality Control and the Improvement Cycle, both introduced in Japan by Deming.
Japan focused on processes and people. This way, Continuous Improvement started to develop there under the name Kaizen.

According to Continuous Improvement principles, all the processes can be enhanced by applying the Deming Cycle.[1] Continuous Improvement allows for the optimization of resources, contributes to their efficiency, and makes them sustainable over time. This is how Continuous Improvement is structured:

The improvement process consists of alternating activities. On the one hand, there are activities related to the maintenance of existing standards, which are those that the organization must follow. On the other hand, there are activities that favor the improvement of standards, which can be carried out through gradual changes (Kaizen) or abrupt changes (innovation).
Problems are the working basis of Continuous Improvement. For improvement activities to be carried out in the daily routine of a company, a problem needs to be identified; that is to say, **"something needs to be improved".** Any problem requires a solution and, based on that, it requires standardization to avoid repetition.

FIG.1
Improvement process and standards



1.2. Kaizen: The Value for Clients, Suppliers, and Companies

In a first instance, Continuous Improvement aims at identifying the activities that are necessary or unnecessary in a company, based on the assessment made by the client. Unnecessary activities are those that can be worked on to either reduce or eliminate them as much as possible, as they generate a cost that the client is unwilling to pay. However, irrespective of the client perspective, other parties are interested in improving corporate productivity: the suppliers, who are part of the production chain, and the company's workers.

This leads to the conclusion that, when it comes to generating value at the workplace, focus should be not only on the client, but also on the process and on every intervening party, being clear —at each stage and in each position (and even outside the company)— about which value the company generates for its workers, suppliers, shareholders, and society in general.

In this sense, it is very important to understand the values and principles that form the basis of Continuous Improvement, which ensure the commitment and motivation of each of these parties.

Workers will commit themselves to a Kaizen program if it solves their everyday problems and contributes to the improvement of processes and the transformation of their labor relations, their work environments, and the supervision, support, and efficiency in the performance of their duties. Thus, personnel are empowered and make performance-enriching decisions.

[1] Parenti, Agustina, et al., (2019). Undertaking Kaizen, (chap. 1), INTI.

Apart from benefiting the workers, any such program has a positive impact on the suppliers, who will plan to implement Kaizen in their processes provided that they see good results. Even though the implementation of Kaizen by suppliers does not need to be simultaneous with that of the company, the requirements imposed on them will certainly change. This is a good opportunity to channel efforts into the implementation, identify mutual benefits, and generate an expansion wave based on the convenience of dual application.

Continuous Improvement may have a very positive and relatively fast impact on the supplier. However, for the supplier to adopt Kaizen techniques, the relationship with the company must be correctly managed.

This close relationship between the value for the client and the value for all the parties involved needs to be appropriately managed and maintained over time, integrating all the corporate areas.

1.3. A Cultural View of Continuous Improvement

1.3.1. The Corporate Culture

We may think of a company in terms of the products or services it offers, the technological aspects, or the business environment, but we should not overlook the importance of its relationship with the suppliers, clients, and workers. Taking into account that Kaizen focuses on processes and people, and on corporate management, the corporate culture needs to be identified and considered.

The corporate culture[2] may be defined as a set of shared concepts or a system of shared values and practices resulting from the daily interaction of different members of the company. The corporate culture determines how workers perceive reality and how they react to it —how a problem is addressed, defined, analyzed, and solved. So, *the culture represents "the way things are done" in a specific place.*

Kaizen is a philosophy; that is to say, a way of thinking and acting. It consists of a series of techniques and practices that must be daily applied at the individual and team level. It will be integrated into the corporate culture if and when its values and beliefs are developed and shared. And said values and beliefs will become habits only if they are deemed to be useful for problem solving by the members of the organization.
This aspect of Kaizen, linked to the corporate culture, needs to be worked on.

Developing an appropriate corporate culture will improve the company's performance, the workers' commitment, and will reduce turnover. For that purpose, it is suggested that a sense of belonging and of a common goal by encouraged by the leaders, and the interaction among the members of the company be increased through participative decision-making processes and group coordination, among others. The Senior Management as well as the managers of all levels are those who can favor the development of a participative culture by implementing Kaizen.

In this sense, **Kaizen** requires the Senior Management to:

1. Work on the culture change needed, *by planning its implementation and development, and committing to change the way things are done*

2. Overcome the resistance to change, *by contributing to problem solving, recognizing and promoting the achievements.*

[2] Robbins, Stephen; Coulter, Mary, (2004), Management (5th ed., chap. 3), Pearson

1.3.2. Resistance: Observing Before Intervening

It is necessary to pay special attention, identify which places and persons show resistance, and take time to work on it. The commitment of Management and the involvement of the leaders are essential to develop a Kaizen strategy that clearly sets the goals and integrates improvement tools in the company. This will lead to new workplaces, comfortable environments, and better working conditions, which are the pillars for the development of new behaviors and attitudes among the members of the company.

FIG.2
Resisting

Each improvement action entails a resistance to change. Evidence of this are expressions such as:

- **"WE HAVE ALWAYS WORKED SO WELL..."**
- **"JUST ANOTHER USELESS ACTIVITY..."**
- **"THIS IS NOT MY RESPONSIBILITY..."**
- **"I HAVE NO TIME, BECAUSE I'M VERY BUSY..."**

We suggest working on six aspects to favor the culture change.

1. Change is a strategic priority: the goals of each company level must be clear.

2. Addressing two types of changes: on the one hand, daily Kaizen, which helps us work on everyday improvements, promoting and activating changes; and, on the other hand, Kaizen Projects, which deal with the long term.

3. Using a pilot area: starting on an area with committed leaders that has a positive impact in other corporate areas and motivates them to work on Continuous Improvement is recommended.

4. Changing behaviors little by little: the improvements proposed by the workers must be considered and carried out per area and recognized. Recognition is essential to motivate people. Audits will help to keep the good results.

5. Empowering workers so they can identify problems and propose solutions.

6. Training people in Continuous Improvement so they understand its usefulness, its importance, and the tools necessary for implementation.

1.3.3. The Importance of Learning

The Senior Management must include Kaizen in the strategic agenda, since its implementation will lead to the solution of problems affecting any and all individuals in the company.

Taking into account the above-mentioned cultural aspect, the Senior Management must set Kaizen goals and make available the time and the resources necessary for working on them.

In a first instance, the most relevant problems will be selected, the actions needed for solving them will be defined, and important results will be timely informed as they are obtained. In consequence, resistance to change will decrease, and Kaizen will be integrated into the corporate culture as a useful and practical tool.

Simultaneously, the Senior Management must guide all the members of the company through Kaizen. Kaizen will become a kind of training, based on use cases and real experiences that produced good results. The Senior Management must devote time and resources to train personnel.

Thus, Kaizen will serve not only as an extremely useful tool for problem solving, but also as a systematic and collective learning method, empowering all the members of the company and enabling them to participate in the management and the decision-making process. For that purpose, each member must be aware of the goals, the motivations, the process, and the results of the application of Kaizen.

Therefore, ***Kaizen involves all the members and areas of the organization.*** This guarantees a comprehensive implementation and management, and a participative culture. To have any such participation, it is essential that a Kaizen Committee be created, which must include the Senior Management, managers of all levels, and workers, so all the interested parties are fairly represented.

1.4. Internal Organization

1.4.1. Matrix Modality

A matrix organization is the combination of cross-functional organization and functional organization. Functional organization (such as production, procurement, finance) is considered the typical way of managing companies in western countries. Its characteristics are vertical target deployment and little communication among functions. Cross-functional organization is less frequent. Its main feature is the creation of teams, the members of which come from different corporate areas and report to a leader and to the functional leaders of each area.
The team collaborates with the whole organization, coordinating functional and joint efforts to reach the improvement targets throughout the company.

The matrix management modality was especially developed in the East[3] in response to the companies' need to focus on certain strategic and relevant strategies, common to all functional areas.

[3] Imai, Masaaki, (2001), Kaizen, la clave de la ventaja competitiva japonesa (13th ed. Reprinted), Compañía editorial continental.

1.4.2. Kaizen Committee: Composition

The implementation of Kaizen in the company requires the creation of a committee, which shall be in charge of coordinating Kaizen actions to reach the improvement targets proposed.

The Kaizen Comittee[4] is a permanent working group, composed of individuals from all areas and levels of the company. It manages improvements cross-functionally. Other responsibilities are ensuring correct implementation, giving support during process development, and favoring permanent coordination and communication among the different areas developing Kaizen.

The existence of a Kaizen Committee does not release the leaders from their responsibility to improve their respective functional areas, but it complements it, because it serves as a guide for them to apply the same strategy as the company.

By managing improvements through a matrix modality, the goals of each functional area are in line with the strategy of the whole company.
As the Committee represents all areas and levels, the commitment to a Kaizen program is higher, and communication among functions —necessary for Kaizen groups to work— is easier to coordinate.

It is recommended that the Committee be composed of a coordinator, group leaders, facilitators, auditors, and members of improvement groups. The condition to become a member of the Committee is to actively participate in Kaizen activities, so as to be able to share the experiences.

FIG.3
Responsibilities of Kaizen Committee

[4] See Criterios del Premio Nacional 5S. See also Rosso Julián, Gariglio, Alejandro (2016), Guía de Buenas Prácticas de Implementación de 5S, INTI, and Dorbessan, Ricardo, (2006), Las 5S, herramientas de cambio (chapter 4), Editorial Universitaria de la UTN.

1.4.3. Kaizen Roles and Functions in the Company

To implement Kaizen, we suggest organizing and distributing the functions, which requires the performance of certain roles.

SOME OF THEM ARE LISTED BELOW:

1. MANAGERS

They act as Kaizen coordinators in the areas headed by them, administering the resources and promoting improvement project goals in their areas of influence.

2. FACILITATORS

They are in charge of promoting the continuous improvement process, supporting actions and monitoring Kaizen implementation procedures.

Facilitators are responsible for promoting the development of new skills and collaborating with people so they show all their potential.

To achieve this, we suggest that they have the following qualities and attributes:

- **Knowing the improvement tools and being able to explain them and/or transmit their knowledge**
- **Being strongly committed to and convinced of the execution of the improvement project**
- **Having teamwork skills**
- **Being proactive**
- **Creating and keeping a channel of communication with the Senior Management, informing on project progress and solving any difficulties that may arise**
- **Being sufficiently motivated so as to promote and support the project throughout its development and execution**

3. PLANT PERSONNEL

They form Continuous Improvement groups and perform the improvement actions proposed by them.

4. THIRD-PARTY EXPERTS

They may be necessary, mostly, at the beginning, during project launch. However, they also play an important role ensuring that the improvement process is up to date throughout its development.

1.4.4. Meetings and Minutes

Planning and communicating the Kaizen Plan is necessary to provide the plant personnel with the support they need to perform their duties. To succeed in the implementation of the Kaizen system, the whole organization must be aware of the progress and the improvements. A key factor is the inclusion of different communication channels that facilitate an awareness-raising, visibility, and sensibility strategy, such as:

• Informative e-mails • Boards • Reading material
• Conferences intended to personnel • A3 reports

It is extremely important to communicate each stage of Kaizen implementation, including all Kaizen suggestions[5] adopted, the audit results, and the progress of ongoing projects.

Kaizen events, such as annual launches, meetings held to review results and recognize achievements, are appropriate. Allowing some time to talk about Kaizen during events scheduled by the company is equally appropriate. In meetings of the Management and of each area, Kaizen must be formally addressed as any important agenda item.

FIG.4
Board example

5 Kaizen suggestion: a tool for managing continuous improvement through which any company worker may suggest improvements for their assessment.

FIG.5
Dashboard example

1.5. Daily Kaizen and Kaizen Projects

These are the three pillars we can work on to be able to implement and maintain a continuous improvement system in the company:

- **TRAINING LEADERS ON THE CONTINUOUS IMPROVEMENT PROCESS:** It consists in training people who will facilitate the corporate change and will contribute to modify behaviors for the purpose of giving rise to a new way of working.
- **DAILY KAIZEN:** Improvements will be executed and promoted by frontline workers. The supervisors and middle managers act as coordinators and evaluators of improvements.
- **KAIZEN PROJECTS:** They aim to make big improvements in process efficiency and to involve the Senior Management as coordinators and the middle managers and plant personnel as executors.

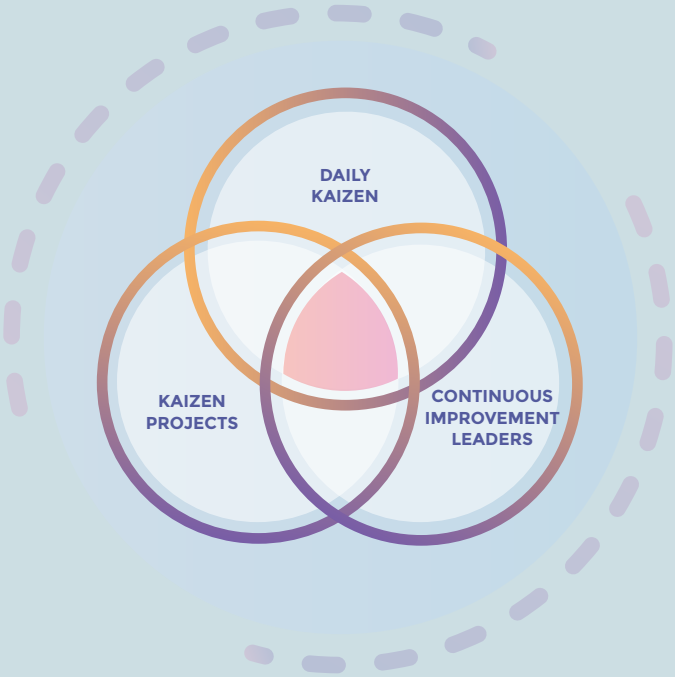


Figure 6 shows the interrelation of these three pillars, which enable the implementation of Continuous Improvement in the company.

FIG.6
Kaizen pillars

1.6. Scenarios for Action in Companies: From a Traditional to an Enhanced Organization

The company must gradually change its management scheme. It must move from the traditional scheme, which is currently in force, to a Continuous Improvement scheme. In this way, the company will succeed in integrating Continuous Improvement to the corporate culture and will increase the number of people working on, contributing to, and developing Continuous Improvement concepts.

As Masaaki Imae said in his book, ***"Kaizen: The Key To Japan's Competitive Success"*** under the traditional scheme, as shown in figure 7, a company devotes around 80% of the available time of workers, department heads, supervisors, and managers to the daily management and to "put out fires" (solving urgent problems). Only around 20% of the time is devoted to planning, projecting, and adding value.

In general, in the organizations, things are not properly anticipated; instead, they are dealt with as they happen. Improvements are only considered in terms of innovation, not in terms of small and regular changes that workers propose and apply.

Under the Continuous Improvement scheme, as shown in figure 8, the available time of workers, supervisors and managers is devoted to solving problems through the use of improvement tools with the aim of standardizing positive results and measuring deviations.

FIG.7
The process of change in a traditional organization. Time allocation based on corporate roles and activities. (Reference: Kaizen: The Key To Japan's Competitive Success)

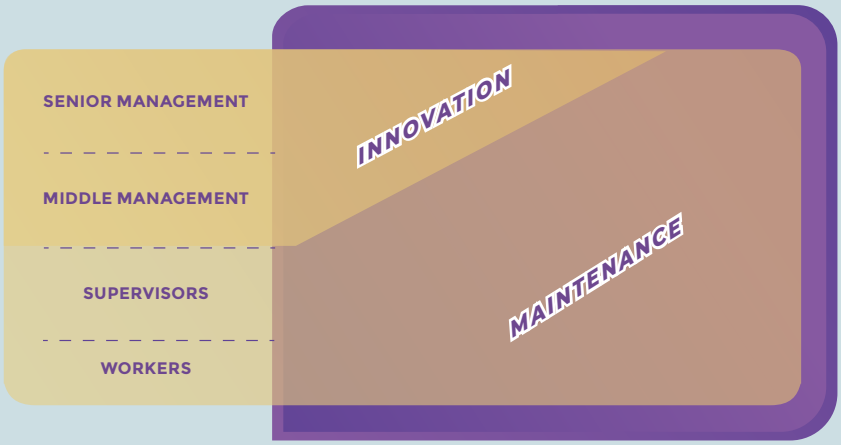
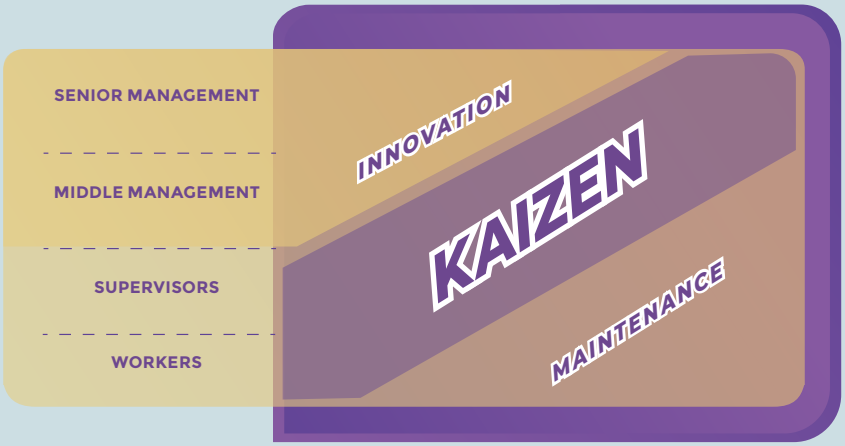


FIG.8
The process of change in an enhanced organization. New time allocation based on roles by adopting Kaizen (Reference: Kaizen, la clave de la ventaja competitiva japonesa. Masaaki Imai)



In consequence, the company stops “putting out fires”, as it has a standardized operating scheme under which 80% of work is defined and only 20% is devoted to problem-solving tools.

To switch from one model to the other, the company must trust the workers, allow them to participate, and train them to use improvement tools, since workers are the ones who add value in the plant floor (GEMBA, as called in Japanese).

Means of implementation refers to the manners to promote Kaizen activities, such as:

- **Training staff in loss detection**
- **Training staff in problem solving**
- **Training staff in teamwork**
- **Determining the amount of hours per week necessary for Kaizen meetings**
- **Training staff in the importance of making suggestions**
- **Structuring suggestion collection mechanisms and forms**
- **Appointing suggestion evaluators per area**

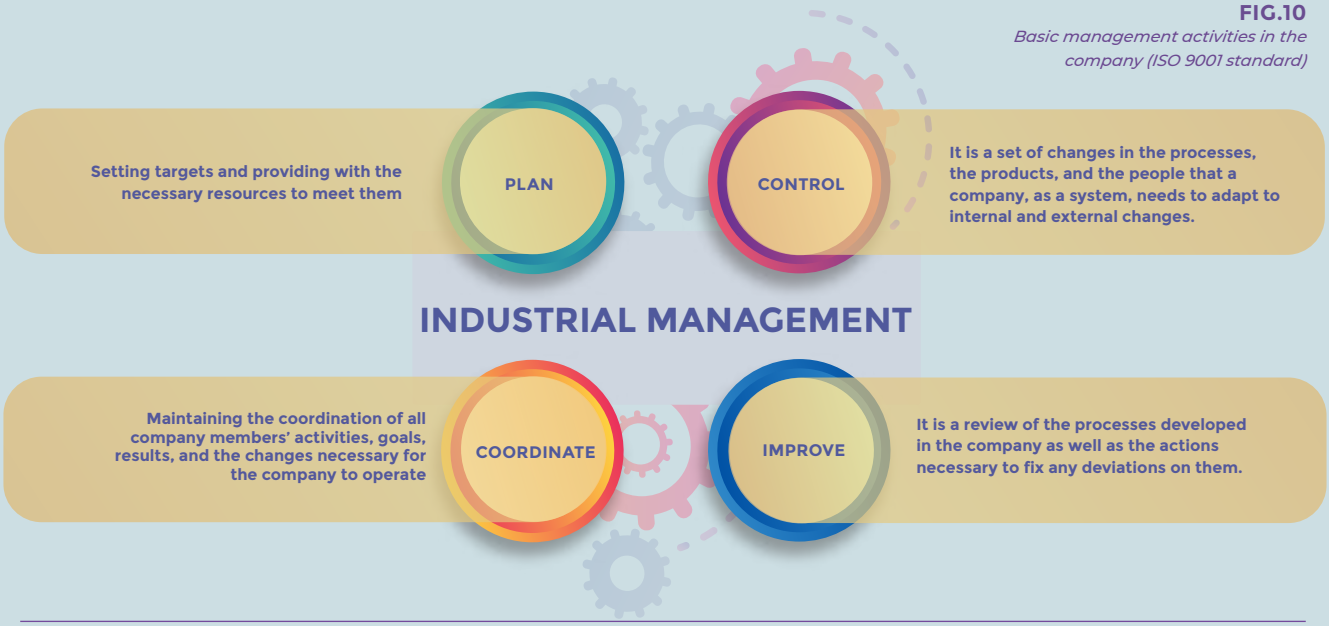
FIG.9
Distinctive features of Kaizen

2 . Managing Continuous Improvement

2.1. Definitions for the Implementation

Industrial Management may be broken down into four basic activities or categories, which are the typical concerns of any manager.[6] These are relevant to understand their responsibilities and can be summarized and grouped in: planning, coordinating, controlling, and improving.
The following figure shows the most important aspects of each one.

FIG.10
Basic management activities in the company (ISO 9001 standard)



[6] To produce the basic management activities graph, we took into account ISO 9001 standard, which mentions the four aspects of quality management: planning, control, improvement, and assurance (in the graph, this term was replaced by coordination, because it is more similar to general management). However, management is not limited to quality; in fact, it includes all company functions. We also took into account how Robbins and Coulter deal with managers' concerns in their book Management, 5th edition, Pearson publishing company, chapters 1, 7, and 12. In chapter 1, the authors mention four managerial activities: planning, organization and supervision (both included in this scheme under organization), and control. They highlight the importance of corporate change, which is developed throughout chapter 12. Moreover, the book Supervision, Managing for Results, of W. Newstrom, 9th edition, Mc Graw Hill, deals with these important activities in chapters 1, 3, 4, and 6. Chapter 1 divides the managerial activities in a higher number of stages. Here, they are summarized in three for simplification purposes (planning, organization, and control), plus the improvement, discussed in chapter 4.

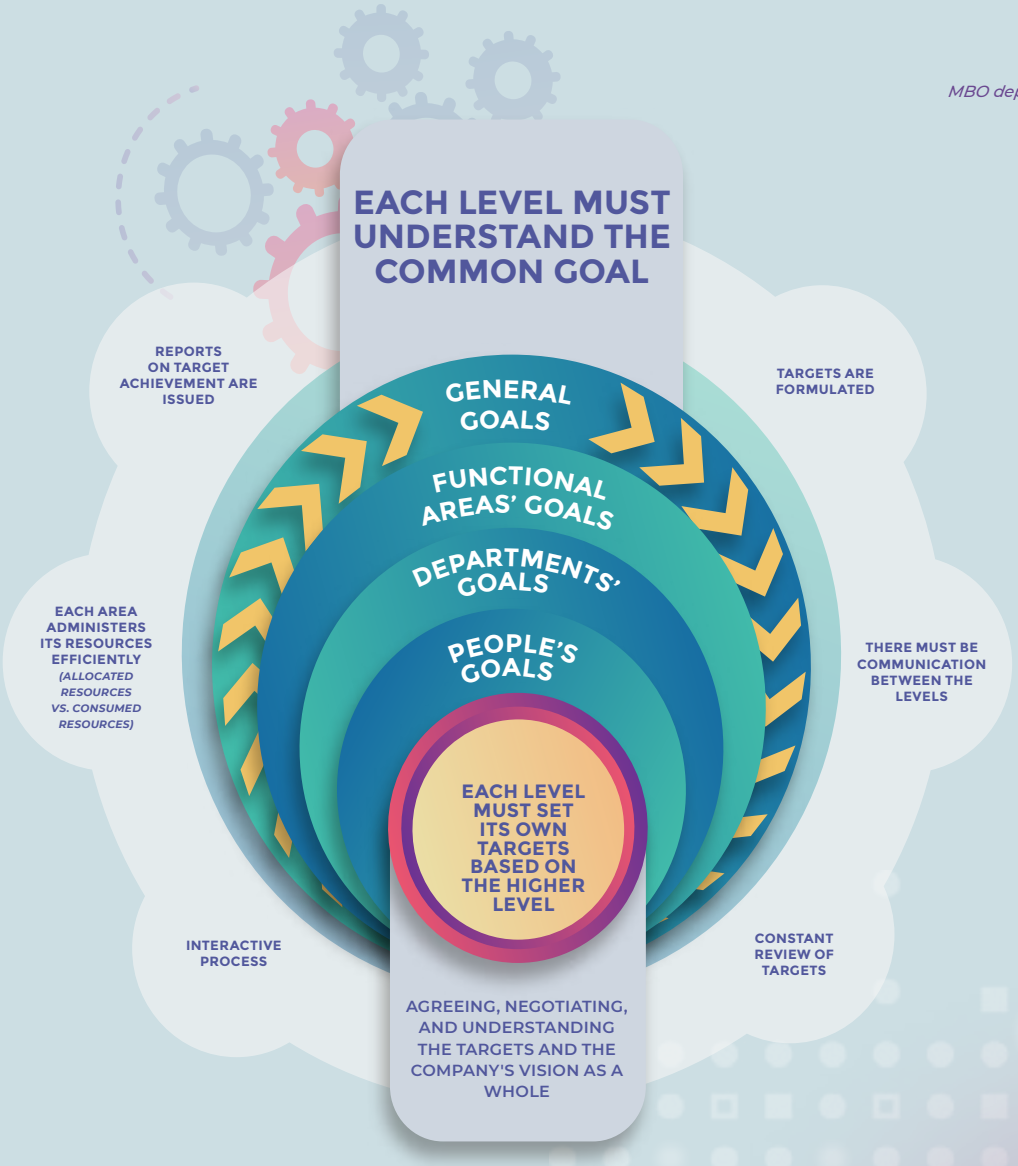
These stages are present in all the organizations to a greater or lesser degree, based on history, structure, evolution, and culture, among others. The implementation of Kaizen must be done considering these four important aspects. Ideally, it must be done “anytime and anywhere”.

In the West, companies tend to apply functional management and the Management by Objectives approach. Each level, starting from the Senior Management, formulates its objectives and cascades them down to the operational levels of each function for their implementation.

2.2. **Management by Objectives:** The Western Vision

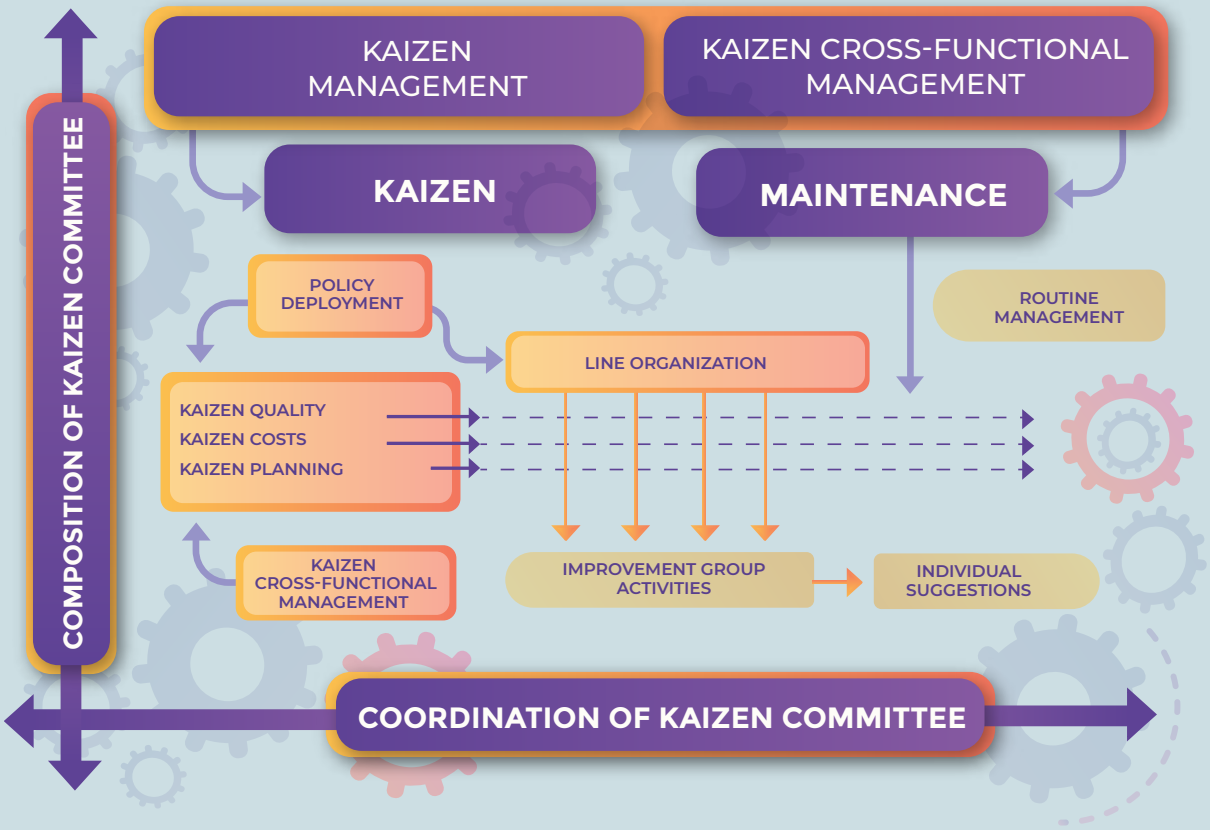
Management by Objectives (MBO) is one of the most extended and accepted theories when it comes to interpreting the strategic development process of a company. According to it, an organization is divided into levels. The Senior Management is in charge of setting the general goals to be reached. Then, each lower operational level will set its own targets, based on the immediate higher level. In Japan, companies use a variant of this planning modality (MBO), called Hoshin Kanri.

FIG.11
MBO deployment



According to Masaaki Imai, Japanese companies apply Kaizen as well as cross-functional management. The following figure shows some characteristics of both schemes, which, if combined, allow for the management of Kaizen throughout the company.

FIG.12
Kaizen and maintenance management, and their application in different company levels.



Based on this information, **how is Continuous Improvement managed throughout the organization? How is Continuous Improvement managed in each functional area, with all individuals involved?**

2.3. Kaizen Planning

As any formal corporate activity, Kaizen requires planning. This step is necessary for the execution of activities and their subsequent control and improvement.

There follows a summary of the steps necessary for simple a Kaizen planning:

0. COLLECTING INFORMATION

1- It observes all the common problems the organization had during the previous year and determines priorities.

2- It makes a vertical and preliminary consultation to each functional area to know and understand all the problems.

3- It evaluates the degree of success of the plan of the previous year.

RESPONSIBLE **COMMITTEE**

1. ESTABLISHING KAIZEN PURPOSE FOR THE CURRENT PERIOD

At this stage, the Owner/Director of the organization must think of the results they wish to obtain by improving some aspects of the organization.
That is to say, the expectations about Kaizen for the next period must be expressed by way of a qualitative "motto".

RESPONSIBLE **CHIEF/ DIRECTOR**

2. TRANSLATING THE KAIZEN PURPOSE INTO GOALS AND DIRECTIVES

At this stage, the adaptation of the Kaizen Purpose of the Senior Management to the responsibilities and functions of each lower area is understood.

Cross-functional Kaizen Goals regarding Improvement, Quality, Scheduling, and Costs are set.

RESPONSIBLE **COMMITTEE**

3. ESTABLISHING INDICATORS AND A MONITORING FREQUENCY

INDICATORS:
They answer the question: How do I know if I am meeting the goals?

MONITORING:
A document is issued for the auditor to control progress.

RESPONSIBLE **COMMITTEE/ DEPARTMENT HEADS/ MIDDLE MANAGERS**

4. ESTABLISHING SPECIFIC ACTIONS

Once methods and measures are defined, supervisors must establish the actions that will be performed by the team to meet the objectives.

RESPONSIBLE **DEPARTMENT HEADS/ MIDDLE MANAGERS/ SUPERVISORS**

FIG.13
Suggested steps for Kaizen planning

0- Collecting Information

It is necessary to gather information from all company levels. Based on the information collected, the Senior Management will determine the main corporate needs for change and improvement, define the annual goals and plans, and communicate this to all individuals.

The items below must be considered in order to define and plan a suitable Kaizen Purpose:

1. *Making a vertical preliminary consultation to each functional area to know and understand all the problems. The graph below provides further details on the vertical consultation process in each functional area. Figure 14 shows an example of vertical consultation in two functional areas: Commercial and Production.*

2. *Observing all common problems that the organization had during the previous year and determining priorities. The Kaizen Committee must classify the problems by level of importance so the Owner/Director can analyze the business condition.*

3. *Evaluating the degree of success of the plan of the previous year. This step is essential to avoid making the same planning and execution mistakes and to adapt the plan to the current business condition.*

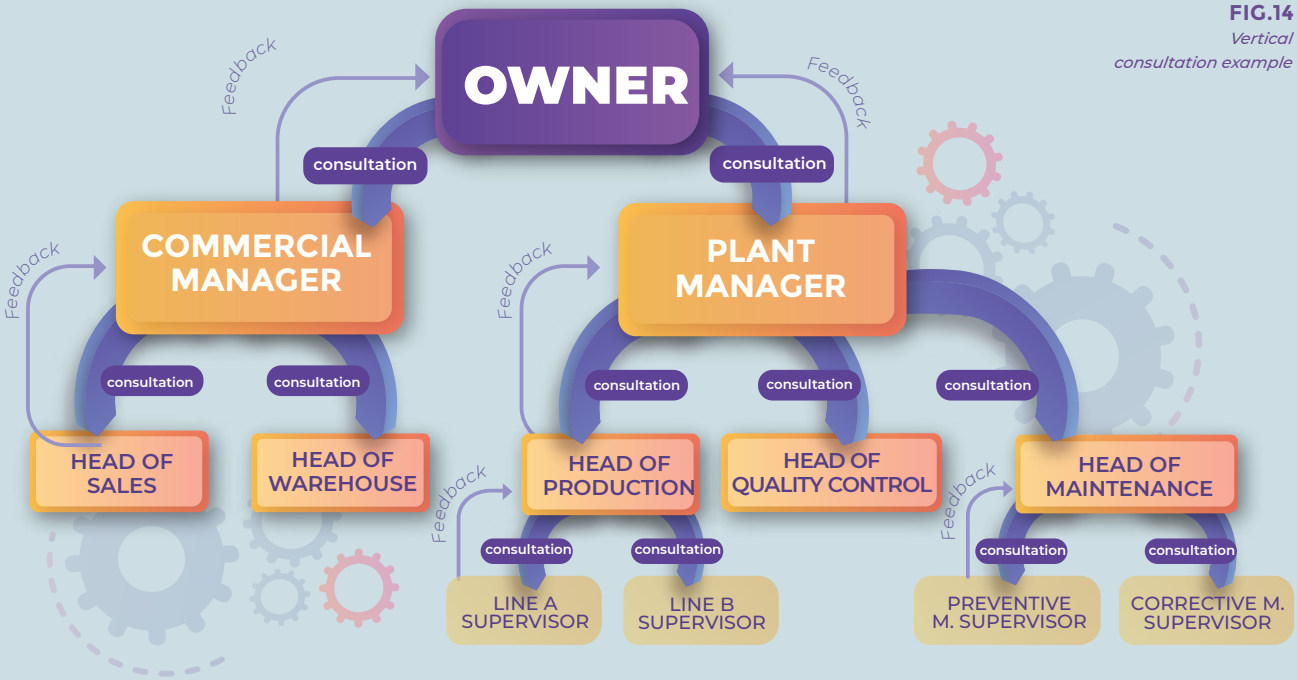


FIG.14
Vertical consultation example

Following the receipt of feedback from all corporate areas, a single report is issued for analysis.

Let us think of a company that manufactures customized corporate gifts and restaurant accessories. Customization will be done through thirty-five 3D printers that manufacture parts of a product for subsequent assembly. The company has the following structure:

- **Production Functional Area** (Production, Maintenance, and Quality Control Departments)
- **Administrative Functional Area** (Procurement and Finance Departments)
- **HR Functional Area**
- **Quality Control Functional Area**
- **Commercial Functional Area** (Sales and Logistics Departments)

Given that this company manages Kaizen, before the end of the annual period, the Committee collects information to detect the opportunities for improvement. As a result of the identification of problems, the following executive summary is issued for the owner:

FIG.15
Problem list example

1 -Establishing the Kaizen Purpose

After receiving the summary issued by the Committee —based on criteria like the impact on the strategy, the possibilities for the application, the expected results— the Senior Management selects improvement topics to be addressed for the current year. Those topics are the Kaizen Purpose.

A Kaizen Purpose announcement has a qualitative nature; that is to say, the Senior Management must create a "motto" that will guide improvements in the rest of the company. To establish the purpose, the Senior Management must understand and analyze the list of problems very well and take into account the functional corporate strategies.

There follow some examples of a Kaizen Purpose:

- **"Reducing the manufacturing costs through our workers' commitment"**
- **"Improving the materials supply system in terms of costs and quality"**
- **"Reducing the number of late-delivery claims"**
- **"Developing a Kaizen philosophy in the company"**

The managers of all levels shall be responsible for translating this purpose into goals, with quantitative targets and specific activities.

In line with the example above, having received the problem list and having made an in-depth analysis, the owner finds that the higher production costs as compared to competitors originate in corporate issues that can be improved. The owner also understands that the higher costs may be related to urgent purchases, unlean manufacturing, and absenteeism.

In addition, the owner supposes that absenteeism is due to the work environment and is sure that one of the tools that help improve this aspect is teamwork through Kaizen. Therefore, the owner chooses to create the following "mottos" for the new period:

"Reducing the cost of best-selling products"

"Promoting the Kaizen philosophy in the company this year"

2 - Deploying Goals

Once the Kaizen Purpose is defined, the Committee, together with all the corporate areas, must transform the "announcement" into goals and directives.

There follow the necessary requirements for deploying the Kaizen Purpose in a suitable manner:

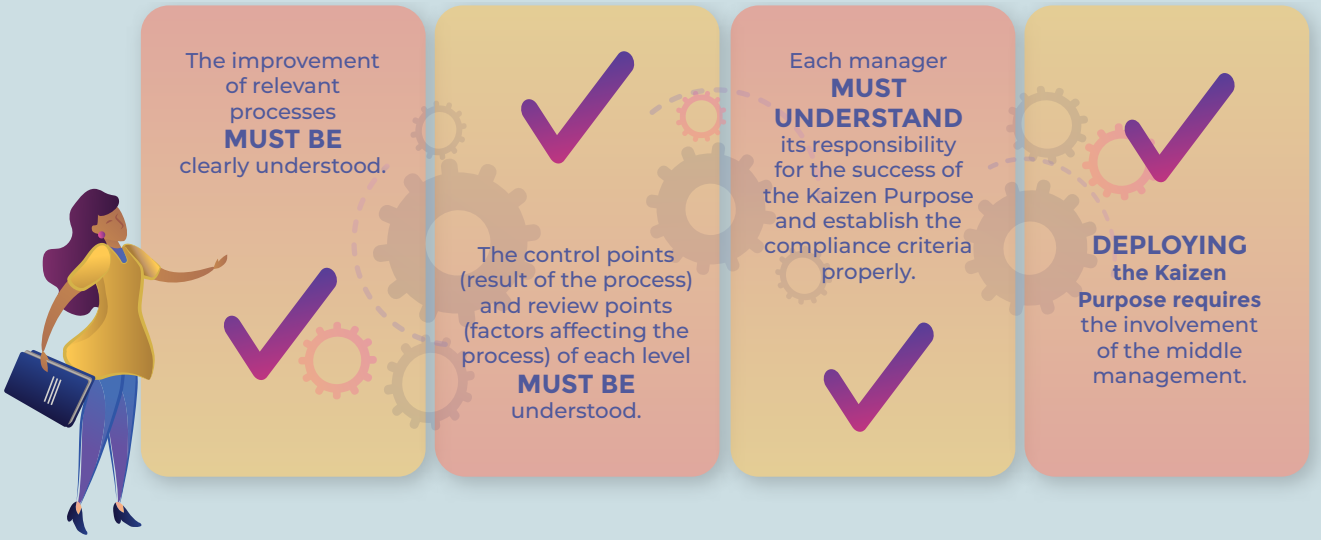


FIG.16
Requirements and criteria for goal deployment

The Kaizen Purpose announced must be transformed into goals for each functional area.

The Kaizen goals must have the following characteristics:

- They must be dealt with cross-functionally.
- The manager of each functional area must ensure that their respective area contributes to the compliance of the general Kaizen Purpose.
- The Kaizen goals will be considered more relevant than those of each function.

Taking into account the distinctive features of each functional area, a new Kaizen Purpose and quantitative targets are set for the managers.

The figure below shows an example of a goal deployment in two areas:

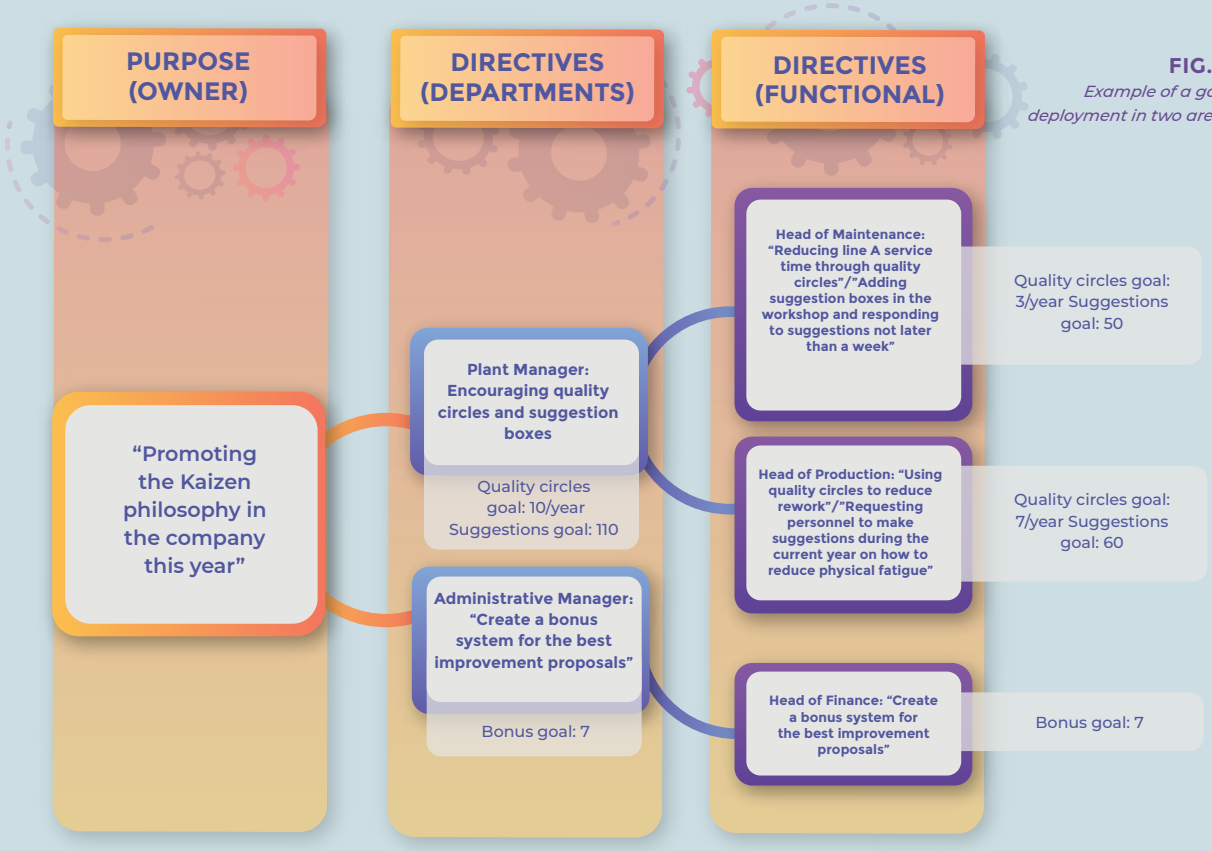


FIG.17
Example of a goal deployment in two areas

The process of deployment of the original purpose and goals per functional area is carried out by all levels of management, prior agreement of them, to ensure that the goals set are feasible.

In line with the example of the item above, the managers are in charge of first transforming the owner's purpose into actions with specific goals. The chart below shows how each manager presents the actions that can be carried out to comply with the Kaizen Purpose for the new period.

FIG.18
Example of a Kaizen Purpose deployment in functional areas

KAIZEN PURPOSE DEPLOYMENT IN FUNCTIONAL AREAS (YEAR 20XX)

DIRECTOR	PLANT MANAGER	COMMERCIAL MANAGER	ADMINISTRATIVE MANAGER	HR MANAGER	QUALITY CONTROL MANAGER
"Promoting the Kaizen philosophy in the company this year"	Encouraging quality circles and suggestion boxes Goal: 110 valid suggestions and 10 projects made in the quality circles	Identifying problems during the sale process and learning to work in quality circles Goal: To train all personnel in identifying waste and in QC Story (7 people). To organize 2 quality circles during the year	Create a bonus system for the best improvement proposals Bonus goal: 7	Identifying the best tools to encourage the adoption of the Kaizen philosophy. Within the area, encouraging people to make improvement suggestions Goal: To engage a third-party consultant to train all members in the Kaizen philosophy for them to adopt it	Interacting with all the functional areas to propose a training in improvement and control tools. Being present in all the quality circles of the company Goal: To provide the statistical tools training to fifteen people. To be present in twelve quality circles
"Reducing the cost of best-selling products"	Reducing unnecessary overtime. Reducing 001 machine scrap. Improving the reprocessing standard Goal: Overtime reduction by 70%/Scrap < 55%/ Reprocessing rate < 5%	Reducing the logistics cost. Reducing the inventory cost Goal: To reduce the logistics cost by 20%. To reduce the inventory cost by 3%	Improving the procurement process. Providing support for the identification of the highest costs of each area Goal: To reduce tolerance to procurement budget deviations from 10% to 4%. To issue weekly reports for each manager	Identifying personnel skills and offering technical training, as necessary. Launching a campaign to decrease the absence rate Goal: Skills matrix fully updated. 7 specific trainings. Decrease of the absence rate from 4.7% to 3%	Developing standards applicable to raw material receipt specifications and detecting optimal process variables to avoid scrap or reprocessing Goal: 1 procedure that links the raw material entrance parameters with line XXAA optimal process parameters (a document)
"Reducing the number of claims from clients"	Strengthening a quality philosophy among personnel Improving the quality control methods Goal: 1 quality commitment survey per worker per semester. To improve the Improving the reliability rate from 95% to 98%	Improving packaging. Reducing the movements inside the warehouse. Identifying the parameters desired by the client market Goal: To increase packaging's capacity to absorb shock (at a similar cost). 1 report on quality and production every two months	Providing financial assistance to the other areas. Working on chargebacks to suppliers who deliver poor quality. Rewarding the commitment to quality Goal: 1 report every two months on the costs from lack of quality and client loss. 2 bonuses for the commitment to quality	Launching a quality campaign in the company Goal: 2 campaigns during the year	Identifying the claims and making a list of the defects that lead to such claims for their resolution in quality circles Goal: To organize 5 quality circles

Deployment is repeated until the final stage. The managers transform the Kaizen Purpose into actions. Then, the heads of different production areas transform the actions informed by their managers to them into more specific actions, and the coordinators who report to each head do the same.

The example below shows how the actions of the Production Manager are deployed by each head reporting to them; that is to say, each head's actions are derived from those of their immediate manager. The ***"Purpose of reducing unnecessary"*** *overtime originates from the purpose of* ***"Reducing the cost of best-selling products and gives"*** *rise to its own action.*

There follows the company's deployment:

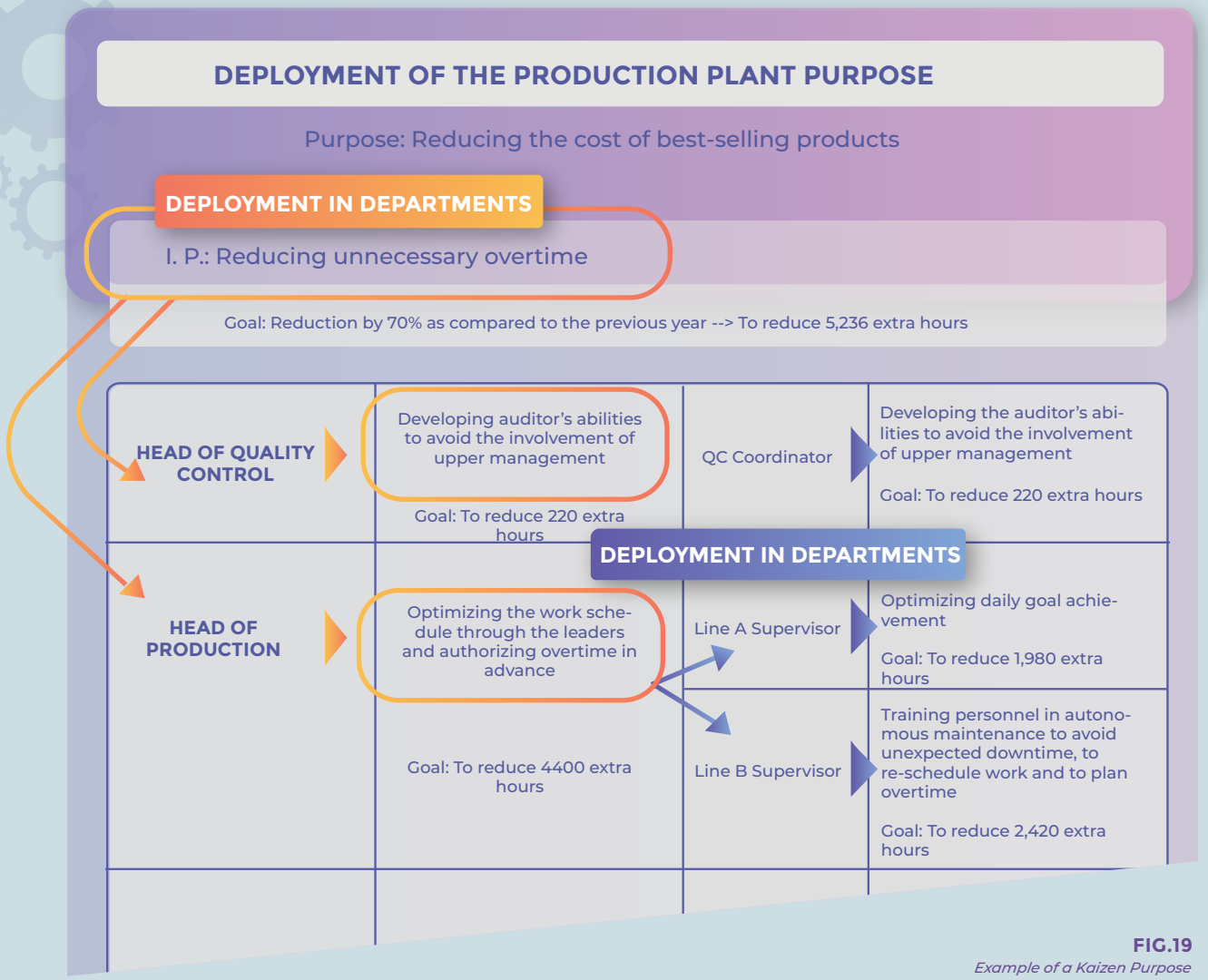


FIG.19
Example of a Kaizen Purpose deployment in the production plant

3 - Planning Indicators and Monitoring

After final deployment of the Kaizen purpose, each functional area must agree on the indicators that will be used to check the result of the activities that will be carried out.

The metrics help assess the development of Kaizen in the company.

Some metrics used to measure the integration or deployment capacity are the following:

- Number of suggestions made per period
- Number of suggestions actually adopted
- Cost of adopted suggestions
- Number of Kaizen Projects
- Number of improvements executed
- Cost of executed improvements
- Improvement in the cost of executed improvements
- Average cycle time of each group

Each problem to be solved or improved will have its own optimal indicator in the company; therefore, each area and sub-area must constantly adapt the indicators to be able to meet the Kaizen Purpose.

Moreover, the monitoring and control period of each of the targets set must be defined. At this stage, it is important that the department heads and the Committee take joint decisions.

In line with the example above, this chart shows how the production area goes through this stage, working on the Kaizen Purpose of ***"Reducing the cost of best-selling products."***

FIG.20
Indicators and monitoring example

MONITORING INDICATORS I. P.: Reducing unnecessary overtime

KAIZEN PURPOSE: Reducing the cost of best-selling products

Goal: Reduction by 70% as compared to the previous year --> To reduce 5,236 extra hours

INDIVIDUAL IN CHARGE	CHARGE KAIZEN	ACTION INDICATOR & MONITORING
Plant Manager	Reduction by 70% as compared to the previous year	INDICATOR: Man-hour cost/Product M. METHOD: Quarterly
Head of Quality Control	Developing the abilities of the auditors to avoid the involvement of upper management	INDICATOR: Number of extra hours M. METHOD: Monthly
QC Supervisor	Developing the abilities of the auditors to avoid the involvement of upper management	INDICATOR: Number of extra hours M. METHOD: Weekly
Head of Production	Optimizing the work schedule through the leaders and authorizing overtime in advance	INDICATOR: Number of extra hours M. METHOD: Weekly
Line A Supervisor	Optimizing daily goal achievement	INDICATOR: Line efficiency M. METHOD: Daily
Line B Supervisor	Training personnel in autonomous maintenance to avoid unexpected downtime, to re-schedule work, and to plan overtime	INDICATOR: Downtime M. METHOD: Weekly

4 -Planning Actions and Scheduling

The final stage is planning and is done by heads and supervisors. They must establish specific actions in line with the deployment of the general purpose.

In figure 20, as regards Quality Control, the QC Supervisor has decided to develop the abilities of the auditors to avoid the involvement of upper management. However, to achieve this, different actions must be executed. The chart below details the specific actions of the company.

ACTIONS IN THE PRODUCTION PLANT

Purpose: Reducing the cost of best-selling products

I. P.: Reducing unnecessary overtime

Goal: Reduction by 70% as compared to the previous year --> To reduce 5,236 extra hours.

	INDIVIDUAL IN CHARGE	ACTION	SUPPORT AREA	ACTION No.	ACTION INDICATOR	KAIZEN INDICATOR
A. Developing the abilities of the auditors to avoid the involvement of upper management	QC COORDINATOR	To make a list of recurring decision-making problems that lead auditors to contact the coordinator		I.P.A. 1	% OF PROGRESS	EXTRA HOURS
		To provide training in decision making	HR	I.P.A. 2	% OF PROGRESS	EXTRA HOURS
		To encourage independent decision making		I.P.A. 3	NUMBER OF CONSULTATIONS	EXTRA HOURS

FIG.21
Example of Kaizen Purpose actions in the production plant

Figure 21 shows that the company identifies not only the indicator that will be used to monitor a specific action, but also the Kaizen indicator to evaluate and track the results of the action in relation to the Kaizen Purpose.

Another important aspect is that the company assigns a code to each action, which will be used later in the general action schedule for simplification purposes.

FIG.22
Action scheduling and monitoring example

SCHEDULING AND MONITORING: I. P.: Reducing unnecessary overtime

	ACTION PLANNING			PROGRESS CONTROL			KAIZEN RESULT
WEEK - PERIOD	ACTION	ACTION INDICATOR	EXPECTED GOAL	ACTUAL DURATION	INDICATOR RESULT	COMMENTS	KAIZEN INDICATOR VALUE - OVERTIME REDUCTION %, AS COMPARED TO PREVIOUS PERIOD
V-FEB2020	I.P.A. 1	PROGRESS	50%				
VI-MAR2020	I.P.A. 2	PROGRESS	100%				
VII-APR2020	I.P.A. 3	NUMBER OF CONSULTATIONS	LESS THAN 15				

A Gantt chart may also be used for monitoring actions.[7]

[7] Parenti, Agustina, IBID

2.4. Kaizen Management Control

2.4.1. Audits

According to Masaaki Imai, the purpose of an audit is to review if the targets deployed in the different levels of the organization have been executed. They are not intended to criticize the results, but to identify which processes have led to such results and, in this way, help recognize the deficiencies that may have arisen. The auditor must understand that they does not have to indicate "who", but "what".

Audits have the following characteristics:

- They are planned and communicated in advance.
- They are done by people who have knowledge of management.
- They are done cross-functionally.

Audits entail conducting personnel surveys during plant visits. Their aim is to identify the level of involvement in the policies of the company and in Kaizen targets.

Moreover, audits help track and control Kaizen actions, which is very important when carrying out improvements through the Deming Cycle, since the results obtained (in the Check step) can be verified and analyzed to determine if they were positive in relation to the goals set. In such case, the improvement made is standardized; otherwise, it is necessary to analyze deviations and begin a new improvement process.

In line with the example above, in the company, la audit is a worker of the Quality Control area. The auditor must fill in the schedule designed in the previous item with the comments from each relevant area, and simultaneously, measure the Kaizen indicator to check the impact of the specific actions on the final purpose, which, in this example, is ***cost reduction.***

FIG.23
Audit example

SCHEDULING & MONITORING: I. P.: Reducing unnecessary overtime

	ACTION PLANNING			PROGRESS CONTROL			KAIZEN RESULT
WEEK – PERIOD	Action	Action Indicator	Expected Goal	Actual Duration	Indicator Result	Comments	KAIZEN INDICATOR VALUE - OVERTIME REDUCTION %, AS COMPARED TO PREVIOUS PERIOD
V-FEB2020	I.P.A. 1	Progress	50%	3hs.	50%	No comments	-5%
	I.P.B 1	Progress	80%	5hs.	100%	The action can be completed thanks to HR's contributions.	
VI-FEB2020	I.P.B 2	Progress	100%	6hs.	100%	Computer issues delayed analysis.	15%
	I.P.C 1	Progress	100%	3hs.	100%	No comments	
	I.P.D 1	Progress	100%	2hs.	100%	Some actions are yet to be carried out by personnel during the week.	
VII- FEB2020	I.P.D 2	vacant m2	25%	4hs.	10m2		
	I.P.B	Fault detections	5	-	2		
	I.P.B	3 EFFICIENCY	90%	-	25%		

The Senior Management sets strategic goals. Upon deployment, these goals are transformed into functional goals (procurement, production, finance, etc.) In turn, these functional goals area transformed into departmental goals and operational goals.

To set the strategic goals, the Senior Management takes into account the actual results achieved in the previous period, as specified in the report, and their deviations. The results, the deviations, the problems each function had to face to achieve them, as well as the list of problems reported by the lower level, are the basis for the improvements needed.

That is to say, they are the starting point of any Kaizen planning. The goals (and the targets and improvements to be reached) are set based on the results and problems of the previous period.

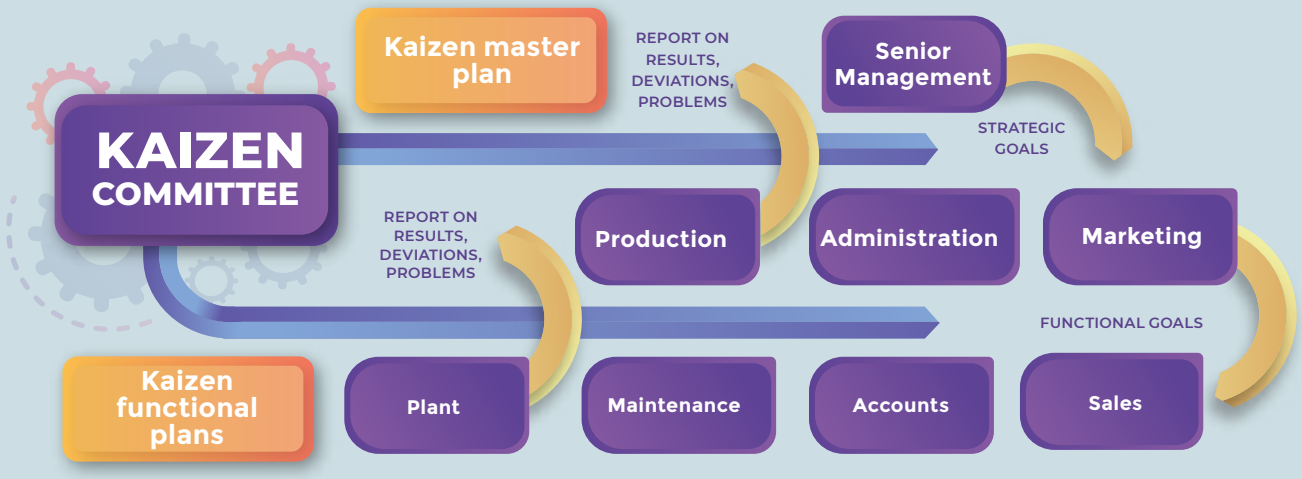
However, the results, their deviations, and the problems faced to achieve them are permanently reported. Each area informs the Senior Management on them through regular meetings and reports.

Thus, the strategic goals represent the goals of the following levels, and the problems and the improvements needed by the company to achieve the results determine the improvement targets, which are the basis for the preparation of the Kaizen Plan.

The strategic improvement targets are the Kaizen Master Plan. This plan, in turn, is deployed in each function and department, and gives rise to operating improvement action plans.

The figure below shows an example of a Kaizen goal deployment, as explained above:

FIG.24
Kaizen goal deployment example



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4. Implementation Task

Perform a KAIZEN policy deployment for a specific corporate area.

To achieve this, first, a **KAIZEN Committee** must be formed, and at least three people representing the different corporate areas must be convened. Depending on the size of the organization, more collaborators may be required to join the Committee so as to ensure representation of all areas. (For more information, see figure 3.) Once the Committee is formed, the following steps must be followed:

0. VERTICAL CONSULTATION

- To assign the corporate areas each Committee member will be in charge of
- Each Committee member must consult the area assigned to them about the problems detected therein
  (For more information, see figure 14.)
- To list all the problems and/or the information received
- Upon the existence of a Kaizen plan from the previous year, to evaluate its degree of success
- To summarize and determine the priorities of the problems detected
  (For more information, see figure 15.)
- To submit the report to the owner

1. KAIZEN PURPOSE

- To review the summary made in paragraph 0 and identify the topics with the greatest potential impact
- To establish a purpose for each topic selected *(For more information, see figure 27.)*
- To inform the whole company on the purposes established

(See the appended chart: ***KAIZEN PURPOSE DEPLOYMENT IN FUNCTIONAL AREAS.****)*

2. PURPOSE DEPLOYMENT

- To convene a meeting of the **KAIZEN Committee** and the managers to transform each purpose into directives and goals

- To convene a meeting of the **KAIZEN Committee** and the departmental heads to inform them on the goals and directives set by the managers and, based on them, to develop the goals and directives of each department

    - To convene a meeting of the **KAIZEN Committee** and the supervisors to inform them on the goals and directives set by the heads and, based on them, to develop the goals and directives of each supervision

*(See the appended chart: **PURPOSE DEPLOYMENT.**)*

3. INDICATORS & MONITORING

- To convene a meeting of the **KAIZEN Committee** and the managers (or heads) to inform the goals and directives set at each level and develop an optimal indicator to evaluate the efficiency of said directives in relation to those of the managers (For more information, see figure 20.)

*(See the appended chart: **INDICATORS & MONITORING.**)*

4. SPECIFIC ACTIONS

- To convene a meeting of the **KAIZEN Committee** and the supervisors, based on the directives set by them, to detail all the actions necessary to execute them, specifying the completion term and the monitoring frequency

*(See the appended chart: **SPECIFIC ACTIONS.**)*

- To arrange a general action schedule, integrating all the actions to be performed

*(See the appended chart: **SCHEDULING & MONITORING/AUDITS.**)*

5. Appendix

KAIZEN PURPOSE DEPLOYMENT IN FUNCTIONAL AREAS (YEAR 20XX)

DIRECTOR	PLANT MANAGER	COMMERCIAL MANAGER	ADMINISTRATIVE MANAGER	HR MANAGER	QUALITY CONTROL MANAGER
PURPOSE 1					
PURPOSE 2					
PURPOSE 3					

PURPOSE DEPLOYMENT

Purpose:

MANAGER'S DIRECTIVE 01

Goal:

Head 1	Goal:	Coordinator H 1	Goal:
Head 2	Goal:	Supervisor 1 H 2	Goal:
		Supervisor 2 H 2	Goal:
Head 3	Goal:	Supervisor 1 H 3	Goal:
		Supervisor 1 H 3	Goal:

PURPOSE DEPLOYMENT

Purpose:

MANAGER'S DIRECTIVE 02

Goal:

Head 1	Goal:	Coordinator H 1	Goal:
Head 2	Goal:	Supervisor 1 H 2	Goal:
		Supervisor 2 H 2	Goal:
Head 3	Goal:	Supervisor 1 H 3	Goal:
		Supervisor 1 H 3	Goal:

PURPOSE DEPLOYMENT

Purpose:

MANAGER'S DIRECTIVE I

Goal:

POSITION	DIRECTIVE	INDICATOR & MONITORING
		INDICATOR: MONITORING:
		INDICATOR: MONITORING:
		INDICATOR: MONITORING:
		INDICATOR: MONITORING:
		INDICATOR: MONITORING:
		INDICATOR: MONITORING:

PURPOSE DEPLOYMENT

Purpose:

MANAGER'S DIRECTIVE II

Goal:

POSITION	DIRECTIVE	INDICATOR & MONITORING
		INDICATOR: MONITORING:
		INDICATOR: MONITORING:
		INDICATOR: MONITORING:
		INDICATOR: MONITORING:
		INDICATOR: MONITORING:
		INDICATOR: MONITORING:

SPECIFIC ACTIONS

Purpose:

SUPERVISOR'S DIRECTIVE

Goal:

	PERSON IN CHARGE	ACTION	SUPPORT AREA	ACTION No.	ACTION INDICATOR	KAIZEN INDICATOR

SUPERVISOR'S DIRECTIVE

Goal:

SUPERVISOR'S DIRECTIVE

Goal:

SCHEDULING & MONITORING/AUDITS

	ACTION PLANNING			PROGRESS CONTROL			KAIZEN RESULT
WEEK - PERIOD	ACTION	ACTION INDICATOR	EXPECTED GOAL	ACTUAL DURATION	INDICATOR RESULT	COMMENTS	KAIZEN INDICATOR VALUE - OVERTIME REDUCTION %, AS COMPARED TO PREVIOUS PERIOD

CAP. #2:
STANDARDIZATION

Authors:
Patricio Bigoglio, Lía Bedatou, Elba Giannasi
and Silvana Vivas

INDEX

INTRODUCTION

When exploring the concepts, tools and methodologies associated to Continuous Improvement, the term **standardization** is often encountered.

To succeed in improving quality or reducing the operating costs and lead time, companies must administer a great number of resources every day, such as personnel, information, equipment, and materials, among others. What is more, they must ensure a safety and healthy environment for workers. In this sense, standard compliance is essential to perform such a complex task efficiently.

But, what does it mean to **standardize** something? To standardize is to define how things will be done in line with the knowledge and technology available in order to improve performance.

Standards represent, at a certain time, the best known manner of doing daily tasks. The importance of complying with standards lies in the fact that processes are "under control", which implies that results will be less likely to vary and processes will become stable and foreseeable.

However, when standardized processes are "under control" and a certain status quo is reached, it is important that the company does not stop there, since Kaizen (Continuous Improvement) shows that things can always be improved. Therefore, **standardization is dynamic,** because standards are the first step for daily enhancement. Each new standard represents a possibility to improve something.

For a company to practice this method regularly, a Continuous Improvement culture must be internalized, supported by training, and followed by all its members and, basically, the Senior Management. This context encourages self-discipline, which is essential for a long-term Kaizen experience.

Standardization is the basis for managing Continuous Improvement. In turn, managing standardization, which implies setting and applying all standards, ensures that standards remain in force. Therefore, the challenge of any company is to create that important synergy that leads to sustainable improvements.

1. What is Standardization?

Standardization is an activity that consists in formulating, issuing, and applying standards.

Standards are written and graphic descriptions that help understand the most efficient and reliable corporate techniques, and provide with the necessary knowledge on people, machines, materials, methods, measurements, and information. They aim at favoring the creation of quality products in a reliable, safe, fast, and economical manner.

The term standard comes from the French, "standort"; a word formed by "stand", which means standing, and "ort", which means high place, and makes reference to the place where the Franks used to put their flags to protect them from their enemies during the Barbarian invasions. The term also comes from the French, "étendard", which makes reference to the flag carried at the front of an army going into battle. Thus, a standard came to be understood as a model, rule, or pattern to be followed.

1.1 Main Purposes of Standardization

To reduce process variability

Clients appreciate a company that delivers a product in due time and form, as agreed.

To reduce mistakes

The aim is to succeed in using methods that always produce the same results, regardless of the persons behind them. This means that the company will be less exposed to individual mistakes that may arise, limiting human error responsibilities. In case of mistake, the methodology will be revised, and the worker will not be held liable in a first instance.

To favor a foreseeable work environment

Setting a standard implies adopting a method that ensures a foreseeable result in relation to safety, quality, delivery, and cost, among others.

To facilitate the performance of the activities

By agreeing on the best way to do something, a company can anticipate a result. In consequence, activities are easier to deal with, and people do not feel under pressure.

1.2. Benefits of a Standardized Work

Implementing a standardization process brings about multiple benefits, which have the following impact in companies in the long term:

✓ Knowing the processes and activities

In general, workers are not aware of how different processes are executed. For companies, the first benefit of a standardization process is the possibility of knowing the activities involved and setting standards.

✓ Improving workers' skills

Workers feel more valued when they are allowed to participate in standard formulation and improvement. When it comes to solving problems, workers' participation, commitment, trust, and self-sufficiency will enable them to execute their tasks more efficiently.

✓ Measuring performance

By setting standards, companies can assess the performance of both processes and workers.

✓ Ensuring the process

Standards serve as a basis for audits and diagnosis. They are fundamental to the certification and accreditation dealings undertaken by companies to demonstrate that their processes ensure product and service quality.

✓ Decreasing operating costs

Operating under standards enables companies to manage processes quicker. This optimization reduces operating costs and translates into a direct financial benefit for the company.

✓ Systematizing and socializing knowledge

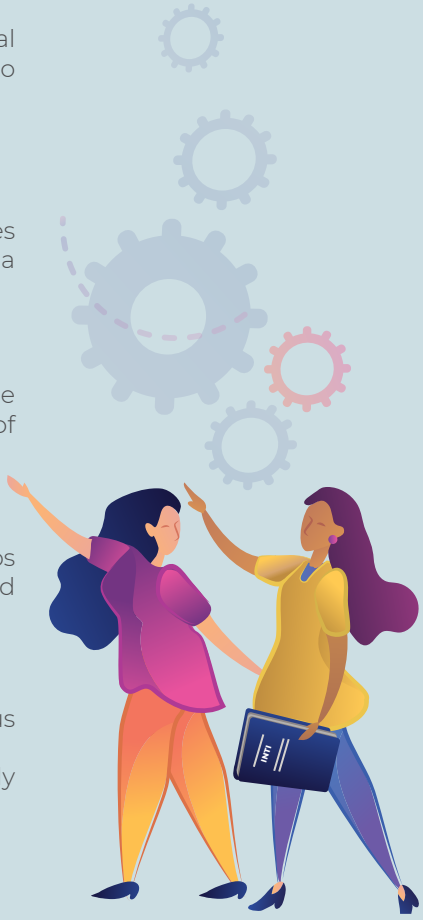
Know-how standardization allows for the integration of knowledge into the organization. As a result, knowledge remains in the company regardless of turnover.

✓ Facilitating learning

Standards serve as a basis and determine the training targets, which helps spread knowledge throughout the organization. Thus, companies will spend less time in trainings.

✓ Forming the basis for Continuous Improvement

Working on standardization is the first step to initiate a Continuous Improvement process.
In this sense, Continuous Improvement management implies permanently monitoring, maintaining, and updating work standards.



2. Standardization as a Basis for CONTINUOUS IMPROVEMENT

Improvement entails analyzing, thinking, re-thinking, and, most of all, acting. Here, "acting" is understood to mean the performance of an action that makes a change and leads us to a new and better stage. So, standardization prevents us from going backwards.

THE STANDARD IS THE WEDGE THAT GUARANTEES THAT, AFTER PROCESS IMPROVEMENT, THERE IS NO TURNING BACK.

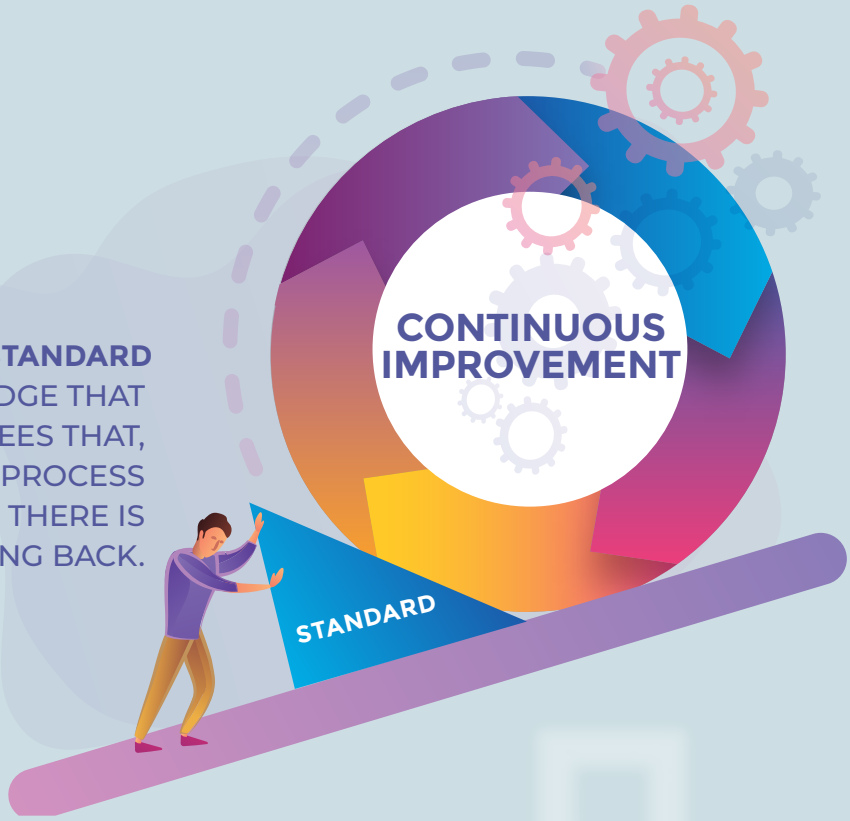


FIG.1
Standardization as a basis for Continuous Improvement

In the book Undertaking **KAIZEN**[1], we mention the need for standardization. The chart below shows the importance of its application:

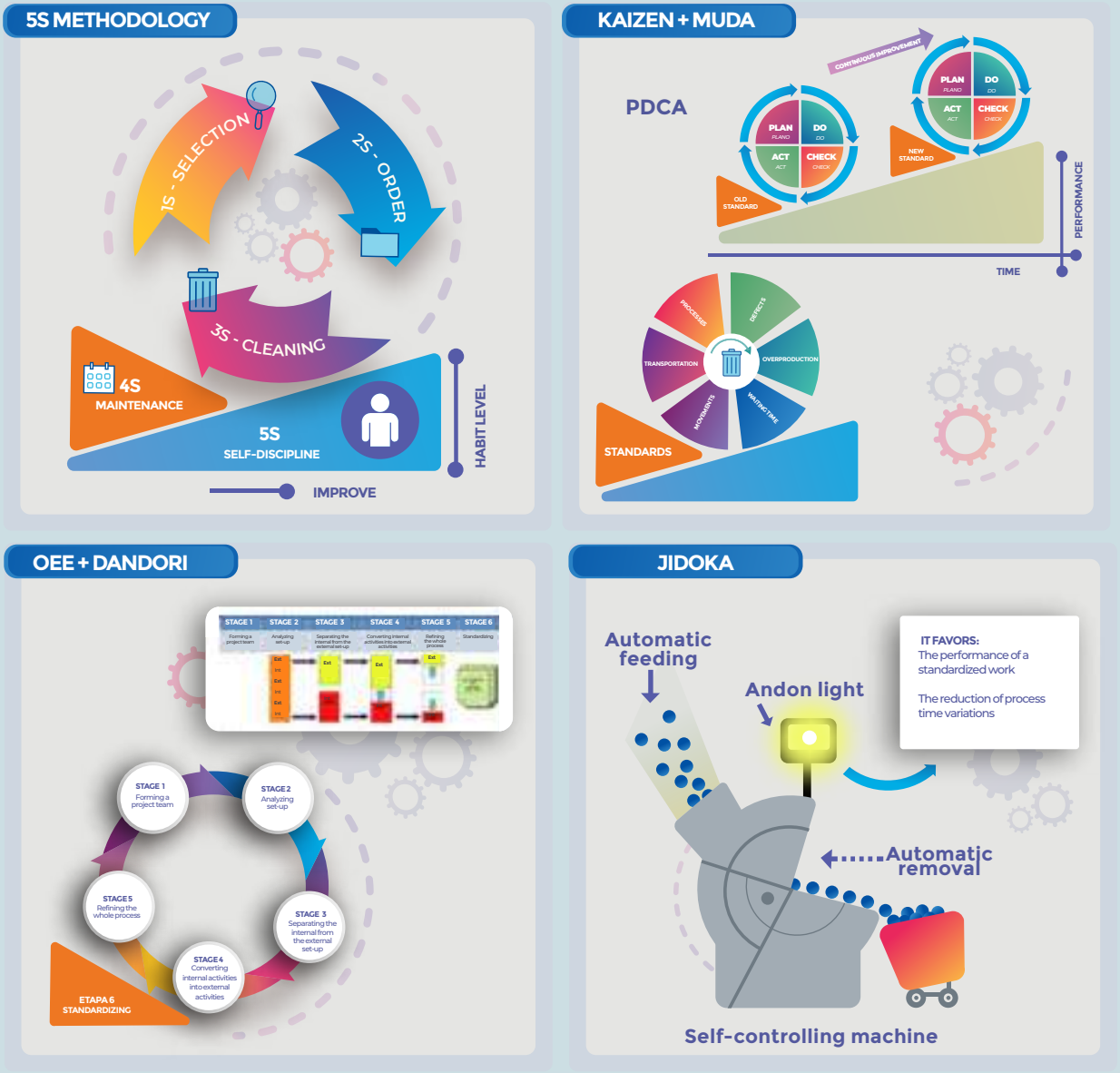


FIG.2
Standardization in different improvement tools

Why is standardization present in different improvement tools?

- Because it helps increase commitment
- Because it contributes to the development of a habit, so that improvements are maintained
- Because it is the wedge that guarantees that there is no turning back

[1] Parenti, Agustina, IBID

3. PDCA/SDCA Cycles

As Masaaki Imai said in his book Gemba Kaizen - *A Commonsense Approach to a Continuous Improvement Strategy:*

"The first step in a Kaizen process is to use the Plan, Do, Check, Act (PDCA) Cycle as a vehicle to ensure the continuity of Kaizen, while searching for a standard **improvement and maintenance policy.**"[2]

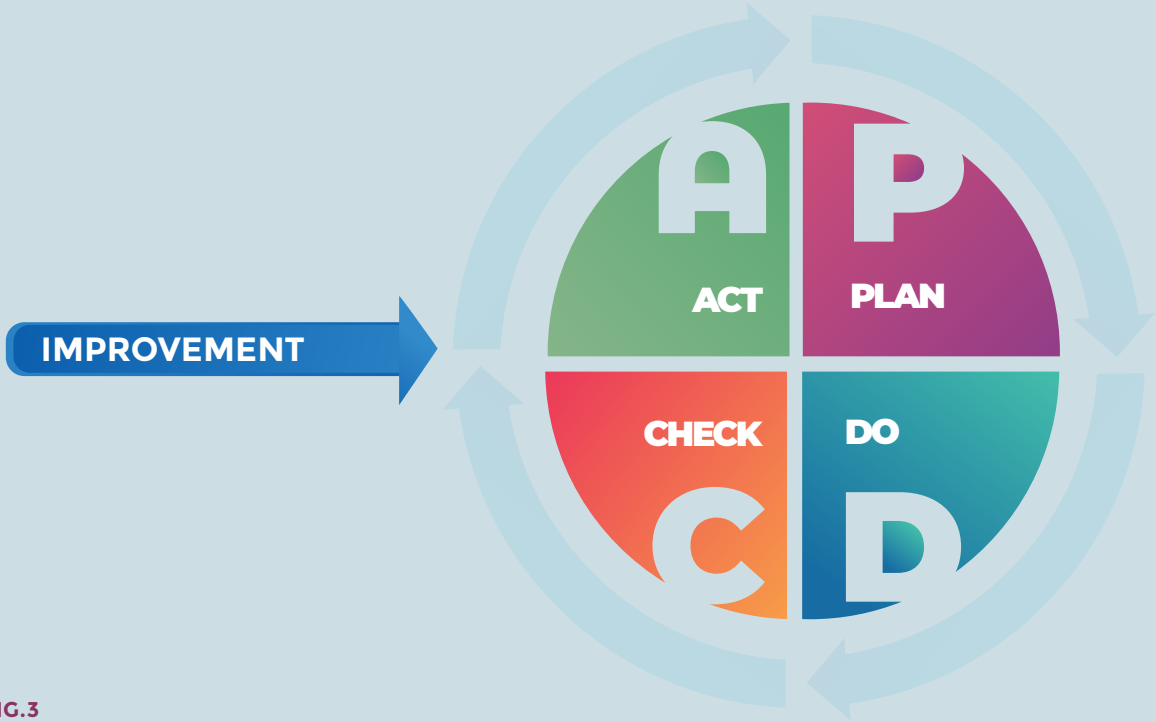


FIG.3
Plan, Do, Check, Act (PDCA) Cycle. Masaaki, I. (2012).

[2] Imai, Masaaki, (2012), Gemba Kaizen - A Commonsense Approach to a Continuous Improvement Strategy, (2nd edition), p. 4 McGraw Hill Education Europe.

PLAN:

Setting an improvement goal. As Kaizen is a philosophy of life, an improvement goal must always be present in any area, as well as an action plan to meet that goal.

DO:

Implementing the plan

CHECK:

Determining if the implementation is still in progress and has produced the improvement planned

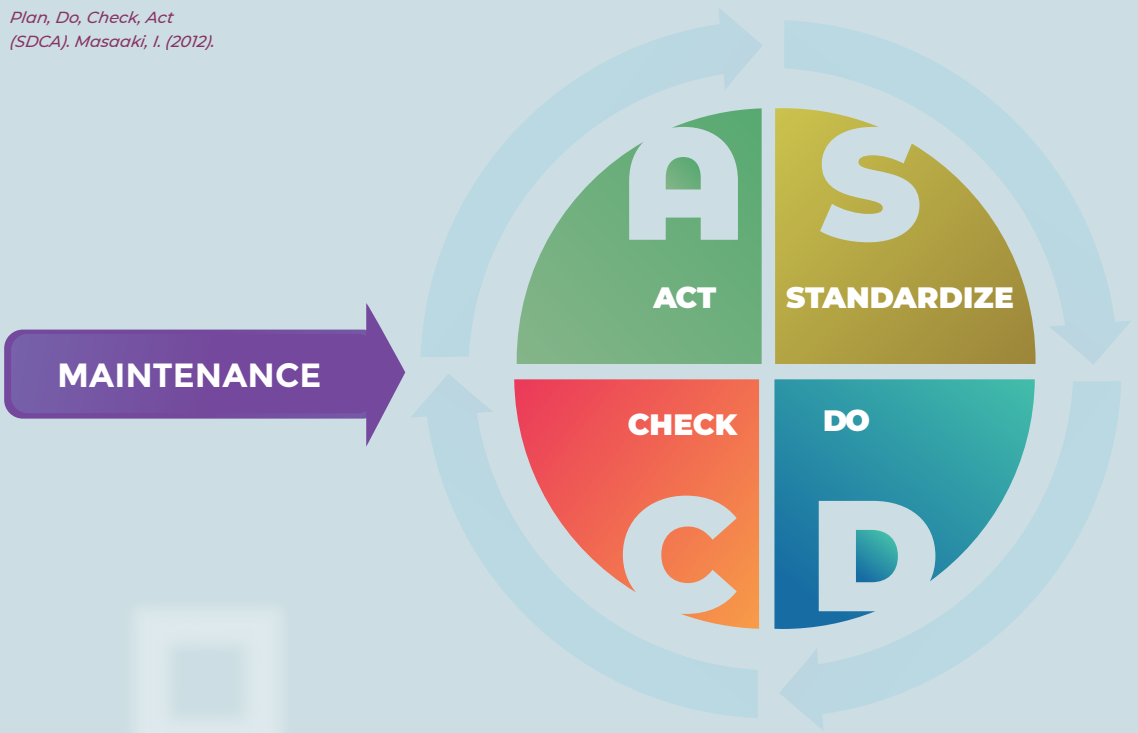
ACT:

Developing and standardizing new procedures to prevent the original problem from repeating or to set targets for the new improvements

The PDCA Cycle shown in figure 3 continually repeats itself. As soon as an improvement is made, the resulting status quo becomes the goal of an additional improvement. A PDCA Cycle implies never being satisfied with the new stage reached.

At first, any new work process is unstable. Before starting to work on PDCA, it is essential to ensure its stabilization through the **Standardize,** Do, Check, Act (SDCA) Cycle. (See figure 4.) In this cycle, the standardization (S) stage consists in setting the standard.

FIG.4
Plan, Do, Check, Act (SDCA). Masaaki, I. (2012).



Every time a fault is discovered in the current process, the following questions must be made:

- Did it happen because we did not have a standard?
- Did it happen because we did not follow the rule?
- Did it happen because the standard was inadequate?

Once a standard has been set and applied, and the current process has been stabilized, we should move to the PDCA Cycle.

Thus, the SDCA Cycle standardizes and stabilizes current processes, while the PDCA Cycle improves them. SDCA deals with maintenance, and PDCA, with improvement.

The figure below shows how improvements are recorded in a company between the **SDCA Cycle** and the **PDCA Cycle.**

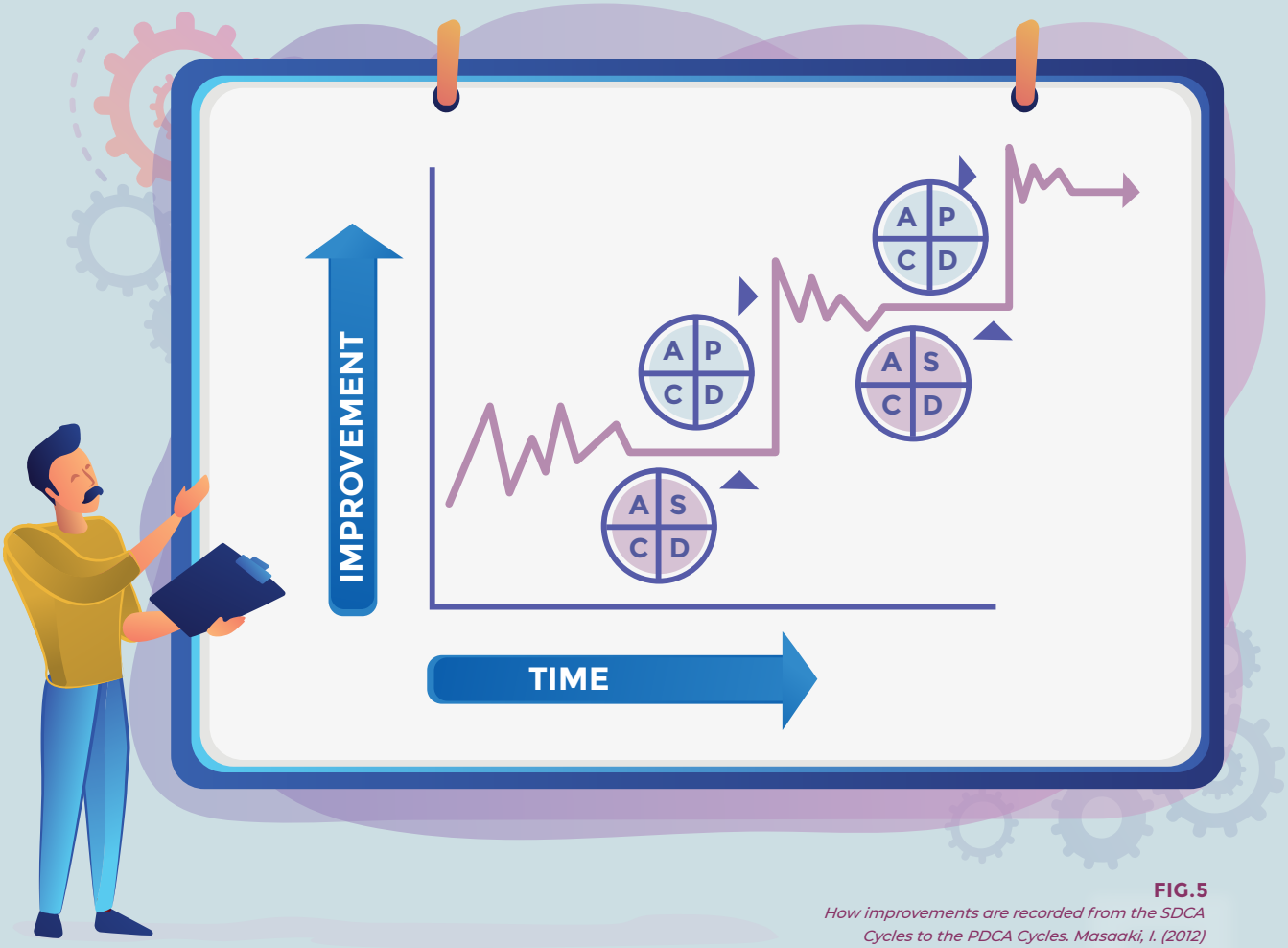


FIG.5
How improvements are recorded from the SDCA Cycles to the PDCA Cycles. Masaaki, I. (2012)

4. Standard Work and Work Standards

Work standards are the models, rules, regulations, patterns, methods, or routines required to perform a standard work.

Now, the concept of **standard work** makes reference to one of the pillars of the Toyota Production System.

Standard work is a manner of doing an activity efficiently and effectively. It implies defining the number of workers required in the workstations, their tasks, the term required to complete each task, and other elements that ensure the consistent execution of activities over time as well as the constant quality of the process output.

In general terms, standards can be classified into:

Result standards:
They determine what we expect to reach. For example, we desire a satisfaction rate of 95%.

Process standards:
They determine how we have to work to reach the result standard.

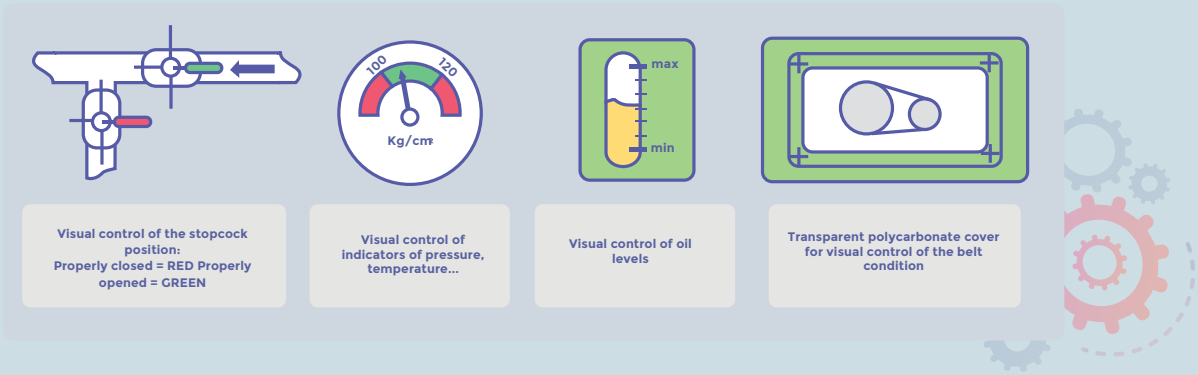
Depending on the source, the following information can be considered:

- Statistical data obtained from past experiences

FIG.6
Standard example.
Francisco Madariaga (2013)

- Technical aspects and specific studies carried out
- Subjective opinions and value judgment

FIG.7
Standard example.



We tend to think of work standards as extremely complex mechanisms. Standards can consist of multiple elements:

- A procedure, an instruction, a rule, a specification
- A symbol. For example, the shape of a tool in a panel, next to a workstation.
- A level, a mark. For example, two marks painted in a shelf that indicate the minimum and maximum stock of a product.
- A quantity, a value. For example, the goal of a process performance indicator.

4.2. Standard Work

At this stage, the standard work and its elements will be developed in the plant floor.

Standard work elements

The standard work requires three basic elements: Figure 8 shows these elements in an U-shaped manufacturing cell.

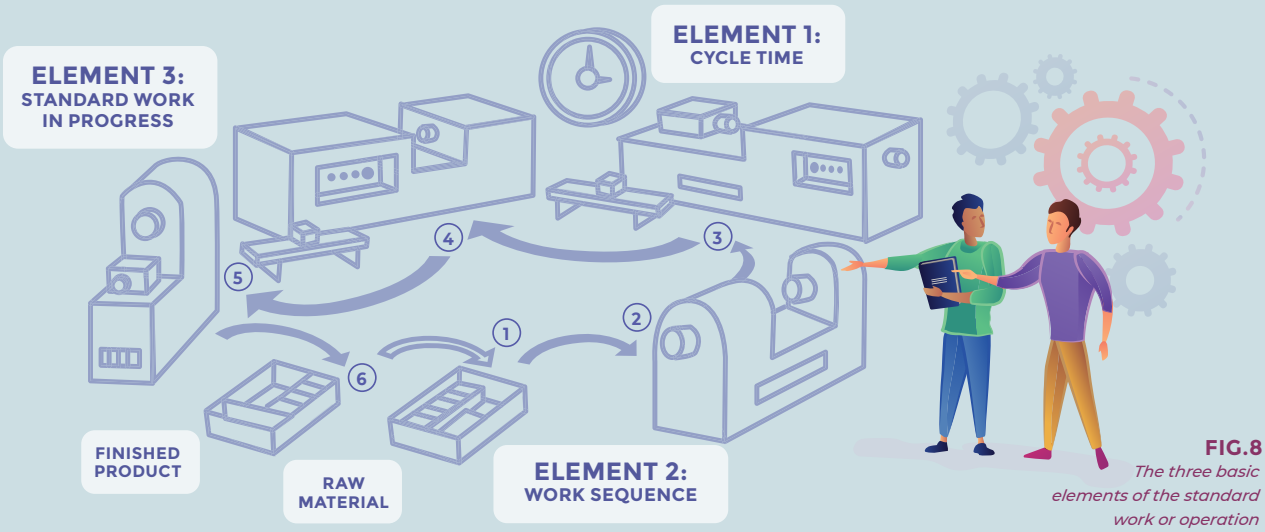


FIG.8
The three basic elements of the standard work or operation

ELEMENT 1:
CYCLE TIME (CT)

IT DETERMINES THE PRODUCTION TAKT TIME

The Cycle Time is the amount of time a worker spends producing an item in a cell. It equals the elapsed time between the reception of two consecutive parts in any workstation.

Based on the Cycle Time set for a specific period, the productive capacity can be calculated, which corresponds to the maximum number of items a process, machine, or system can produce.

ELEMENT 2:
WORK SEQUENCE

ORDER IN WHICH REPETITIVE WORK TASKS MUST BE PERFORMED

It is the order in which tasks are completed by the worker in each process, as initial materials are transformed in finished products.

It is important to stick to the work sequence: transportation, machine loading and unloading. This ensures quality and safety.

ELEMENT 3:
STANDARD WORK IN PROGRESS

IT IS THE MINIMUM INVENTORY REQUIRED FOR OPERATIONS

It is the minimum quantity of in-process inventory required in a manufacturing cell or process station to maintain standard work. It includes the parts assembled in the machine.

The content of these three elements varies in each cell. The immediate supervisor is in charge of analyzing the cell and determining the exact content of each element.

4.3.Steps to create a standard work

The creation of standard operations is a four-step process:

Step 1: Prepare a productive capacity sheet for part manufacturing.

To control the "time" variable, we should start by observing and recording it in a time observation sheet.

TIME OBSERVATION SHEET

INTI Instituto Nacional de Tecnología Industrial

PROCESS	MACHINE	DONE BY	REFERENCE	DATE
Drill inner Ø of shell	Manual drill	Shell	F.M	08/19/2012

WORKER																				
N°	WORK ELEMENTS	OBSERVATIONS No.												VA NVAN NVAI	SHORTEST REPEATING			AUTOMATED CYCLE TIME (ACT)	OBSERVATIONS
		1	2	3	4	5	6	7	8	9	10	11	12		MANUAL CYCLE TIME (MCT)	PARALLEL MANUAL TIME (PMT)	WAITING TIME		
1	Load shell	5	5	5	4	5	6	5	5	5	6	5	5	NVAN	5				
2	Drill inner Ø of shell	40	41	40	41	39	40	40	41	40	40	42	40	VA	40				Value added by worker
3	Unload shell	5	6	5	5	5	6	5	5	5	6	5	5	NVAN	5				
4	Deburr outer Ø													NVAN	6				
5	Place inside the box													NVAN	2				
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
Note: If the machine has an automated cycle, start by unloading the part.														TOTAL	50	0	0		

References:

VA = worker's actions that add value

NVAN = worker's actions that do not add value, but are necessary

NVAI = worker's actions that do not add value and are unnecessary

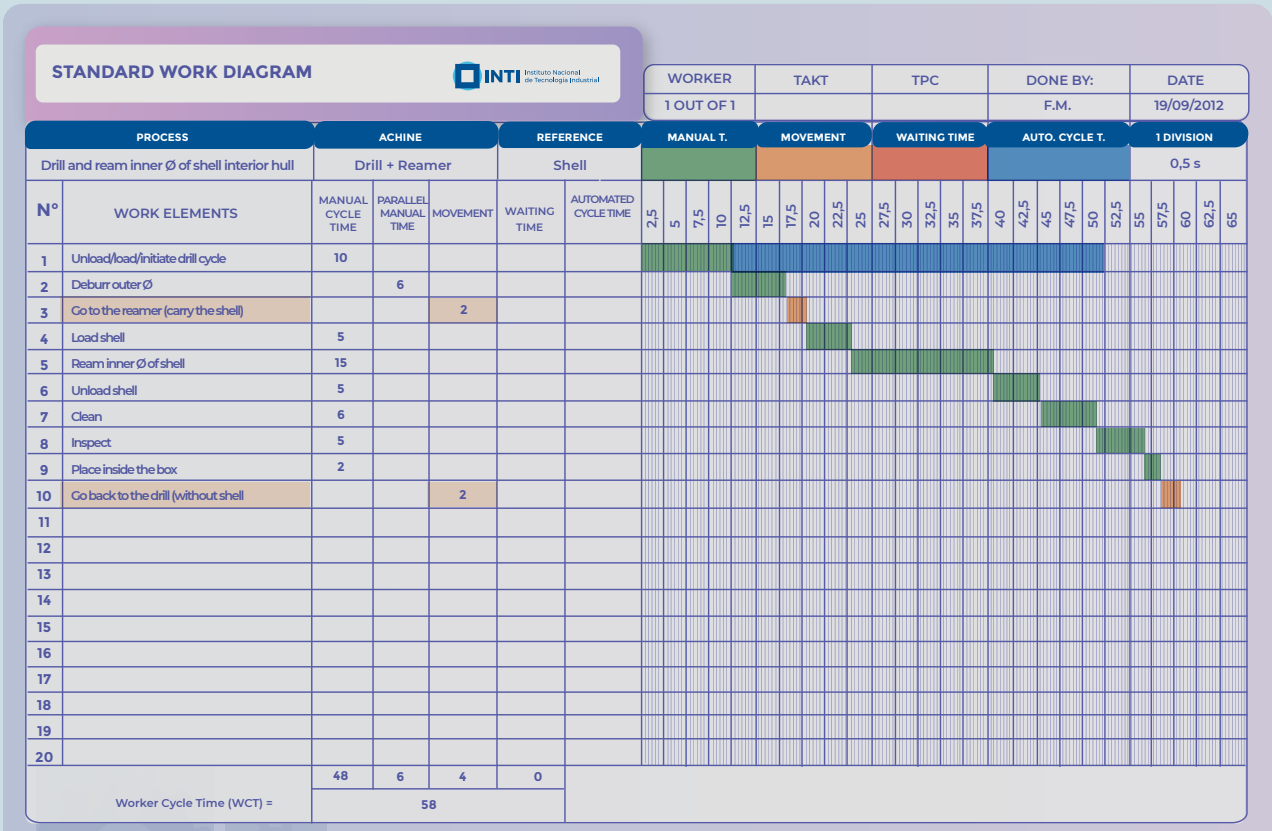
FIG.9

Time observation sheet
Francisco Madariaga (2013)

Step 2: Prepare a combined standard work diagram.

This diagram helps us understand the relationship between human operating time and machine operating time.

Recording manual operation time, automatic feeding time, and movements is recommended.



STANDARD WORK DIAGRAM

INTI Instituto Nacional de Tecnología Industrial

WORKER	TAKT	TPC	DONE BY:	DATE
1 OUT OF 1			F.M.	19/09/2012

PROCESS	ACHINE	REFERENCE	MANUAL T.	MOVEMENT	WAITING TIME	AUTO. CYCLE T.	1 DIVISION
Drill and ream inner Ø of shell interior hull	Drill + Reamer	Shell					0,5 s

N°	WORK ELEMENTS	MANUAL CYCLE TIME	PARALLEL MANUAL TIME	MOVEMENT	WAITING TIME	AUTOMATED CYCLE TIME
1	Unload/load/initiate drill cycle	10				
2	Deburr outer Ø		6			
3	Go to the reamer (carry the shell)			2		
4	Load shell	5				
5	Ream inner Ø of shell	15				
6	Unload shell	5				
7	Clean	6				
8	Inspect	5				
9	Place inside the box	2				
10	Go back to the drill (without shell			2		
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
		48	6	4	0	
Worker Cycle Time (WCT) =		58				

2,5 5 7,5 10 12,5 15 17,5 20 22,5 25 27,5 30 32,5 35 37,5 40 42,5 45 47,5 50 52,5 55 57,5 60 62,5 65

FIG.10
Standard work diagram.
Francisco Madariaga (2013)

Step 3: Prepare a work method guide.

This document provides explicit instructions on how to perform standard operations in each process. Giving instructions to new workers is both useful and necessary.

INTEGRATED MANAGEMENT SYSTEM DOCUMENT
WORK INSTRUCTION TEMPLATE

INTI Instituto Nacional de Tecnología Industrial

DOC.:
REV.:
DATE:
PAGE: 1 OUT OF 1

TASK	OPENING PACKS
PARTS	RUNNING BOARD PACKS
TOOLS AND MATERIALS	LINE DEVICES AND TOOLING
PROTECTIVE EQUIPMENT	GLOVES HEARING PROTECTORS SAFETY SHOES

	MAIN STEP	KEY POINT (Success, safety, skill)	KEY POINT REASON	PICTURES
	Any reasonable step that helps progress the task	Important points of the main step that may have an impact on quality, cause accidents, facilitate work.		
	(What do I usually do?)	(How do I do it?)	(How do I do it?)	
1	POSITION PACK 1 ON THE CUTTING MACHINE	RIGHT SIDE UP	TO ENABLE INSPECTION	
2	INSPECT THE PROFILE AND MARK NONCONFORMITIES	WITH AN INDELIBLE MARKER	TO FACILITATE DETECTION DURING THE RECOVERY OR DISPOSAL PROCESS	
3	POSITION PACK 1 ON THE ROLLER CONVEYOR	MOVING THE PACK ALL THE WAY TO THE RIGHT	TO ENSURE THE CUTTING LENGTH	
4	PRESS THE DOUBLE BUTTON TO CUT THE ENDS OFF	1ST LEFT BUTTON TO TAKE DOWN THE HOLD-DOWN DEVICE; 2ND RIGHT BUTTON TO CUT OFF AND TAKE DOWN THE CAP	TO AVOID ACCIDENTS AND BE ABLE TO PERFORM THE TASK	
5	AIRBLAST THE SURFACE OF THE RUNNING BOARD	WITH A COMPRESSED AIR DEVICE	TO REMOVE SHAVINGS AND AVOID SCRATCHES	
6	CUT THE PACKAGING OF THE RUNNING BOARDS	WITH THE CUTTER ON THE SLOT OF THE WEATHER STRIP OR THE REVERSE SIDE	TO AVOID DAMAGING THE RUNNING BOARD	
7	MOVE THE PROFILE TO POSITION 2 FOR CUT-OFF	MOVING THE PACK TO THE RIGHT	TO TAKE THE SECOND PACK DOWN	
8	POSITION PACK 2 ON THE ROLLER CONVEYOR	RIGHT SIDE UP	TO ENABLE INSPECTION	

FIG.11
Work method guide

Step 4: Prepare a standard worksheet.

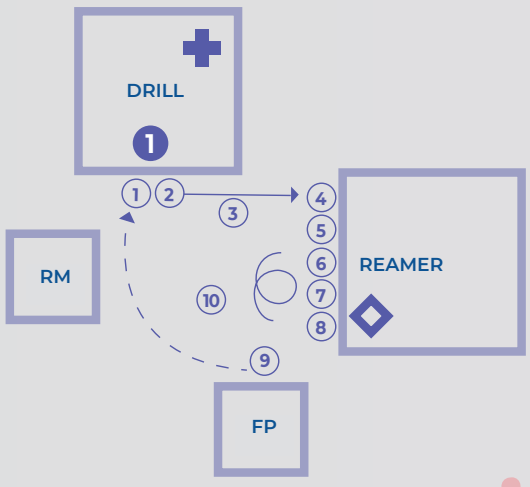
This schematic diagram serves as a visual aid.
It shows and describes the machine's layout, cycle time, work sequence, standard work in progress, and other factors of standard operations. Workers must use this sheet to verify if they are performing the standard operations well.

STANDARD WORKSHEET

INTI Instituto Nacional de Tecnología Industrial

PROCESS	MACHINE	REFERENCE	WORKER	TAKT	TPC	DONE BY:	DATE
	Drill + Reamer	Shell	1 out of 1			F.M.	09/19/2012

	WORK ELEMENTS	MANUAL CYCLE TIME	PARALLEL MANUAL TIME	MOVEMENT	WAITING TIME	AUTOMATED CYCLE TIME
1	Load shell	10				40
2	Drill inner Ø of shell		6			
3	Unload shell					
4	Deburr outer Ø					
5	Place inside the box					
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
	Worker Cycle Time (WCT))	48	6	4	0	
		58				



Safety Inspection 1 Standard WP

FIG.12
Standard worksheet
Francisco Madariaga (2013).

4.4. Standard Setting Considerations

What we do

The tasks to be standardized are defined.

1- Describing and grouping specific steps

2-Defining an ideal sequence

It is essential that workers have all the information they need to follow the steps of a process.

Key points: How we do it and why we do it

The key points include common knowledge or knowledge people have but fail to transmit properly. This type of knowledge is necessary to perform a task correctly. In general, these important details are not well documented and get lost over time.

3- When describing the steps of a process, adequate detail is a must.

4- The standard work is not a training tool, but a reference for an already-trained person, even if that person has not performed the relevant task within a reasonable period (for example, one day, one week, or one month). In this case, the standard work must guarantee that the worker becomes familiar with the task quickly.

5- The key points are often related to quality, efficiency, and safety, and include all the details necessary to ensure suitable results.

6- Including "why we do it" in a work standard is very important. People will stick to a standardized work if they understand the reason behind each instruction.

Duration and schedule/timetable

The standard work also includes how long a task should take.

7- Indicating task duration and time

Visual representation of the standardized work

The results are shown.

8- Preparing a document of, ideally, one page, including all the information above

Tips for successful standard setting

- Simple, clear, and visible descriptions. The standards should be communicated in a visual manner, since visual information is easier to assimilate.
- Dynamic information. Standards must always be considered a starting point for future improvements. They must be living documents that change as team members improve their tasks.
- Standard setting must originate in an improvement group. Personnel and leaders must be encouraged to participate in the definition of standards.
- Work documents must be published in the area where the work is done.
- It is important to analyze the main processes, and to identify and prioritize those that are critical and lead to more waste and problems (and frustration).

4.5. Standards' Scope of Application

Process standardization is often linked to corporate productive processes and work standards. However, **process standardization can be applied to various sectors, such as:**

- An annual activity; for example, the annual budget process. This may —and must— be standardized too.
- **Sales and Marketing, Customer Service, Procurement, Scheduling, Accounting,** all manufacturers' and non-manufacturers' support functions.
- **Customer assistance,** in terms of the way guests are received and served in the hospitality industry or the way medical care is provided to patients (for example, speed standards, accuracy standards, transparency standards, among others).
- Commercial banks' **ATMs, call centers, and help desks.**
- **Creative processes** that mainly involve information flows, identifying which information is necessary, where to get it, and what to do with it. As any process, they are compatible with standard work.

Thanks to standardization, processes become more predictable and stable. Undoubtedly, it can be applied to anything.

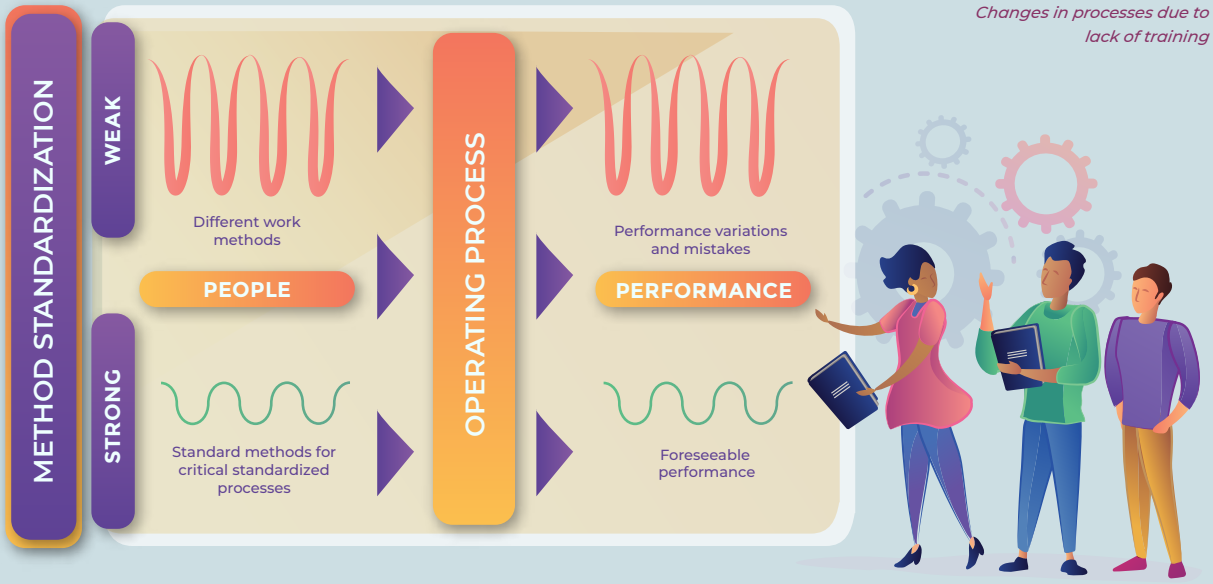
5.
Standards Training and Transmission

Once the standard setting process is completed, the company should train the person who will use it and monitor its application.

Failure to provide training or monitor work, or even incomplete training or monitoring, automatically leads to a change in the process method, with subsequent impact on results. As Masaaki Imai said, "in case of change, even when standards are complied with, the manager must, first, discover the cause, and then, review and update the existing standards or train the workers to do their tasks in accordance with the standards. Something about the standards may not be clear, or workers may need more training to do their tasks correctly".[3]

In these situations, the role of leaders and supervisors as trainers is of great importance, since they are responsible for transmitting the concepts of the standard work.

FIG.14
Changes in processes due to lack of training



[3] Imai, Masaaki, IBID, p. 55

5.1 TWI: The Toyota Training Method

Training Within Industry (TWI) is a training program for middle managers or team leaders that originated in the United States during the Second World War. The aim was to train new middle managers so they could contribute to the increase in productivity and face the urgent needs arising after the War.

During 1950s, the program was introduced in Japan by American experts to help rebuild the Japanese industry. Toyota adopted TWI in 1951 and, together with William Edwards Deming's ideas, it became one of the pillars of the Toyota Production System. At Toyota, TWI had direct influence in the development of standardized work, Continuous Improvement, and Kaizen methodology.

The TWI Program is comprised of three courses and aims to help **middle managers, leaders, or any person who may, at any time, supervise the work of others develop these three skills:**

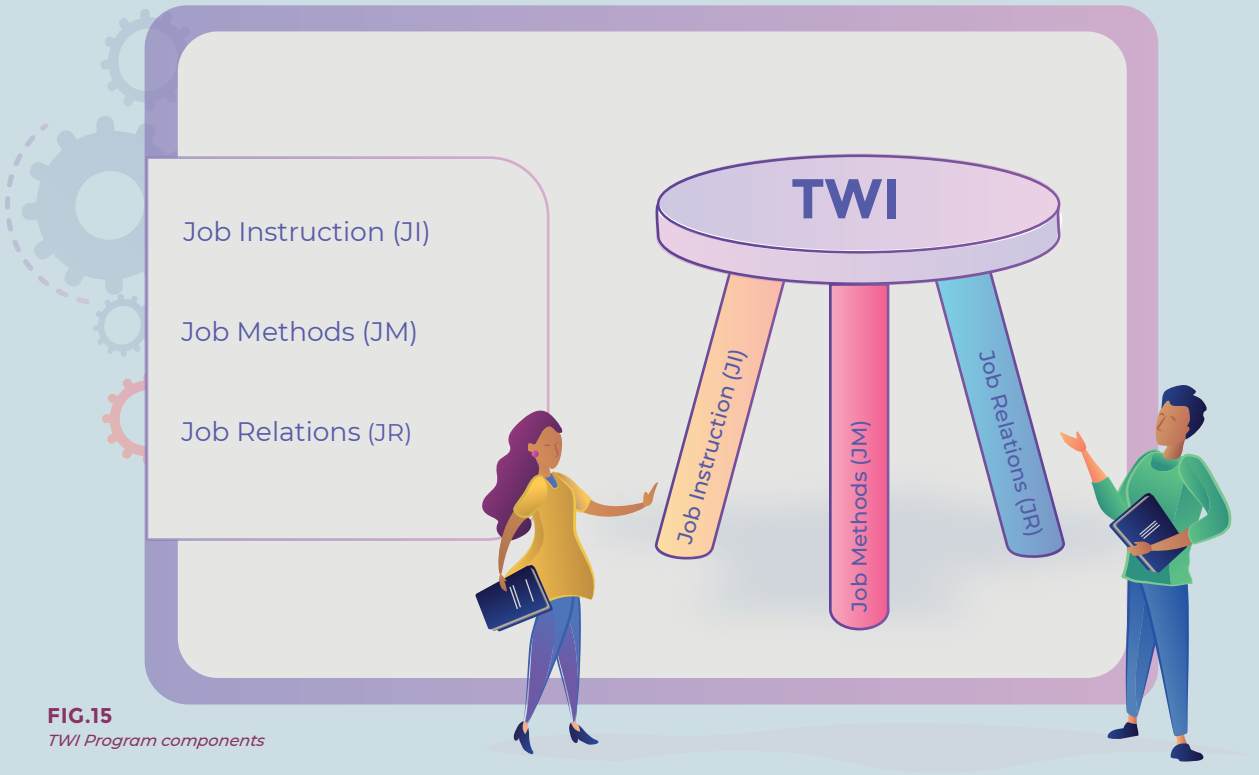


FIG.15
TWI Program components

Job Instruction (JI)

The aim of this course is to train leaders so they **can teach the standard job to others** and help link the written job standard with real practice at the workshop; that is to say, it is a complement that mixes theory and practice. This training technique ensures that people do their tasks in a reliable manner and obtain good results.

The Job Instruction (JI) helps supervisors learn how to plan by observing a breakdown of each job and the human resources necessary for production. In this way, supervisors can teach personnel how to act self-assured, correctly, and consciously.

Job Methods (JM)

This module is intended to train supervisors in **process improvement.** The aim is to teach leaders how to analyze jobs and how to make simple improvements within their area. To be improved, each task must be analyzed. The leaders must wonder why a task is done in a certain manner and whether the task could be eliminated, combined with another one, reorganized, or simplified.

Job Relations (JR)

At this stage, leaders learn how to build **healthy relationships with workers** —as a basis for good labor relationships— and how to avoid conflicts. They also learn to solve people-related production problems through trust, collaboration, commitment, and teamwork.

By way of an introduction, the chart below shows how the TWI Program is integrated into the PDCA improvement Cycle.

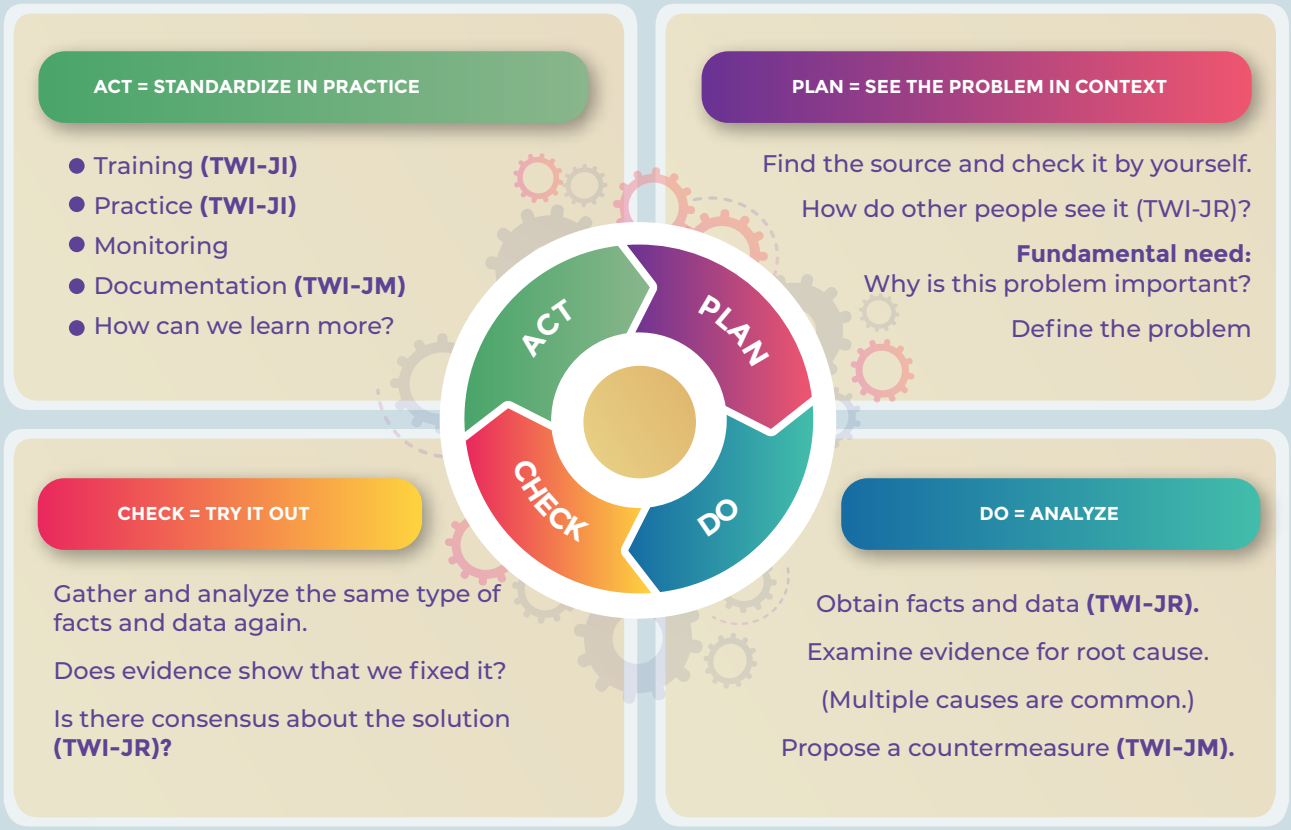


FIG.16
Relationship between TWI and PDCA. Adapted from Huntzinger, J. (2006)

Final Thoughts

Standardization is the basis for Continuous Improvement. If processes are not standardized, they can hardly improve.

"Without standards, there can be no improvement. Improvement begins when you know exactly where you are".

Taiichi Ohno

A productivity improvement tool implemented by a company will only survive if based on its own standards.

It is important to highlight that unsustainable improvements lead to loss of efforts and resources (time, money, etc.) and generate great discouragement among people involved.

Therefore, we insist on the importance of process standardization, based on solid standards effectively taught to people to ensure understanding and correct application. In other words, standardization paves the way to Continuous Improvement.

"Today's standardization... is the necessary foundation on which tomorrow's improvements will be based. If you think of standardization as the best that you know today, but which is to be improved tomorrow... you get somewhere. But if you think of standards as confining, then progress stops".[4]

Henry Ford

[4] Ford, Henry (1988)

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7. Implementation Task

1. DO A GROUP ACTIVITY

In a brainstorming session (see appendix **Brainstorming Session**), identify the situations in which the lack of standardization affects one of the following corporate operation aspects:

- **Safety**
- **Quality**
- **Cost**
- **Delivery**
- **Work environment**

2. CONSIDER

How standardization could help improve the situations identified in the brainstorming session.

3. SELECT

One of the situations identified and define the Standard Work, following the steps mentioned in item 4.3.

- **Step 1:** Prepare a productive capacity chart for manufacturing.
  See appendix: ***Time Observation Sheet.***
- **Step 2:** *Prepare a combined standard work diagram.*
  See appendix: ***Standard Work Diagram.***
- **Step 3:** *Prepare a work method guide.*
  See appendix: ***Work Method Guide.***
- **Step 4:** *Prepare a standard worksheet.*
  See appendix: ***Standard Worksheet.***

8. Appendix

BRAINSTORMING SESSION

Objective: Finding a joint conclusion by gathering and analyzing various ideas and solutions contributed by the members of a group around a specific topic. A key aspect is that all spontaneous ideas must be noted down.
During the session, it is important to:

- **Encourage worker's participation (group members)**
- **Obtain different views on and approaches to the same topic**
- **Assess different problems**
- **Complement the approaches of the different group members**

Application: It is applied at the assessment (situation diagnosis), analysis, or evaluation stage, depending on the objective set. As regards standardization, in particular, this technique may be useful for:

- **Identification of situations and assessment of operational aspects**
- **Ideas and steps for process standardization**
- **Analysis of results obtained in a new implementation scenario**

Necessary materials: a whiteboard or posters for the group members to watch the ideas being provided, markers, cards, or sticky notes to write the most important information.

Development: There must be a **coordinator,** who must know this technique, establish the main points to work on, make questions directly and clearly, convene the participants, encourage individual or group participation, ensure availability of necessary materials, and conduct the session. The coordinator selects a main point they deems interesting and, based on that point, convenes the participants. After some time for reflection, the coordinator calls for ideas. Each idea is shown in the poster or the whiteboard so the rest of the group members can watch it. The coordinator may ask new questions on the ideas received and/or written, ask for any further details as they may consider relevant, suggest connections between the ideas provided, propose central concepts to classify the sticky notes, papers, or cards written, among others. To wrap up, the coordinator may select the most important aspects arising from the session as input for future work.

TIME OBSERVATION SHEET

INTI Instituto Nacional de Tecnología Industrial

PROCESS	MACHINE	REFERENCE	DONE BY	DATE

WORKER

N°	WORK ELEMENTS	OBSERVATION No.												SHORTEST REPEATING			AUTOMATED CYCLE TIME (ACT)	OBSERVATIONS
													VA NVAN NVAI	MANUAL CYCLE TIME (MCT)	PARALLEL MANUAL TIME (PMT)	WAITING TIME		
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		
11																		
12																		
13																		
14																		
15																		
													TOTAL					

Note: If the machine has an automated cycle, start by unloading the part.

STANDARD WORK DIAGRAM

INTI Instituto Nacional de Tecnología Industrial

WORKER	TAKT	TPC	DONE BY:	DATE

PROCESS	MACHINE	REFERENCE	MANUAL T.	MOVEMENT	WAITING TIME	AUTO. CYCLE T.	1 DIVISION
							0,5 s

N°	WORK ELEMENTS	MANUAL CYCLE TIME	PARALLEL MANUAL TIME	MOVEMENT	WAITING TIME	AUTOMATED CYCLE TIME
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
	Worker Cycle Time (WCT) =					

INTEGRATED MANAGEMENT SYSTEM DOCUMENT
WORK INSTRUCTION TEMPLATE

INTI Instituto Nacional de Tecnología Industrial

DOC.:
REV.:
DATE:
PAGE:

TASK	
PARTS	
TOOLS AND MATERIALS	
PROTECTIVE EQUIPMENT	

MAIN STEP	KEY POINT (Success, safety, skill)	KEY POINT REASON	PICTURES
Any reasonable step that helps progress the task	Important points of the main step that may have an impact on quality, cause accidents, facilitate work		
(What do I usually do?)	(How do I do it?)	(Why do I do it?)	
1			
2			
3			
4			
5			
6			
7			
8			

STANDARD WORKSHEET

INTI Instituto Nacional de Tecnología Industrial

PROCESS	MACHINE			WORKER		REFERENCE	TAKT	TPC	DONE BY:	DATE
	WORK ELEMENTS	MANUAL CYCLE TIME	PARALLEL MANUAL TIME	MOVEMENT	WAITING TIME	AUTOMATED CYCLE TIME				
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20 Worker Cycle Time (WCT)										

Safety Inspection 1 Standard WP 1

CAP. #3:
JUST IN TIME

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INDEX

INTRODUCTION

Just in Time consists in producing only what is needed, when needed, and as needed. Although the concept is easy to define, it is difficult to implement, because companies find it very hard to coordinate all their resources to meet the actual production demands in an effective and economical way.

To do it "just in time", companies need to work hard and systematically so as to establish a solid corporate base, resulting from a stable and leveled production, based on actual demand, with standardized processes and permanent continuous improvement activities. Therefore, Just in Time comprises the concepts of production leveling, flow, and coordination, and deals with them through a set of tools, such as the Pull System, the Value Stream Mapping, the Continuous Flow, and Kanban, further explained in this chapter.

These tools have their own methods and applications, but they all contribute to the main aim of Just in Time: eliminating waste in the production process, which means eliminating all the activities that add no value to a product and imply underusing resources. This is the main benefit of Just in Time and the reason why it has a strong impact in the whole productive system of a company.

Moreover, a fundamental aspect of Just in Time is that it is not limited to a specific company, but it involves other links of the supply chain. Producing "just in time" implies coordinating all process stages: both suppliers and clients will feel compelled to collaborate by producing what is needed, when needed. Thus, they will start carrying out improvement actions in their own processes. In consequence, the Just-in-Time-related improvement actions will make an impact far beyond the company itself.

1. Just-In-Time (JIT) Pillar

1.1. What is it?

It is a set of principles, tools, and techniques that, when adopted as a production system by a company, allows for the production of small amounts, with short time cycles, delivered exactly when demanded. In other words, it means **producing the item required, at the time required, in the amount required.**

THE REST IS MERELY WASTE

1.2. Purposes and goals

The goal is to **eliminate waste** in a productive process.
The main purposes are the following:

- To reduce the level of raw material and supply inventories, as well as products in process and finished products
- To eliminate all unnecessary activities adding no value to the product
- To develop agile procedures that enable a more efficient management
- To develop a multipurpose working capacity among workers (applicable to U-shaped cells)
- To generate formal and stable systematic communication channels among both the members of the organization and the suppliers and clients
- To design and implement management systems to identify, address, and solve problems

These purposes shift the perspective of companies and allow them to find solutions for common problems.

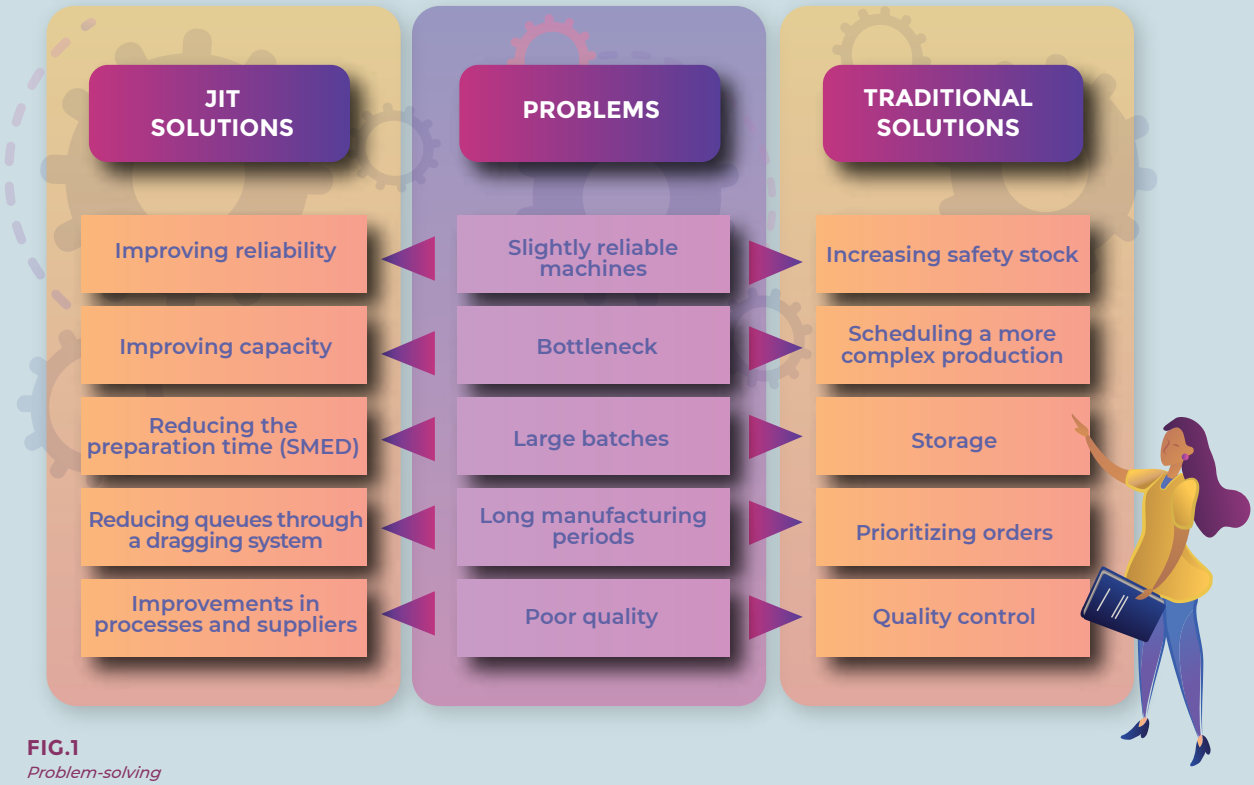


FIG.1
Problem-solving perspective

1.3. The Beginnings

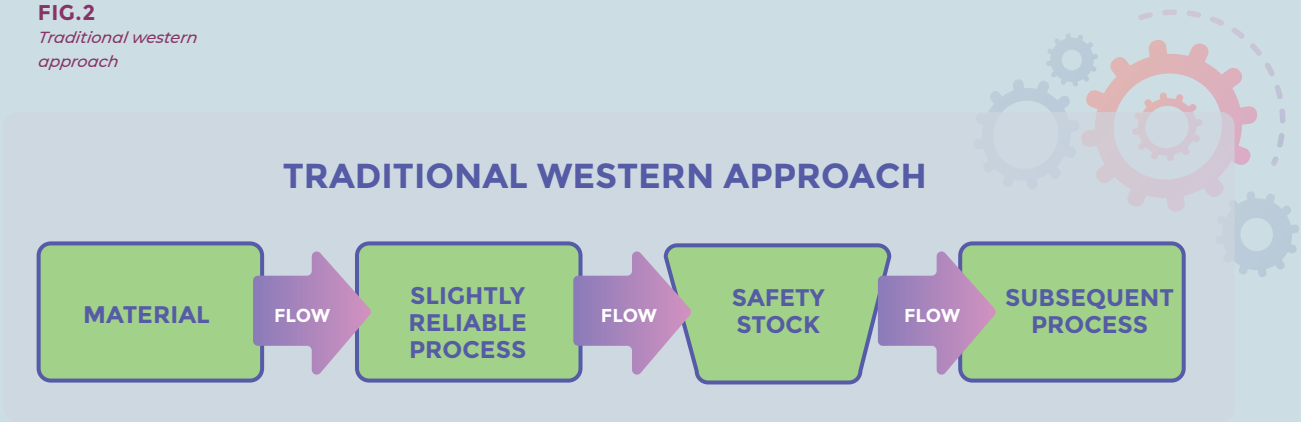
The JIT system first appeared in Japan, during the Second World War. It was developed by expert Taiichi Ohno, at Toyota, in the early 1950s, since the company needed to produce a few units of different models.

The main goal was to eliminate unnecessary elements of the production area, as well as existing inventories, which were a worry to the company, since space was limited and expensive.

Other important quality and productivity consultants from Japan, such as Imai, Ishikawa, and Taguchi joined Ohno and contributed more ideas. As time went by, this new system began to be implemented in other Japanese companies.

Meanwhile, western companies focused on planed manufacturing, increased automation, and mass production, underestimating the importance of product quality. As their aim was to reduce the cost/hour of products in each machine, mass production led to the accumulation of inventory and longer delivery times. As a result, these companies became less and less competitive in a more and more demanding market.

FIG.2
Traditional western approach



Since 1980s, the good practices implemented by Japanese companies started to become known in the West, together with their associated benefits: excellent quality, high productivity, manufacturing methods oriented to waste elimination, and an approach centered in people's participation. This led to a new era in which JIT was globalized and became a key tool for companies searching for competitiveness.

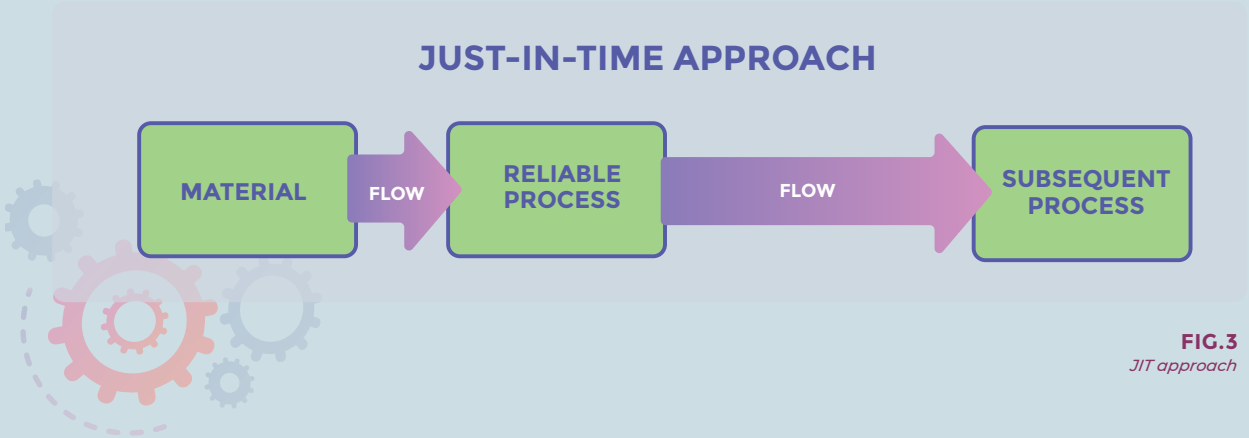


FIG.3
JIT approach

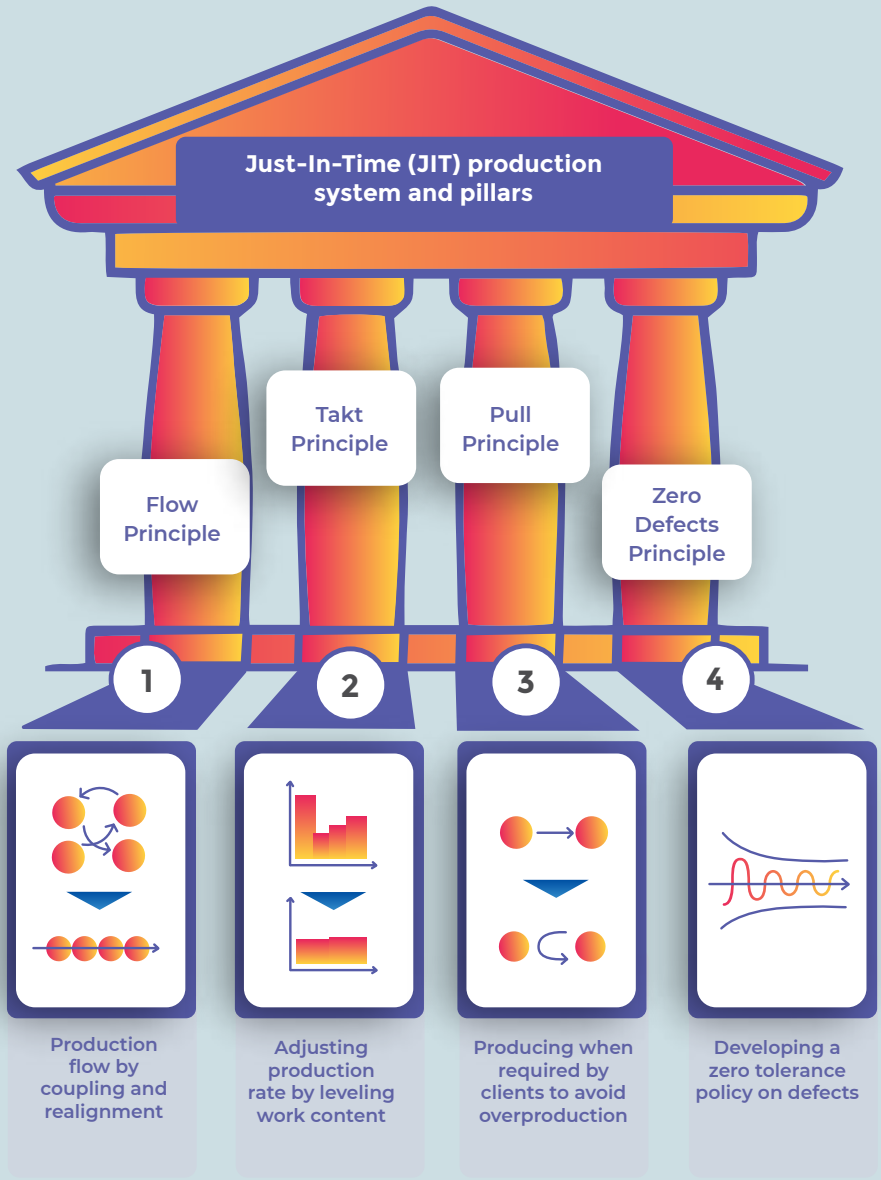
1.4. Implementation

To start producing under the JIT system, a company must adopted it as a philosophy of work throughout the organization. It must take into account from strategic planning to continuous evaluation techniques that enable monitoring, including efficient preventive maintenance, set-up time optimization through SMED,1 workers' involvement in the changes, and workers' organization in smaller cells. Likewise, as regards production, the company must shift from the Push to the Pull system; and if the Kanban method is also adopted, the company will be able to produce orderly, only on demand.

As mentioned before, **the JIT pillar is oriented towards responding quickly to the actual production demand.** To succeed in producing what is needed, when needed, the company must previously adopt three basic concepts: leveling, flow, and coordination. **Leveling** makes reference to the importance of the production process being in line with demand. **Flow** makes reference to the fact that the products must be in constant movement. **Coordination** makes reference to the development of process activities and materials supply under a constant flow.

[1] Parenti, Agustina, IBID, Chap. 3

FIG.4
JIT pillars



Based on that, the company can develop four basic principles for a successful production system:

Flow Principle | Takt Principle | Pull Principle | Zero Defects Principle

To comply with these principles, the company must implement the following concepts: Continuous Flow, Pull System, Kanban, and Value Stream Mapping (VSM).

- Continuous Flow **enables the company to produce in a smooth, uninterrupted manner.**
- Pull System, **coupled with** Kanban, **paves the way for producing what is demanded by the client, at the exact time of demand.**
- VSM **enables the company to check the value chain for non-value-added activities and related waste within the organization.**

It is important to remember that, in order to implement JIT, a company must eliminate unnecessary or redundant activities. Thus, the implementation must be based on the **Five Zeros theory, which aims at eliminating any potential mistakes or delays in the processes.**

Zero defects: It is important to produce non-defective items from the very first production stage; an error causes delays and increases inventory, leading to waste.

Zero faults: The company must deploy a preventive maintenance system as well as a Total Productive Maintenance (TPM) strategy; the breakdown of any machine or equipment causes delays and inefficiencies in processes.

Zero inventory: Inventory should be maintained at the lowest possible level. An excessive level, even when products can be delivered in due time, generates hidden storage and financial costs and may lead to problems in the production process and the coordination with other corporate areas.

Zero time: It is necessary to reduce production cycles. As a result, the waiting time, the equipment preparation time, and the movement time can be shortened.

Zero documentation: It implies reducing bureaucracy to the fullest extent, eliminating physical records, and optimizing communication channels for information to flow simply and seamlessly.

2.
Pull System

2.1. What is it?

One of JIT's basic principles is the Pull principle, which states that a company should only produce what is demanded.

Basically, in a Pull System, a company only produces those items for which a firm order exists, and as long as minimum inventory is available to satisfy immediate demand. The annual production plan is based on market research. Monthly and weekly production is planned in accordance with estimated demand, but daily production schedules entirely depend on the orders. As daily production approaches, the plan is continuously refined as per the orders accepted, and changes are applied to previous processes through Kanban in order to meet the non-stock production requirements.

This principle is difficult to comply with, since demand fluctuates according to product seasonal cycles, the economic situation, the monetary policies, etc. In consequence, part of current production systems is based on demand estimates or speculations; and production schedules, on past sales and market research. However, actual demand often differs greatly from the projections and estimates made.

The Pull System is intended to a market that demands fast delivery of a wide variety of products, manufactured in small batches.

Usually, companies produce in large batches, at maximum machine efficiency, often adjusting delivery dates to the production system requirements and pushing the product to the market. This production method is known as the **Push System**. From the TPS perspective, which aims at identifying and eliminating waste, and reducing costs, under this production system, at least two of the seven production losses are incurred:[2] excessive inventory and overproduction.

[2] Parenti, Agustina, IBID, Chap. 1

The method proposed by Japanese experts to control these losses is the Pull System, because production is based on demand.

2.2. Comparison between Push and Pull Systems

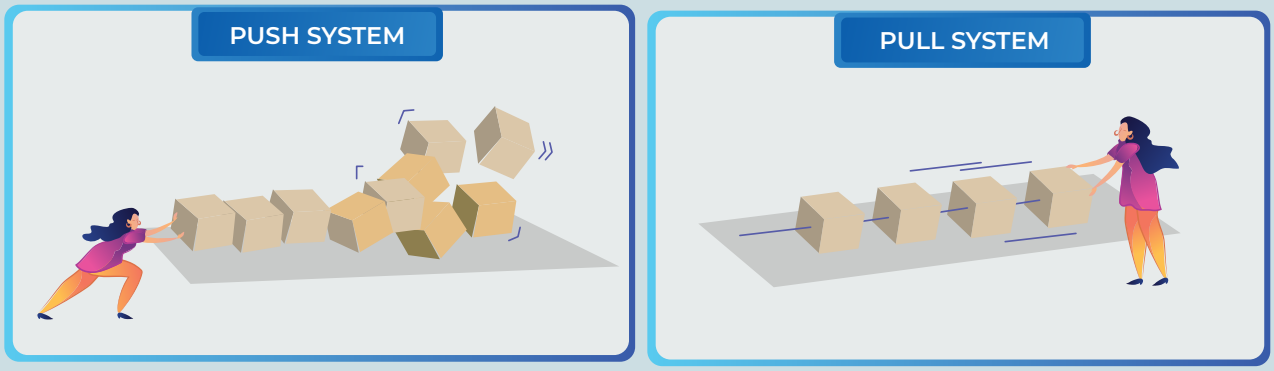


FIG.5
Comparison between Push and Pull systems

There follow some of the main features of each:

Push System

- ✓ Demand based on forecast or speculation
- ✓ Daily-production-scheduled operations independent from the rest
- ✓ Manufacturing based on the operating capacity
- ✓ Excessive inventory due to production at maximum installed capacity

Pull System

- ✓ Demand based on firm orders
- ✓ Schedule based on the last operation
- ✓ Defined-quantity manufacturing based on internal or external customer request
- ✓ Minimum inventory due to demand-based production

What things must be taken into consideration when deciding to move from a Push to a Pull system?

- Estimated demand
- Possibility to work with a continuous flow and a small batch
- Characteristics of critical or main machines
- Reduced machine preparation time
- Preventive maintenance
- Communication between processes, clients, and suppliers
- Reduced inventory level

3. Value Stream Mapping (VSM)

From all the tools that are part of the universe of Continuous Improvement, **Value Stream Mapping** is an essential one. This analytical tool is among the first to be applied when it comes to transforming a traditional company into a Kaizen company.

As in other tools discussed in this chapter, the premise is the following:

"Maximizing value for the client, while minimizing waste".

3.1. What is it?

VSM is a tool that, by means of specific symbols, **shows the flow of material** and information throughout a product-family value chain and how to add value in that process.

3.2 Purpose and goals

Value Stream Mapping is applicable to companies that both manufacture products and provide services; besides, it is useful to **analyze the current process condition and create a better one.** The main aim of designing and interpreting this tool is **to check the value chain for non-value-added activities** as well as any related time and waste.

In practice, value mapping has become such an essential activity in the formulation of improvement plans that it forms part of process diagnosis (current VSM) and the improvement strategies proposal (future VSM).

3.3 Relevant Value Mapping Indicators

Takt Time

Takt time indicates the frequency at which a client demands products. It is an objective time to which the production system must adapt to satisfy the client's expectations. It is calculated as follows: Available time/Demand.

Individual Cycle Time

It is a standard time related to each task of the process. For example: The standard time associated with part painting or part packing.

Total Cycle Time

(Manufacturing Lead Time)

It is the time required to perform all tasks and is obtained by the addition of all individual cycle times.

Client Needs Forecast Time

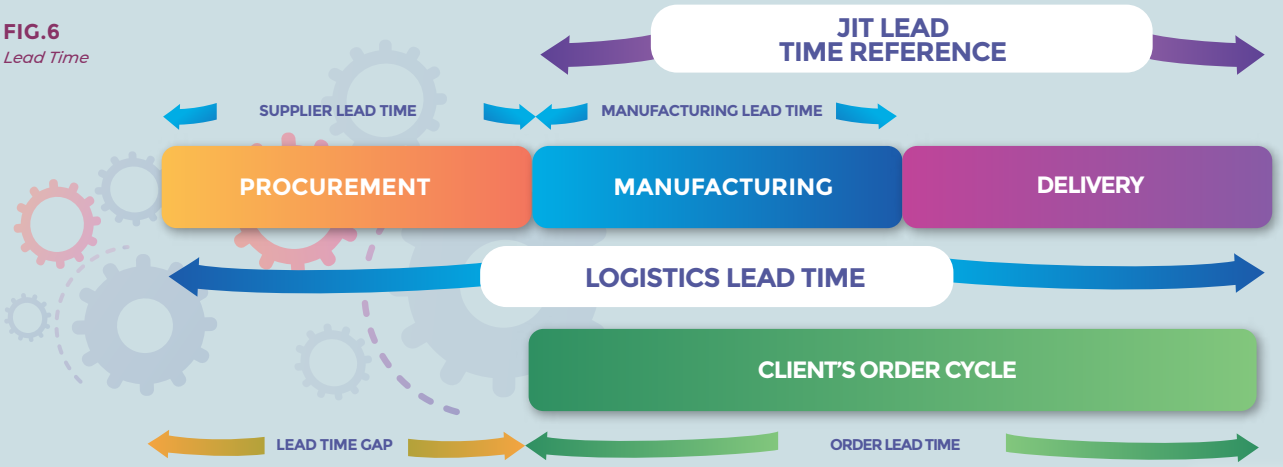
(Lead time GAP)

In this interval, future products and quantities must be estimated. The size of the GAP is directly proportional to forecast mistakes.

Logistics Lead Time

It is the time starting when raw material, materials, and supplies are picked up by the company to the moment when the finished product is distributed to the client.

FIG.6
Lead Time



3.4 Implementation

When preparing a Value Stream Map, we should answer a series of key operating questions:

What is the production system capacity?

What bottlenecks are there in the process?

What is the client's takt time?

What are the available and the utilized capacity?

What are the process restrictions? Are they internal or external?

How can the process be improved to comply with the business goals?

To start with VSM implementation, we should prepare a map of the company's most representative process by following these steps:

1. Establish product families: It is necessary to take into account the tasks each product is subject to and the individual cycle time of said tasks. A product family is a group of references that are subject to the same tasks and have slightly different cycle times.

2. Record the following information:

- Cycle time of each task of the process
- Availability of the equipment involved in the process
- Time allocated to preparing an operation for another product (set-up time, ST)
- Inventory at each stage of the process
- Clients' demand, the means through which products are demanded, the frequency, and the quantity
- Forecasts used to predict demand and procurement needs, the means through which supplies are demanded, the frequency, and the quantity
- The process sequence and the flow of materials and information

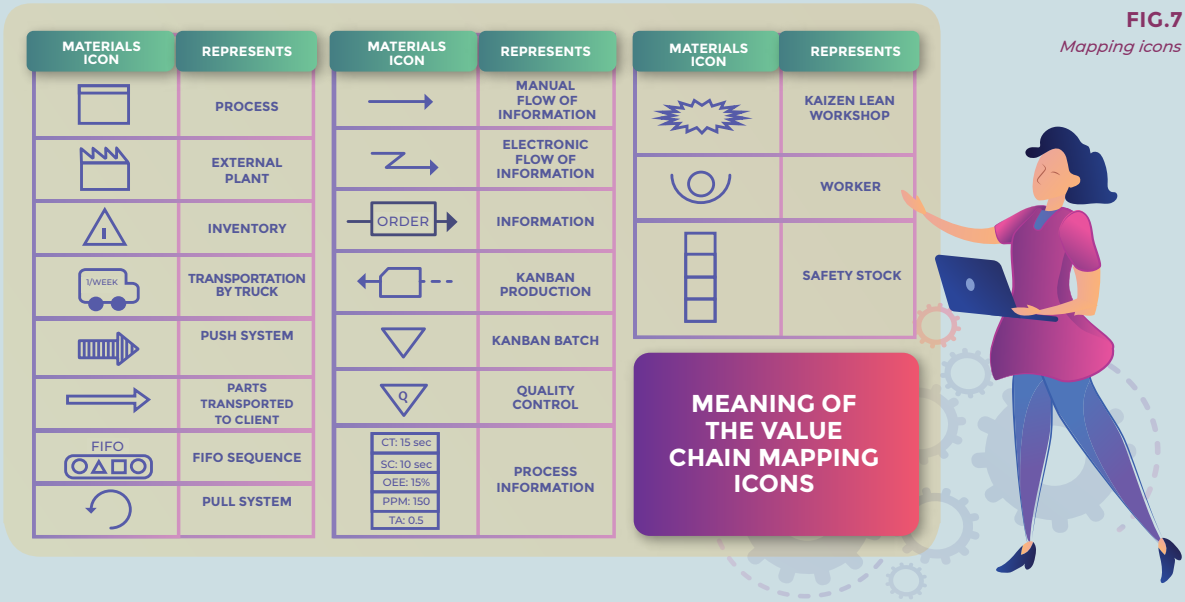


FIG.7
Mapping icons

3. Prepare the current VSM: First, the client's symbol is placed on the top right corner of the plan. Second, the flow of information that links the client's demand (actual and potential orders) with production control is connected. Third, production control, the requirements sent to the supplier, and the materials forecasts are interrelated, connecting the flow of information that links materials needs with the supplier.

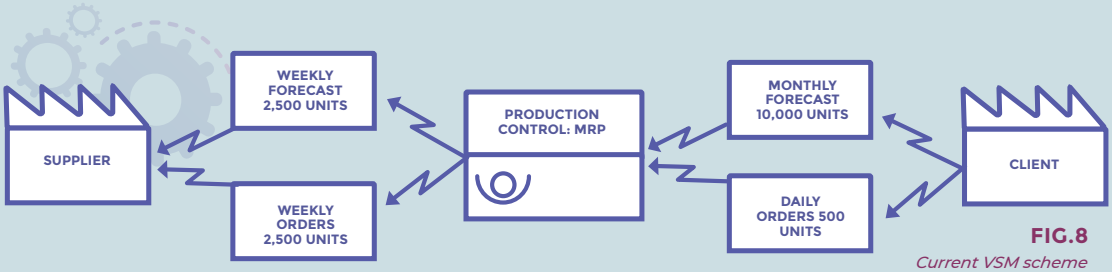


FIG.8
Current VSM scheme

4. Represent transportation from suppliers to the company

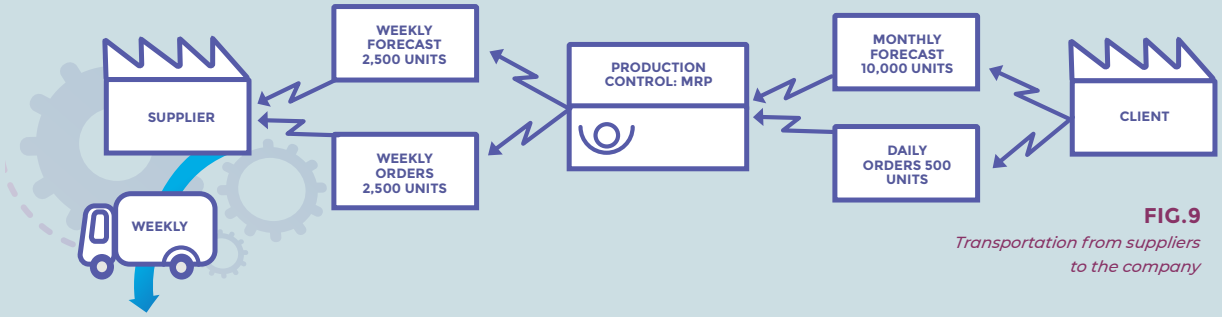


FIG.9
Transportation from suppliers to the company

5. Draw the task sequence by stating the time for each task, the set-up time, the equipment availability, the available time, and the works in progress

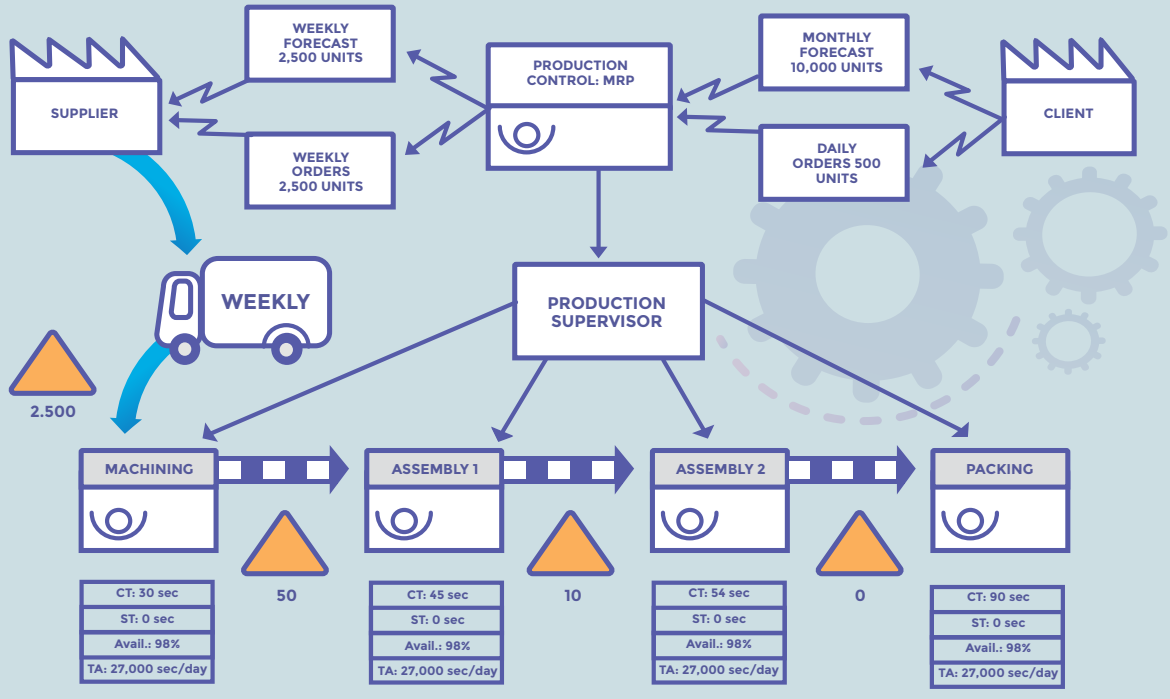


FIG.10
Tasks sequence

6. Represent the production schedule, stating the quantity to be processed in each task, as well as the (manual or electronic) flow of information that links these tasks. Transportation from the plant to the clients should also be represented.

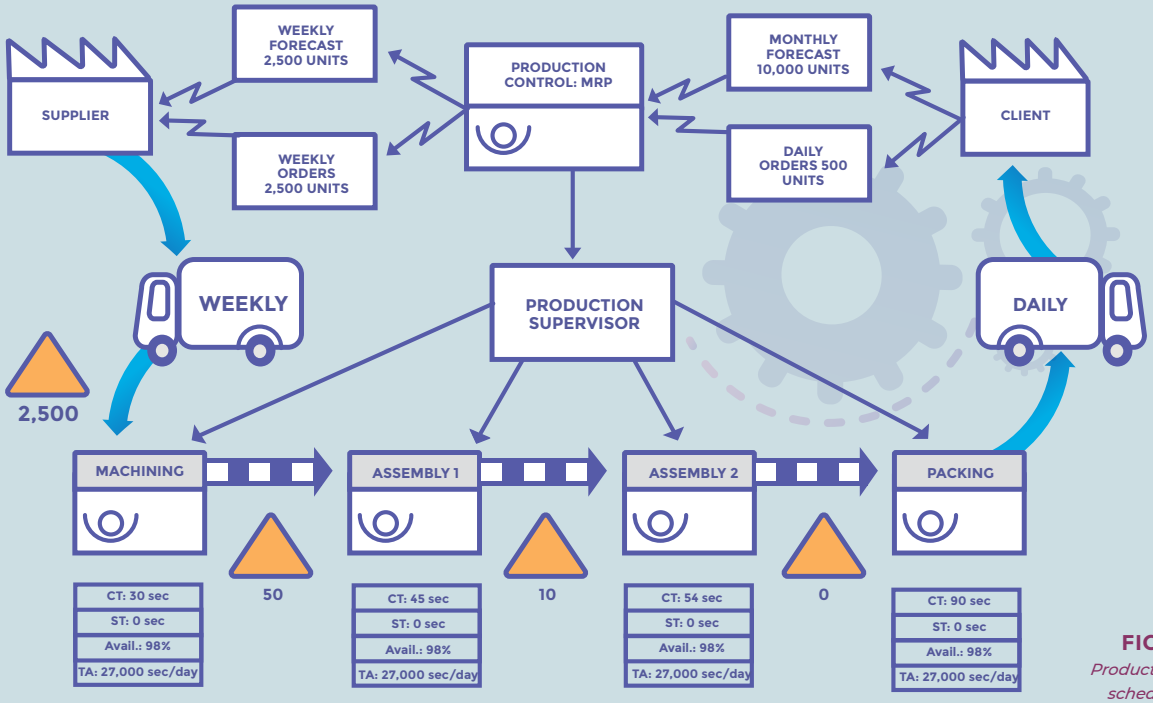


FIG.11
Production schedule

7. By means of a square sawtooth wave, represent the cycle time of each task (value-adding time) in the lower line, and the non-value-adding time, in the upper line. Inventory, which is deemed to add no value to the process, is recorded in accordance with time. This can be done by dividing the quantity of each inventory by the daily quantity required by the client.

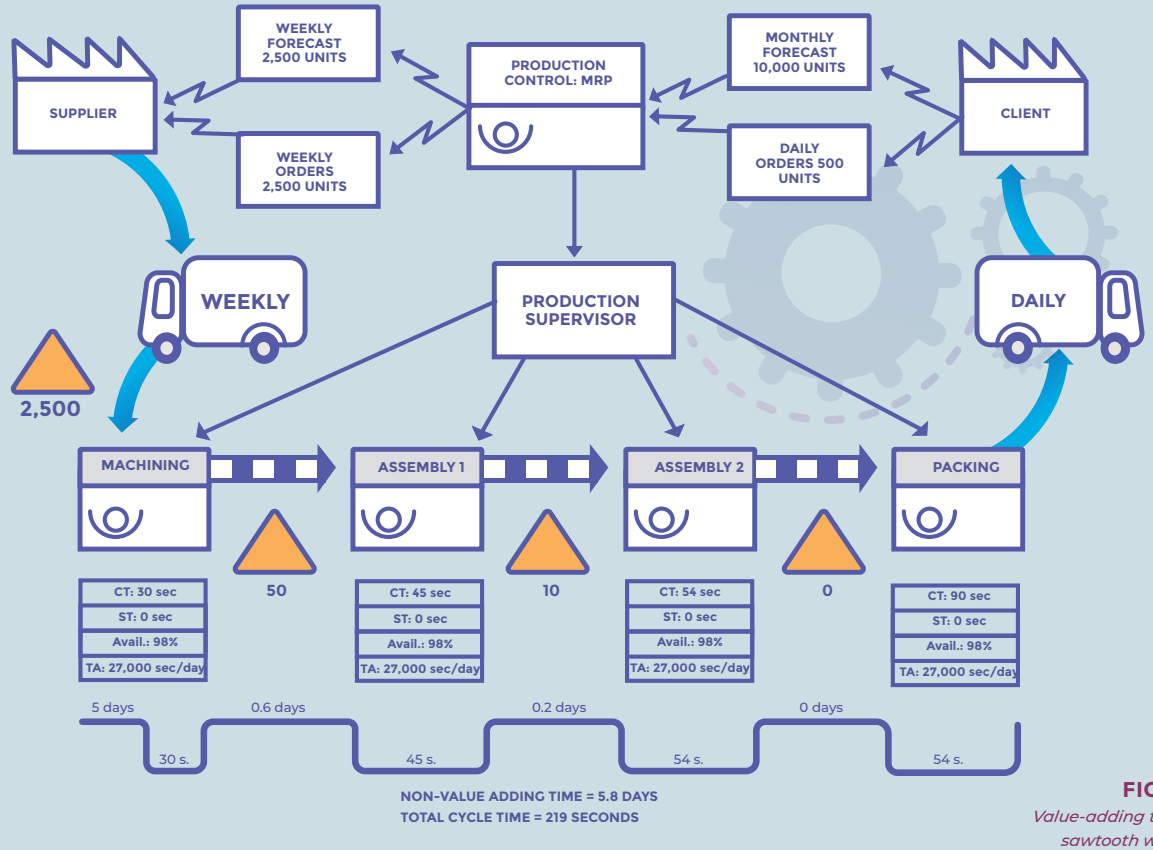


FIG.12
Value-adding time sawtooth wave

8. **Calculate takt time,** which will be the production goal. Now, the VSM shows that there are processes to be improved and inventories to be reduced. Based on the example given, the takt time is the following:

- Available time = 27,000 seconds/day
- Daily demand = 500 units/day
- Takt time = 27,000/500 = 54 seconds/unit

9. **Analyze what the future condition should look like:** At this stage, knowledge and experience are necessary to design a better version, using management technology tools, such as Kanban, SMED, Kaizen, among others.

10. **Create the future VSM,** which must show the improvements planned to decrease the identified waste.

4. Continuous Flow

4.1. What is it?

According to Continuous Flow —or one piece flow—, **the products are manufactured and transported directly from one stage of the process to the following, one piece at a time.** That is to say, each stage of the process only begins when the previous one finishes, with no work in progress in between. Therefore, the size of the production batch is of one single piece. This configuration **enables the company to minimize waste, simplify controls, and gradually reduce the amount of materials and work in progress until final elimination.**

Currently, for a company to move from a per-batch production, in which items are produced "just in case", to a per-piece production, re-ordering the process sequence or the machine layout is not enough. Creating, maintaining, and improving the continuous flow requires a daily effort, commitment, and genuine willingness from all the members of the organization to perform their work differently.

4.2. Benefits of its Implementation

The benefits of implementing the continuous flow in the company are the following:

- **Increase in productivity:** By having multipurpose workers, the company can assign other activities corresponding to other products/services to them, thus avoiding the overproduction of a single product/service for the mere reason of having the time.
- **Cost reduction:** The resources necessary for manufacturing a product are maintained at the lowest level (machines, materials, equipment management, and personnel).
- **Inventory reduction:** As the company does not invest money in accumulating inventory inside the plants, more capital is available to invest in other areas. Likewise, no obsolete inventory is generated.

- **Increase of available space:** Wasted floor space between machines and inventory is eliminated. Everything is located near the workstation, and the space for inventory is very limited.
- **Quality manufacturing and services:** Workers review their work and solve their problems in their own workstations; thus, even though a worker misses a defected part, that part will be detected in subsequent tasks.

4.3. Where should Continuous Flow be applied in the company?

Ideally, Continuous Flow should be applied to the whole value chain of all the product families manufactured by a company. It is important to check the value chain in advance —through the VSM— for any limitation to the comprehensive application of Continuous Flow, such as the following:

- The cycle of any machine is faster than the client's demand pace.
- The cycle of any machine is not fast enough to reach the minimum time necessary during regular work time.
- A machine is not reliable, as it produces persistent and significant waste and has a low uptime (available time).
- Expensive machines, shared with other value chains, cannot be duplicated; thus, they cannot be exclusively allocated to the product family selected to create a flow.
- Heavy and big equipment cannot be moved for various reasons.
- Some processes cannot be integrated into one cell for technology reasons.

In consequence, the company needs to analyze the speed of the flow and identify the machines that have some of the above-mentioned limitations. It has to gradually work on synchronizing all the processes and operations for the constant flow of materials, in compliance with one-piece requirements and ensuring due delivery to the client (production rate).

4.4. U-Shaped Cell Layout

The machines involved in the product family process are laid out by forming an U shape so they can produce at, as nearly as may be, the planned cycle time (PCT) rate. Likewise, as long as the breakdown time and set-up time can be reduced, the PCT will become closer to the Takt Time.[3]

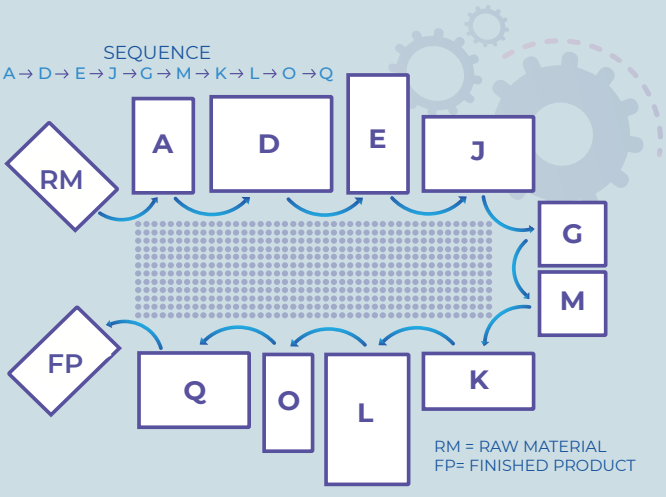


FIG.13
Sequence of tasks in an U-shaped cell

[3] Parenti, Agustina, IBID, Chap. 5

The plant must be divided into cells, occupied by multipurpose workers. The number of people working in the cells can be increased or decreased, as necessary. Thus, the cell is flexible enough to operate at different production rates and with multi-size equipment.

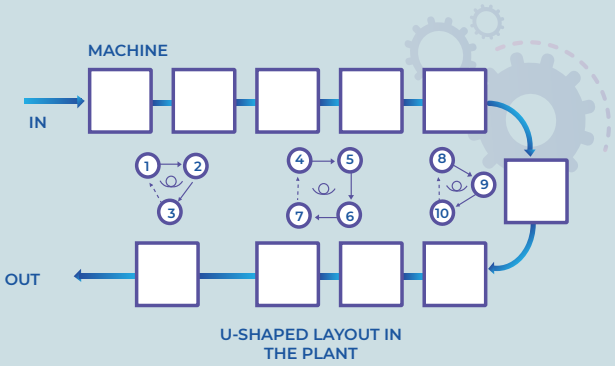


FIG.14
Distribution of tasks among multipurpose workers in a plant divided into cells

The U-shaped cell layout has the following features:

- The layout minimizes the distance workers must walk to start a new cycle (the start and ending position are located in the same sector).
- A U-shaped cell can consist of a mix of manual, semi-manual, and automatic machines/workstations.
- The workstations in a U-shaped cell can be laid out in accordance with the process sequence, either clockwise or counterclockwise. This is determined by the physical layout of the existing machines.
- The width of the internal corridor of a U-shaped cell must be between 1.50 and 1.75 meters.
- Depending on the layout, a cell has capacity for 1 to 10 workers. A properly-designed cell allows for changes in the number of workers, based on the fluctuations in the client's demand rate (takt time), without losing efficiency.
- Each workstation typically produces one single part, though not always.
- Workers move from one workstation to the other to perform all the tasks necessary for the manufacturing process.
- Each worker's tasks must be standardized through a standard worksheet.
- A worker can perform all or part of the tasks of a cell process, as specified in the standard worksheet.
- A worker can perform part of the tasks of the process, and they do not need to be consecutive.

The benefits of implementing Continuous Flow in a U-shaped layout are the following:

- ✓ The parts of the previous task are fully inspected. Defects are repaired at the time of detection, and, thanks to the single-unit transference batch, no substantial loss is produced.
- ✓ Semi-manufactured stock or work in progress is maintained at the lowest possible level, thus decreasing inventory-related costs.
- ✓ The high flexibility of machines and manpower improves the response to the client's fluctuating demand.

4.5. Types of Work Sequences in U-Shaped Cells

These are the most widely used methods when organizing the work sequence in a U-shaped cell:

4.5.1 *Split Work*

Through this method, each worker of the cell does part of the manual work content. Multiple combinations of said content can be distributed among the workers in a balanced manner. It is important that workers' movements do not overlap.

In the example shown in figure 15, worker 1 performs the tasks in machines A→O→Q and goes back to machine A. Before moving from A to O, worker 1 places the part on a ramp so it is transferred to machine D.

Worker 2 performs the tasks in machines D→E→L and goes back to machine D. Before moving from E to L, worker 2 places the part on a ramp so it is transferred to machine J. Before moving from L to D, worker 2 places the part on a ramp so it is transferred to machine O.

Worker 3 performs the tasks in machines J→G→M→K and goes back to machine J. Before moving from K to J, worker 3 places the part on a ramp so it is transferred to machine L. Allocating the same worker to the first and last processes (A and Q) helps monitor the planned cycle time.

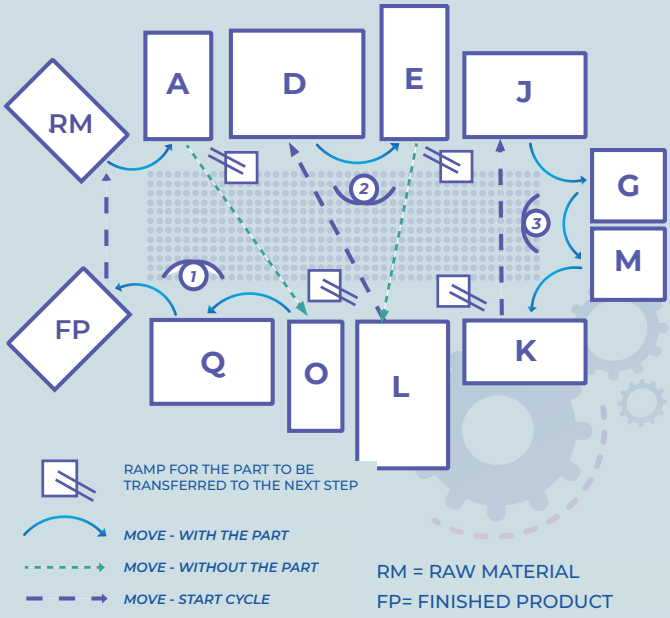


FIG.15
Sequence of tasks under the split work method

4.5.2 *Nagare Work*

Nagare is a Japanese word that can be translated as "rabbit chase".

In this case, as shown in figure 16, each worker completes the A→D→E→J→G→M→K→L→O→Q circuit, one after the other, several workstations behind. In cells with more than two workers, this method can be difficult to coordinate.

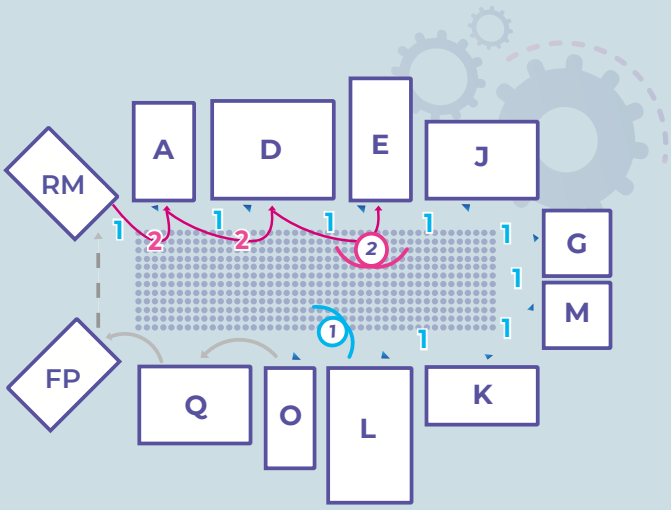
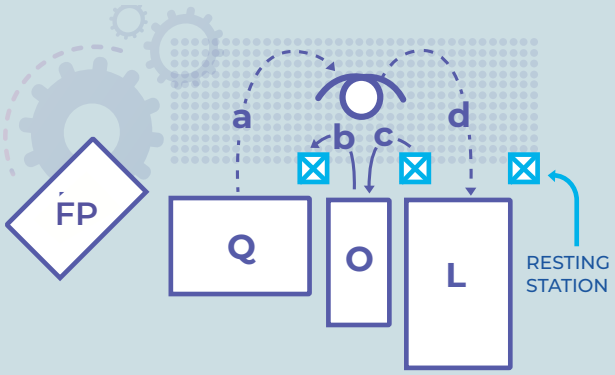


FIG.16
Sequence of tasks under the Nagare method

4.5.3 *Reverse Flow Work*

FIG.17
Sequence of tasks under the reverse flow method



The worker moves in the opposite direction of the product flow. The move-work sequence is more natural. It is used when the worker needs to use both hands to handle the part and the machines are semi-automatic. For that purpose, a "resting station" must be inserted between each machine for the worker to place the part there. **The figure shows the following example:**

The worker arrives from machine Q to machine O (counterclockwise) with hands free, passing the empty resting station O/Q. The worker unloads the part from machine O —after completing the task— and places it in the resting station O/Q. The worker takes the part from the resting station L/O —task L completed— and loads it into machine O, starts the cycle, and leaves machine O operating automatically. Then, the worker moves to machine L (counterclockwise), passing the empty resting station L/O.

Before applying the reverse flow method, several cycles must be repeated to load the machines and the resting stations of the cell. The reverse flow can be combined with the split or the Nagare methods.

5.
Kanban

Producing piece by piece, only when demanded, guarantees the absence of unnecessary inventory. To identify a specific demand, even if it arises in the opposite side of the plant, there is a very easy tool: Kanban.[4]

5.1. What is it?

Kanban is an informative tool developed by Toyota, which is based on the way supermarkets operate and enables the **implementation of a Pull production system.**

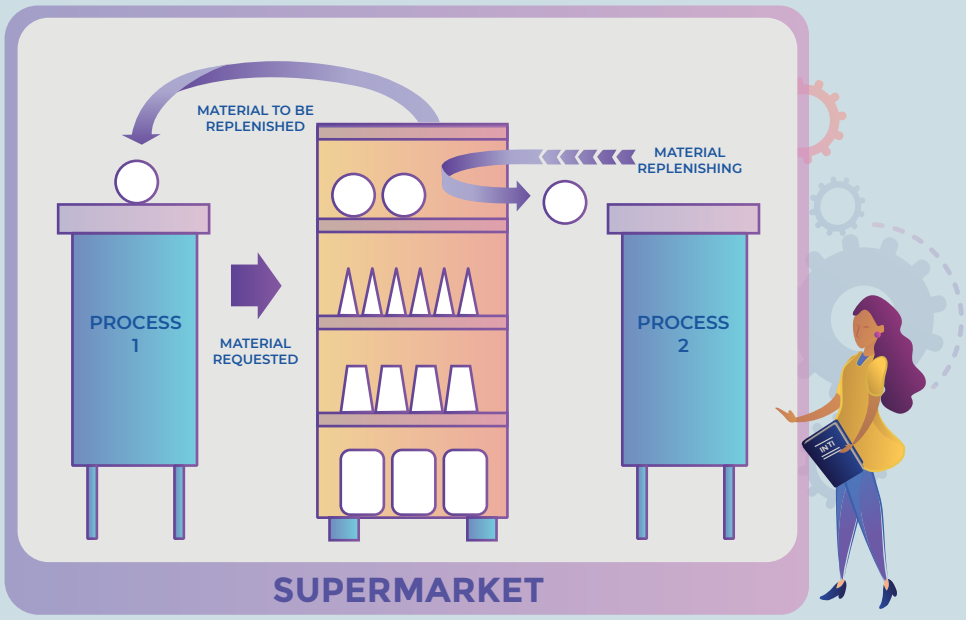


FIG.18
Supermarket operation

[4] Parenti, Agustina, IBID, Chap. 1

Kanban is a Japanese word that can be translated as “instruction label”, “production order”, or “work order”. This tool acts as an automatic directional device that gives us information concerning what to produce, which quantity, through which means, and how to transport it.

Kanban is a card used to request –from the previous process or supply– a number of parts that must be replenished since they have already been consumed.

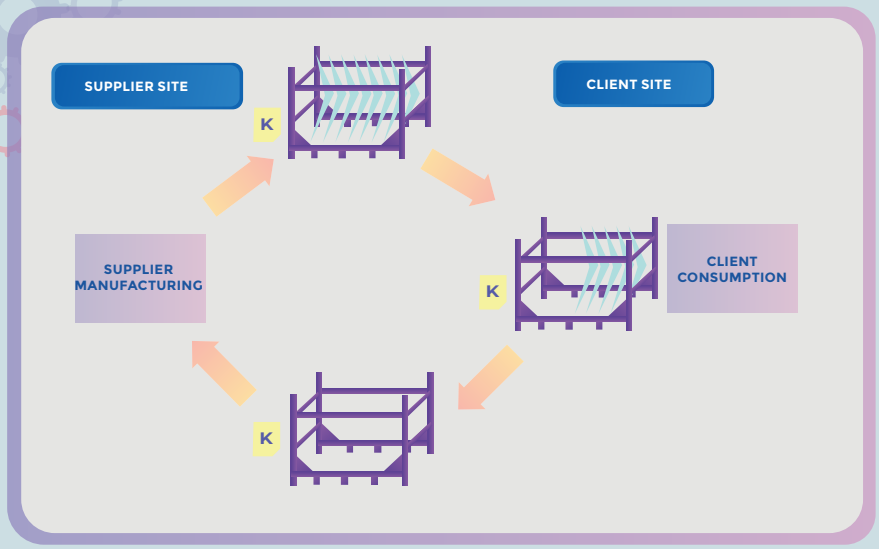


FIG.19
Kanban card system

5.2. Objectives

The aims of a Kanban implementation are the following:

1) Limited amount of materials under intermediate or final process: The quantity manufactured is the one stated in the card, which represents the quantity required.

2) Production instruction: It serves as a work order. Manufacturing only begins upon arrival of the Kanban card; in this regard, any prior actions are forbidden.

3) Material identification card: Each container of part batches is identified with the card. It includes codes, quantities, dates, destination, among others.

Rules for Kanban production instructions:

1. Each workstation collects parts from the previous one only when required and in the amount required.

2. The downstream workstation must manufacture products in the amount collected by the upstream workstation.

3. Defective products must be retained in the current process. They should never move on to the upstream workstation.

4. No part should be manufactured without a Kanban card.

5. Kanban should be used to adapt production to demand.

5.3. How it Works

A “manufacturing Kanban card” is useful to send production orders from one workstation to another, avoiding any risk of mistakes. Every time a card is received, the part requested is manufactured in the amount requested; and after filling the container with the parts, the card is affixed to it again, and the container is left in the area specified. In this way, production progresses workstation per workstation, throughout the manufacturing process.

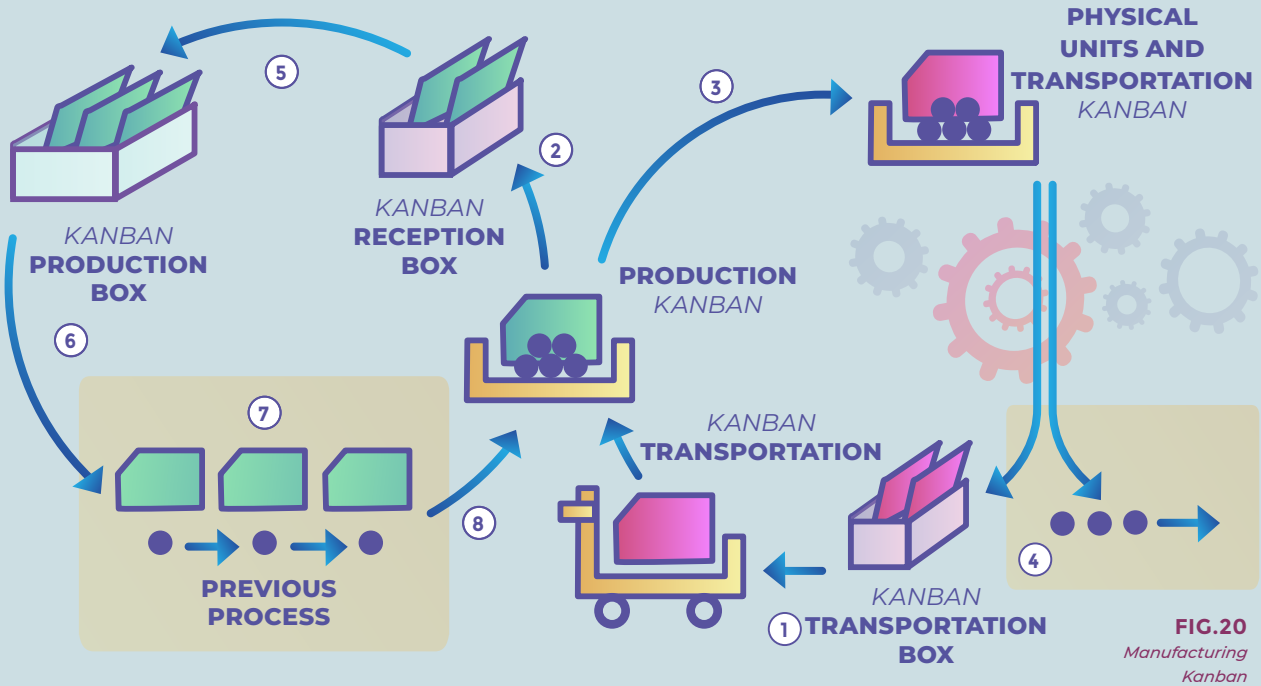


FIG.20
Manufacturing Kanban

When a client, either internal or external, needs a specific part, the client takes the container and returns the Kanban card to the supplier (which can simply be the downstream workstation), and this card immediately becomes the production order of the part stated therein, in the amount stated therein.

5.3.1 *Kanban Cards*

Kanban cards contain information on the supplies requested: product, code, quantity of batches, size of the batch, requesting center, recipient center, among others.

FIG.21
Kanban card

Each product, part, or component has its corresponding container and Kanban card. The maximum amount of cards each container can have must be specified.

The production order can also be represented by a file placed inside a box or by a card hanging from a board.

FIG.22
Use of a Kanban card

There are two types of cards:

1. Production Kanban or Card

The Production Kanban states the quantity that the downstream workstation is authorized to produce. It is used to request the production of a product batch, which will carry its corresponding card, as a substitute for another product that has already been consumed and is requested by the upstream workstation.

2. Transportation Kanban or Card

The Transportation Kanban states the quantity that must be sent to the upstream workstation. It is used to request the transportation of a batch or container of a product that has already been consumed from a workstation to the upstream workstation or a warehouse.

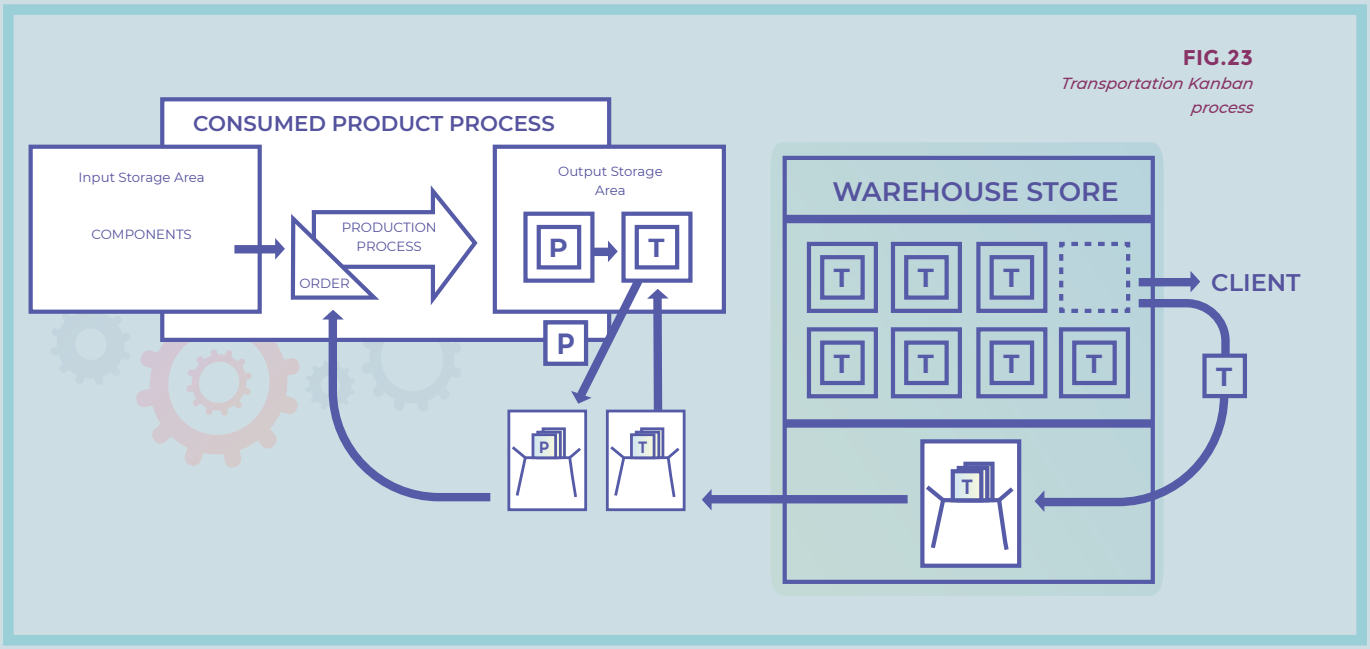


FIG.23
Transportation Kanban process

5.4. Kanban Today

In the last few decades, Kanban has been growing in popularity. Even though it was originally designed for the automotive manufacturing process, it later caught the interest of software developers and agilists who needed it to manage their projects.

Nowadays, one of the possible areas to which Kanban can be adapted is project management: **Kanban Board** is an agile tool that ***helps visualize work, limits work in progress, and maximizes efficiency.*** The boards include cards, columns, and Continuous Improvement to help technology and service teams commit themselves to an appropriate workload and, of course, to complete it.

FIG.24
Kanban board

These are some of the main advantages of a Kanban Board:

- ✓ *Visualizing the workflow (workload)*
- ✓ *Managing processes in a continuous and smooth manner*
- ✓ *Encouraging visibility and transparency in the activities to be performed*
- ✓ *Building a feedback culture*
- ✓ *Making improvements through collaboration*

Thanks to the technological advances, Kanban is also improving steadily. An example of this is the booming **digital Kanban Board,** which is replacing the physical one. This digital solution has been developed to overcome the problems arising in remote equipment. Team members cannot work in a single physical board; thus, they need a digital one to have access anywhere.

The cloud Kanban Board is the most effective way of ensuring that all team members are working under the same conditions, as it gives access to all the information from any device, at any time, and shows the actions in real time.

Moreover, the Kanban software allows for a sophisticated analytical process that helps monitor performance in detail, detect bottlenecks, and implement the necessary changes.

The digital Kanban Board is easy to integrate to other systems, offers a valuable perspective of the whole process, **saves time, and increases efficiency.**

KANBAN GAME

PORTEZUELO KANBAN GAME

(Website of the developing company, which includes a brief description of the game and some images)

6. Bibliography

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7. Implementation Task

Prepare a basic VSM of a process of your choice. To employ this methodology successfully, it is necessary to gather data on each of the points listed below and present it graphically, through the sample template.
(See appendix: SAMPLE TEMPLATE.)

1) Choose a process to map. We suggest focusing on a product family (products subject to similar processes and common equipment) and detail how many products there are in the family. Determine its key stages to prepare the flowchart or value stream.
(See appended chart 1: VALUE STREAM.)

2) Calculate the work time and determine its features:

- *Business days per month*
- *Shifts per day*
- *Hours per shift*
- *Breaks per shift*

(See appended chart 2: WORK TIME.)

3 Gather critical data from each of the previous stages. Per each workstation or machine, obtain the following information:

- *Number of workers*
- *Cycle Time (CT) = Available time/Units produced5*
- *Set-Up Time (ST)6*
- *Availability (A) = Operating time/Loading time7*
- *Planned Time (PT) = Shifts per day*(Hours per shift - Planned downtime)*
- *Work in progress*
- *Work in progress time = Work in progress/Daily demand*

(See appended chart 3: KEY STAGES.)

[5] Parenti, Agustina, IBID, chap. 5
[6] Parenti, Agustina, IBID, chap. 3
[7] Parenti, Agustina, IBID, chap. 3

4) Analyze materials entrance to the plant (supplier) of the process chosen:

- *Delivery frequency (daily, weekly, bimonthly, monthly)*
- *Amount sent*

(See appended chart 4: PROCUREMENT.)

5) Determine the client's requirements:

- *Daily demand = Monthly demand/Business days per month*
- *Number of orders*
- *Delivery frequency (daily, weekly, bimonthly, monthly)*

(See appended chart 5: CLIENT'S REQUIREMENTS.)

6) Indicate the process takt time, which represents the frequency at which a client demands products. It is an objective time to which the production system must adapt in order to satisfy the client's expectations.

- *Tk = Planned Time (PT)/Daily demand*

The cycle must always be equal or shorter than the takt time.

7) In the square sawtooth wave of the sample template graph, include the value-added (VA) and the non-value-added (NVA) element of each task.

- The VA must be placed in the lower line. It is expressed in seconds, minutes, or hours, and it equals the cycle time of each stage; that is to say, the time it takes for a part to be processed.

- The NVA must be placed in the higher line. It is linked to the work in progress, which must be recorded based on time; that is to say, how long partially finished products have been waiting for further processing between two stages.

8) Determine the value added of the process and the waste. For that purpose, it is necessary to calculate the total VA and total NVA of the process represented.

- The total VA results from the addition of all the figures of the lower lines.
- The total NVA results from the addition of all the figures of the higher lines.

Then, after making the calculations, the following formulas are applied:

- Value added of the process = (Total VA/Total NVA)*100
- Waste = 100% - Value added of the process

From now on, the organization should think of improvements in different stages of the process with the aim of decreasing waste and increasing the VA in relation to the NVA. After that, a new VSM should be prepared and the older figures should be re-calculated.

8.
Appendix

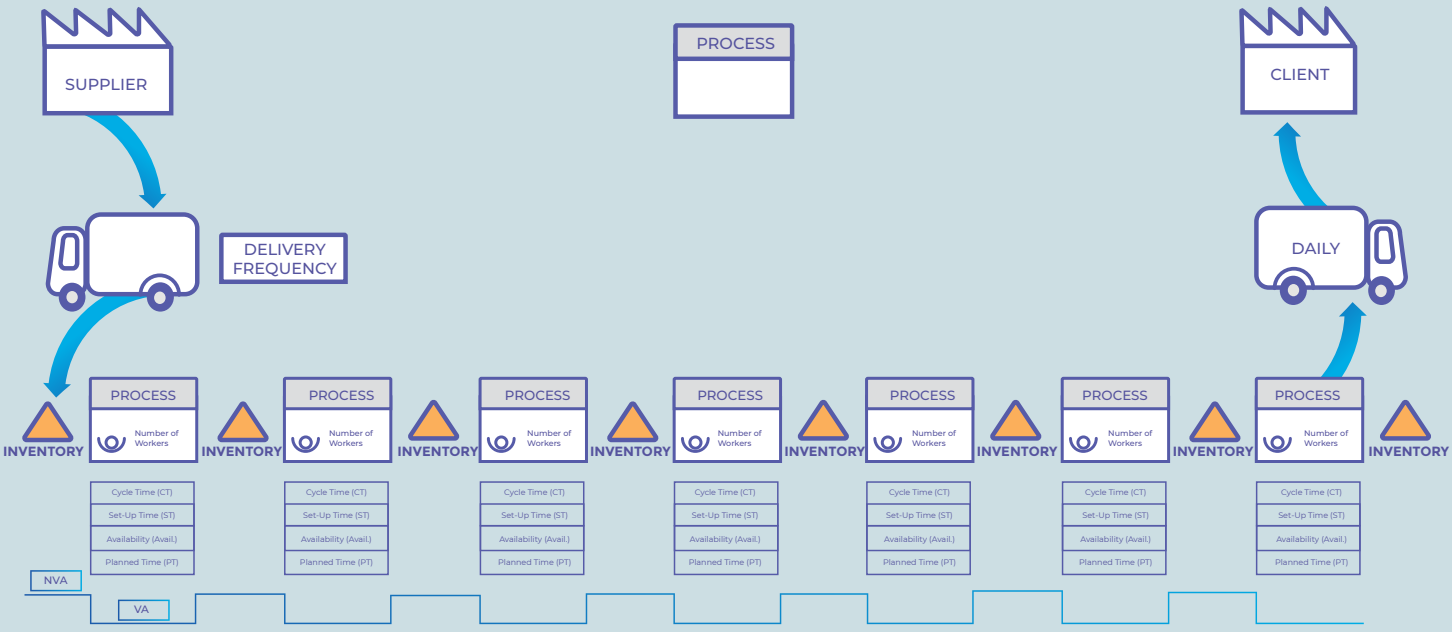
SUPPLIER
PROCESS
CLIENT
DELIVERY FREQUENCY
DAILY
PROCESS
Number of Workers
INVENTORY
Cycle Time (CT)
Set-Up Time (ST)
Availability (Avail.)
Planned Time (PT)
NVA
VA

Chart 1: STREAM FLOW

Process to be mapped (product family)	
Number of products	Products
Number of stages or workstations	Workstations

Chart 2: WORK TIME

Business days per	Days
month	Shifts
Shifts per day	Hours
Hours per shift	Hours

Chart 3: KEY STAGES

Name of stage 1	
Cycle Time (CT)	Seconds
Set-Up Time (ST)	Seconds
Availability (A)	%
Planned Time (PT)	Seconds
Work in progress	Units
Work in progress time	Days

Name of stage 2	
Cycle Time (CT)	Seconds
Set-Up Time (ST)	Seconds
Availability (A)	%
Planned Time (PT)	Seconds
Work in progress	Units
Work in progress time	Days

Name of stage 3	
Cycle Time (CT)	Seconds
Set-Up Time (ST)	Seconds
Availability (A)	%
Planned Time (PT)	Seconds
Work in progress	Units
Work in progress time	Days

Chart 3: KEY STAGES

Name of stage 4	
Cycle Time (CT)	Seconds
Set-Up Time (ST)	Seconds
Availability (A)	%
Planned Time (PT)	Seconds
Work in progress	Units
Work in progress time	Days

Name of stage 5	
Cycle Time (CT)	Seconds
Set-Up Time (ST)	Seconds
Availability (A)	%
Planned Time (PT)	Seconds
Work in progress	Units
Work in progress time	Days

Name of stage 6	
Cycle Time (CT)	Seconds
Set-Up Time (ST)	Seconds
Availability (A)	%
Planned Time (PT)	Seconds
Work in progress	Units
Work in progress time	Days

Name of stage 7	
Cycle Time (CT)	Seconds
Set-Up Time (ST)	Seconds
Availability (A)	%
Planned Time (PT)	Seconds
Work in progress	Units
Work in progress time	Days

Chart 4: PROCUREMENT

Delivery frequency	
Amount sent	Units

Chart 5: CLIENT'S REQUIREMENTS

Daily demand	Units/Day
Number of orders	Orders
Delivery frequency	
Takt Time	Seconds

CAP. #4:
PROBLEM-SOLVING METHODOLOGIES

Authors:
Rocío Armando, Roque Arnaldo Bielli,
Carla Campoy and Mariel Lioren Korb

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INTRODUCTION

Problematic situations and their approach tend to be a source of uncertainty, discomfort, or frustration. To mitigate this, organizations where Continuous Improvement is a cultural pillar, that is to say, where deviations and anomalies are not seen as a problem, but an opportunity to improve, have established problem-solving methods as an essential element of their daily operations.

These methods consist of a standardized sequence of steps that must be followed to face a problematic situation. They give workers autonomy to determine when they should warn about a situation (ANDON), thus favoring early detection of anomalies, and favor the interaction among different experts of cross-trained teams to gather information, apply the PDCA tool, and finally, arrive at a solution.[1]

The importance of establishing these methods lies in the fact that, by setting out simple and sequenced steps, known by all the workers, a clear path to problem solving is revealed. Without underestimating the difficulties, they help solve problems with more calmness and assurance, through a valid process that ensures that the "opportunities for improvement" detected will be analyzed to find the root cause and avoid problem recurrence.

These methods that combine detection, warning, and analysis tools, with management tools, are essential to corporate management.

[1] For more information, see chapter 1, Managing Continuous Improvement.

1. Problems: Definition and Approach

Organizations come across multiple obstacles in their daily operations. In general, they learn to live with these problems, instead of facing and solving them. This situation leads to an accumulation of problems when it comes to identifying, classifying, and managing them.

FIG.1
Iceberg

As shown in figure 1, for the effective resolution of problems arising from daily operations, a formal system of communication and visible indicators are required. They favor problem visualization and sharing. They can be considered the hardware or physical resources needed, such as dashboards, whiteboards, physical space, etc.

Moreover, a corporate culture based on leadership, training, and process and procedure standardization must be promoted. It is recommended that the Go & See method be adopted to understand problems through an in situ observation of the place or machine where the problem has occurred. This can be considered the software (or intangible) resources needed, such as skills, teamwork, leadership, and habits.

Both the hardware (physical or tangible) and software (intangible) resources are important and complementary to achieve the expected results.

Why should we solve problems in a structured rather than creative way? A structured problem-solving method guarantees the identification and elimination of root causes, thus enabling the company to survive in the market.

It ensures sustainable solutions and helps workers understand how to solve their own problems.

FIG.2
Benefits and focal points to approach problems

2.
Problem Solving: Methods, Types of Problems, and Implementation of Tools

Before implementing a method, we should know which type of problem-solving tools we have at our disposal and how they work so as to be able to select the one that fits best with our company and the specific situation.

There are various methods and tools with different stages or phases to solve complex problems:

PDCA | DMAIC/ SIX SIGMA | A3 | 8D | KAIZEN SHEET

FIG.3
Methods and tools chart

PDCA	DMAIC/ SIX SIGMA	A3	8D/PSP	KAIZEN SHEET
Plan	Define	Classify	Form a Team and Collect Information Describe the Problem	Problem Identification
	Measure	Break Down the Problem		Opportunity for Improvement
		Set the Target	Define	Targets/Goals
	Analyze	Analyze the Root Cause	Analyze the Root Cause	Problem Analysis
		Develop Countermeasures	Define Options of Corrective Action	
Do	Improve	See Countermeasures	Perform Corrective Actions	Action Plan
Check	Control	Evaluate Results and Processes	Define Actions to Avoid Recurrence	Improvement Assessment Execution Cost
Act		Standardize Success	Congratulate the Tea	Learned Lessons

- **PDCA Cycle** also known as the Deming Cycle): It is the classical approach to problem solving in a LEAN environment and the most recognized and accepted method. Many times, it is used as a basis for the development of other more specific methodologies. The PDCA is useful for medium-size problems, and the ***Act*** stage implies that the cycle must start again as it is deemed to be a continuous improvement process.

- **DMAIC/SIX SIGMA:** The Six Sigma process consists in performing activities in five stages: ***Define, Measure, Analyze, Improve, and Control*** (DMAIC). In statistical terms, Sigma makes reference to the standard deviation of data in a normal distribution. It is useful for big problems that generally entail a great volume of available data. The term of a DMAIC project may be longer than three months, depending on the complexity of the problem and the process to be improved.

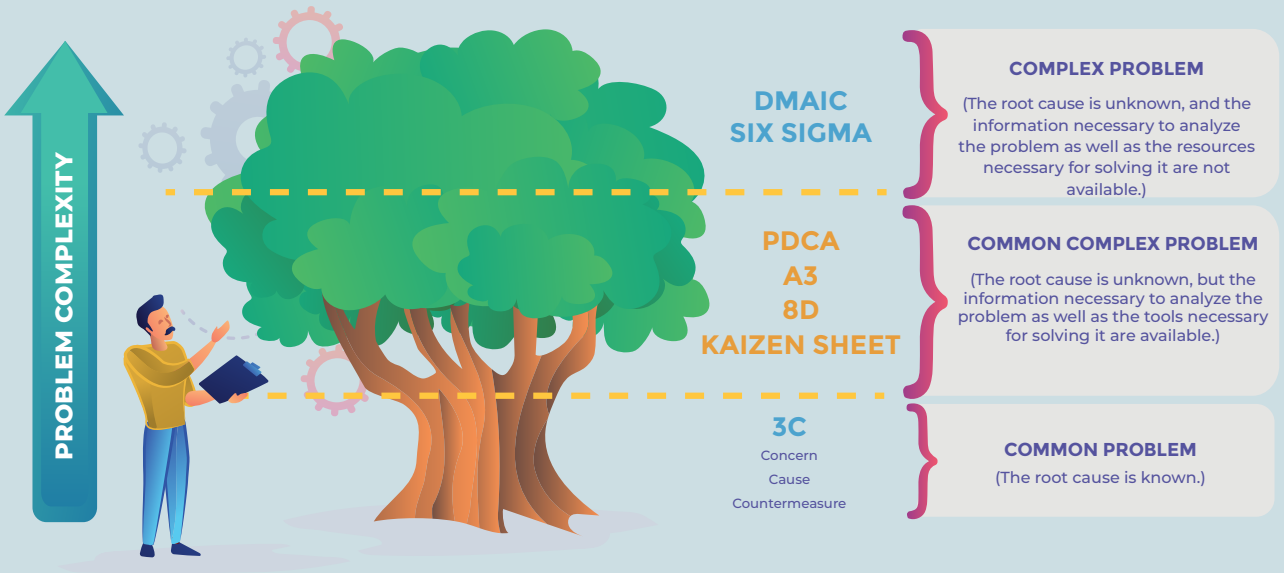
- **A3 Report:** It is a collaborative and visual tool designed by Toyota. It is divided into eight steps and executed in an A3 sheet of paper. It is useful for medium-size problems that can be solved in approximately one week or less. A3 reports are very common in a LEAN environment.

- **8D** (also known as the 8D Report): It is often used in the automotive industry. As the name suggests, it consists of eight steps centered on the quick response to clients' claims resulting from product or service non-conformities.

- **Kaizen Sheet:** It is a visual and collaborative tool based on the PDCA method. Many times, more stages are added in order to gather and analyze more information on the aspects that need to be improved. It is useful for medium-size problems.

2.1. Types of Problems and Related Tools

FIG.4
Problems tree



The problems arising from a daily production process can be classified into three categories: complex, common complex, and common. Each problem will fall into one category or the other depending on the information available to analyze it. The approach requires various problem solving tools.

2.2. Implementation of Tools

2.2.1 *For common problems*

Upon the occurrence of contingencies in which the root cause and the respective solution is known, the 3C tool[2] is used. The acronym means Concern, Cause, and Countermeasure. They can be solved by a worker without making a deep analysis of the information available.

The image below shows the recommended steps:

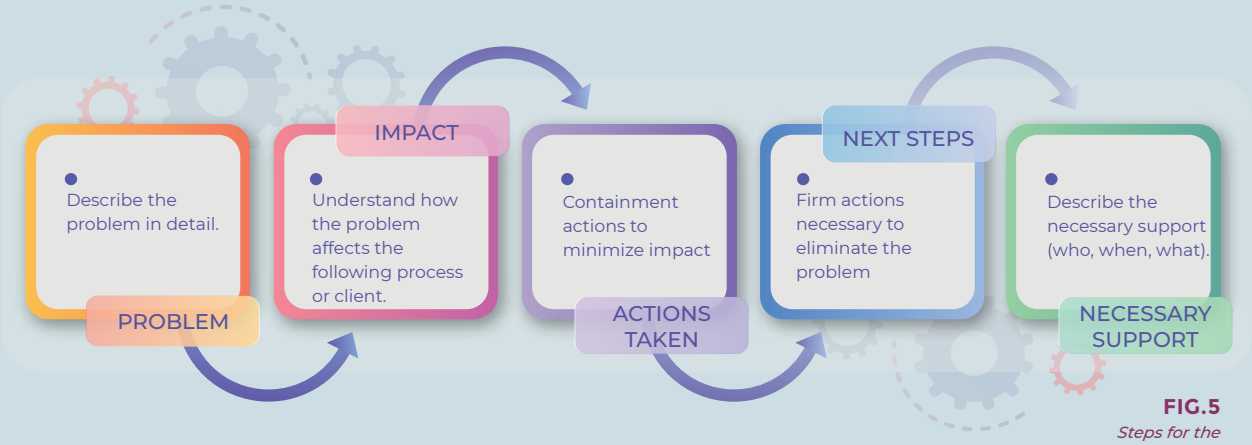


FIG.5
Steps for the implementation of the 3C tool

If on day 3 (72 h) the problem remains unsolved, a deeper analysis is needed.

Seek help from the support area (for example, Maintenance) and the person in charge of executing actions and controlling compliance if necessary.

PROBLEM DESCRIPTION FORMAT (3C)

DAY	**D**: DESCRIPTION; **I**: IMPACT; **C**: CONTAINMENT; **RC**: ROOT CAUSE; **S**: SOLUTION	SUPPORT	PERSON IN CHARGE
1°	**D:** What? Where? When? (Data)	YES	
	I: When? Quantitative and measurable data		
2°	**C:** Urgent actions to reduce/minimize impact		
	Rc: Why has this problem happened? Why? Why? Why?		
3°	**S:** How can I eliminate the root cause definitively?	NO	

Containment should not be confused with solution. The solution eliminates the root cause.

FIG.6
Problem description (3C)

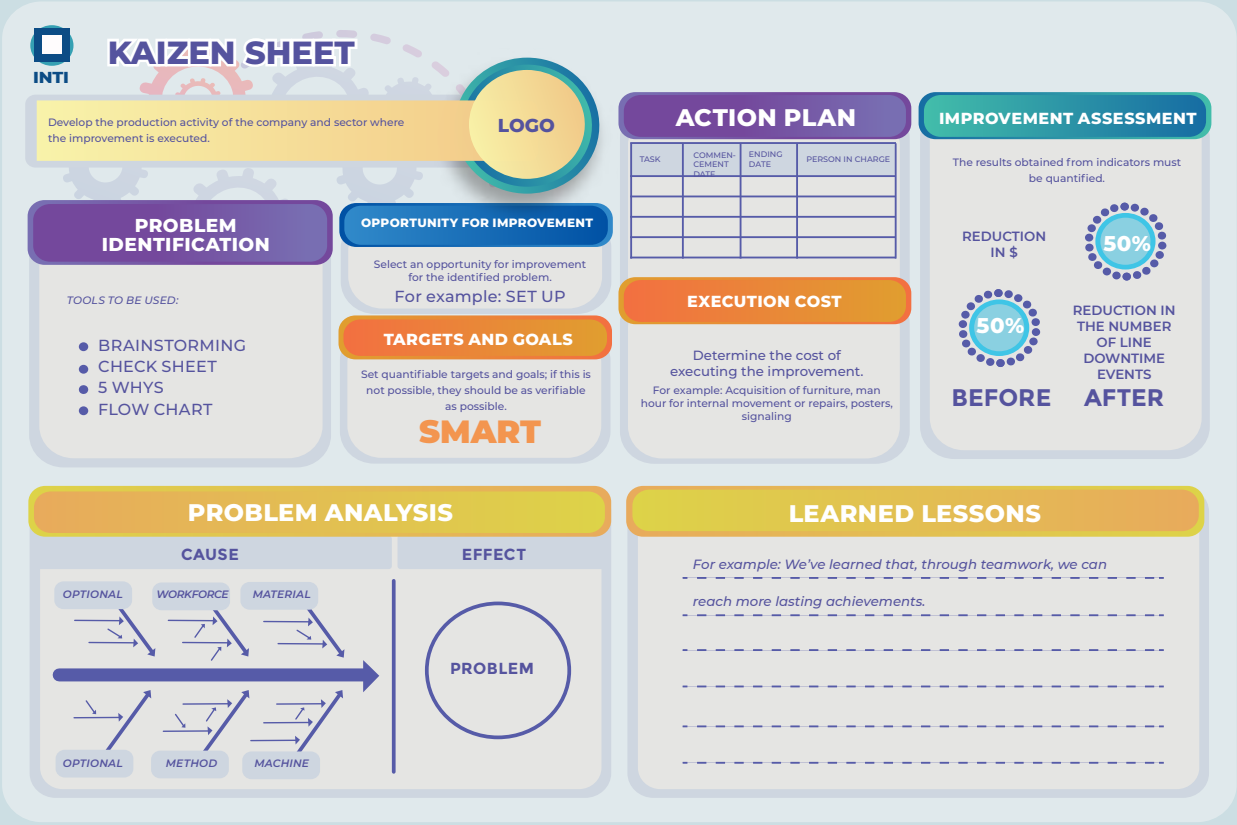
[2] This method is not detailed in figure 3 because it is intended to solve common minor problems with known root cause.

2.2.2 *For common complex problems*

When the root cause is unknown but the information to approach the problem is available, a PDCA-based method can be applied.

A KAIZEN SHEET will be used, due to the following reasons:

- It ensures the correct interpretation of data to discover the root cause and solve the problem.
- It helps the work team develop problem-solving skills.
- It provides an account of the problem and its solution.



2.2.3 *For complex problems*

The problem-solving method used to address these types of problems is based on the Six Sigma approach. This approach is recommended for problems with unknown root cause, because it is governed by the five-stage DMAIC improvement cycle.

- More sophisticated statistical methods are used.
- The project and its goals are defined, the process is measured to determine its current behavior, the root cause is analyzed through a statistical method, actions are taken accordingly in order to improve, and the evolution of the process is controlled.

3.
Andon: A Tool to Identify Problems

Andon is a Japanese word that can be translated as **"signal" or "lantern".**

It is a visual management tool that shows the status of the operations in a specific area and helps visualize anomalies quickly.

In this case, it notifies about the existence of a problem in a quality control or production flow.

3.1. How it Works

The aim of a process Andon is to notify of the existence of a problem at the time it occurs so the issue can be fixed immediately.[3]

The warning signal, either audio or visual, must be easily identifiable. It helps localize the specific work area where the problem has occurred.
Andon is triggered through a button that pauses production automatically. This enables the team to gather information, apply PDCA, analyze the root cause, and finally produce a solution.

In general, companies have this tool either because they use Andon-equipped machines or because they have implemented it at a certain time. However, it is evident that they do not use the tool properly or, even worse, they do not repair the device.

[3] Parenti, Agustina, IBID, chap. 4

3.2. Features

There follow some features of Andon:

- It is a signal intended to provoke an immediate reaction to address a problem or an anomaly.
- It helps recognize easily the operating status of the equipment. In most cases, information on the anomaly can be obtained.

3.3. Current Types of Andon

There are different types of Andon:

BASIC
ANDON

The simplest version of Andon has up to three lights and one audio alert. Some systems incorporate an alarm, which may consist of light, audio, or a combination of both.

Advantage: The installation is easy and very cheap.

Disadvantage: It can only be used in production plants with a visual control area of less than fifty meters.

This type of Andon is mostly recommended for small businesses.

BOARD-EQUIPPED
ANDON

This type of Andon is a more comprehensive tool since it has additional features; for example, it enables to measure production indicators, such as the number of machine downtime events, the quantity of scrap (quality %), the quantity of products/time, among others.

Advantage: It can only be used in plants with a visual control area of more than fifty meters. Moreover, depending on the complexity of the board, the leader does not need to classify problems, as it is the worker who identifies the problem and decides how to proceed.

Disadvantage: The installation is expensive.

It can only be used in medium or big production plants.

3.4. Andon visual aids in the production line

FIG.7
Andon visual aids in the production line

STACK LIGHTS

Colored lights, known as stack lights, are installed in production lines or equipment to indicate their status. They are often used in very big production lines. Sometimes, they are replaced by colored flags. Each color makes reference to a specific status, which can vary among the different companies.

COMMONLY USED COLOR CODES:

White/Blue: Problems with raw material

Green: Normal machine operation

Yellow: Inactivity due to machine fault

Red: Problems with quality or accident

ALARMS

Alarms are audiovisual control tools, generally used to indicate an urgent situation. The different number or types of sounds correspond to various warnings.

Very often, drills are held so all workers can practice what they should do in a specific situation.

INFORMATION DASHBOARDS

An information dashboard is a more complex visual control tool. It is used to monitor the production plan continuously.

It is connected to another meter, which gives a constant update of the records of finished units sent from the line. Thus, it provides information on actual process productivity.

Any person in charge analyzing the results will understand the process status and will be able to act or intervene where appropriate.

ONE POINT LESSON (OPL)

One Point Lesson is a tool that helps communicate how a task must be performed in order to standardize a work method and avoid problem recurrence.

CHECK LIST

Check lists are another type of visual aid. They ensure that the tasks are performed in accordance with the procedure and the steps already established.

RESULT DASHBOARDS

A result dashboard, also called performance dashboard, is another type of visual control tool. It is used to include performance indicators.

The main aim is to evidence how workers' performance impacts on the results of processes, lines, and corporate goals.

Innumerable visual control methods can be implemented. The Senior Management's strong commitment on control tools implementation is essential for these methods to be efficient. And this depends on the interest shown by the workers in these methods.

FIG.8
Communication

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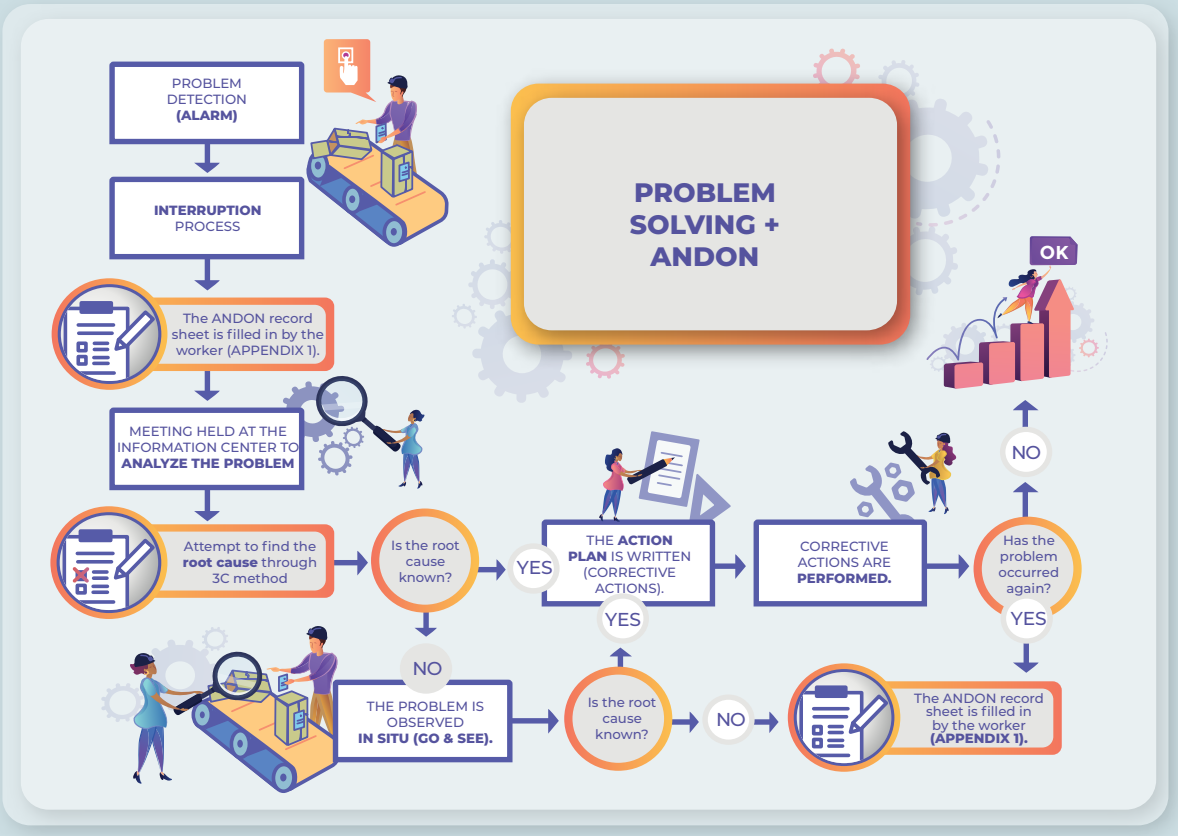
- https://geinfor.com/business/que es andon sistema de control visual de produccion/

5. Implementation Task

1. Solving problems in a methodological manner implies following a series of steps that enable us to approach the problem orderly and make a deeper analysis of the situation. The flow chart below shows the sequence to be followed when a problem is detected during the work day. The worker in charge of the operation starts the process by triggering an alarm (ANDON).



a) Analyze if workers know the sequence of actions they must follow upon the occurrence of a problem. Are they formalized? Are support structures defined?

b) Recording the events that take place every day at the workstations is essential to detect deviations and identify their causes. We suggest choosing a workstation and recording all the events that happen during a specific period, using the ANDON record sheet.

(See appendix ANDON RECORD SHEET.)

How to fill in the sheet:

Provide the details of the worker/person in charge.

Record:

- **Step 1:** *Provide the dates.*
- **Step 2:** *Classify events by color code, as described in this chapter.*
- **Step 3:** *Cross out COMM or COMP depending on the type of event.*[4]
- **Step 4:** *Cross out "I" to record each event occurrence.*

c) Based on data provided in the ANDON record sheet, identify which is the most recurring or most influential situation and address it by following the sequence proposed in the flow chart.

[4] COMM: Common. COMP: Complex.

6.
Appendix

ANDON RECORD SHEET

Product:	Sector:
Line and/or workstation:	Inspector:
Name of worker:	Batch number:

DATE	STACK LIGHTS			
	WHITE/BLUE	GREEN	YELLOW	RED
Day 1: Monday	COMM/COMP	COMM/COMP	COMM/COMP	COMM/COMP
Number of events:	I I I I I I I I I	I I I I I I I I I	I I I I I I I I I	I I I I I I I I I
	WHITE/BLUE	GREEN	YELLOW	RED
Day 2: Tuesday	COMM/COMP	COMM/COMP	COMM/COMP	COMM/COMP
Number of events:	I I I I I I I I I	I I I I I I I I I	I I I I I I I I I	I I I I I I I I I
	WHITE/BLUE	GREEN	YELLOW	RED
Day 3: Wednesday	COMM/COMP	COMM/COMP	COMM/COMP	COMM/COMP
Number of events:	I I I I I I I I I	I I I I I I I I I	I I I I I I I I I	I I I I I I I I I
	WHITE/BLUE	GREEN	YELLOW	RED
Day 4: Thursday	COMM/COMP	COMM/COMP	COMM/COMP	COMM/COMP
Number of events:	I I I I I I I I I	I I I I I I I I I	I I I I I I I I I	I I I I I I I I I
	WHITE/BLUE	GREEN	YELLOW	RED
Day 5: Friday	COMM/COMP	COMM/COMP	COMM/COMP	COMM/COMP
Number of events:	I I I I I I I I I	I I I I I I I I I	I I I I I I I I I	I I I I I I I I I
	WHITE/BLUE	GREEN	YELLOW	RED
Day 6: Saturday	COMM/COMP	COMM/COMP	COMM/COMP	COMM/COMP
Number of events:	I I I I I I I I I	I I I I I I I I I	I I I I I I I I I	I I I I I I I I I

If on day 3 (72 h) the problem remains unsolved, a deeper analysis is necessary (PDCA-A3).

Seek help from the support area (for example, Maintenance) and the person in charge of executing actions and controlling compliance if necessary.

PROBLEM DESCRIPTION FORMAT (3C)

DAY	D: DESCRIPTION; I: IMPACT; C: CONTAINMENT; Rc: ROOT CAUSE; S: SOLUTION	SUPPORT	PERSON IN CHARGE
1°	**D:** What? Where? When? (Data)	YES	
	I: When? Quantitative and measurable data		
2°	**C:** Urgent actions to reduce/minimize impact		
	Rc: Why has this problem occurred? Why? Why? Why?		
3°	**S:** How can I eliminate the root cause definitively?	NO	

Containment should not be confused with solution. The solution eliminates the root cause.

KAIZEN SHEET

INTI

PROBLEM IDENTIFICATION

OPPORTUNITY FOR IMPROVEMENT

TARGETS AND GOALS

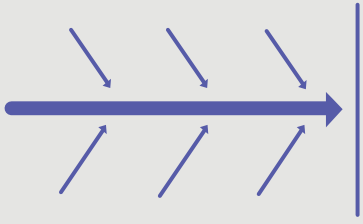
ACTION PLAN

EXECUTION COST

IMPROVEMENT ASSESSMENT

PROBLEM ANALYSIS

CAUSE | EFFECT



LEARNED LESSONS

KAIZEN SHEET FORMAT - STAGES

INTI

HEADING

LOGO

The heading provides information on the assisting entity or institution through the logo (INTI) and the company where the improvement is executed (logo of the assisted company), as well as details of the company's production activity.

PRODUCTION ACTIVITY OF THE COMPANY

The activity carried out by the company and the sector where the improvement is executed must be described. (For example: In the Machining sector, the 5 S method was implemented.)

IMPROVEMENT ASSESSMENT

The results shown by the indicators must be quantified (screenshot of the situation before and after 5 S, meters gained after plant re-distribution, less work time as distances shortened after plant re-distribution, less scrap, less inventory, higher productivity, less re-work time).

PROBLEM IDENTIFICATION

If the specific problem to be solved has not been detected, or if people are not clear about how to address it, we suggest using any method (such as, brainstorming, check sheet, 5 Whys) to start analyzing which our opportunity for improvement will be.

IMPROVEMENT COST

It is the investment required to execute the improvement (hours/personnel necessary for internal movements or repairs/construction, furniture, posters, signaling, shelves). For example: In order to change the layout, the company leased a forklift to move the machines. Forklift lease: $xx.

OPPORTUNITY FOR IMPROVEMENT

When selecting an opportunity for improvement, we must make a description of our current situation in relation to our choice.

LEARNED LESSONS

The lessons learned from the experience of applying a problem-solving method must be described. For example: "We've learned that, through teamwork, we can reach major achievements."

TARGETS/GOALS

It is convenient to determine quantifiable targets and goals; if this is not possible, they must be as verifiable as possible.
The goals must comply with the **SMART** rule.

CHAP. #5:
EVALUATING CONTINUOUS IMPROVEMENT RESULTS

Authors:
María Lucila Albisu, Emiliano Martínez and Franco Strano.

INDEX

INTRODUCTION

In a Continuous Improvement-based organization, improvements take place every day; that is to say, they are not isolated or occasional events resulting from fashion or from a need to replicate other companies' success, disregarding the own context. Understanding the context in which an improvement is to be executed is fundamental to its success. With regard to context, it comprises two main aspects: the motivation of the workers and the maturity level of the corporate processes.

The success of an improvement process is directly related to workers' involvement; in fact, workers play a vital role: without their commitment and willingness, improvements are unfeasible. Therefore, it is essential to understand workers' motivation and how to generate it.

The maturity level determines the starting point of any improvement execution project. Knowing and understanding the current situation gives us clarity of vision to identify the shortcomings of processes and their management. If we make this analysis before executing an improvement, we can set goals accordingly.

Understanding the current maturity level of the company and the workers' motivation enables us to pave the way to a better stage.

1. KAIZEN, a Process-Oriented Philosophy

The aim of any organization is to achieve the expected results and, where possible, improve them over time. The Kaizen philosophy does not focus on achieving these improvements immediately, but through an **enhancement system.** To implement this system, it is necessary to formulate proposals or detect opportunities for improvement in the current processes and in the way things are done.
Incorporating Kaizen as a habit requires an environment where both routine management and improvement management coexist. These aspects are complementary. Respectively, they enable companies to guarantee the results and to question them with the aim of changing them and achieving better standards.

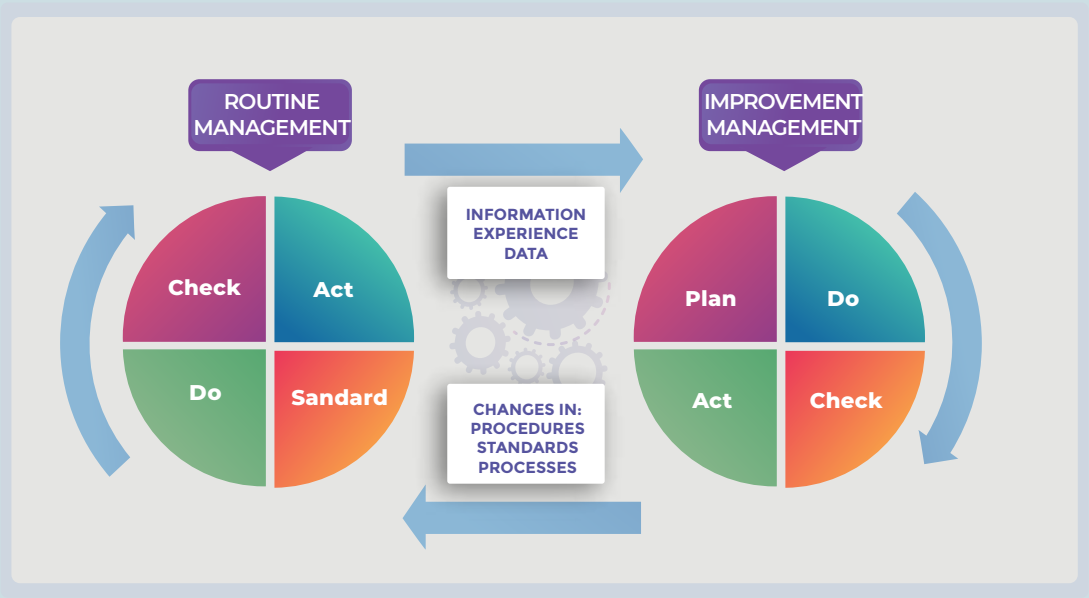


FIG.1
Routine and improvement management

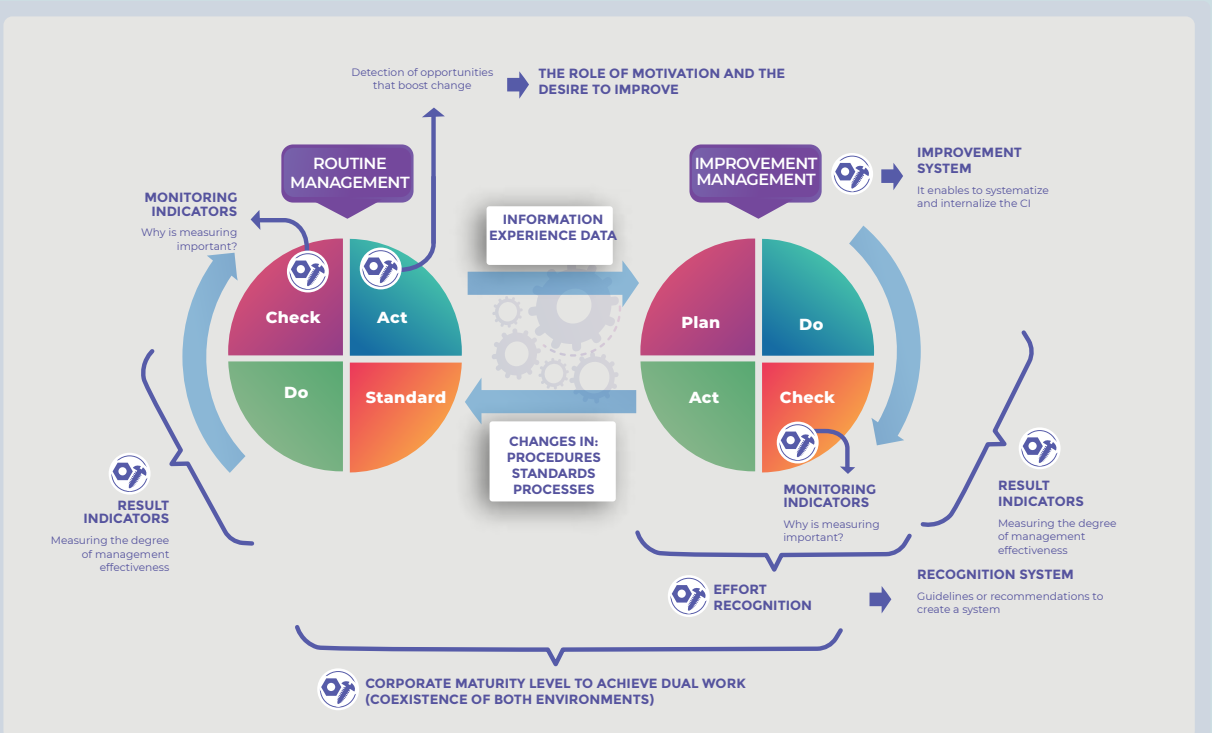
Routine management consists of a sequence of steps to ensure that the results achieved have been set as targets, in compliance with standards and procedures. Each person in their own workstation will do the tasks required (Do) and validate the results (Check) all the time. Upon any deviation from the expected situation, the company must analyze the type of problem and act (Act). If the situation can be solved through a corrective action, the irregularity is managed, and the expected situation is restored (Standard); otherwise, an improvement cycle (PDCA) will be initiated, the standard will be re-defined, and the process will change.

With regard to **improvement management,** it is not only a reaction to irregularities, but also to the detection of opportunities for improvement. The Kaizen philosophy is mainly based on a proposal formulation process in which each member of an organization can find a new way of doing things. An environment that promotes the formulation and discussion of proposals ensures Kaizen sustainability.

Which variables create that environment? Does the environment itself guarantee the implementation of improvement processes and the achievement of good results? How are these results measured? Are there specific aspects or characteristics a company should have to implement Kaizen?

The chart below shows the topics to be developed, which are considered essential for the creation of an environment that favors the development of a Kaizen habit in the organization and the promotion of changes in order to improve results.

FIG.2
Comprehensive routine and improvement management system



1.1. Routine Management: Components

Routine management is a way of ensuring results. It establishes a method to carry out and measure activities to achieve the expected results. There are three important aspects:

Result indicators, which measure how effective the management of daily activities or improvements is.

Monitoring indicators, which serve as a control tool to know how far the intended situation (standard) is or how an improvement process is evolving.

The role of motivation and the desire to improve when it comes to detecting the aspects that boost a change in current standards (due to either a problem or a new opportunity)

1.2. Improvement Management: Components

After identifying an opportunity for change, the organization can proceed with improvement management. Improvement management has the same stages as an improvement cycle, with three key aspects:

The improvement system, which is a method for managing Continuous Improvement in the organization —a method to create, receive, analyze, and work on improvement proposals. This implies team formation, improvement cycle monitoring, result evaluation, and standard setting.

Monitoring and result indicators. As in routine management, they enable us to understand action effectiveness, validate hypothesis, and verify goal achievement.

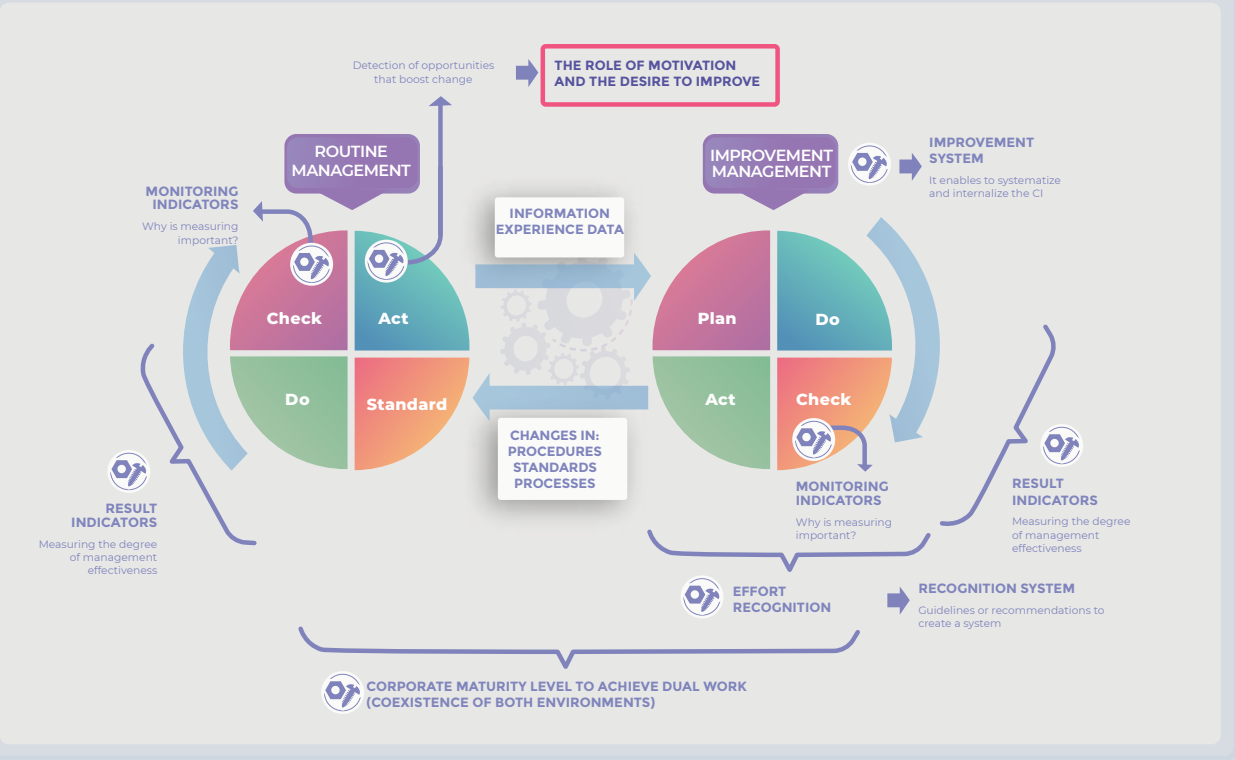
The recognition system, which is essential to value the efforts made to boost, develop, and implement improvement processes.

Identifying routine and improvement management, as well as their components, enables us to carry out a synchronized work to ensure, maintain, and improve results. Likewise, this analysis **helps us classify companies into different stages, based on the level of maturity, to manage and implement Continuous Improvement.** While analyzing the aspects necessary to build this management system, we can identify the different stages companies undergo until Continuous Improvement becomes a habit and part of the corporate culture.

The stages reflect how companies manage to create a growing and professional management system, as well as the **maturity levels** of their processes.

1.3. The Role of Motivation and the Desire to Improve

FIG.3
Comprehensive routine and improvement management system. The role of motivation



People plan, lead, and manage organizations so they can operate efficiently and comply with the goals. In this sense, motivation is essential for professional development.

Motivation is what drives people to act in a certain way or, at least, stimulates their willingness to behave in a specific manner.[1] ***This urge to act*** can originate from an external environmental stimulus or from internal mental processes of the individual. In this respect, motivation is associated to the cognitive system. According to Krech, Crutchfield, and Ballachey, human actions are driven by knowledge (what the individual thinks, knows, and foresees).[2] Motivation comes from active and impulsive forces that can be translated as desire and rejection.

People who feel appreciated are more self-confident and more willing to contribute and collaborate with others. They accept changes and adapt better to them, have a sense of belonging and commitment to the organization, are more satisfied with the professional development, and show a significantly lower level of stress. They become better and more motivated workers, and the work environment improves substantially.[3]

Motivated people are more productive.

It is estimated that workers who feel happy and fulfilled are 30% more productive.

They go to work more excited, are more efficient, and perform better; in consequence, they produce better results for the organization.[4] Motivating and inspiring workers through recognition and gratitude strengthens a positive behavior from people and ensures corporate success.

[1] Kast, Fremont, E., Rosenzweig, James, E., (1970). Organization and Managment: A Systems Approach. McGraw Hill Kogakusha
[2] Krech, David, Crutchfield, Richard, S., Ballachey, Egerton, L., (1962). Individual in Society. McGraw Hill
[3] Nelson, Bob, (2005), 1001 formas de motivar a los empleados. Grupo Editorial Norma
[4] Consultora Crecimiento Sustentable (2012). Study: Felicidad y Trabajo

1.4. Effort Recognition

The interaction among people and organizations can be explained as an exchange of incentives and contributions. People are willing to cooperate if and when their work in the organization directly contributes to the achievement of their personal goals. The chart below shows that, in the improvement management PDCA cycle, achieving and sustaining a balance over time depends on the incentives given and the contributions granted to the organization in return.

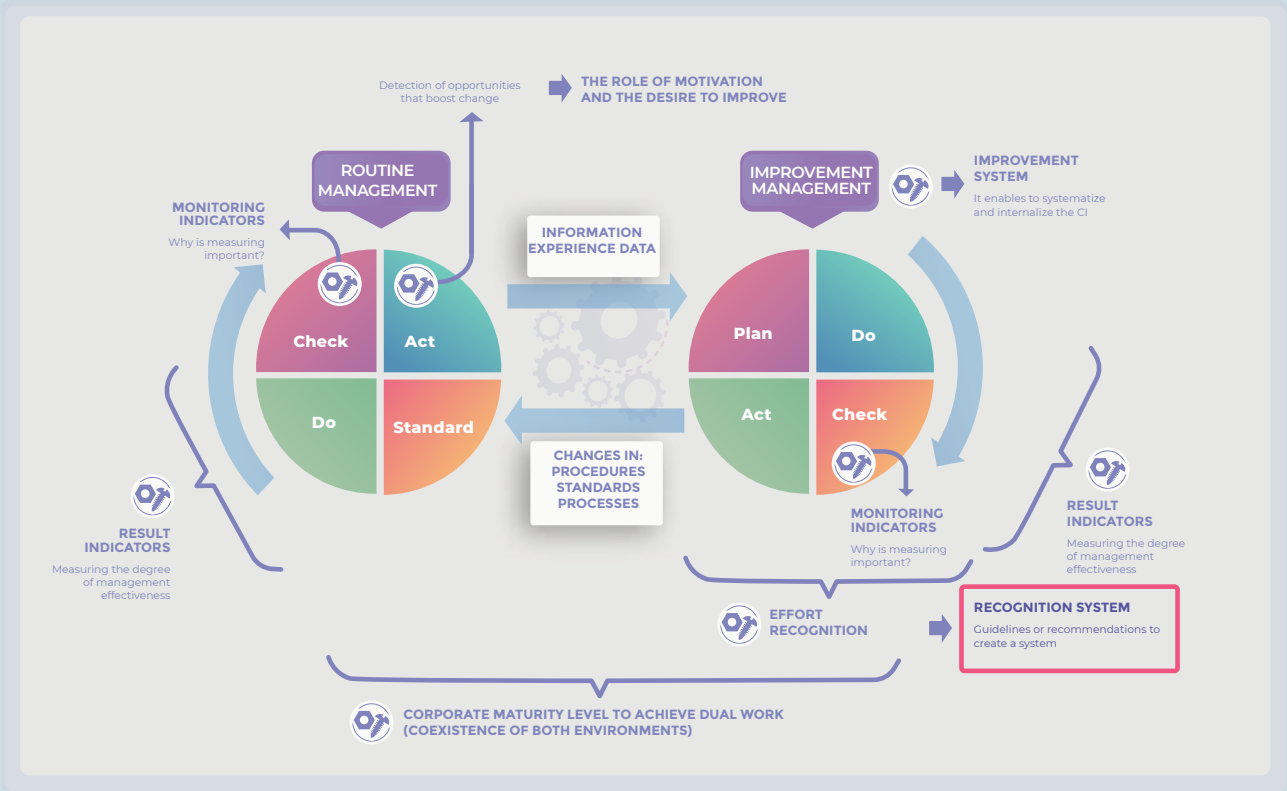


FIG.4
Comprehensive routine and improvement management system. Recognition system

A recognition program that intends to strengthen voluntary conducts must distinguish between motivation and satisfaction. Motivation is the urge and the effort to satisfy a desire or target. Instead, satisfaction is the joy experienced when a desire has been satisfied. In other words, **motivation implies an impulse towards a result, whereas satisfaction is the result already experienced.**

For an appropriate recognition, the following aspects must be taken into consideration:

- **Consider each work important,** and recognize both the quality of the work done and the effort made.
- **Be sincere, timely and in proportion to the performance and the results obtained.** The more specific, the better; that is to say, saying "good job" is not enough. We must describe the specific aspects that made the work so valuable.

- **Share** with the other workers the actions and attitudes that motivated recognition.
- **Encourage personnel training** so they have a more specific knowledge of the activities carried out and their impact in the organization.

The ability to recognize people appropriately can be develop. Over time, it becomes a specially beneficial habit for both the recognized and recognizing person. This ability can be encouraged through the establishment of corporate plans or recognition processes specifying the valuable actions and behaviors, as well as the steps to value them.

By way of an example, there follows an actual case that shows the importance of recognizing people as part of an improvement management process, in any type of organization.

Noreen Wahl, Human Resources Manager of Sherpa Corporation, a software developer from San José (California), highlights that the most important thing is not the award itself but the recognition. ***"Our company, for example, bought an old bowling championship trophy, ugly and big, which is used as a circulating award to recognize excellent results. Each person receiving the trophy feels very proud of it until they pass it on to the following winner".***[5]

Recognition must be adapted to the characteristics and preferences of each person. It must be in line with the values of the organization and the strategic goals, as well as the things that are specially important and valuable for it.

Teamwork, one of the fundamental pillars of improvement management, is a key motivating factor for people, due to the experience of working together to find new ways of improving the company and solving its problems. When a team achieves a target, the resulting satisfaction is unique and creates a stronger sense of belonging among the workmates.

Giving autonomy (a synonym for trust), creating a sense of belonging in a team, showing support when someone makes a mistake, and granting public recognition or opportunities for professional development are some of the most appreciated aspects by people in an organization.

[5] Nelson, Bob, (2005), IBID

2. Indicator System

It is important to establish and work with references; that is to say, to have parameters or elements that enable us to identify the current situation. If we know the starting point, history, and motivation, we have the information and knowledge necessary to make better decisions and act consciously, thus performing effective actions.

It is then when recording and measuring gain true importance, when the efforts to know the result of our actions make sense. While value-adding activities transform the product or service and are likely to be paid for by the client, measurement activities (such as, data analysis, recording, monitoring, among others) do not add value, but are necessary[6] to perform the value-adding ones.

Measurement activities include a set of elements that are essential for their performance: indicators.

Indicators are mechanisms that enable us to translate events or data into information and to use that information to manage tasks and activities better.

Developing an indicator implies determining how something is going to be studied. It is a tool that provides information to verify how a process or task evolves, or the result of that evolution.

2.1. Types of Indicators

There are plenty of indicators, depending on what is going to be measured or analyzed. It is important to recognize which role the work environment plays. Indicators are part of routine and improvement management, and can be classified, in accordance with usefulness, into monitoring or result indicators.

[6] By "necessary", we mean that they help comply with the client's requirements in due time and form, at the lowest cost.

According to the environment:

- *Routine management indicators:* They are used in everyday activities to measure performance or critical variables of the process.
- *Improvement management indicators:* They are used during improvement cycles to measure aspects of the process.

According to usefulness:

- *Result indicators:* They are used to know the impact of every day actions and improvement actions. Their aim is to measure management effectiveness.
- *Monitoring indicators:* They are used to monitor and track certain process aspects or variables. Their aim is to verify how well things are done, to warn about deviations from the expected situation and, sometimes, they serve as input for a deep understanding of processes and problems. Moreover, they are essential for the development of result indicators or for the evaluation of changes in the processes.

Indicators can have associated standards or goals. These elements can be used as a reference to analyze and identify deviations easier. Given that an indicator represents a manner of measuring and analyzing an activity, task, or operation, it can also be interpreted as a standard, since it establishes the calculation guidelines, calculation frequency, scope of calculation, and scope of analysis.

2.2. Indicator Proposal

There follows an outline of the main productive categories requiring indicators.

Quality

It measures the level of defective or non-conforming products in the amount processed. The defective parts can be disposed of or reprocessed and recovered, but the most important thing is to know the proportion of conforming parts in the first attempt.

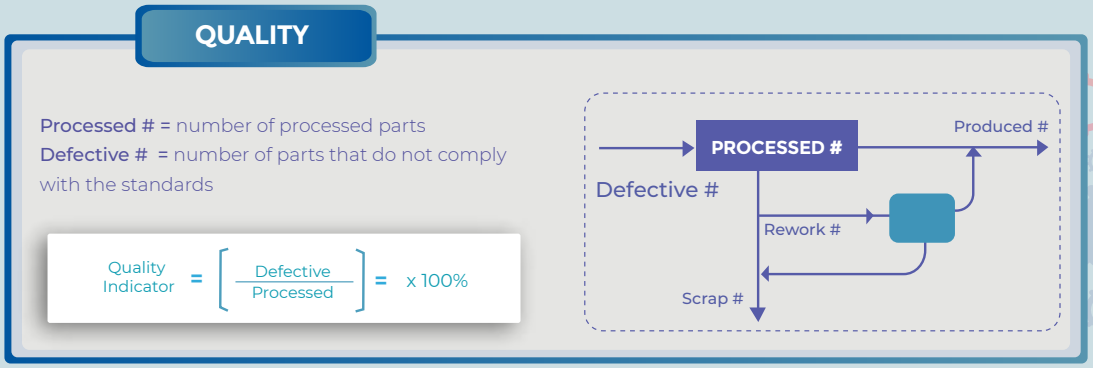


FIG.5 *Quality indicator*

Response Time

It measures the lead time from work order issuance to delivery to client. It is obtained by adding the processing time and the waiting time within a process.

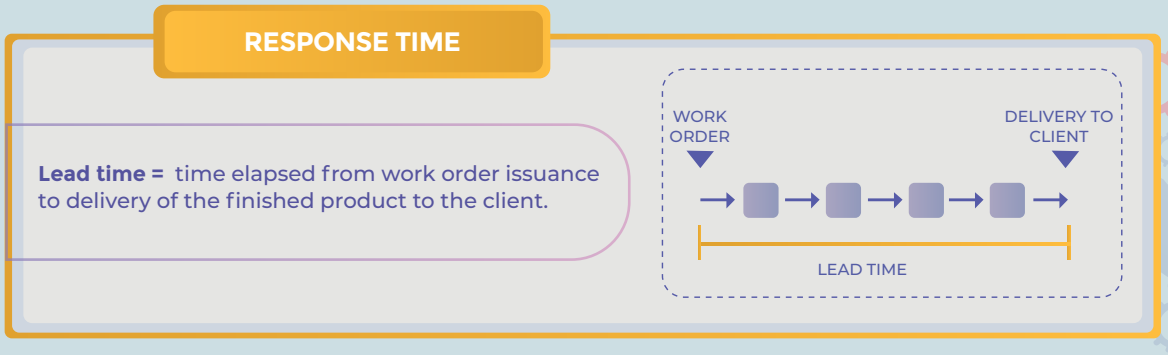


FIG.6
Response time indicator

Productivity

It measures the relationship between the number of processed parts and the hours needed for their production.

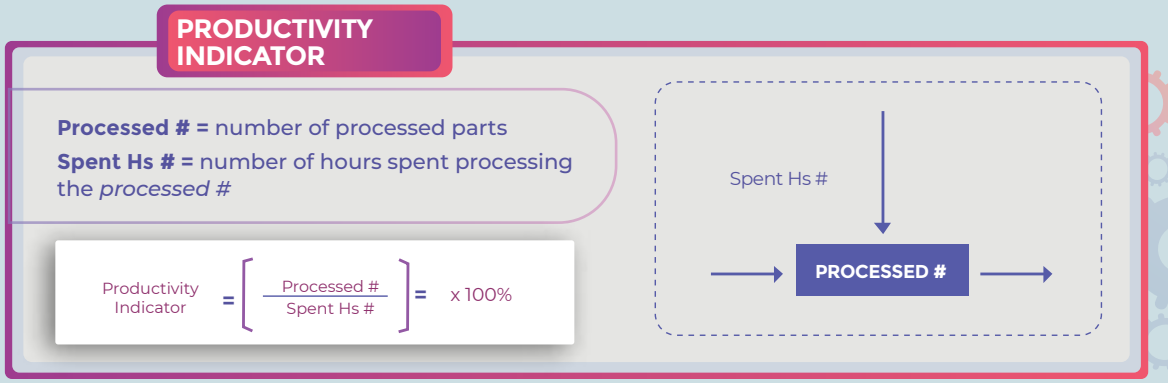


FIG.7
Productivity indicator

Availability

It measures the relationship between the operating or worked time and the available time. It provides information on the impact of unexpected downtime events.

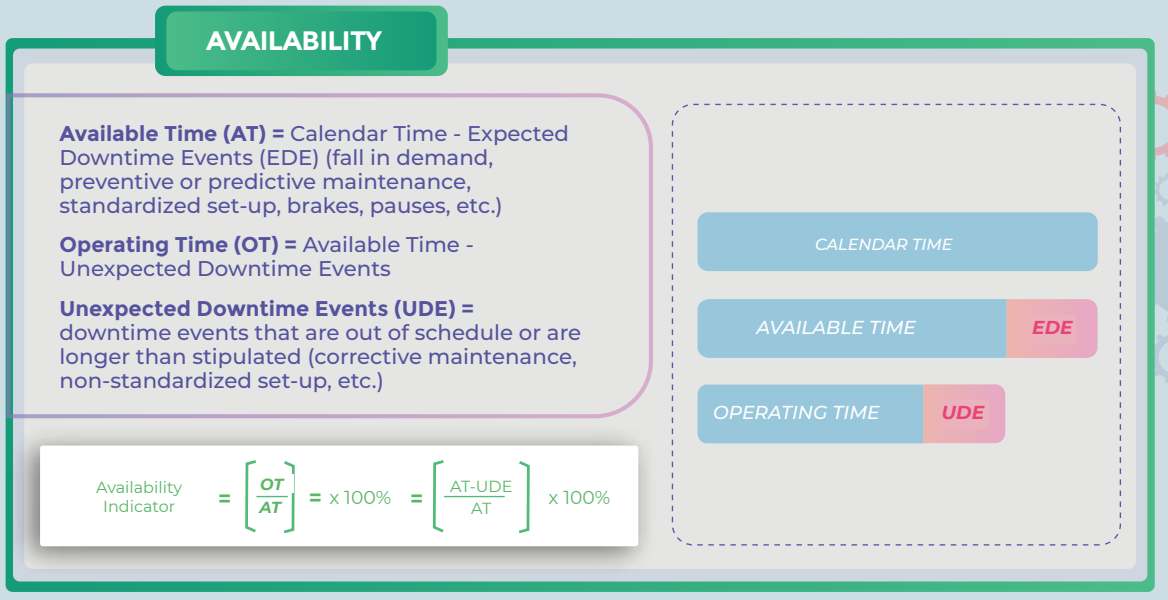


FIG.8
Availability indicator

Performance

It measures the relationship between the number of processed parts and the number of parts the company expects to process within the operating time. It measures the operating rate, as compared to the rate set (standard).

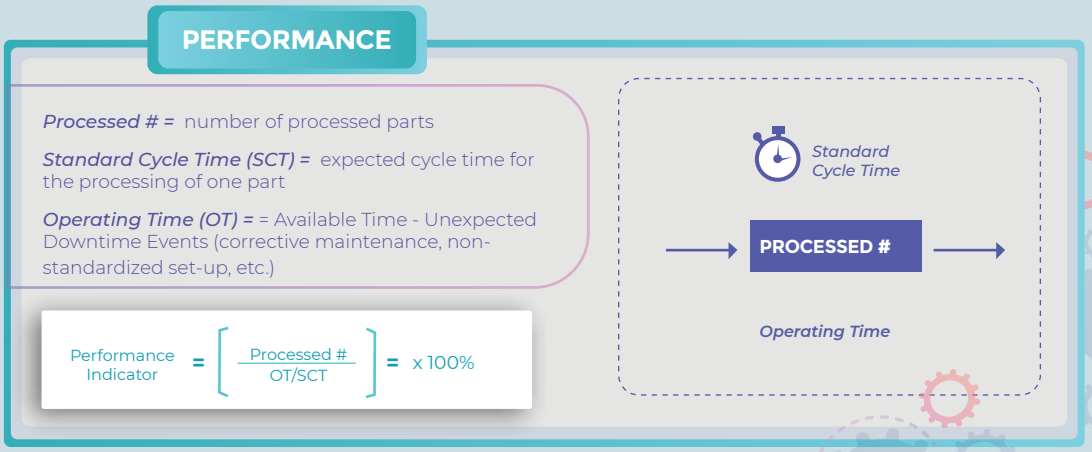


FIG.9
Performance indicator

Other indicators measure the following aspects:

- Number of processed parts
- Machine efficiency
- Number of products returned due to non-conformities
- Level of non-compliance with orders

2.3. Project Evaluation Based on Indicators

Improvement projects can be evaluated through the analysis of indicator results. Indicators are essential to analyze improvement cycles. They are like a compass, which helps us check if the cause analysis (hypothesis validation) gave positive results and the actions performed were successful. They also help us check the development of the improvement process, and that information serves as input to enhance improvement process management.

2.3.1 *How can we evaluate improvements?*

Regardless of the aspect to be improved, improvements are evaluated by comparing the initial situation and the final situation, after the improvement cycle.

BEFORE – AFTER → variation %

Evaluation examples:

FIG.10
Evaluation of a decrease in defective products

DECREASE IN DEFECTIVE PRODUCTS

$$\frac{\left[\frac{\text{Defective \#}}{\text{Processed \#}}\right]_{Initial} - \left[\frac{\text{Defective \#}}{\text{Processed \#}}\right]_{Final}}{\left[\frac{\text{Defective \#}}{\text{Processed \#}}\right]_{Initial}} = \text{x } 100\%$$

$$\frac{\left[\frac{20}{100}\right]_{Initial} - \left[\frac{5}{100}\right]_{Final}}{\left[\frac{20}{100}\right]_{Initial}} \text{ x } 100\% = 75\%$$

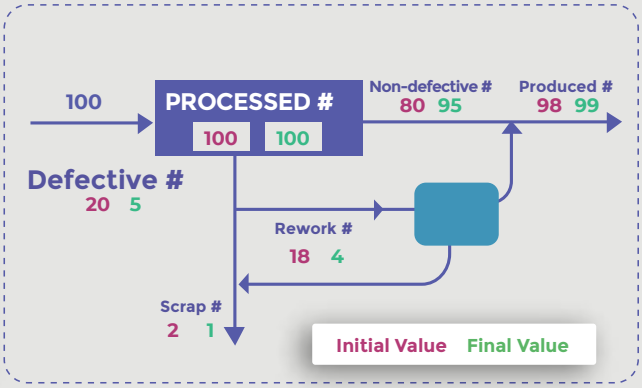


FIG.11
Evaluation of an increase in productivity

INCREASE IN PRODUCTIVITY

$$\frac{\left[\frac{\text{Processed \#}}{\text{Spent Hs \#}}\right]_{Initial} - \left[\frac{\text{Processed \#}}{\text{Spent Hs \#}}\right]_{Final}}{\left[\frac{\text{Processed \#}}{\text{Spent Hs \#}}\right]_{Initial}} = \text{x } 100\%$$

$$\frac{\left[\frac{100}{4}\right]_{Final} - \left[\frac{100}{5}\right]_{Initial}}{\left[\frac{100}{5}\right]_{Initial}} \text{ x } 100\% = 25\%$$

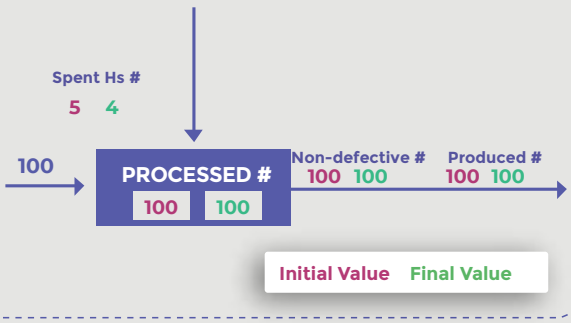


FIG.12
Evaluation of an increase in performance

INCREASE IN PERFORMANCE

$$\frac{\left[\frac{\text{Processed \#}}{\text{OT/SCT}}\right]_{Initial} - \left[\frac{\text{Processed \#}}{\text{OT/SCT}}\right]_{Final}}{\left[\frac{\text{Processed \#}}{\text{OT/SCT}}\right]_{Initial}} = \text{x } 100\%$$

$$\frac{\left[\frac{100}{385/2}\right]_{Final} - \left[\frac{100}{320/2}\right]_{Initial}}{\left[\frac{100}{320/2}\right]_{Initial}} \text{ x } 100\% = 33\%$$

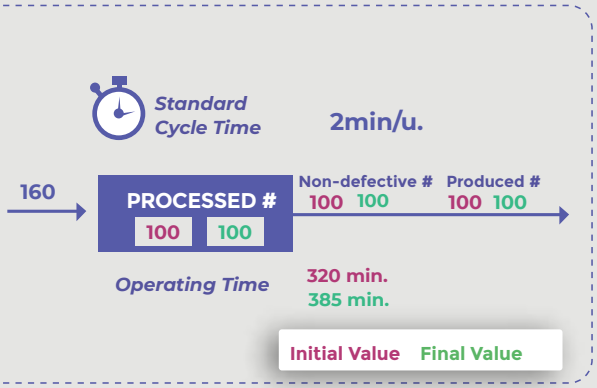
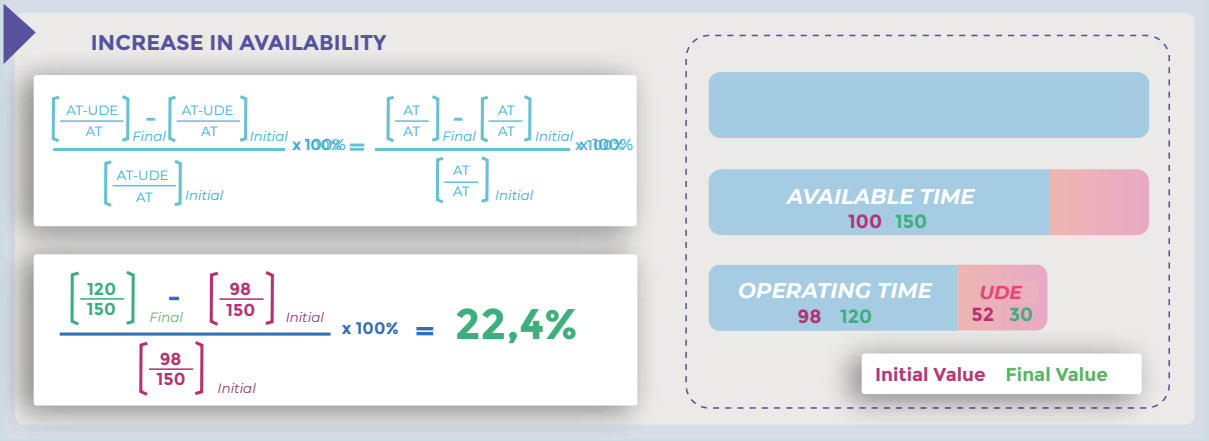


FIG.13
Evaluation of an increase in availability



Benefits of the evaluation:

- ✓ Valuing efforts and results
- ✓ Measuring result effectiveness
- ✓ Analyzing compliance with the goals set

2.4. Maturity Levels

Any process shows the current situation of a company. Based on the characteristics of process management, each process falls into a specific level or stage. These levels —referred to as the process maturity levels— reflect the situation of the company.

As corporate processes grow in maturity, they become institutionalized through policies, standards, and structures. Institutionalization implies creating a corporate structure and a corporate culture to support the methods, practices, and procedures performed in order to ensure excellent results.

Thus, **maturity levels** can be defined as a set of stages that serve as a baseline to measure process maturity and evaluate process capacity.7 When describing processes, however, we may find stages that differ from the ones described below or intermediate stages. The aim of leveling is to help identify process management characteristics in order to prioritize improvement efforts.

[3]Process capacity is defined as the range of results that can be expected from a process.

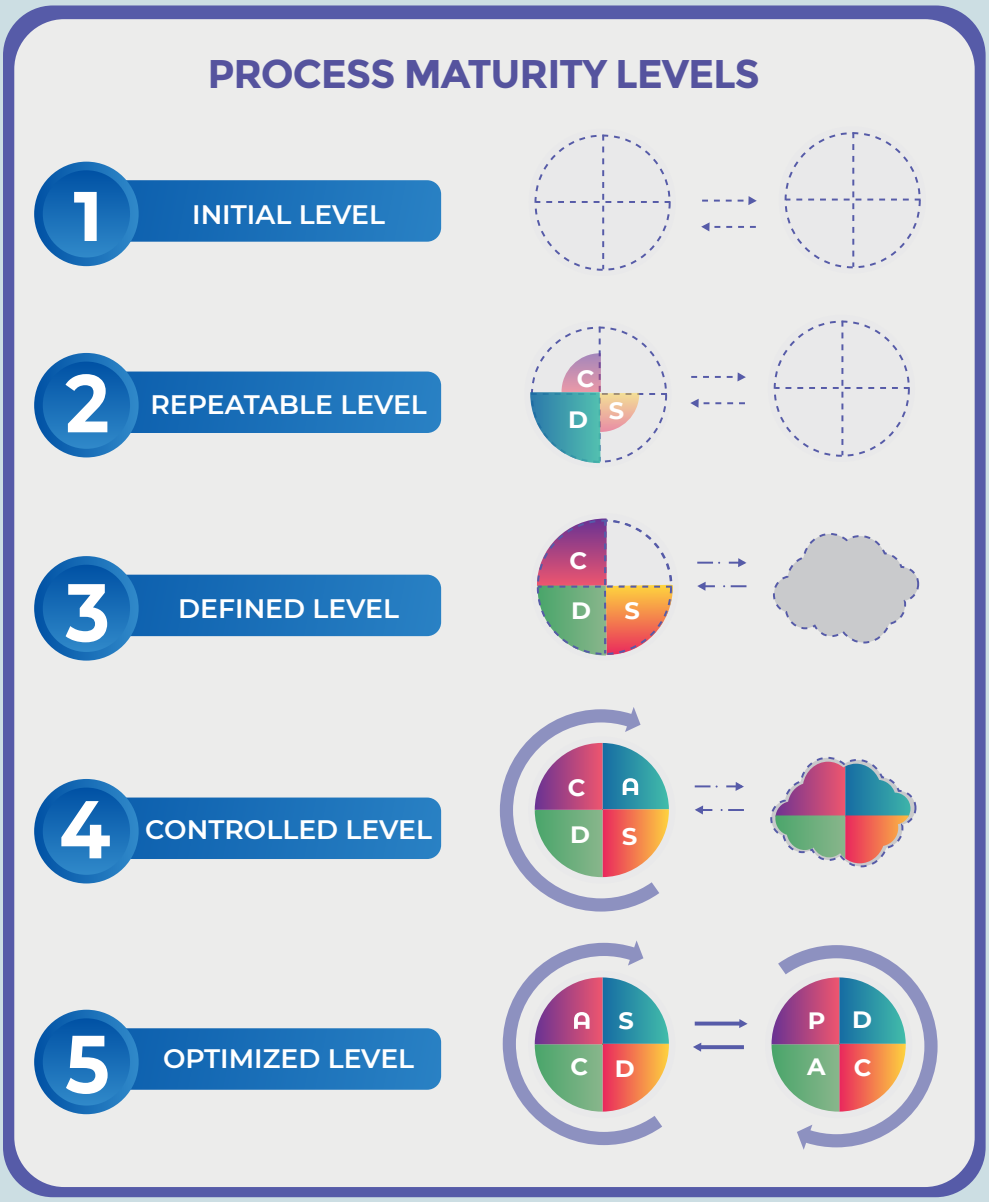


FIG.14
Process maturity levels

The five maturity levels proposed serve as a frame of reference to help identify the starting point of a process, its characteristics, its dynamics, and to understand its results. Knowing and understanding the factors that determine and influence the results is the first step to create a management method and to develop controlled, predictable, and effective processes.

In each organization, there are specific aspects that may be related to the activities it performs, the industry it belongs to, or its size, among others. Instead, maturity levels show common aspects that contribute to the scope and fulfillment of goals and results. For example: An injection process and a manual assemble process have different characteristics that determine their complexity, but both processes, with a similar maturity level, include defined standards and working methods that help achieve certain results.

A description of each maturity level is provided below for the purpose of analyzing the aspects that are common to all the processes and determine process management and results.

The first or **initial level** makes reference to processes characterized by the total absence of a routine and improvement management system. The process is inefficient and, probably, ineffective in terms of time, cost, or quality.

Among its distinguishing aspects, we can highlight the lack of standards and records. These processes are not defined; that is to say, they are informal. An undefined process implies an absence of shared work guidelines, which complicates the development of a repeatable method and, in consequence, leads to unforeseeable and uncontrolled results.

FIG.15
Initial level

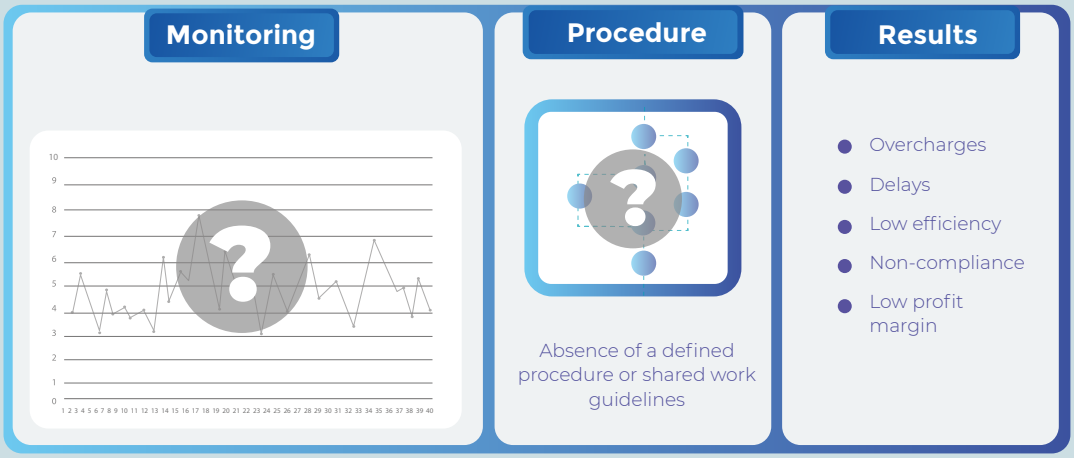


FIG.16
Monitoring, procedure, and results in the initial level

In conclusion, there is not a basis for the implementation of a routine management system that helps monitor daily tasks and detect deviations from the intended situation. The execution of process improvements is an occasional, spontaneous, and informal event.

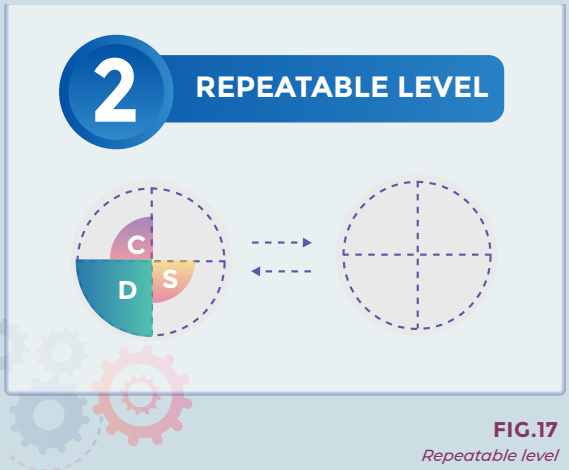


FIG.17
Repeatable level

The second or **repeatable level** makes reference to processes having the partial structure of a routine management system. The cycle is still incomplete, as it is necessary to work on standard setting (S) and checking practices (C) to proceed with the action (A). The process is still inefficient, though more effective.
Unlike the initial level, at this stage, the process has basic standards and records. The work method is known, shared, documented, and repeatable; however, neither the work method nor the standards are questioned.

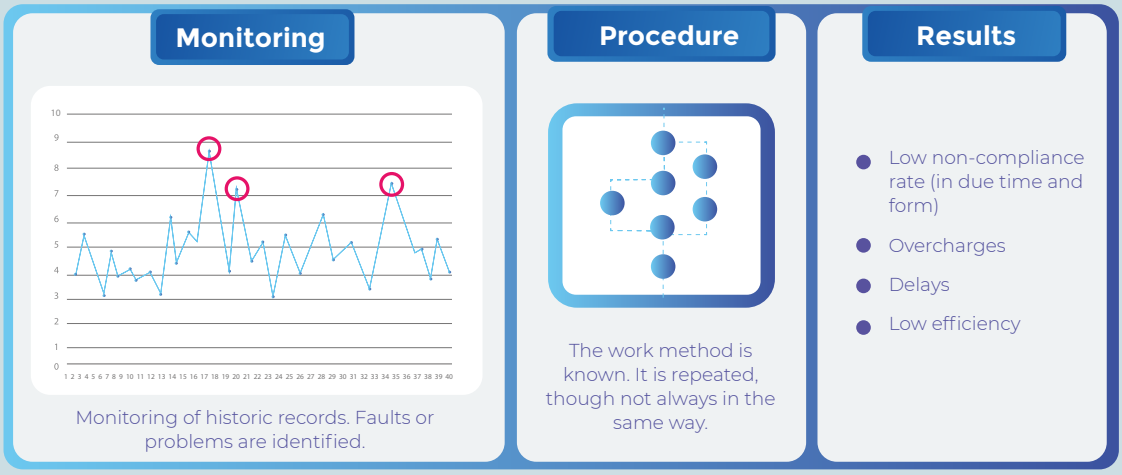


FIG.18
Monitoring, procedure, and results in the repeatable level.

As the process is defined, the method is always repeated with the aim of controlling the results. Due to the lack of monitoring guidelines to detect deviations from the method and the results, the procedure is not always carried out in the same way, which leads to high variability. In consequence, information and records are not used to detect deviations or control the process, but to identify problems after their occurrence; that is to say, to monitor historic records.

As in the initial level, improvements are occasional, spontaneous, and informal events.

The third or **defined level** makes reference to processes that still have the partial structure of a routine management system. The cycle is still incomplete due to the lack of an action (A) stage; however, unlike the previous level, the check (C) and standard (S) stages have been completed. The process is more efficient and more effective, since results are achieved.

At this stage, the process is repeatable and defined. The same applies to controls, procedures, work criteria, and their verification, which enables the organization to monitor the process and reduce its variability. The records, standards, and methods are standardized. The information and the records are only useful to identify where problems occur.

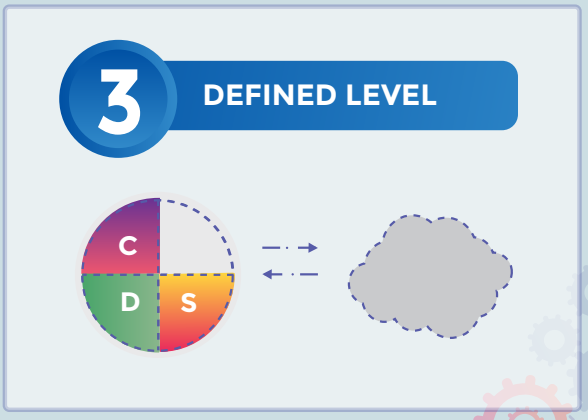


FIG.19
Defined level

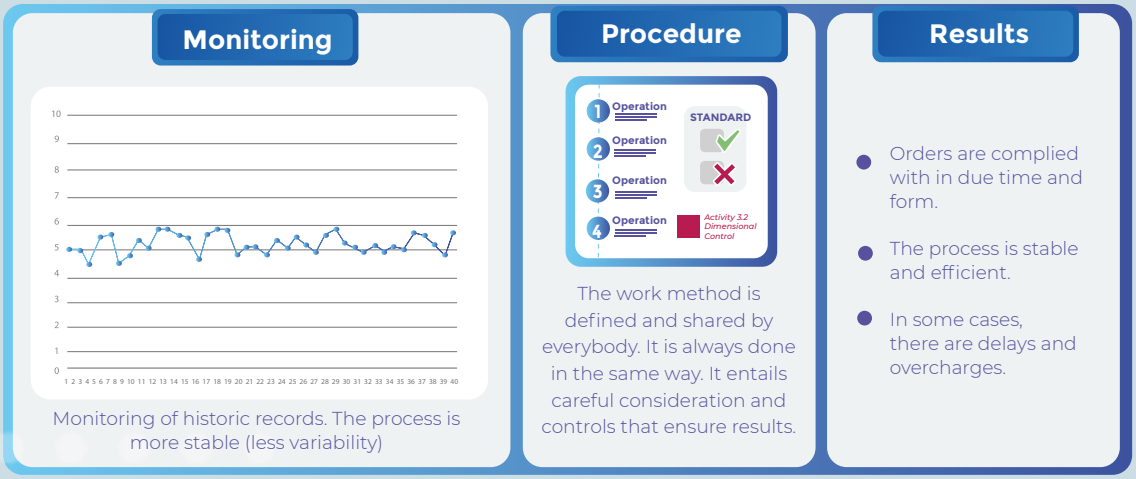


FIG.20
Monitoring, procedure, and results in the defined level

The improvement cycles are occasional and do not follow a defined process, as they are only implemented after detecting historic opportunities or problems. The methods and standards start to be questioned.

The fourth or **controlled level** makes reference to processes having a formal routine management system that operates as a cycle. The process is efficient and effective, and the results are sustainable over time. Improvement management is still not formal, but improvement opportunities appear and are addressed with or without an established method.

The process is measured and implemented within the limits set. The records and measurements help detect deviations from the intended situation (standard) to act and manage irregularities. Variability decreases, and forecast becomes possible, since the organization proceeds with the action stage upon any deviation. The process is controlled.

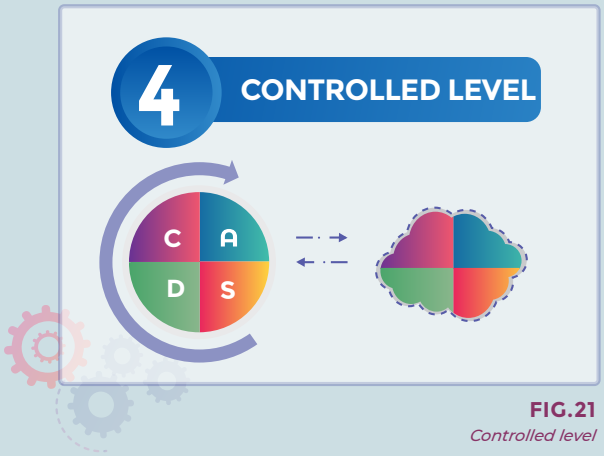


FIG.21
Controlled level

In this level, unlike the previous ones, the organization recognizes the importance of information at the time of dealing with a problem. Moreover, information serves as input to study and improve the processes by questioning existing standards.

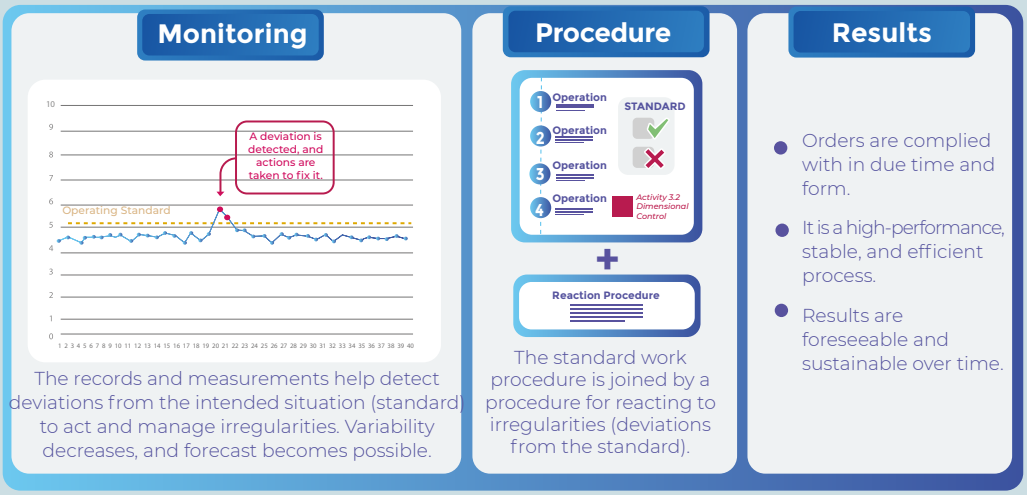


FIG.22
Monitoring, procedure, and results in the controlled level

The improvement cycles are still occasional and may or may not follow a defined process; however, what makes them different is that they take place as a result of the detection of problems or opportunities arising from daily control and monitoring management.

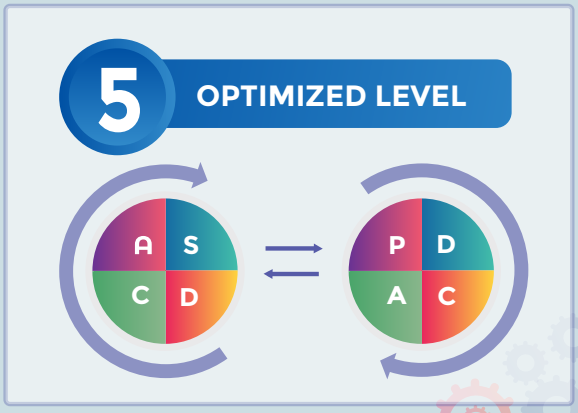


FIG.23
Optimized level

Finally, the fifth or optimized level makes reference to processes having complete routine and improvement management systems. Both systems are closely connected and synchronized. The process is defined and is associated to a method. The records and measurement procedures are also standardized. Goals and standards are set as intended values; besides, upon the occurrence of any deviation, the organization knows how to act; that is to say, reaction procedures are established.
There are formal improvement cycles, with a defined work method, which enables the company to change routine, re-set standards, and evaluate their benefits with the aim of improving the work conditions and the results.

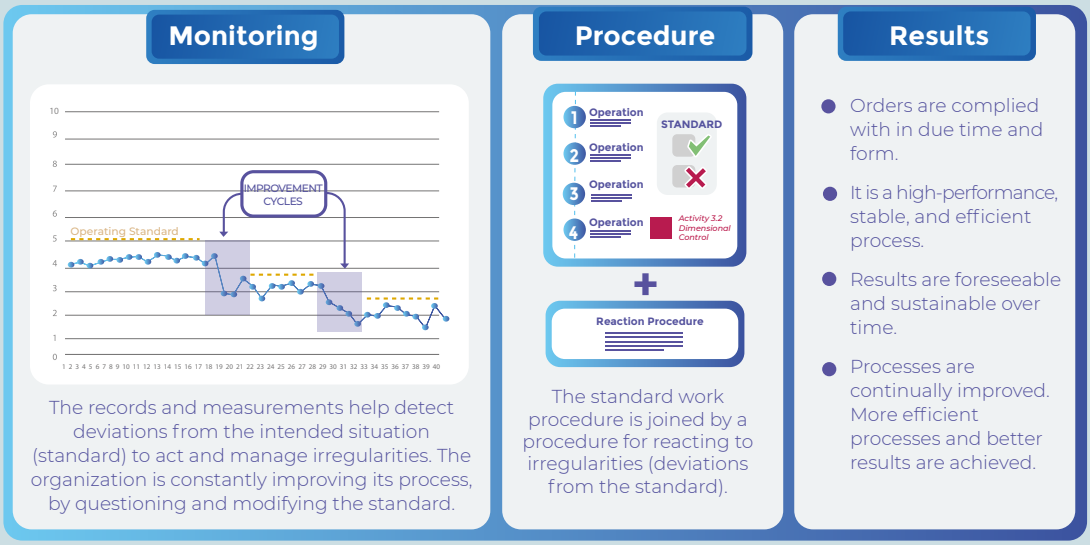


FIG.24
Monitoring, procedure, and results in the optimized level

The company is constantly improving its process, by trying new ways of doing things; always in a controlled and methodological manner. Kaizen is part of the corporate culture.

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4. Implementation Task

1) Select a production process or operation to find out its maturity level. Analyze in which level or stage the process or operation is, by answering the following questions:

- Are there process standards? (Regarding quality, time, among others)
- Are there work guidelines? Is there a defined method? Does the method repeat itself systematically?
- Are there process records? How often are records analyzed? Are records useful to control the process? Is there any mistake evidenced by the records?
- Are there monitoring and result indicators? Are there monitoring guidelines to detect deviations?
- Are standards and methods questioned? Are improvement cycles implemented? Are their procedures formalized? Are them a common and constant practice?

2) Select an operation or work area that needs to be improved. These are some of the aspects that can be analyzed:

- **Quality**
- **Response time**
- **Productivity**
- **Availability**
- **Performance**

Once the aspect is determined, define the data to be gathered, keep records during two weeks, and calculate the corresponding indicator. Publish the results and share them with the people involved in the operation or work area selected.

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