INTI Instituto Nacional de Tecnología Industrial | 65 Años 1957-2022

TG GLOSSARY

Continuous Improvement Environment Definitions

INTI MANAGEMENT TECHNOLOGY NETWORK

AUTHORS:
Natalia Gentile
María Constanza Kunath Walsh
María Eugenia Lagier
Ayelén Richard
Martín Romanelli
Julián Rosso
Franco Strano

EDITORS:
Federico Blanco
Yamila Mathon
María Agustina Parenti
Germán Posse
Natalia Vazquez
Ana Zielinski

TRANSLATOR:
Flavia Marcos

TG Glossary: Continuous Improvement Environment Definitions / Franco Strano... [et al.] ; general coordination of Franco Strano ; edited by Federico Blanco... [et al.] ; prologue by Héctor R. Formento.- 1st ed.- San Martín :

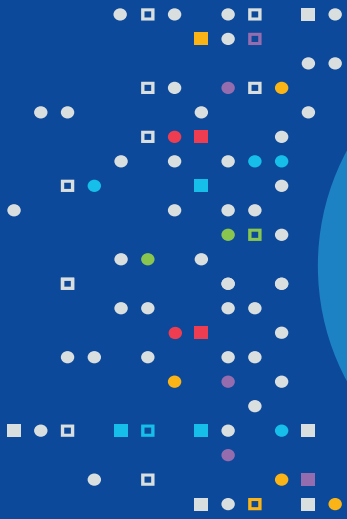
National Institute of Industrial Technology - INTI, 2022.

eBook, PDF
Digital File: download and online
ISBN 978-950-532 546-7

1. Management techniques.
I. Strano, Franco, coord.
II. Blanco, Federico, ed.
III. Formento, Héctor R., prolog.

CDD 658.002

ISBN 978-950-532-546-7



TG GLOSSARY

Continuous Improvement Environment Definitions

INTI MANAGEMENT TECHNOLOGY NETWORK

ACKNOWLEDGMENTS

The National Institute of Industrial Technology is proud of the confidence that the Japan International Cooperation Agency (JICA) has placed in us for more than 15 years to work together in the dissemination of management technologies, aiming from the origins of this cooperation at building knowledge in and for the region.

On this path, the contribution of Japanese experiences through the transfer of knowledge and the development of activities to raise awareness of the importance of Kaizen in the development of small and medium-sized industrial enterprises has been a particularly valued asset.

In turn, our Ministry of Productive Development has encouraged INTI's technical assistance to contribute to the strengthening of our country's industrial framework.

The permanent support of the Ministry of Foreign Affairs of Argentina, through the General Directorate of International Cooperation, has made it possible to consolidate these actions over the years.

The commitment of the leaders of the different areas of the Institute involved in the TANGO Kaizen project and of our Management Technologies team, seeking to promote continuous improvement on a daily basis and accompanying companies in their development processes, has allowed INTI to consolidate its position as a national and regional benchmark.

For all these reasons, I would like to thank each one of you for this collaborative work process that has allowed us to walk this virtuous path together to support our productive network throughout the country.

Our commitment is to continue strengthening it,

Dr. Ruben Geneyro
President
National Institute of Industrial Technology

INDEX

Preface

Continuous improvement is an undisputed management strategy.

It would be difficult to find a businessman, manager, professional or even worker who denies this idea or argues against it.

Most people who have heard the term think they understand what it is; the very phrase "continuous improvement" seems to be self-explanatory, making its meaning self-explanatory.

From there, confusion and misunderstandings follow one after the other, since, from assuming that a training course or a consultant can solve the issue, to thinking that it is a matter of investment capacity (for which SMEs have few possibilities), there is a tremendous lack of knowledge of the philosophy of continuous improvement and all its associated nomenclature.

It is therefore easy to accept that, if it is not clear what "continuous improvement" means, much less will it be possible to understand and select the various elements that comprise it and use them.

In this sense, INTI, through its Management Technology Network, has been developing, for years, a magnificent task of dissemination and assistance to Argentine SMEs. This publication is a further expression of this virtuous path by providing a complete glossary of the different components of the continuous improvement process, which does not exist in English. It is not a simple dictionary on the matter, but each term is accompanied by its definition and a summarized, but highly didactic explanation, so that its approach can be clearly understood by the reader.

It has been very rewarding for me to read this work and write this brief preface because I sincerely believe that its disclosure will make a great contribution to the field of continuous improvement, to its practitioners and to those who want to begin to venture into the field.

Héctor Ricardo Formento
Professor - Researcher
Institute of Industry - UNGS

The origin of the idea

Throughout the years of work, we have identified the need for material that summarizes and synthesizes the concepts, tools and methodologies of management technologies commonly used, both during assistance and training sessions and in the exchange with people who were taking their first steps in continuous improvement.

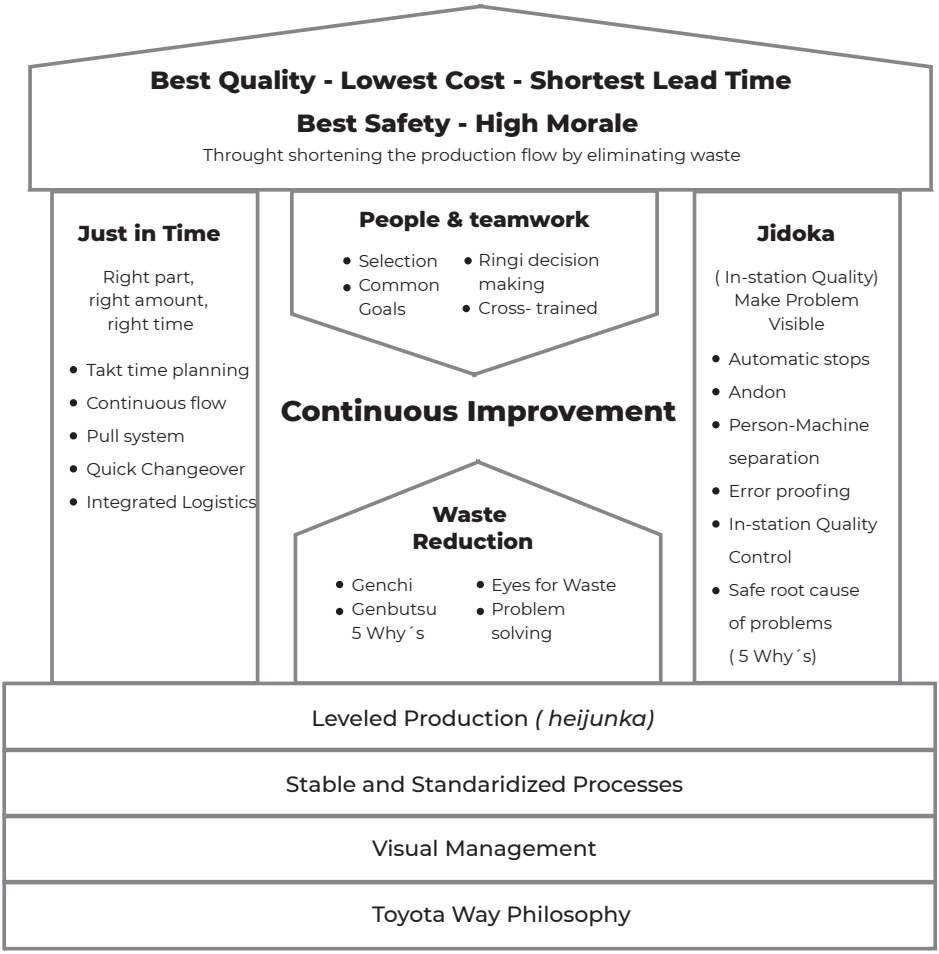
This inspired the work team to start a development process to generate a reference material to provide a first approach to the Kaizen environment to facilitate its understanding and contribute to its comprehension.

As a result of a process of dialogues, discussions and theoretical consensus, the **TG GLOSSARY** is born with the aim of providing the reader with a brief introduction to the subject with a simple and clear reference material. With this idea in mind, we developed and designed it so that it can be used by anyone interested in or carrying out continuous improvement.

To organize the content and facilitate its use, the TG GLOSSARY is inspired by the section structure of the Toyota Production System (TPS) house. In each section the concepts, tools and methodologies are placed according to their characteristics.

To learn about the original structure of the TPS house we will take a tour through an abstract published in the book "The Toyota Way".

> The TPS house diagram has become one of the most recognizable symbols in modern manufacturing. Why a house? Because a house is a structural system. The house is strong only if the roof, the pillars, and the foundation are strong. A weak link weakens the whole system. There are different versions of the house, but the core principles remain the same. It starts with the goals of best quality, lowest cost, and shortest lead time—the roof. There are then two outer pillars—just-in-time [...] and jidoka, which in essence means never letting a defect pass into the next station [...]. In the center of the system are people. Finally there are various foundational elements, which include the need for standardized, stable, reliable processes, and also heijunka, which means leveling out the production schedule in both volume and variety. A leveled schedule or heijunka is necessary to keep the system stable and to allow for minimum inventory. [...]
>
> Each element of the house by itself is critical, but more important is the way the elements reinforce each other.

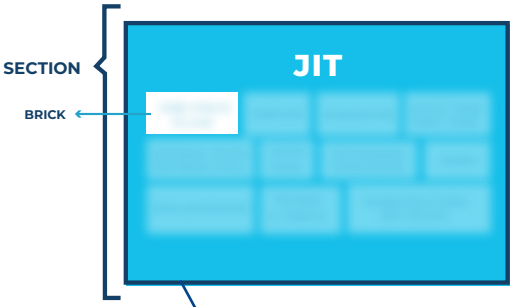


Source: The Toyota Way - Jeffrey K. Liker

For the construction of the publication we used the basic principles of the original structure of the TPS house. This process consisted of the selection of the Concepts (C), Tools (T) and Methodologies (M) of management technologies, the subsequent research and discussion for the generation of contents, and finally their compilation and grouping in the different sections.

The house has different sections and each section contains bricks.

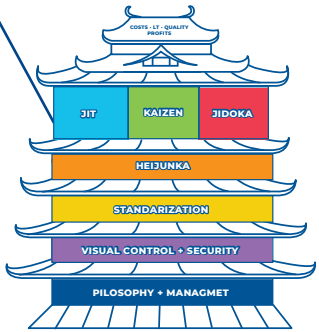
Each brick is a:
Concept **(C)**,
Tool **(T)**
or Methodology **(M)**

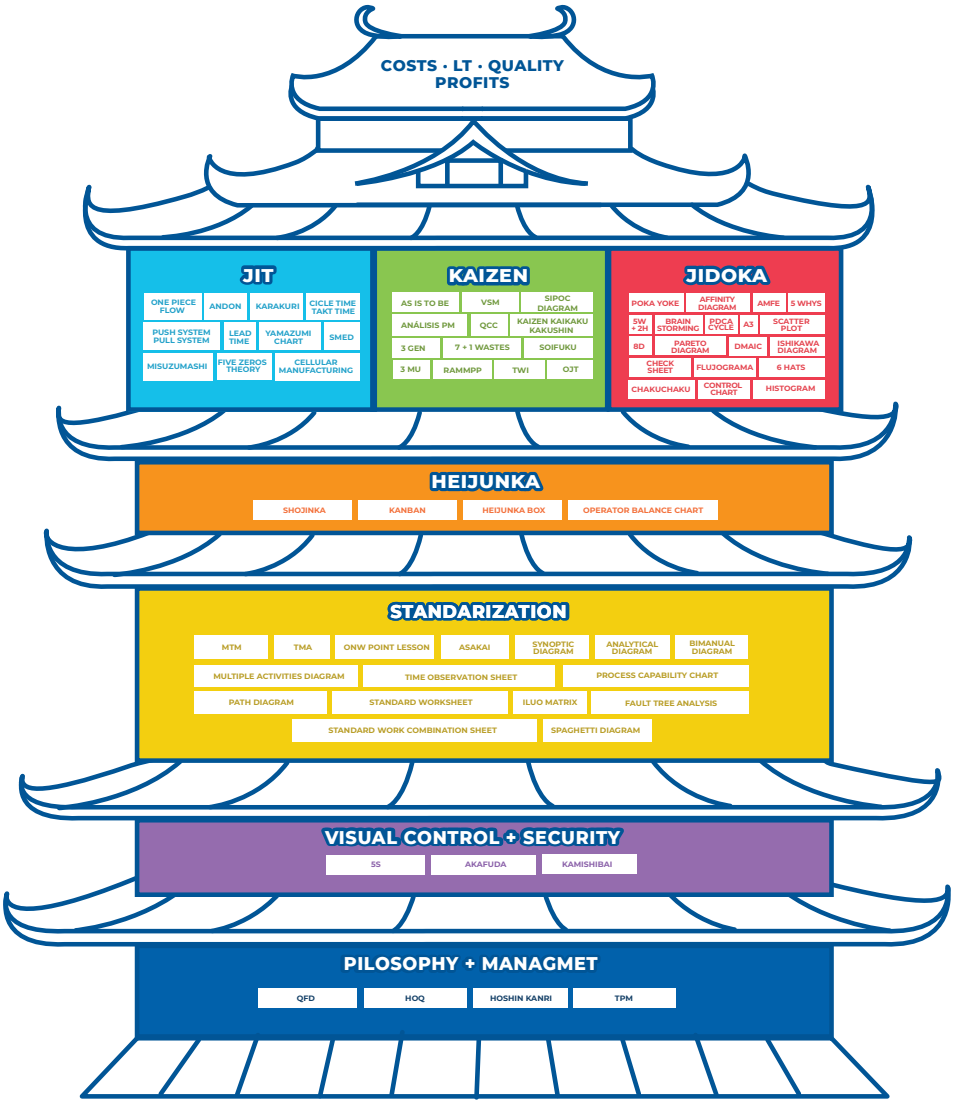


- **Concept:** any definition, idea or knowledge that makes it possible to understand a situation and/or be used to put it into practice through a tool or methodology.

- **Tool:** concept put into practice that has a particular utility and is the means to achieve an objective.

- **Methodology:** concept or tool that has a defined series of steps to be implemented.




COSTS · LT · QUALITY
PROFITS
JIT
ONE PIECE FLOW
ANDON
KARAKURI
CICLE TIME TAKT TIME
PUSH SYSTEM PULL SYSTEM
LEAD TIME
YAMAZUMI CHART
SMED
MISUZUMASHI
FIVE ZEROS THEORY
CELLULAR MANUFACTURING
KAIZEN
AS IS TO BE
VSM
SIPOC DIAGRAM
ANÁLISIS PM
QCC
KAIZEN KAIKAKU KAKUSHIN
3 GEN
7 + 1 WASTES
SOIFUKU
3 MU
RAMMPP
TWI
OJT
JIDOKA
POKA YOKE
AFFINITY DIAGRAM
AMFE
5 WHYS
5W + 2H
BRAIN STORMING
PDCA CYCLE
A3
SCATTER PLOT
8D
PARETO DIAGRAM
DMAIC
ISHIKAWA DIAGRAM
CHECK SHEET
FLUJOGRAMA
6 HATS
CHAKUCHAKU
CONTROL CHART
HISTOGRAM
HEIJUNKA
SHOJINKA
KANBAN
HEIJUNKA BOX
OPERATOR BALANCE CHART
STANDARIZATION
MTM
TMA
ONW POINT LESSON
ASAKAI
SYNOPTIC DIAGRAM
ANALYTICAL DIAGRAM
BIMANUAL DIAGRAM
MULTIPLE ACTIVITIES DIAGRAM
TIME OBSERVATION SHEET
PROCESS CAPABILITY CHART
PATH DIAGRAM
STANDARD WORKSHEET
ILUO MATRIX
FAULT TREE ANALYSIS
STANDARD WORK COMBINATION SHEET
SPAGHETTI DIAGRAM
VISUAL CONTROL + SECURITY
5S
AKAFUDA
KAMISHIBAI
PILOSOPHY + MANAGMET
QFD
HOQ
HOSHIN KANRI
TPM

Reading instructions

There are different ways to read the TG Glossary. Below, we present some alternatives to navigate through its contents.

1 From start to finish

Similar to any textbook, the reader goes through the glossary by reading each section and its component elements. When choosing this alternative, we suggest that it is with the intention of going deeper into the content and finding the existing connections.

2 Spot search

A. Search for the location of the C/T/M using the Alphabetical Index (List located at the end of the publication detailing where to find each item).

B. Find the section of interest in the table of contents and browse through it to learn about the elements that compose it and their relationships.

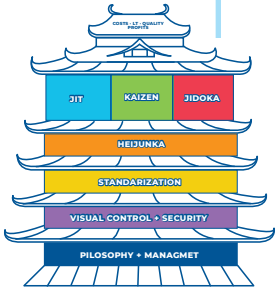
C/T/M ELEMENT IDENTIFIER

Symbol indicating what type of element it is:

- **Concept (C)**
- **Tool (T)**
- **Methodology (M)**

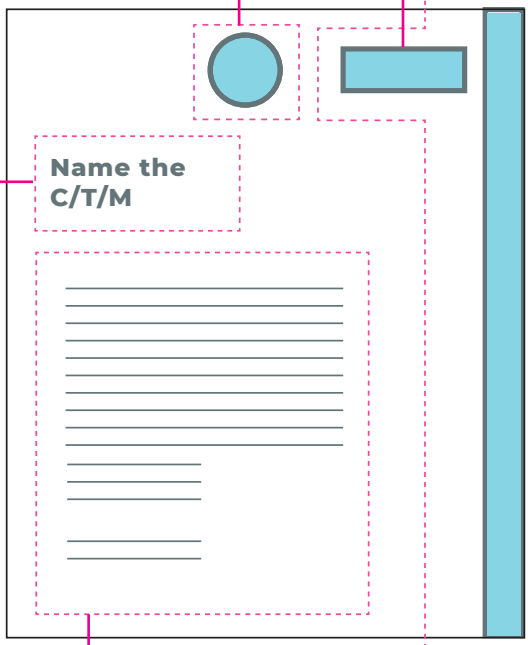
SECTOR IDENTIFIER

Color indicating the sector of the house to which the element belongs.



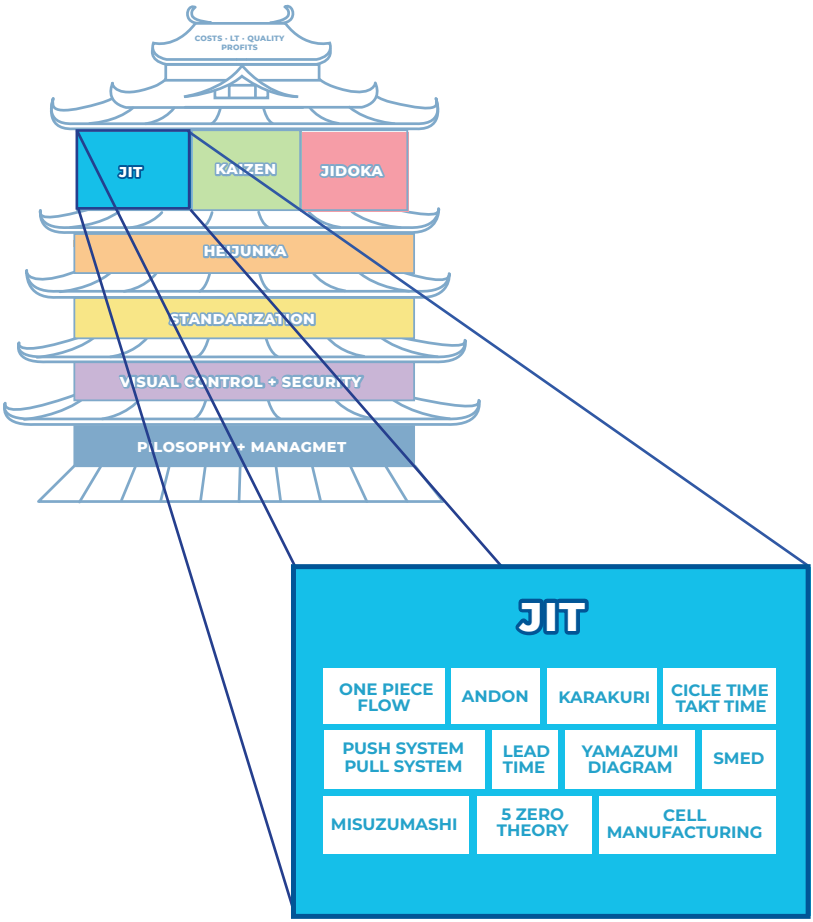
NAME THE C/T/M

Element to which the page content belongs.



CONTENT

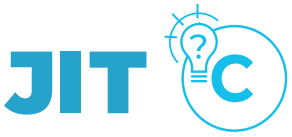
Theoretical development of the element that may include definitions, sequences of steps, diagrams, graphs.


COSTS - LT - QUALITY
PROFITS
JIT
KAIZEN
JIDOKA
HEIJUNKA
STANDARIZATION
VISUAL CONTROL + SECURITY
PHILOSOPHY + MANAGMET
JIT
ONE PIECE FLOW
ANDON
KARAKURI
CICLE TIME TAKT TIME
PUSH SYSTEM PULL SYSTEM
LEAD TIME
YAMAZUMI DIAGRAM
SMED
MISUZUMASHI
5 ZERO THEORY
CELL MANUFACTURING

JIT
Just in Time

Just in Time consists of producing only what is needed, when it is needed and in the quantity in which it is needed.

In this section you will find the C/T/M used to ensure compliance with the timelines when working on the coordination of all the elements of the system.



One piece flow

It means "to create flow piece by piece". It involves having each part move from one operation to another, without a complete lot moving, allowing no buffer stock to accumulate between operations.

To implement One Piece Flow in a process, it is advisable to previously perform certain actions, such as:

- Standardize the tasks and operations involved.
- Coordinate operations.
- Balancing the pace of jobs. The different stations that make up the production line must have a similar rhythm so that the parts in process wait as little as possible (fluidity).
- Minimize transportation and commuting.

There are cases where piece-by-piece manufacturing has some advantages over batch production:

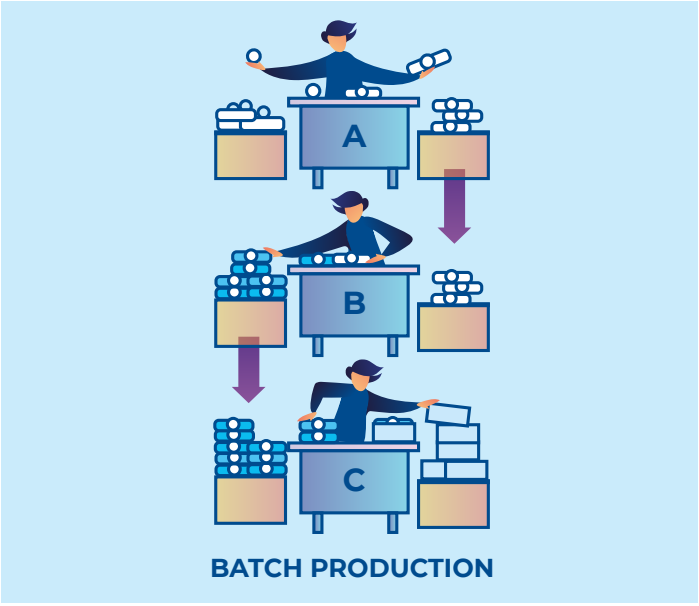
✓ Reduce Lead Time. The products finish the production process in a shorter time than working in batches, thus reducing response times.

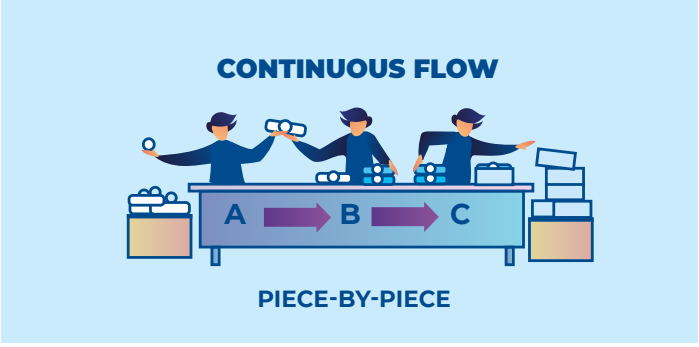
✓ “Work In Progress”. The intermediate stock would be smaller, since the part is produced uninterruptedly (without waiting).

✓ Quality improvement. By manufacturing part by part, defects are detected quickly, as each part is checked and approved in the next operation. In batch production, problems are noticed late and errors continue to occur during the processing of the rest of the parts in the batch.

- ✓ Increases flexibility. It is easier to adapt to the characteristics of customer demand (diversity and quantity). Product inventories can be replenished on a continuous basis.

- ✓ Increases efficiency. It tightens the process and forces operations to be coordinated, reducing production losses.





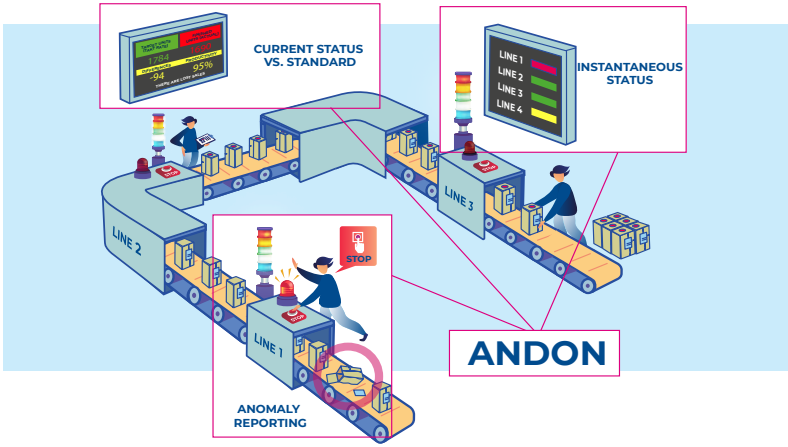
Andon

It is a Japanese word that means "lantern". It is a visual and/or audible management tool that provides information about the process, allowing to reduce communication and response times to events. It is located in strategic places so that it is perceived by all the people involved in the process.

Its implementation must be accompanied by methods to act on the information it provides.

The device or system serves to communicate:

- The current status of the process versus the standard allowing to detect deviations.
- The detection of an anomaly.
- The instantaneous status of a process.
- A combination of the above.



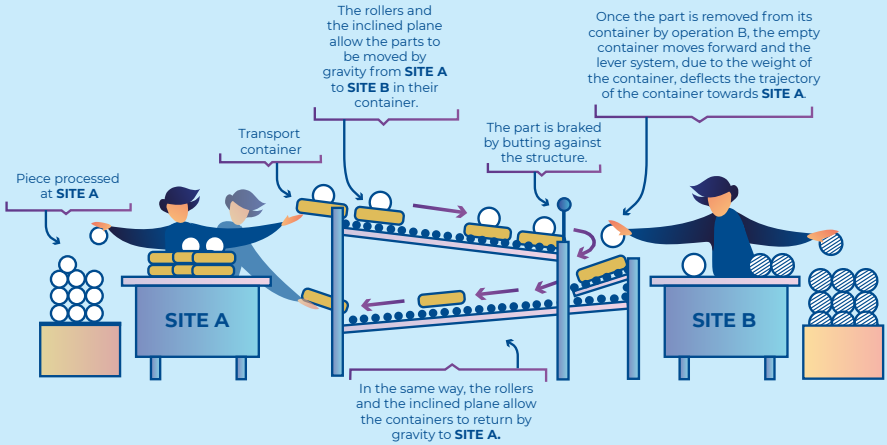
Benefits:

- Communicates in a practical and simple way the status of a production system.
- Transmits a shared visualization of information.
- Allows for agile decision making and quick response to deviations.

Karakuri

It is a Japanese term that can be interpreted as "mechanical deception". These are devices developed based on principles and properties of mechanics, hydromechanics and magnetism, among others, to build simple systems that simplify the task and improve the ergonomics of the workspace. They are characterized by their simplicity and low cost, being a tailor-made solution for each job.

The *karakuri* principle is applied in factories to improve the transfer systems of materials, packaging or components between workstations, reducing time and respecting the established method.



Benefits:

- Optimizes processes and energy use
- Provides safety for operators
- They are adaptable and low-cost to produce

Requirement:

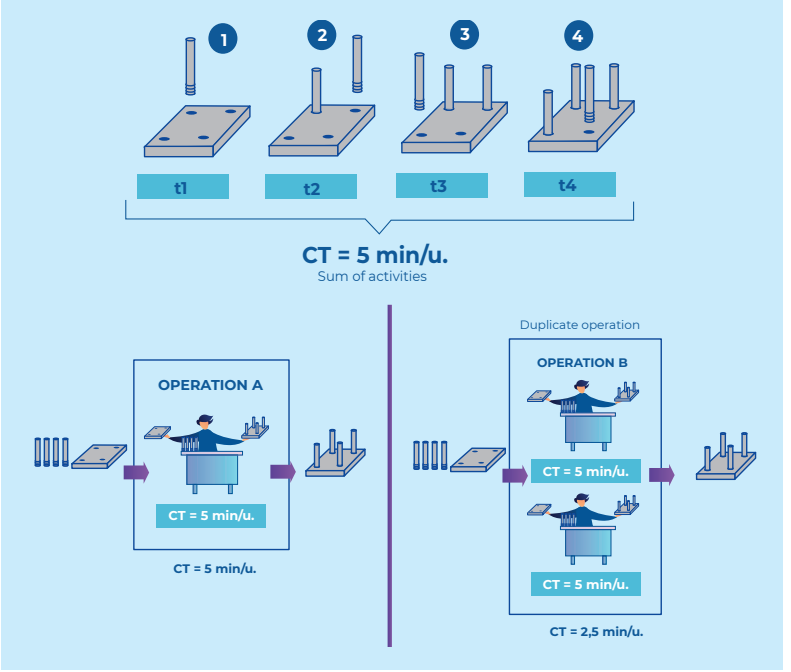
For the most advanced *karakuri* there is a requirement that the process in which it is implemented is standardized.

Cycle Time (CT)

Cycle Time of an operation can be defined as the time it takes a person or a machine to complete all the activities composing an operation before repeating them. It can also be defined as the time it takes an operation to complete a product.

These two meanings may result in different values depending on the configuration of the line.

For example, if another machine is added to an operation that takes 5 minutes per machine (duplicate operation) and both machines work out of phase, delivering 1 product every 2.5 minutes, we can consider the two times as cycle times depending on what is to be analyzed.



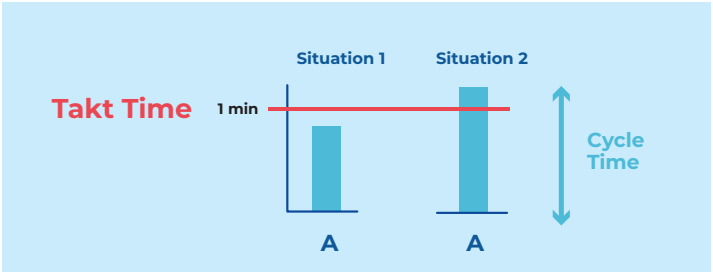
Takt Time (TT)

The *Takt Time* of a product or set of products expresses the rate at which the customer demands the product in a given period. The customer is the one who defines the *Takt Time* regardless of the responsiveness of the production process.

$$TT = \frac{Ta}{D}$$

TT = Takt Time
Ta = Net time available for work, or working time per period.
D = (customer) demand, or units required per period.

The net time available is the amount of time set for the work to be performed. This excludes rest breaks and any pre-established stops, such as scheduled maintenance, breaks for giving instructions, among others.



Comparison of situations of operation A:

Situation 1 If TT > CT → Ok ✔
Situation 2 If TT < CT → Not Ok ✖

In order for a company to satisfy its demand, it requires a Cycle Time less than Takt Time (situation 1), so that it does not have to resort to the use of extra hours or shifts to complete the work. However, if the difference is too great in favor of Takt Time, this can lead to waiting times that are detrimental to the performance of production systems.

Note: generally, CT and TT are expressed in sec/u or min/u. c

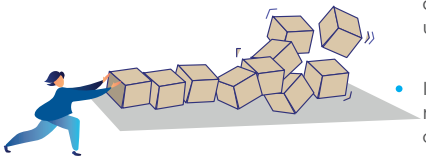
Productive management by PUSH System or PULL System

PUSH SYSTEM

"The company ***pushes*** the product to the market"

The company manufactures based on the capacity of the operations. When planning, scheduling and operating, priority is given to installed capacity over customer orders.

Main features of the PUSH System



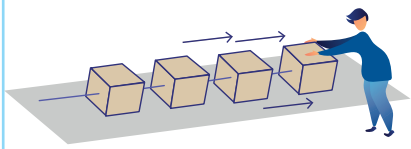
- Demand is anticipated based on forecasts and production control is centralized.
- It may happen that the scheduling is done in batches to maximize the capacity utilization of the processes/machines.
- Inventory is the consequence of manufacturing for the highest utilization of installed capacity.

PULL SYSTEM

"The market ***pulls*** the product"

The company determines production based on specific customer orders. When planning, scheduling and operating, priority is given to installed capacity over orders.

Main features of the PULL System



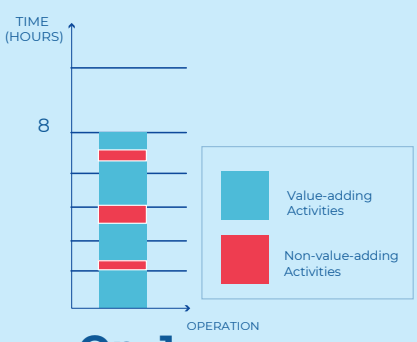
- Demand is known based on the PULL System's specific orders and production control is decentralized.
- Machines or operations start manufacturing once there is a request for a defined quantity from the internal or external customer.
- Inventory should not exist because it is manufactured based on demand.

Yamazumi Chart

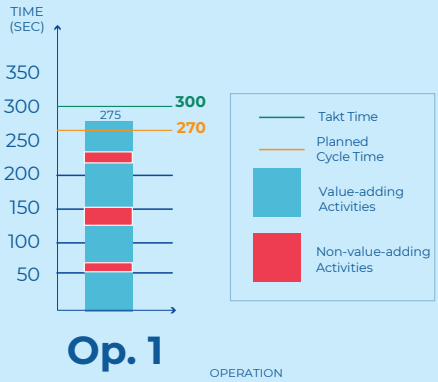
The *Yamazumi Chart* (or Yamazumi board) is a graphic representation of stacked columns that shows how the time or production capacity of an operation is divided between activities that add value and those that do not.

Its application can be both at a general level, analyzing extended periods of work (e.g., a full working day), and to analyze in detail the composition of cycle times.

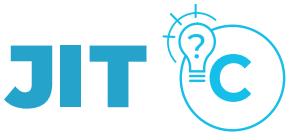
The usefulness of the diagram lies in the fact that it allows a quick understanding of the situation of the means of production and the impact of activities that do not add value.



YAMAZUMI CHART
OF A WORKDAY



YAMAZUMI CHART
OF A ONE-PART CYCLE



Lead Time

Different types of *Lead Time* (LT) can be found depending on what is being analyzed or the working conditions of each company.

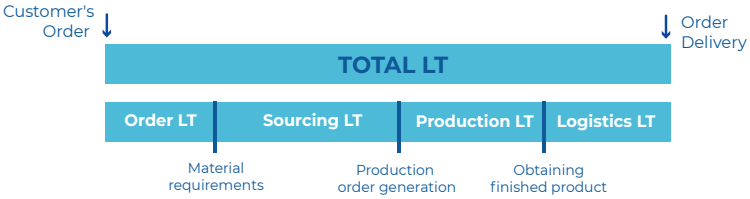
- **Total LT**
  The time elapsed from the time an order is received from the customer until it is delivered. It is the total time to perform all the tasks required to fulfill the customer's order, from order processing (Order LT), material sourcing (Sourcing LT), production (Production LT) and delivery (Logistics LT).

- **Order LT**
  This is the time allocated to the processing of customer orders. It covers the time from receipt of a customer order to the generation of material requirements. In case a frequent production has been agreed with a customer (procurement contract), the Order LT can be disregarded or is close to 0, since the material requirements are known.

- **Sourcing LT**
  This is the time that elapses from the time the material requirements are generated to prepare an order, until the materials are received and stored in their warehouses. It covers material ordering times from suppliers and their logistics. In the case of working with a stock of materials, the Sourcing LT has no impact on the Total LT since the necessary materials for production are available. Sourcing LT will continue to influence the planning of materials replenishment (purchase planning).

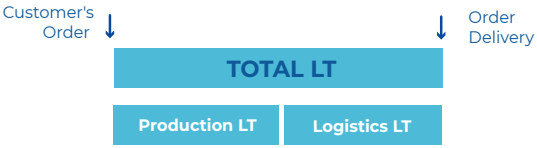
- **Production LT**
  It is the time allocated to the development of the product or service. It covers the entire process, from the generation of the production order to obtaining the finished product. In turn, partial LTs can be calculated for each operation belonging to the production process. For example, if a process is made up of operations A, B, C, an LT can be obtained for each one (LTa, LTb, LTc) and a Production LT equivalent to the sum of them (Production LT = LTa + LTb + LTc).

- **Logistics LT**
  It is the time covered by the product or service delivery tasks, from the procurement of the finished product to the delivery of the order to the customer.



In the case of working with Stock of Materials

In the case of working with Stock of Materials and Procurement Agreement



We can also find *Lead Time Efficiency*

It is a measure of the amount of value-added time in any process, in relation to the Lead Time.
The calculation formula is:

$$\text{LT Efficiency} = \frac{\text{Value Added Time}}{\text{Lead Time}}$$

Lead Time = Value-Added Time + Non-Value-Added Time

The higher the ratio, the more efficient the process. This metric quantifies the waste through a production process, being the Waiting time one of the most frequent.

SMED (Single Minute Exchange of Die)

It is a tool that proposes to follow a series of steps to reduce Set-up time.

Set-up time or DANDORI is the time elapsed from the production of the last part of a series until the first conforming part of the next series is obtained.

The total set-up consists of:

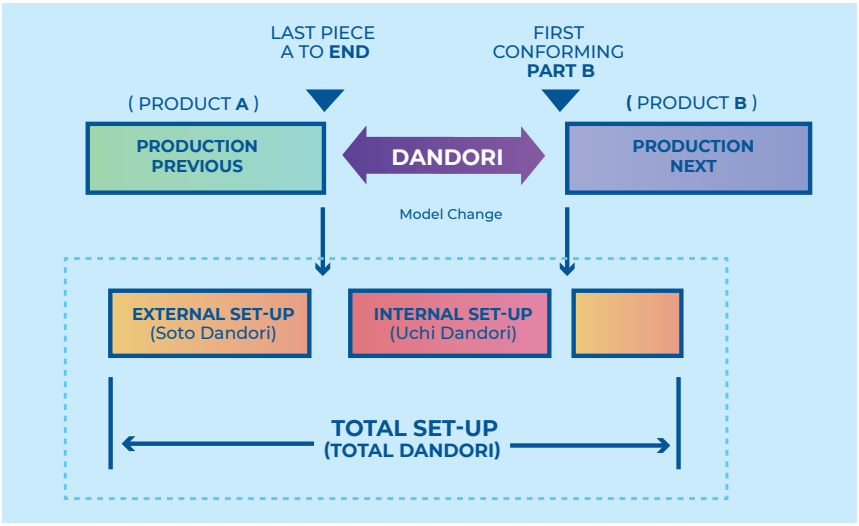
EXTERNAL SET-UP (Soto Dandori)	INTERNAL SET-UP (Uchi Dandori)
Aquellas actividades que pueden realizarse con la máquina en marcha (en plena producción).	Aquellas actividades que se llevan a cabo exclusivamente cuando la máquina o equipo se encuentra detenido.

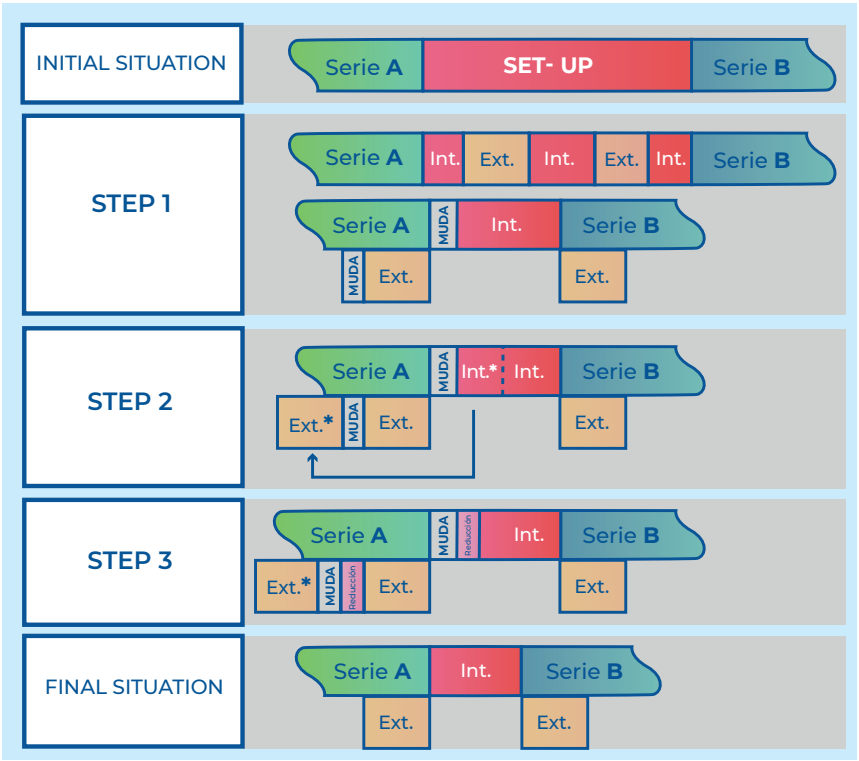
Methodology

1. Separate Internal and External Set-up activities
In the first instance, the activities may not be differentiated, generating a prolonged set-up for both internal and external activities. In this step, the objective is to analyze and separate each type of activity accordingly.

2. Convert Internal Set-up to External Set-up
Once the activities have been differentiated, the objective in this step is to try to identify which Internal activities could be adapted and become External.

3. Improve aspects related to Total Set-up
Once the previous steps have been completed, the objective is to reduce or eliminate activities in order to reduce and improve the total set-up. It is recommended to start by analyzing internal activities.


LAST PIECE
A TO END
FIRST
CONFORMING
PART B
(PRODUCT A)
(PRODUCT B)
PRODUCTION
PREVIOUS
DANDORI
PRODUCTION
NEXT
Model Change
EXTERNAL SET-UP
(Soto Dandori)
INTERNAL SET-UP
(Uchi Dandori)
TOTAL SET-UP
(TOTAL DANDORI)


INITIAL SITUATION
Serie A
SET- UP
Serie B
STEP 1
Serie A
Int.
Ext.
Int.
Ext.
Int.
Serie B
Serie A
MUDA
Int.
Serie B
MUDA
Ext.
Ext.
STEP 2
Serie A
MUDA
Int.*
Int.
Serie B
Ext.*
MUDA
Ext.
Ext.
STEP 3
Serie A
MUDA
Reducción
Int.
Serie B
Ext.*
MUDA
Reducción
Ext.
Ext.
FINAL SITUATION
Serie A
Int.
Serie B
Ext.
Ext.

Mizusumashi

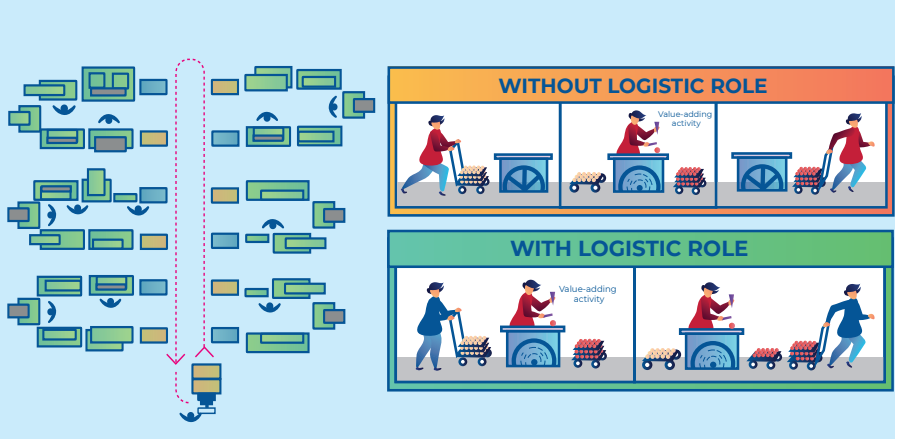
It is a role within the internal logistics of the plant floor that is responsible for the provisioning of work centers. Its objective is to guarantee the availability of supplies and materials necessary to execute the task, trying to maintain minimum inventory levels. This ensures that the process does not stop (continuous flow) and the workstations spend as much time as possible on value-adding activities, eliminating the transport activity from each operation.

The person in charge of the role of mizusumashi requires a high level of knowledge of the process as he/she interacts with different points of the process. In order to develop it efficiently, its activity must be standardized: route, transport method and sourcing must be defined and optimized.

Due to the type of tasks performed, which involve frequent travel to different workstations, this role can perform communication (information flow) and supervisory functions.

Prior to implementing Mizusumashi the following is necessary:

- Good organization, order and cleanliness
- Standardized operations
- Repeatable, stable and predictable process



Theory of the 5 Zeros

The theory of the 5 zeros represents five goals to be achieved by a production system operating under the Just In Time concepts.

Zero Defects

It seeks to do things right the first time to avoid defects, since they generate loss of value, image and additional costs in the product. In terms of processes and operations, delays and non-compliances.

Zero Breakdowns

It seeks to ensure equipment reliability to avoid delays and unbalanced operations that may affect response times.

Zero Stocks

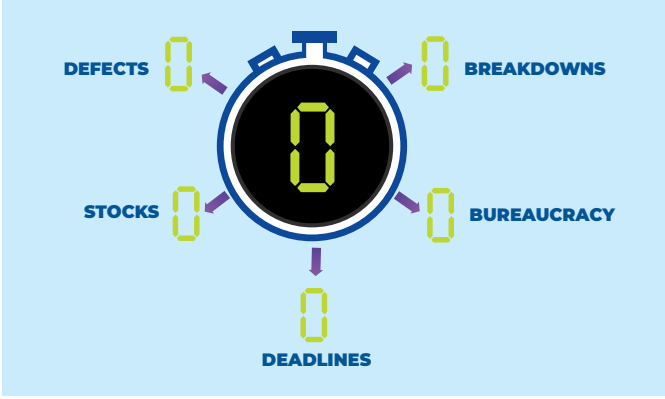
It seeks to eliminate negative effects such as operating costs, time, capital tied up and unused space, incurred by the existence of inventories.

Zero Deadlines

It seeks to ensure immediate delivery to eliminate delays in processes and operations.

Zero Bureaucracy

It seeks to achieve efficient processes by eliminating management-related activities that are complementary to the production process.



Cellular Manufacturing

It is a characteristic tool of the Toyota Production System (TPS) and Lean Manufacturing. It is also often referred to as a "work cell". It is a way of arranging and organizing the operations that make up a process or sub-process. The fundamental objective is to create continuous flow, thus minimizing transfer batches (ideally one-piece flow).

For the design of the cell, on the one hand, the physical layout is considered, which traditionally takes the shape of a "U" (although, depending on the characteristics of the machinery involved or some other spatial constraint, it can take the shape of an "L", "S", "V"). On the other hand, its operation is planned, defining the way in which people will distribute the tasks and interact with the cell's own process, as well as the peripheral organization contemplating the supply of materials.

A characteristic aspect of the cells is their ability to adapt to the different production volumes required by varying the rate at which they are produced. In manual or semi-automatic processes, this is achieved by varying the number of people assigned to the cell and redistributing activities in such a way as to achieve the required rhythm and maintain a uniform flow.

Main benefits:

Associated with continuous flow

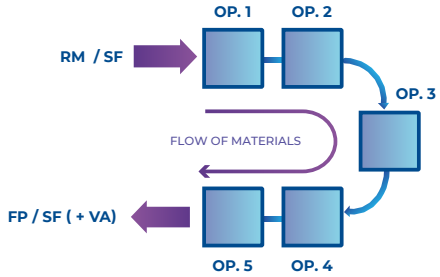
- Reduction of work-in-process inventories (WIP)
- Reduction of Production Lead Time by minimizing waits between operations
- Reducing non-quality costs through early detection of defects

Associated with the physical layout

- Reduction of space required for the process
- Flexible adaptation to required production volumes (within the ranges stipulated in the design)

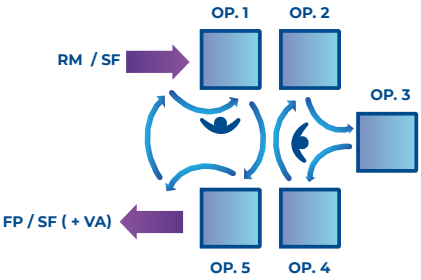
Although the benefits obtained are many, their correct management and operation requires the pre-existence of certain requirements, the most critical of which are the following:

- Multi-purpose people
- Flexibility of machines (low changeover times)
- Standardization of processes
- Product families with similar workloads
- Failure detection or prevention mechanisms

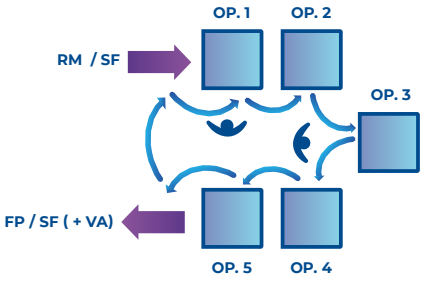


U-SHAPED MANUFACTURING CELL

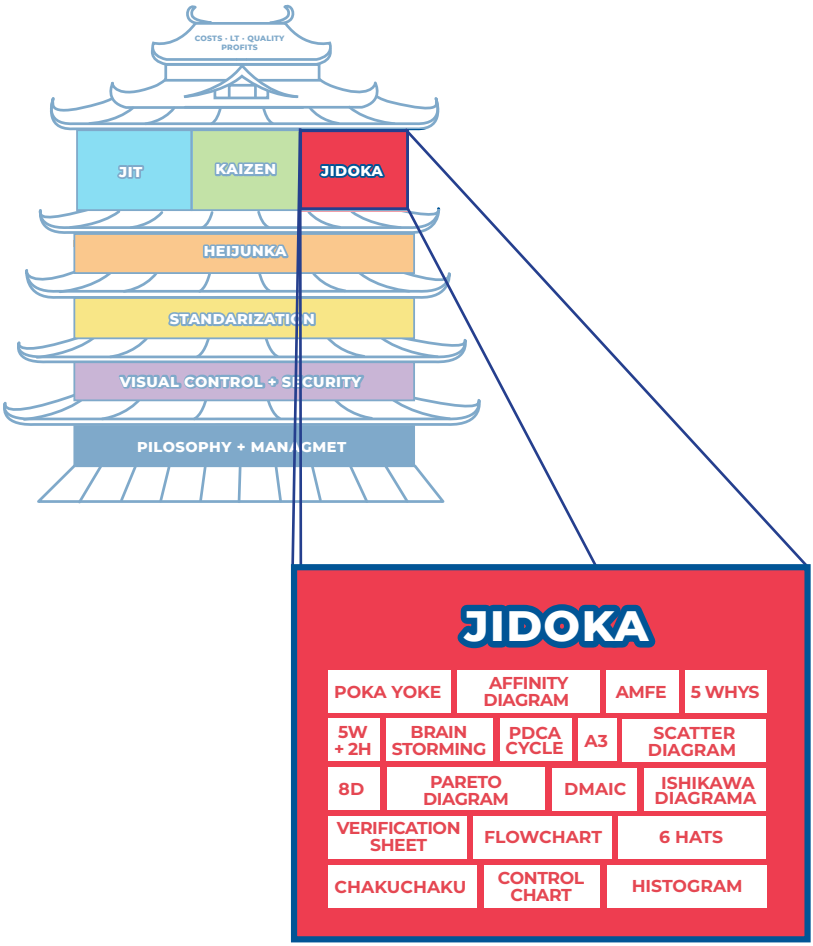
RM = (Raw Material), **SF** = (Semifinished), **VA** = (Value Added), **FP** = (Finished Product)



ALTERNATIVE DISTRIBUTION OF "SPLIT" OPERATIONS



ALTERNATIVE DISTRIBUTION OF "NAGARE" OPERATIONS


COSTS - LT - QUALITY
PROFITS
JIT
KAIZEN
JIDOKA
HEIJUNKA
STANDARIZATION
VISUAL CONTROL + SECURITY
PILOSOPHY + MANAGMET
JIDOKA
POKA YOKE
AFFINITY DIAGRAM
AMFE
5 WHYS
5W + 2H
BRAIN STORMING
PDCA CYCLE
A3
SCATTER DIAGRAM
8D
PARETO DIAGRAM
DMAIC
ISHIKAWA DIAGRAMA
VERIFICATION SHEET
FLOWCHART
6 HATS
CHAKUCHAKU
CONTROL CHART
HISTOGRAM

JIDOKA

Jidoka, also known as "the pillar of quality", aims to avoid the generation or permanence of errors or problems through prevention, detection and action.

This section contains the C/T/M used to anticipate deviations, detect them early or study them in search of a solution to prevent their propagation or recurrence.

JIDOKA

Poka Yoke

It is a term of Japanese origin that means "to avoid error". It is an inspection tool that has among its main functions:

- prevents an error from occurring
- detects when an error occurs
- detects defects that arise as a result of an error

Poka-yokes can be also be control mechanisms or warning mechanisms. The control mechanisms act on the operation by interrupting it while waiting for the detected phenomenon to be corrected, while the warning mechanisms have no action on the operation.

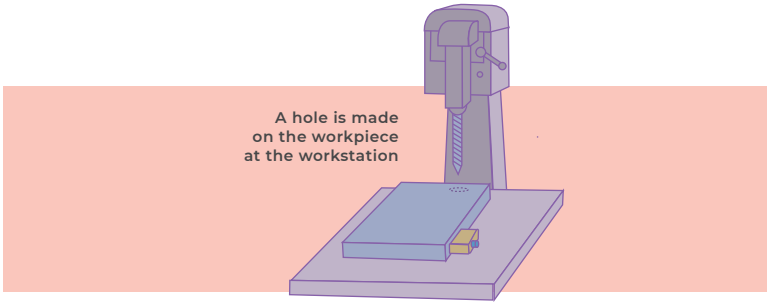
Depending on the method of error detection, they can be classified as follows:

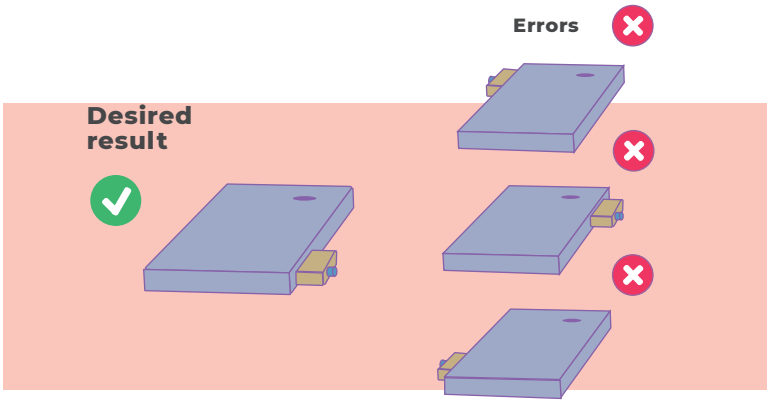
- By contact, detection related to dimensional characteristics of the products
- By fixed value, detection by number of movements or events performed
- Sequential, detecting an orderly succession of movements or events

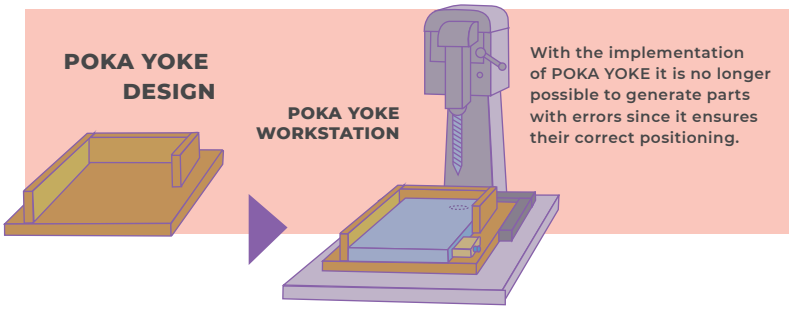
Features:

- The inspection is carried out on 100% of the products
- Immediate feedback: shutdown and alarm signal
- Avoids interfering with production and becoming a control point in the process
- They are simple and do not require specialized personnel

JIDOKA


A hole is made
on the workpiece
at the workstation


Errors
Desired
result


POKA YOKE
DESIGN
POKA YOKE
WORKSTATION
With the implementation
of POKA YOKE it is no longer
possible to generate parts
with errors since it ensures
their correct positioning.

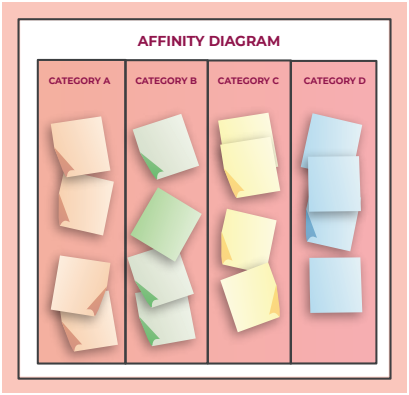
Affinity Diagram

The *affinity diagram* (also known as the KJ method in reference to its author Kawakita Jiro) is one of the *7 new quality tools* used to collect and organize different points of view in order to explore a complex subject on which no information is available. Synthesizes a set of ideas, opinions and expressions by grouping them according to their relationship to each other.

The tool is based on teamwork that allows interaction and joint analysis, seeking to build a situation map in a participatory manner. The participants of the work team give their opinion anonymously, achieving a discussion about the topic and not about the person giving the opinion.

Recommended methodology for implementation:

1. **Definition of the focus question:** once the participants have gathered, the facilitator explains how the dynamics will be developed and what it is expected from them. Next, it sets out the topic to be analyzed in the form of a question. It is advisable that the questionnaire be present in a visible place during the dynamics.
2. **Generation of ideas:** each member of the group individually and silently captures each of his or her ideas on different cards. A total time of 5 to 10 minutes is allowed for this stage.
3. **Presentation of ideas:** at the end of the time allowed for the generation of ideas, the facilitator removes the cards written by the participants and mixes them to present them randomly to the group.
4. **Grouping of ideas:** the ideas presented are discussed in search of common characteristics that allow the creation of the smallest possible number of categories (4 - 5) under which the cards are grouped according to their affinity. It is advisable to assign a name to each category summarizing the common characteristic.
5. **Analysis and ranking:** the relationship of each category with the question is analyzed and each one is ranked according to its degree of influence on the question.
6. **Conclusions:** reflection on the diagram constructed and the findings obtained.



Benefits:

- Stimulates the participation and creativity of the team members
- It is a visual tool that facilitates communication
- Promotes commitment to the achievement of results by the people who make up the group

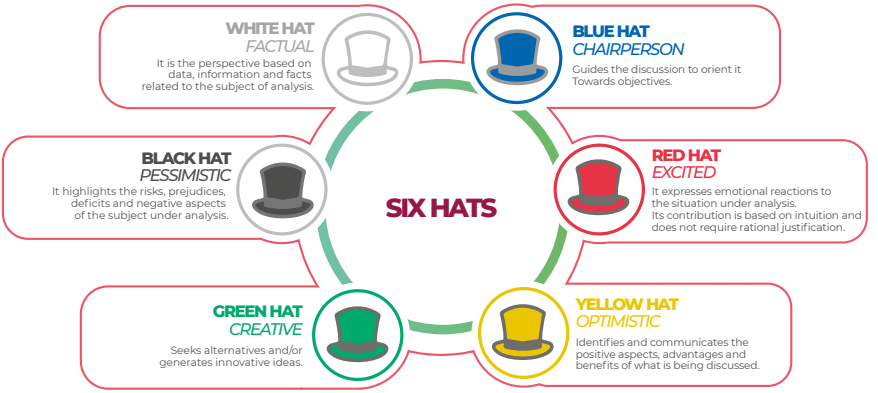
JIDOKA

Six Hats

The 6 Hats also known as *six thinking hats or Bono's six hats,* after its author, is a tool to guide the approach to discussions and analysis for decision making. The objective is to build a description of the situation under study by analyzing it from six perspectives, trying to leave aside prejudices that inhibit the generation of ideas.

The different perspectives are represented by six different colored hats. Each symbolizes a particular way of observing reality. When analyzing a situation, either individually or as a group, the tool proposes to put on each hat and think according to the focus established for each color.

For example, when using the yellow hat, the point of view is to identify and communicate the positive aspects, advantages and benefits of what is being discussed. In contrast, when the black hat is used, the focus is on highlighting the risks, harms and negative aspects of the subject under analysis.



Applying this tool is useful for:

- Stimulating divergent thinking
- Enabling a change of perspective
- Building more robust analyses for decision making

AMFE

Failure Mode and Effects Analysis (FMEA) is a quality tool focused on failure prevention and process improvement. It consists of evaluating possible scenarios assuming potential failures and the effects they may generate. Based on the evaluation, the tool allows to initiate and conduct efficient improvement processes in the organization based on a weighting.

FMEA can be applied to different objects of study (processes, products, services, among others) and in different instances (process or product design, review, among others). However, all these uses share the same structure and sequence of steps, having as a characteristic element: the calculation of the "Risk Priority Number" (RPN) indicator.

The sequence of steps to be followed:

1. Define the different elements to be studied
2. List potential failure modes
3. Analyze the potential effects of failure
4. Establish the severity (S) index associated with each effect
5. Analyze the potential causes of failure
6. Establish the occurrence (O) rate associated with each cause
7. Analyze the current control method for potential failures
8. Establish the associated detection (D) rate
9. Calculate the NPPR indicator and prioritize the failure mode to be worked on
10. Propose improvement actions, implement them and evaluate their results

Risk Priority Number Indicator

RPN = S x O x D

S (Severity)
Measures the damage normally expected to be caused by the failure

O (Occurrence)
Measures the repeatability of a given failure

D (Detection)
Measures our ability to identify the failure

FAILURE MODE AND EFFECTS ANALYSIS (FMEA)

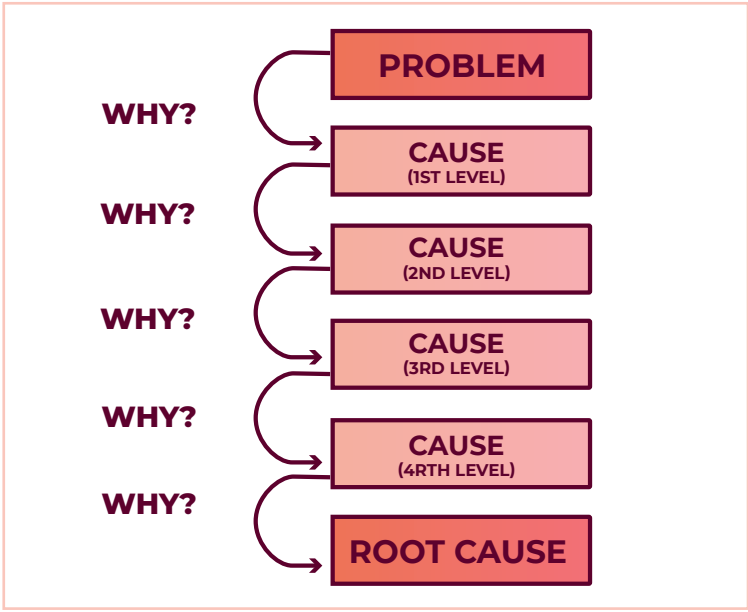
PROJECT FMEA ☐ PROCESS FMEA ☐				COMPONENT NAME PART OF THE PROCESS		COMPONENT IDENTIFICATION CODE		PAGE:			
NAME AND DEPARTMENT OF PARTICIPANTS AND/OR SUPPLIER:				COORDINATOR (Name/Department)		MODEL/SYSTEM/ MANUFACTURE		START DATE: REVISION DATE:			
OPERATION OR FUNCTION	FAILURE No.:	POTENTIAL FAILURES			CURRENT STATUS				CORRECTIVE ACTION	RESPONSIBLE / TERM	IMPROVEMENT SITUATION
		MODES FAILURES	EFFECTS	CAUSE OF FAILURE MODE	PLANNED TESTING AND CONTROL MEASURES	F	S	D	N°:		IMPLEMENTED ACTIONS	F	S	D	N°:

5 WHYS

The *5 Whys* is a tool for the search of the causes that give rise to a given problem. It is usually used in improvement cycles during the Root Cause Analysis stage.

People tend to identify the symptom of a problem and confuse it with its true cause. The tool induces the in-depth questioning of the real motive and the construction of the chain of effects leading to the problematic situation.

It consists of asking why a certain event occurred or happened? Once the most likely answer is identified, the same question is asked again but now the focus is on the answer obtained and not on the original problem. The name of the tool suggests that if the action of asking why is repeated 6 times, the 5th answer obtained is the root cause (although in practice it may involve more or fewer instances).



5W + 2H

It is a tool that seeks to describe and characterize all the aspects that make up a situation (problem or opportunity for improvement) to obtain a comprehensive view. This is achieved by answering the 7 questions that give the tool its name:

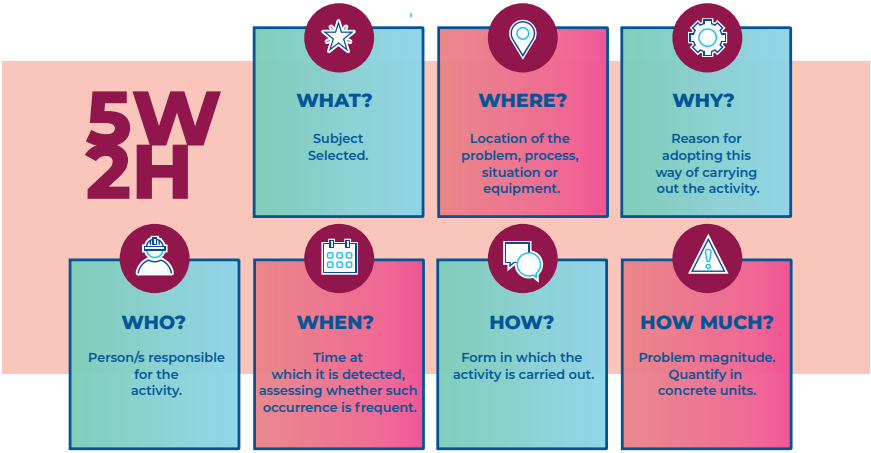
- ***What:*** are the events and actions that make up the subject matter
- ***Who:*** are the protagonists and stakeholders
- ***When:*** places the action in a defined time, indicating its beginning, duration and end
- ***Where:*** is the physical space where the events occurred
- ***Why:*** are the reasons for the occurrence of the event
- ***How:*** are the specific circumstances under which the events took place
- ***How much / How many:*** is the quantification of the problem in concrete units

When faced with the need to analyze a situation, this tool allows for a better understanding so that when proposing a change, errors are minimized and the design and implementation of actions is effective.

The tool allows for certain variations

· **5W+1H:** only the "How?" is used. and "How much/How many?" are excluded.

· **6W+2H:** a "W" is added which refers to "With?" = "With what?", in relation to what resources are needed.



JIDOKA

Brainstorming

It is a group work tool that allows the generation of a large number of ideas on a previously proposed topic. It is used in early stages of analysis when there is a need to encourage team creativity by involving all team members in the identification of opportunities for improvement, possible causes, ideas or proposals for action.

Recommended methodology for the development:

1. **Appoint a person to moderate the activity.**
2. **Presentation of the topic to be analyzed:** once the participants have gathered, the moderator explains how the dynamics will be developed and what is expected of them. Next, it sets out the topic to be analyzed in the form of a question. It is advisable that the questionnaire be present in a visible place during the dynamics.
3. **Idea generation:** depending on the type of brainstorming that is carried out, the group members put their ideas on paper or share them orally. The fundamental rule for this stage is not to discard, dismiss or criticize your own or other people's ideas. It is recommended to define a duration of 30 minutes.
4. **Summary of ideas:** at the end of the time allowed for the generation of ideas, the moderator reviews all the ideas generated and consolidates them in a list.

Benefits:

- ✓ Stimulates the participation and creativity of the team members.
- ✓ Allows to contemplate the different approaches of the participants on a given topic.
- ✓ Promotes participants' commitment to results

PDCA

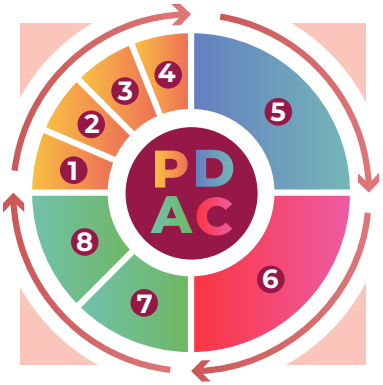
The *PDCA* improvement cycle is a methodology for problem solving that is developed through 4 consecutive stages: Plan, Do, Check, Act.

This methodology allows an objective and in-depth analysis of the situation to be improved. It enables people to have a practical guide, preventing them from acting intuitively by repeating the mechanism commonly known as "trial and error", which in most cases does not achieve effective results in chronic situations (frequent problems associated with methodical weaknesses).

The 4 stages, in turn, contain 8 fundamental steps:

1. Select the topic and form the team
2. Define the initial situation and set an objective
3. Identify and study the potential causes of the problem under analysis.
4. Develop an action plan
5. Implement the plan
6. Evaluate the results
7. Standardize changes or deviation analysis
8. Conclusions

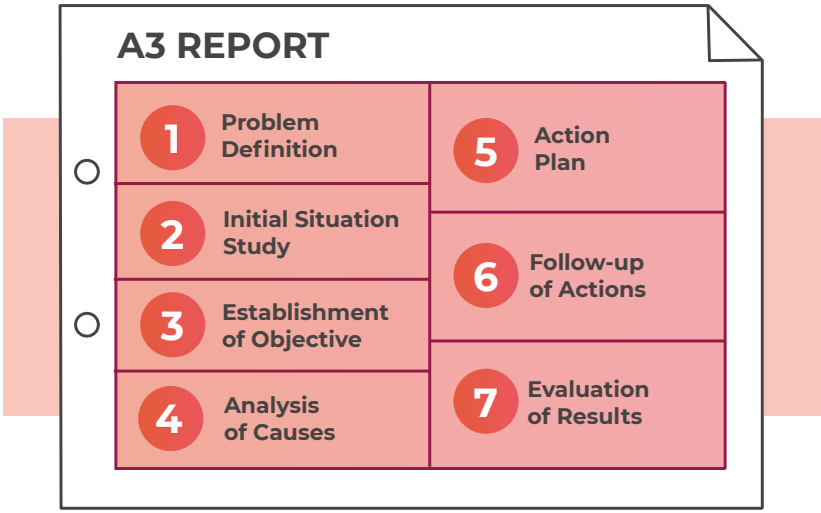
PDCA stands out for taking advantage of quality tools to achieve objectivity in each of the steps. Another relevant point of the methodology is that it aims to achieve the standardization of solutions with results that establish the basis for a new cycle of improvement.



A3

It is a tool to monitor, report and communicate in a standardized way the PDCA improvement process. It is named after the fact that it is prepared on an *A3*-size sheet, which summarizes the actions carried out in the stages of this process.

The following diagram shows the structure of an *A3* report and its component sections:



Benefits:

- Provides a methodological approach to problem solving
- Provides a standardized communication format that favors the construction of a common language within the organization
- Facilitates the understanding, follow-up and evaluation of the improvement processes by any member of the organization
- Establishes the basis for future cycles by documenting improvement processes

8D

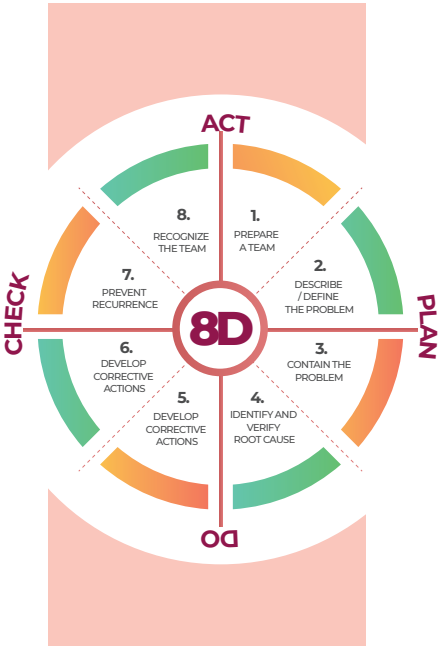
It is a problem-solving method characterized by including immediate action to contain the impacts of a problematic situation until progress is made in its definitive resolution. When faced with a problem, contingency action comes first, followed by investigation of the cause and design of solutions.

Although it can be used to deal with any inconvenience, it is especially useful when a serious situation arises for the organization, either because it affects its operations or its relationship with customers.

It is named after the **8 D**isciplines that the team must put into practice for problem solving.

Becoming aware of the problem is the first step in applying the methodology and the following steps make up the 8 Disciplines:

1. Form a Team
2. Describe the Problem
3. Implement contingent actions to avoid or mitigate the effects of the problem
4. Establish the root causes of the problem
5. Select permanent corrective actions
6. Implement corrective actions.
7. Stabilize the results to avoid recurrence of the problem
8. Recognize the team



DMAIC

It is a problem-solving methodology proposed by the 6 sigma approach, which focuses on the application of statistics to the production process to "strengthen" its quality.

The distinctive feature of this methodology is to achieve an understanding of the behavior and capability of the process using statistical methods. This allows to achieve a controlled process aligned with customer requirements.

DMAIC is an acronym that refers to the name of each of the 5 stages that make up this methodology:

D. (Define): Define the improvement project, the scope according to the client's requirements (embodied in critical characteristics: CTQ/CTD/CTP)* and its objectives. In addition, deadlines and the work team are defined.

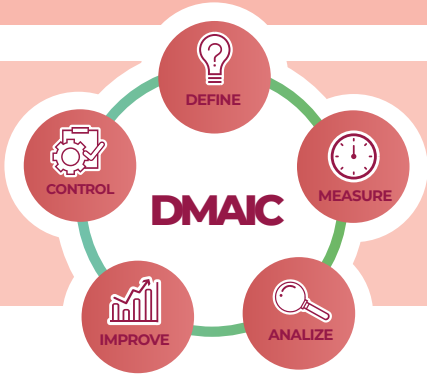
M. (Measure): Collect information on the process to be improved and analyze it to build the initial situation based on the definition of statistical parameters (measurement system). These parameters will also be used in the Control stage.

A. (Analize): Identify and study root causes using statistical methods.

I. (Improve): Identify, implement and evaluate improvements through design of experiments.

C. (Control): Control the subsequent evolution of the process to stabilize it and standardize changes.

* CTQ Critial to Quality
/ CTD Critical to Delivery
/ CTP Critical to Process



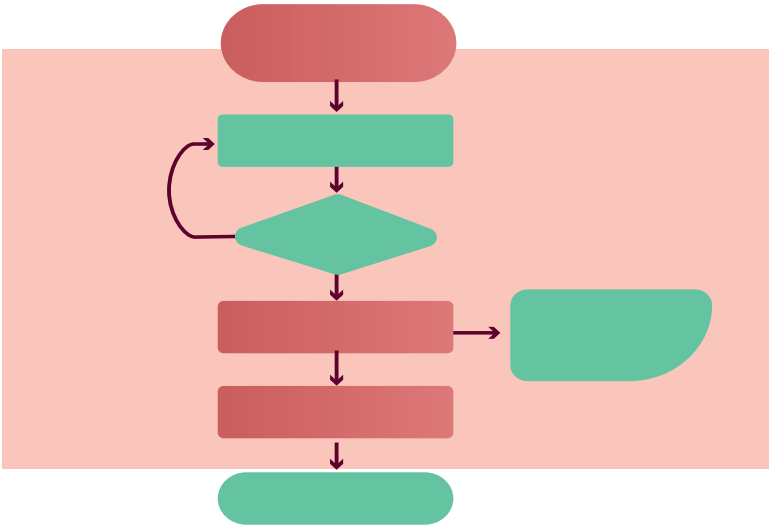
Flowchart / Flow Diagram

The *Flow Chart* or *Flow Diagram* is one of the 7 traditional quality tools. It is a graphic representation that allows to schematize the different stages of a process, showing their relationships and the existing information/material flows.

There are different symbology standards used for the construction of *flowcharts*. The standardization of these standards aims to define a common language of elaboration and thus unify their understanding. The choice of which one to use depends on the nature of the process under study and the focus of the analysis. Some of them are: ISO, ASME, DIN, ANSI, among others.

The Flowchart is used for the following:

- Analyze the status of a process and propose alternatives for its improvement
- Standardize and document its stages
- Facilitate communication and transfer of the information it represents



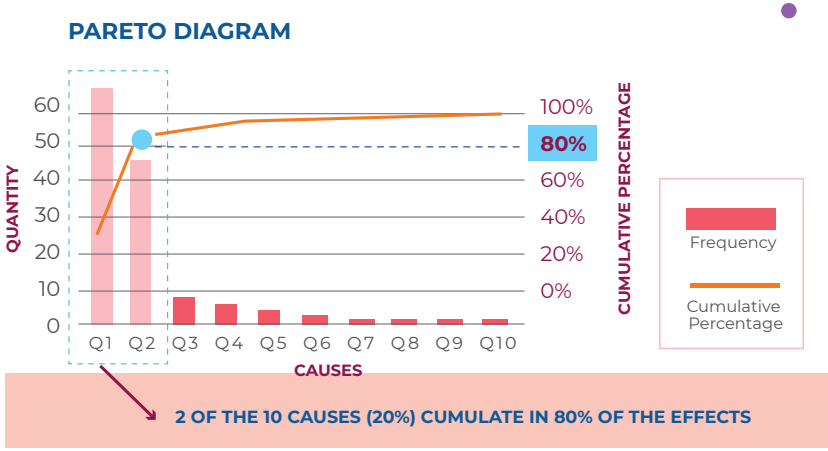
Pareto Diagram

The Pareto Diagram is one of the 7 traditional quality tools. It helps to establish priorities for action based on the study and identification of the factors that have the greatest impact on the object of analysis. It is based on the Pareto principle, better known as the 80-20 rule, which in practice states that 20% of the causes generate 80% of the consequences or effects. These figures are not exact, but rather provide a ratio reference.

The diagram consists of a bar chart that groups from left to right in descending order the causes or factors detected around a phenomenon according to the data collected and their measurement (frequency, quantity, among others). Once the data is sorted, the percentage of each factor is calculated based on the total and then the cumulative percentage curve is plotted.

Once the combined graph has been constructed, the next step is to identify the set of causes that accumulate 80% of the effect.

By using the tool during the execution of improvement cycles or problem-solving methodologies, it is possible to study which are the few problems that generate the greatest impact or which are the few causes that have the greatest incidence, and thus focus efforts and resources for their effective resolution.



Ishikawa Diagram

The Ishikawa Diagram is one of the 7 traditional quality tools. Also known as fishbone, cause-effect or causal diagram, it allows to graphically represent the causes that generate the analysis problem. The representation encourages reflection on the various factors involved, and enables simple and easy identification of the relationships between each other and with the problem.

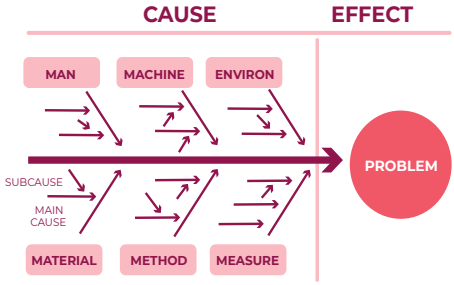
In an improvement process, this tool is especially useful for the root cause analysis phase as it promotes group reflection on the problem to be addressed, focusing on listing, linking and recording the causes that originate it. It is important to point out that the causes identified correspond to the opinions of those who participated in their elaboration; therefore, even if there is consensus, they should be validated at a later date.

Recommended steps for the elaboration of the Ishikawa Diagram:

1. Gather the group of people convened in order to reflect on the causes of the problem under analysis.
2. State the problem synthetically and precisely, and place it at the end of the main arrow.
3. Define the categories of causes and place them in the diagram. Variation factors (6M) are generally used as categories.
4. Identify first-level causes through discussion and consensus among participants. These causes are shown in the diagram according to the category to which they belong.
5. Discuss and reach consensus to identify the subcauses that generate or influence the first level causes.
6. Interpret the diagram in search of root causes by analyzing repeatability or agreeing on the relevance of the detected causes.

For the elaboration of the diagram, the following is recommended:

- Apply techniques that stimulate divergent thinking (e.g., brainstorming) and debate.
- Promote in-depth analysis, for which the 5 Whys tool can be applied to investigate the root causes.
- Always keep in mind that the objective is to identify and capture causes, not solutions.

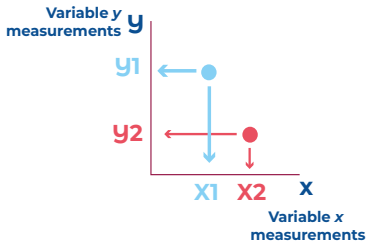


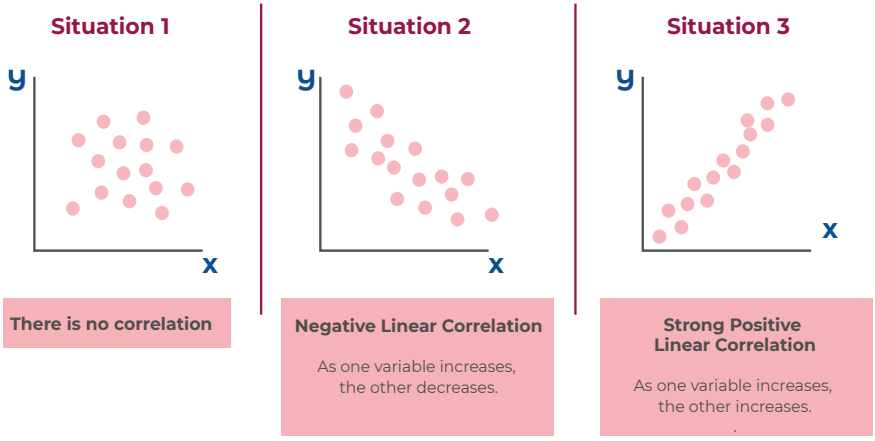
Scatter Diagram

The Scatter Diagram is one of the 7 traditional quality tools, which allows to analyze the degree of correlation between 2 factors and to evaluate to what extent a change in one will affect the other.

It is constructed from the measurement of the factors under study. Each pair of measurements constitutes a point on the graph. Once a significant number of measurements (point cloud) has been obtained, it is possible to determine the degree of correlation.

The usefulness of the tool is to provide information to verify if there is a correlation between the variables and thus be able to predict the behavior of one from the values of the other.





Note: the fact that the graph shows a correlation between two variables does not ensure that a causal relationship exists in reality.

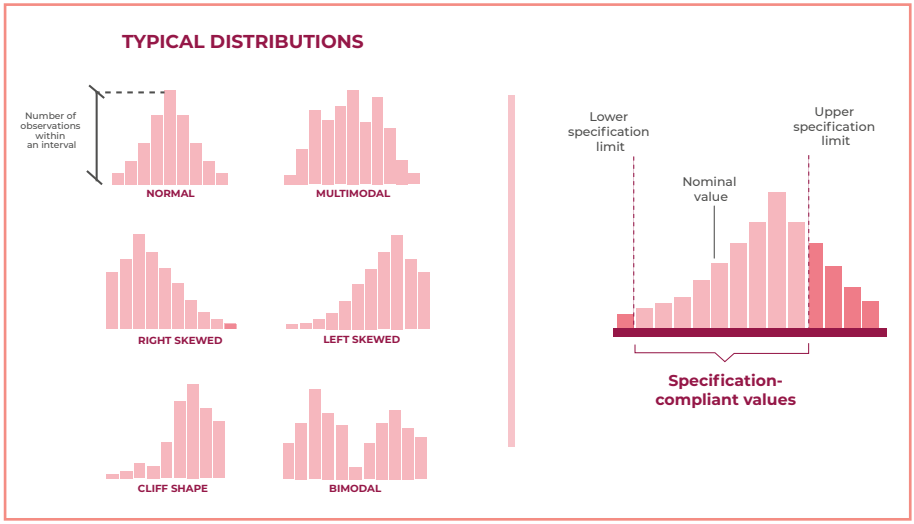
Histogram

The *Histogram* is one of the 7 traditional quality tools. It is a bar chart useful to understand an event occurred in a process. It is based on the analysis of the data collected and the description of their behavior and distribution.

The height of the bars represents the frequency of occurrence, equivalent to the amount of data within each range. This means that the greater the height of the bar, the greater the amount of data included in that range, or vice versa.

Although each histogram is unique, there are certain typical distributions to which certain interpretations correspond. Therefore, once the histogram has been made, it is possible to compare it with these distributions and, depending on the interpretations, to have a preliminary analysis of the situation.

In turn, this analysis can be complemented with the requirements defined on the process to perform a capability study. These requirements are displayed in the histogram as limits (lower or upper) that establish the boundary between the values that meet the specification and those that do not.



JIDOKA

Control Chart

The Control Chart is one of the 7 traditional quality tools used to monitor the behavior of a process. Its application involves the identification of a critical process variable whose evolution is monitored over time. This way, it is verified whether its values remain within the established limits or if there are deviations.

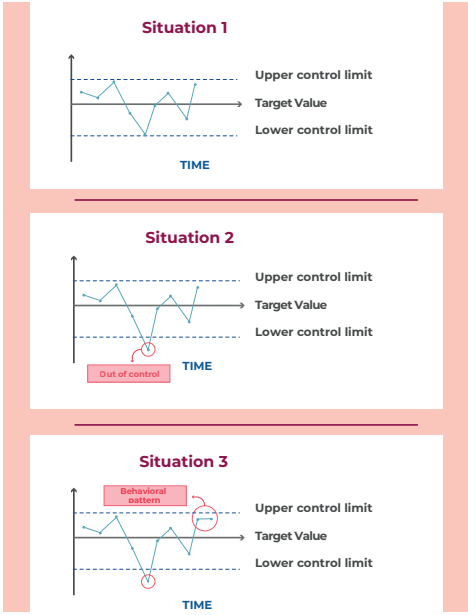
Control charts make it possible to distinguish between variations generated by so-called *natural/common/random* causes and variations due to causes that can be identified and eliminated, called *assignable/special* causes.

When the measurements taken are within the established limits and do not show any pattern*, the process is considered to be under control and only natural variations exist. Otherwise, the process is out of control.

This tool can be applied to the tracking of continuous variables (e.g. weight, length, concentration, hardness, time) or attributes (e.g. compliant or non-compliant product, pass/fail).

The benefit of its use is to have a visual and easy-to-interpret tool that helps decision-making in real time.

***There are certain defined patterns of behavior that statistically indicate the presence of non-random variation.**



Verification Sheet

The *Check Sheet* is one of the 7 traditional quality tools. It is a document designed to record data in a simple way, at the time and place where an event occurs.

In many cases it allows the interpretation of the results without the need for additional processing since its design favors the analysis and speeds up the associated decision making. However, it can also be used to collect data that will serve as input for other tools in subsequent analyses.

In quality control it is usually used to determine:

- The frequency of occurrence of a defect
- Occurrence of defect by relevant factor (e.g. day of the week, operator, machine)
- Where defects occur (e.g. sectors of a product, sectors in an operation or a machine)
- The dispersion of a variable (e.g., weight, thickness, hardness)

INSPECTION FORM	
PRODUCT:	SECTOR:
LOT:	WORKER:
WORK ORDER:	DATE:
QUANTITY:	SHIFT:

TYPE OF DEFECT	CONTROL	SUBTOTAL
CRACK:	///	3
SURFACE SCRATCH:	~~////~~ ////	9
BREAKAGE:	~~////~~ ~~////~~ ////	14
DEFORMATION	////	4
OTHER:	//	2
	TOTAL DEFECTIVE	32
TOTAL REJECTED:	~~////~~ ~~////~~ ~~////~~ ~~////~~ //	22
REMARKS:		

The format of the worksheet varies depending on the use of the data collected and the conditions of each workplace.

Its main benefit is to have data as input for decision making and to avoid relying on subjective opinions for this purpose.

Chaku-Chaku Cells

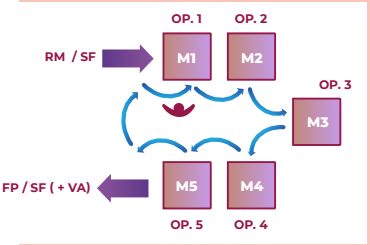
The *"Chaku-Chaku"* work cells are a particular case of manufacturing cells. Its name, of Japanese origin, translates into English as *"load-load"* and refers to the way in which people interact with the operations that make up the cell.

It is a way of operating manufacturing cells that results from implementing the concept of "man-machine separation" associated with JIDOKA, which proposes different levels of process automation. In this sense, the cells are made up of semi-automatic operations in which the processing and unloading of the machine are automatic, and the person only has to load the machines with the corresponding parts and activate them.

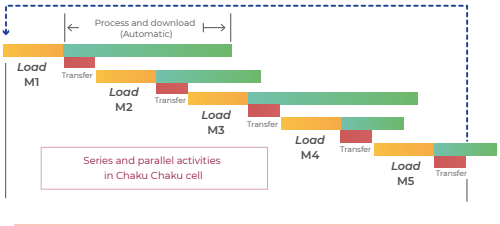
If we consider consecutive operations within a chakuchaku cell, the person loads the first machine (M1), activates that machine, takes the part previously processed by that machine (located in the unloading zone of M1), transports it to the next operation (M2), loads the machine with that part and activates it. It then removes the part previously processed by M2 and continues sequentially with the following operations.

Among the various types of manufacturing cells, the *chaku-chaku* is especially useful for generating One Piece Flow and increasing the productivity of the cells due to parallel work.

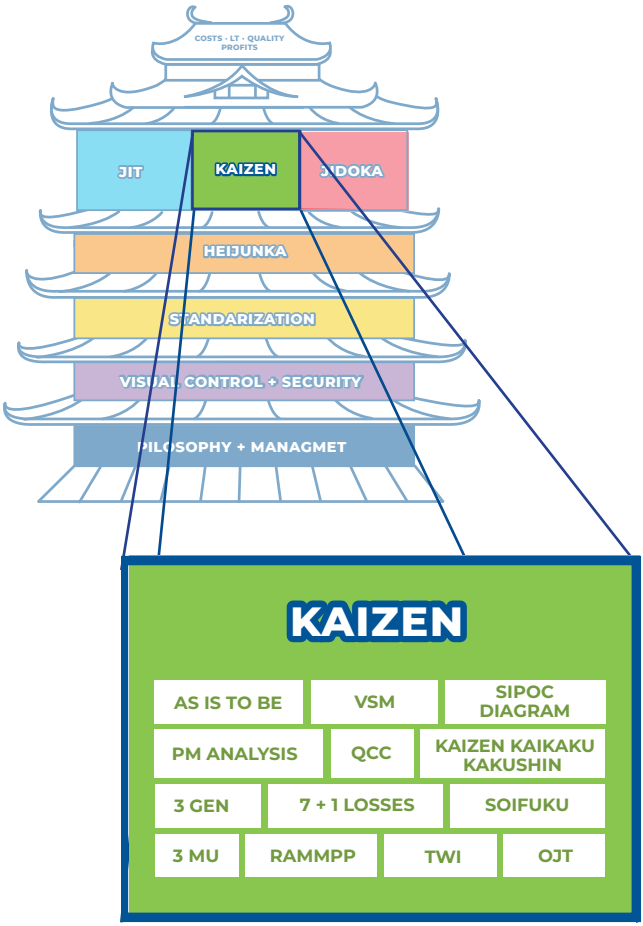
JIDOKA



OP. = Operations
M = Machine
RM / SF = Raw Material / Semi-Finished
FP / SF (+ RM) = Finished Product / Semi-Finished (+ Value Added)



Activity of the person (upload)
Activity of the person (moving and transporting)
Activity of the machine (processing and unloading)


COSTS - LT - QUALITY
PROFITS
JIT
KAIZEN
JIDOKA
HEIJUNKA
STANDARIZATION
VISUAL CONTROL + SECURITY
PHILOSOPHY + MANAGMET
KAIZEN
AS IS TO BE
VSM
SIPOC DIAGRAM
PM ANALYSIS
QCC
KAIZEN KAIKAKU KAKUSHIN
3 GEN
7 + 1 LOSSES
SOIFUKU
3 MU
RAMMPP
TWI
OJT

KAIZEN

Kaizen means continuous improvement and is the core value of any system. Its critical approach to processes allows the identification of opportunities and the implementation of actions to improve performance.

In this section you will find the C/T/M that allow you to develop capabilities and skills to find the problems or opportunities for improvement.

KAIZEN T

AS IS / TO BE Process Mapping

It is a process analysis tool used to manage improvements based on the description and comparison between the current processes *(AS IS)* and the target processes *(TO BE)* that would be reached if the designed proposal is implemented.

Stages of the method:

1. *AS IS* Process Mapping

The objective of this stage is to describe the current process. To do so, the following must be done:

- Identify key users (process owners or key users).
- These are the people who will be asked to provide the information for the mapping, since they are the ones who have the most knowledge about the process because they are involved in it on a daily basis.
- Review the AS IS process: the aim is to arrive at a description of the process that includes: the sequence of operations and tasks that comprise it, the persons responsible for each one, the resources involved, and the input and output points for both supplies and information. To collect the information, on-site observations and interviews with the key users were conducted. The purpose is to map the process as it is, therefore suggestions for improvement should not be incorporated.
- Validate: the mapping done with the key users is corroborated to verify that it is correct.

2. *TO BE* Process Mapping

The objective of this stage is to describe what the process will look like once the improvement has been implemented. It is not a description of the actions to be taken to implement the improvement; it is a snapshot of what the process will look like once redesigned. To perform this mapping it is necessary to have experience in process optimization.

3. Analysis and definition:

At this stage, the two scenarios (AS IS and TO BE) are compared and evaluated:

- Benefits of improvement: process simplification, cost reduction, higher quality, better alignment with the organization's strategic objectives, among others.
- Impacts of the improvement: changes in behavior and development of required skills, adaptation of infrastructure, modifications in the organizational chart, among others.
- Critical path: identification of the tasks, actions and investments to be carried out to implement the improvement.

Based on the evaluation of these elements, the organization makes the decision whether or not to implement the proposed improvement.

Benefits:

- ✓ Process standardization.
- ✓ More efficient decision making, based on data and not perceptions

SIPOC Diagram

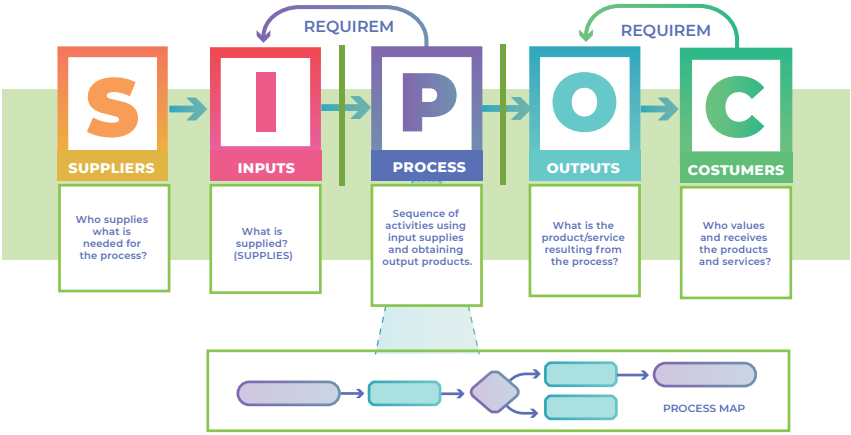
It is a process analysis tool based on the mapping of 5 key components: Suppliers, Inputs, Processes, Outputs and Customers. The *SIPOC diagram* is a representation that allows us to understand and communicate the operation of a production, administrative or mixed process. It can be used both to analyze the current configuration of a process, as well as the expected outcome of a redesign.

Recommended methodology

1. Select the process and identify the "Process owner"
2. Identify customers and their requirements
3. Identify the Process Outputs
4. Define process boundaries (beginning and end) and build the overall Process flowchart.
5. Identify the Inputs that are required by the Process
6. Identify Suppliers for each of the Inputs

Benefits:

- Enables a better understanding of customer requirements and the processes they value.
- Allows to visualize the current process through its representation and to identify opportunities for improvement.
- Allows to establish the input needs to ensure that what is generated with the processes is what is required based on a better understanding of the customer's expectations.



KAIZEN

VSM (Value Stream Mapping)

It is a graphic representation that allows mapping the different stages of a production process, to analyze and identify those activities that add or do not add value and plan improvement actions to optimize the process. The tool analyzes the process in a comprehensive manner, looking for improvement opportunities that maximize its impact on the system. The *VSM* shows the flow of materials, the flow of information, the main indicators of each operation and the LEAD TIME of the total process segregated into its different stages.

The following steps are recommended for its application:

1. **Select the product or family of products to be analyzed.**
   Use the Product-Process Matrix to identify the set of products that share the same operations (product families).

2. **Diagram the current status**
   Identify, with standardized graphical elements, inventories between operations, material flow and information flow.

3. **Analyze to establish a projection of the future state**
   How the process works should be evaluated and questioned for modifications to improve its performance (future state).

   Some issues to consider in this step include:

   - Identify the bottleneck: where products are wasted and where resources are wasted.
   - Identify existing inventories and define the necessary levels (maximum - minimum).
   - Identify appropriate solutions to reduce or eliminate losses.

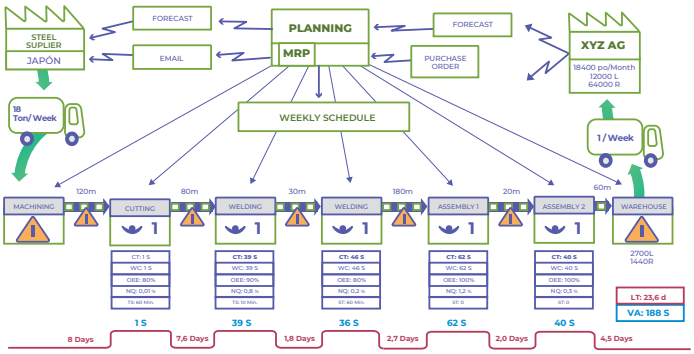
4. **Drawing the future VSM**
   Outline, with standardized graphic elements, the expected projection of the process flow map as a result of the previous step. The scheme reflects the status of the process to be achieved.

5. **Building the action plan and implementing the actions** Diagram the sequence of activities to be carried out to modify the current state and reach the future state. Define deadlines, goals and resources needed to achieve it.

KAIZEN

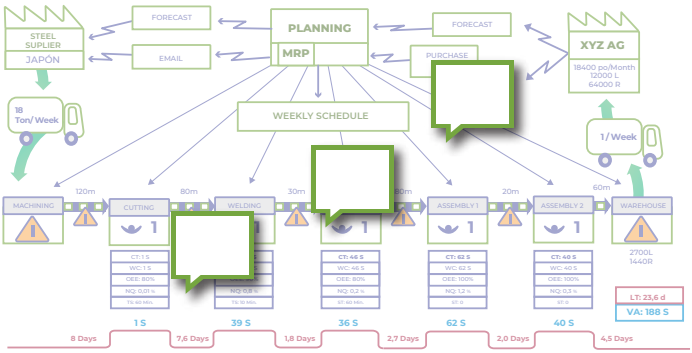
CURRENT

CURRENT VSM: Date: 02/02/2014 / Manufacture of metal parts



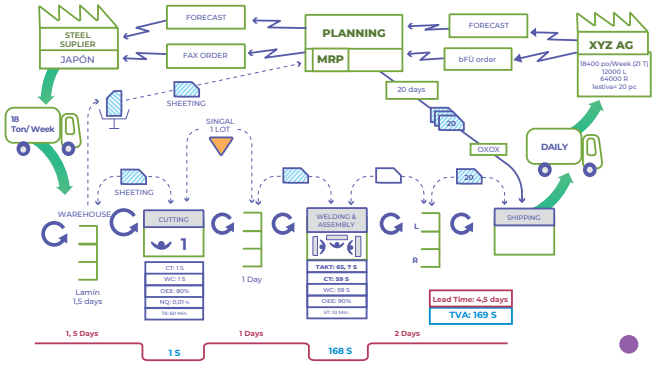
ANALYSIS

CURRENT VSM: Date: 02/02/2014 / Manufacture of metal parts



FUTURE

FUTURE VSM: Date: 06/02/2014 / Manufacture of metal parts



KAIZEN T

PM Analysis

It is a tool focused on solving chronic losses. For this purpose, the Phenomena are analyzed Physically clarifying the Mechanisms of their occurrence and the intervening production factors (4M: Machine, Man, Material and Method). Chronic losses are analyzed according to the inherent principles of operation, highlighting the conditions that must be controlled to prevent them.

The Phenomena-Mechanisms (PM) Analysis can be performed in several ways. Below is an example of the usual steps to do so:

Step 1: **Define and categorize the anomalous phenomenon.**
What is the problem?

Step 2: **Describe the Phenomenon in Physical Terms**
What physical principles may have been involved in causing the problem to occur?

Step 3: **Establish the conditions that cause the Phenomenon to recur**
What conditions must be met for the problem to occur?

Step 4: **Study the causal factors related to the analyzed Phenomenon (4M analysis).**
What factors influence the occurrence of the problem?

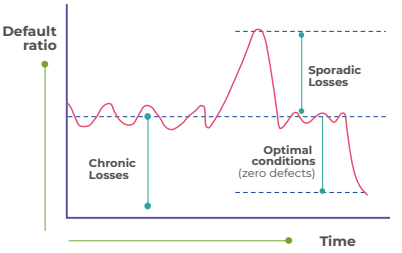
Step 5: **Study how the processes and activities work according to the desired standard and establish the optimal values for each variable.**
How should activities function normally?
What is the ideal value of each process parameter?

Step 6: **Confirm factors and causes (steps 3 and 4)**
Relay and measure the processes under study.

Step 7: **Define actions to isolate the anomalous Phenomenon**
Develop an action plan.

Chronic Losses

These are losses that occur repeatedly in a short period of time and have multiple causes that are complex to discern from each other and their effects. They are not easy to solve and involve more complex analyses.



In order to use the tool, it is necessary to have complete, reliable and accurate data. It cannot be developed based on assumptions or prejudices.

QCC (Quality Control Circle)

Also known as Quality Circles, they are a methodology for developing improvement activities, developed in Japan in the 1960s within the framework of TQM (Total Quality Management).

They consist of small working groups, mainly composed of workers, who meet to develop improvement processes in their workspaces.

QCC characteristics:

- Groups have between 3 and 10 people
- One person assumes the role of leader
- They have autonomy in the decision making of certain actions in the improvement processes
- Use quality control and continuous improvement concepts, tools and methodologies
- They are developed as part of a business strategy, either TQM or a comprehensive QCC implementation

Objectives:

- Improving the work environment and working conditions
- Increasing people's morale and motivation
- Improve the quality of the company's work, products and/or services

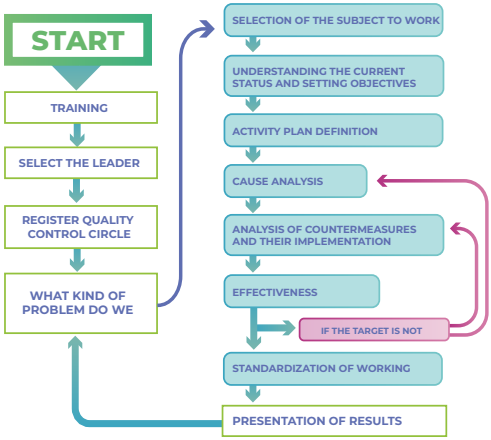
Benefits:

- Analytical skills are developed to improve the quality of the products.
- Strengthening human relations through teamwork
- It generates trust among people and commitment to the company's objectives

Requirements:

The company must have people trained in improvement process concepts, methodologies and tools.

Time must be allocated for the continuous development of the teams.



KAIZEN C

Kaizen – Kaikaku – Kakushin

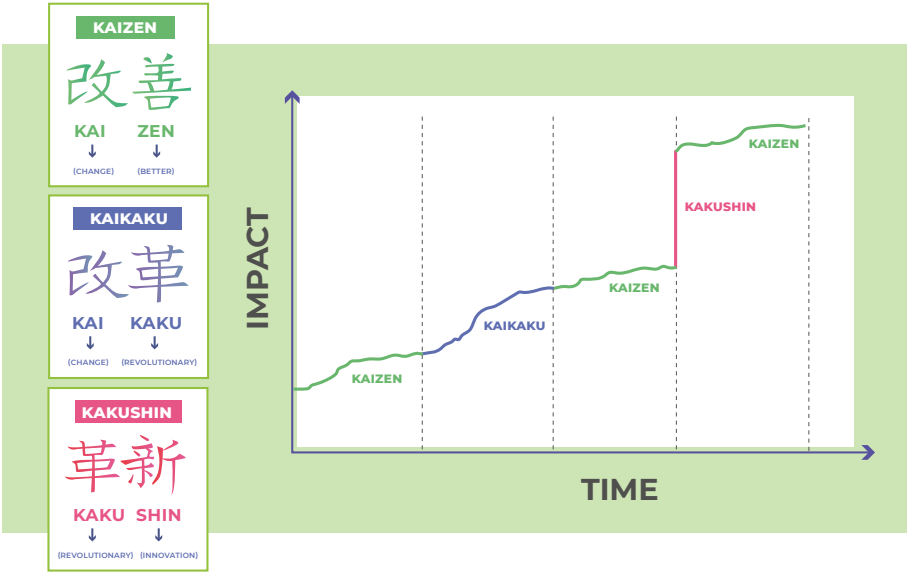
Improvement actions have different impacts depending on how they are organized and developed.

In this sense, they can be classified into 3 categories:

Kaizen translates as *continuous improvement*. It refers to the daily improvement actions carried out by people in their environment. The impact of each of the actions individually is low, but their accumulation generates great changes over time.

Kaikaku translates as *radical improvement*. It is used to describe those transformations of a process seeking its redefinition or a change of great magnitude. Its impact is high and is perceived in the short term.

Kakushin translates as *innovative improvement*. Describes those disruptive discoveries or developments that transform industrial processes. Its impact is revolutionary and immediate.



3 Gen (Genba – Genbutsu – Genjitsu)

Concept *3 Gen* refers to three fundamental aspects for a comprehensive approach to an improvement process based on empirical knowledge. The concept proposes gathering information at the place where the opportunity for improvement is detected, witnessing and observing the phenomenon or aspect under analysis and reflecting on the data.

Three words that, in Japanese, begin with Gen" are used to refer to this approach:

GENBA

現場

GEN ↓ REAL

BA ↓ PLACE

Its translation is "Real place"

It is the place of work, the place where things happen. This aspect highlights the need to know the precise place where the facts occur and their context.

GENBUTSU

現物

GEN ↓ REAL

BUTSU ↓ OBJECT

Its translation is "Real object"

It is what is being analyzed, the concrete object.

This aspect emphasizes the importance of observing/experimenting to understand the object or phenomenon under study.

GENJITSU

現実

GEN ↓ REAL

JITSU ↓ DATA

Its translation is "Real data"

These are the data that corroborate the facts that are occurring.
This aspect highlights the importance of making decisions based on objective information.

Focusing improvement processes from this perspective allows decisions to be based on information and data obtained from experience. In this way, we avoid working on wrong assumptions based only on theory or subjective perceptions that lead to ineffective results.

KAIZEN C

7+1 Wastes

The *7+1 Production Losses* is the classification used by the Toyota Production System (TPS) to name the wastes (mudas) or activities that do not add value. At the beginning, the classification contemplated seven loss categories and in the 1960s an eighth was added. Each is described below:

Overproduction
Produce more than necessary or earlier than necessary, whether intermediate or finished products. Customer demand is what determines the level of production required.

Excess Inventory
Having stocks larger than those necessary to carry out production. The types of stocks can be: raw materials, inputs, in-process or semi-finished products, finished products and spare parts.

Transportation
It refers to any transfer of materials, parts, groups of parts or finished products from one place to another. It is an activity that adds no value, but it is necessary, therefore, it must be minimized.

Movements
It refers to any movement made by workers or equipment that does not contribute to adding value to the product.

Defective Product
A product or service that does not meet the quality standard defined for approval. Defective products cause important losses in work time and materials: scrap, wastage, inspection costs due to defects, response to claims, repairs, among others.

Overprocessing
Those activities, operations and processes that are not necessary because they exceed customer requirements.

Waiting
A machine or a product must wait to continue with the production process.

Human talent (+1)
People who are part of the organization cannot display their full capacities and competencies to offer ideas that may contribute to the improvement processes.

Soikufu

It is a term of Japanese origin that can be translated as "Promotion of innovative ideas". This concept refers to gathering creative and innovative ideas and suggestions from all the people who make up the organization with the aim of implementing improvements in any of the areas that comprise it.

In order to identify opportunities for improvement and solve problems quickly and effectively, the involvement of all employees is required, as well as the existence of clear mechanisms for participation.

These mechanisms involve:

- Pre-established formats for describing and detailing ideas
- Support and follow-up by the organization
- Implementation of ideas
- Team recognition
- Communication of lessons learned

By applying *Soikufu,* each employee perceives that his or her ideas are listened to and valued, generating the consolidation of his or her commitment to continuous improvement within the organization. This is why its practice favors the elimination of the eighth loss of the Toyota Production System (TPS): non-utilization of human talent.

It is generally found as a complement to *Shojinka (personnel flexibility)* since the degree of involvement and commitment it generates allows employees to contribute ideas to improve process performance.

3MU: Muda, Mura, Muri

The *3MU* refers to three Japanese terms *Muda, Mura and Muri*. These are three interrelated concepts that make it possible to identify, describe and classify situations and activities in order to analyze them. This makes it possible to highlight and understand the opportunities for improvement and thus address them effectively.

MUDA (Waste)

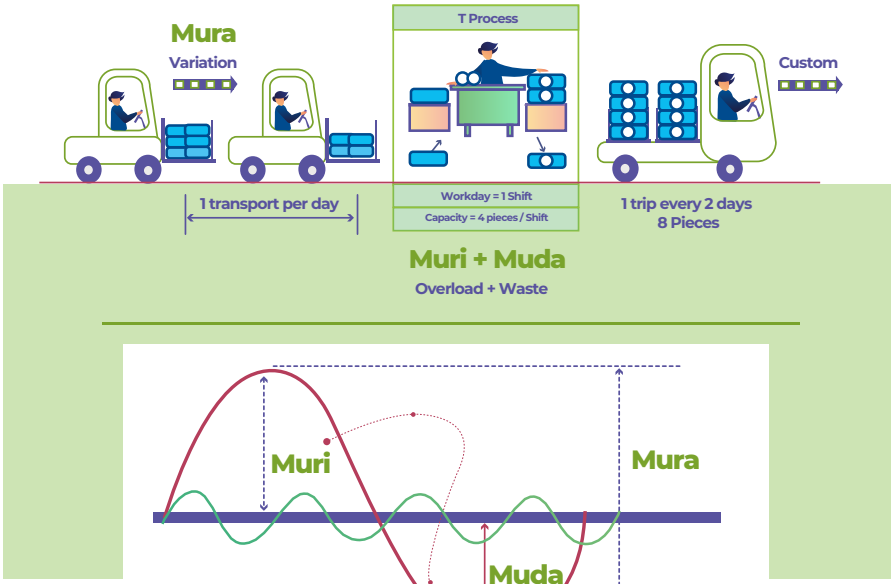
These are activities that do not add value to the product or service. There are different ways to classify them, the Toyota Production System (TPS) groups them under the name of "7+1 losses".

MURA (Inequality)

It refers to the variation that occurs in a given situation. In a process, such variation may manifest itself in fluctuations in the times and/or quantities involved.

MURI (Excess)

Refers to the overloading of people and/or machines. Overloading machines can lead to breakdowns and defects, while overloading people can lead to safety and quality problems.



RAMMPP Matrix

It is a tool to identify improvement opportunities in the administrative or management processes involved in the activities of a work team. Its acronym represents categories of analysis derived from the initials of six English words:

Reports
Approvals
Meetings
Measures
Policies
Practices

The *RAMMPP matrix* consists of a double-entry table in whose columns are placed the areas of responsibility (individual, team, department, company and external) and in its rows the categories of administrative or management processes to be analyzed *(RAMMPP)*.

By means of a team meeting, the activities of the process under analysis are listed in the matrix and placed in the appropriate box according to the category and areas of responsibility.

A mapping of the administrative and management activities of the process is generated and reviewed for improvement opportunities. For this purpose, the following questions serve as a guide for the analysis of each activity:

Can it be partially or totally eliminated? Can it be thin?

Can its frequency be reduced?

Can it be simplified?

Can it involve fewer people?

Can it be automated or facilitated with technology?

The result is a list of opportunities for improvement and proposed actions to address them.

CONTROL / PLACE WHERE IT EXISTS					
	INDIVIDUAL	TEAM	DEPARTMENT	COMPANY	EXTERNAL
REPORTS					
APPROVALS					
MEETINGS					
MEASURES					
POLICIES					
PRACTICES					

AREAS OF RESPONSIBILITY

CATEGORIES OF PROCESSES TO BE ANALYZED

KAIZEN

TWI (Training Within Industry)

It is a training program developed to enable people to perform effectively in the role of middle management.

It has a hands-on approach and originally focused on the development of three types of skills:

- Ability to instruct others
- Ability to promote good relations with and among workers
- Ability to standardize and improve working methods

Currently, two groups of skills have been incorporated into the program: those related to safety in the work environment and those linked to effective problem solving.

Benefits:

- By being practice-based, it favors the incorporation of leadership skills.
- Enhances knowledge transfer between leaders and experienced and inexperienced people.

OJT (On-the-job Training)

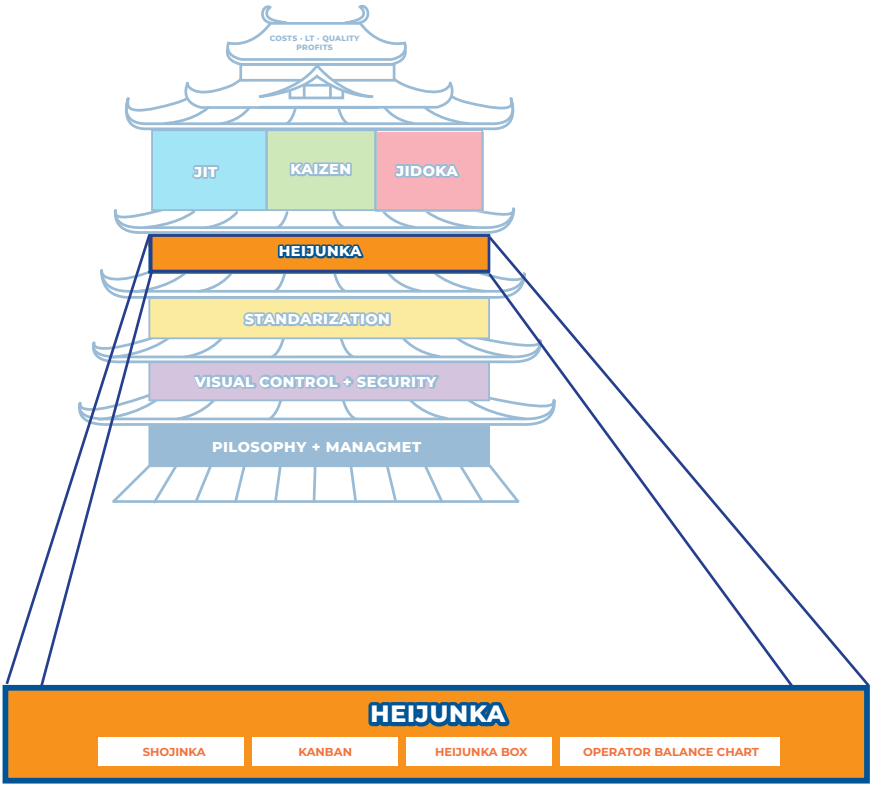
It is a training modality characterized by the fact that it takes place in the place where the person carries out or will carry out his or her daily work activities.

The *OJT* method is especially used when an experienced person must transfer his/her knowledge to a "novice". The objective is to teach the skills, knowledge and competencies required for the activity. The most effective way to transfer that which is derived from experience is through observation and practice at the site of the task. This requires tools, machines, documents, equipment and personnel in the workplace.

For the training process to be effective, the organization should not assume that it will occur spontaneously. Like any training process, it must be planned, from the definition of a person responsible for the training who has the necessary competencies to train others to the programming of the schedule of activities.

Benefits:

- Provides comprehensive training: transferring the knowledge necessary for the job, transmitting the values and culture of the organization, and contributing to the creation of team spirit.
- Facilitates the learning process: simplifies the incorporation of knowledge by connecting what is learned in training with the concrete operation of the work routine.


COSTS - LT - QUALITY
PROFITS
JIT
KAIZEN
JIDOKA
HEIJUNKA
STANDARIZATION
VISUAL CONTROL + SECURITY
PILOSOPHY + MANAGMET
HEIJUNKA
SHOJINKA
KANBAN
HEIJUNKA BOX
OPERATOR BALANCE CHART

HEIJUNKA

Heijunka is one of the foundations that support the pillars. This refers to the leveling of production by both volume and variety in order to achieve a stable and balanced production schedule.

In this section you will find the C/H/M used in the study and organization of the different components of the system to achieve a level and stable production that responds to the customer's variable requirements.

Shojinka

It is a term of Japanese origin that can be translated as "flexible staffing". *Shojinka's* main objective is to adapt the number of workers, readjusting the number and redistributing it to the different parts of a production process according to changes in the demand for different products and/or services, allowing the process to respond in a flexible and efficient manner.

In order for this to be feasible in operational terms, the following requirements must be taken into account:

- Layout of the plant (lay-out) designed to facilitate the mobility of personnel between positions and the reassignment of tasks.
- Multi-skilled personnel, who possess the ability and knowledge to perform in multiple operations.
- Continuous review and evaluation of operational standards.

The direct benefit of applying Shojinka is to obtain a flexible process. In addition, other advantages are:

- ✓ Increasing staff qualification due to multi-skill development.
- ✓ Encourage the contribution of people in the improvement processes due to their experience and broader and systemic knowledge of the production process.
- ✓ Encourage the development of individual motivation and team spirit within the organization.

The term *Shojinka* is closely related to the term *Soifuku* which can be translated as "Promotion of ideas". It could be said that Shojinka provides conditions in terms of knowledge and teamwork so that the ideas of all the people in the organization can then be exploited through their active participation in the improvement processes.

OBC (Operator Balance Chart)

The *Operator Balance Chart* (OBC) is a tool for analyzing a process made up of multiple operations and how their activities are distributed among the people who perform them. This analysis allows to know the line's production rate and compare it with the rate required to meet the demand (Takt Time).

The OBC is a column chart. Each one represents the Cycle Time of an operation (usually measured in seconds), i.e., there will be as many columns as there are operations in the process. In turn, the Takt Time, which indicates the rate required to meet demand, is plotted with a line.

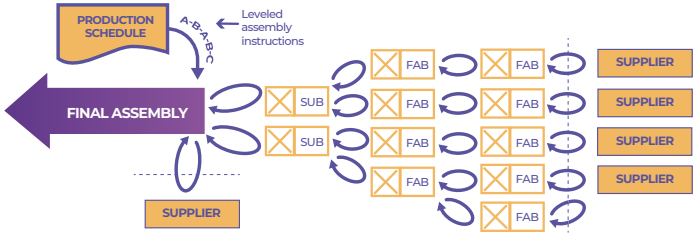
From this, the line production rate can be identified which is determined by the highest cycle time (highest column). Also, if at least one cycle time above the Takt Time is detected, it is warned that the entire process will not be able to meet the demand and that it will be necessary to balance the line. In this case, a breakdown of the activities that make up each operation is performed to identify opportunities for redistribution and/or time reduction that will allow compliance with the Takt Time (see diagrams).

Among the associated benefits is the simplicity to visualize both the times involved in the process and the needs for improvement. Its use promotes the efficient use of resources and the standardization of processes.

HEIJUNKA M

Kanban

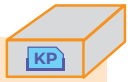
Kanban is a Japanese word that translates into English as "instruction label". It is a methodology used for the management of material flow and production according to the "Pull" principle. It uses tags or cards to generate self-regulating control circuits to ensure material supply by organizing production and logistics.



The cards act as signals, informing the upstream operation that a certain quantity of parts has been consumed, triggering their production or transport for replenishment. In other words, production is "pulled" from a customer operation to its predecessor supplier operation. One of its main benefits is to avoid overproduction and associated excess inventory.

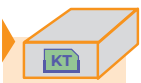
There are different ways to implement Kanban depending on the configuration of each process. The case of 2 operations (A and B) with an intermediate warehouse (supermarket) is described below. It supplies different inputs to various operations (including operation B). In this case 2 types of Kanban cards are used (Production Kanban and Transport Kanban).

KANBAN PRODUCTION	
ITEM CODE	63 11 2200
DESCRIPTION	PLA 63X11X2200
QUANTITY TO BE MANUFACTURED	50
QUANTITY OF KANBAN	1/2
MATERIAL	63X11
WAREHOUSE / SHELF	A02
RE-ORDERING POINT	20



The **Production Kanban** is an instruction that communicates the need for production of a certain part, circulates between the supermarket and the supplying operation.

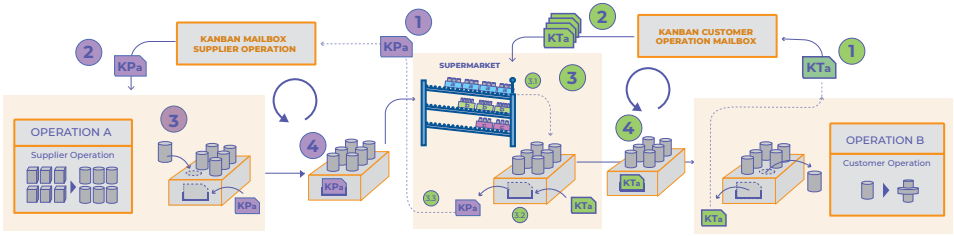
KANBAN TRANSPORTATION	
CODE	
DESCRIPTION	
QUANTITY	
PRODUCTION CONTROL	
SUPERMARKET LOCATION	
DESTINATION	
POINT OF USE	



The **Transport Kanban** is an instruction that communicates the need to supply a certain part of a customer operation. The transport card circulates between the customer operation and the supermarket.

HEIJUNKA

KP a: Kanban of production of part "a".
KT a: Kanban for transport of part "a".



REPLENISHMENT CIRCUIT

1. When the client operation withdraws a box of a certain part from the supermarket, it extracts the ***Production Kanban*** (step equivalent to step 3.3 of the transport circuit).
2. The supplier Operation operator removes the ***Production Kanban*** deposited in the mailbox and starts with the production of the indicated quantity of parts.
3. The operator produces the exact quantity indicated on the ***Production Kanban*** and, once finished, places the ***Production Kanban*** in the box with the parts.
4. Deposits the box in the supermarket, in its corresponding location, according to the coordinates indicated in the ***Production Kanban.***

TRANSPORT CIRCUIT

1. When the customer operation consumes the first piece of a box, it removes the ***Transport Kanban*** and deposits it in its ***Kanban Box.***
2. At set intervals, a transport operator collects the ***Transport Kanban*** from the ***Kanban Box*** and goes to the supermarket of the supplying operation.
3. Once at the supermarket, the transport operator:
   - 3.1 Locates and removes the boxes of parts corresponding to the transport Kanban.
   - 3.2 Replaces production Kanban with transport Kanban.
   - 3.3 Deposits the production Kanban in the supplier operation's Kanban Box. (Equivalent to step 1 of the reset circuit).
4. The boxes, with their corresponding ***transport Kanban,*** are transported to the customer operation and deposited at the points of use, starting the cycle again.

Heijunka Box

It is a communication tool between the production planning areas and the plant floor to direct the management of production processes. The box is subdivided into rows and columns, thus forming mailboxes, where Kanban cards are placed, indicating what must be produced in a period of time (e.g. a day), placed according to the temporal and sequential order derived from the production leveling (Heijunka).

Each row represents a specific type of product and each column a specific time span (e.g. 15 min., 30 min., 1 h., etc.). Kanban cards are placed inside the boxes according to the production planning (see diagram 1). With a preset frequency, the person in charge removes the cards located in the column corresponding to the schedule in which he/she is located and delivers them to the operation or workstation called pacemaker, thus communicating the need for manufacturing.

It is called pacemaker since it sets the production rate, of a set of interlinked operations, based on the information it receives from the *Heijunka Box* (what to produce, in what order and at what rate). In this way, the Kanban card system is triggered for the management of the rest of the operations (see diagram 2).

HEIJUNKA

Diagram 1

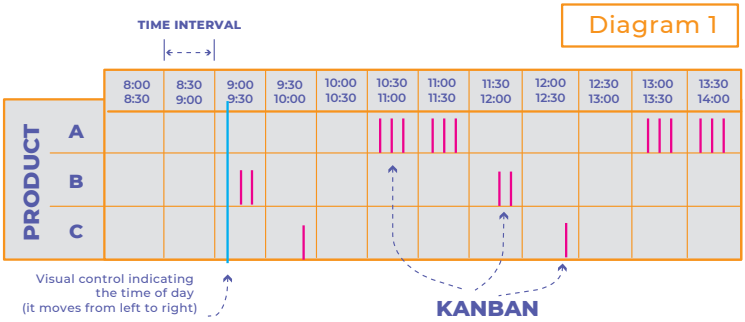
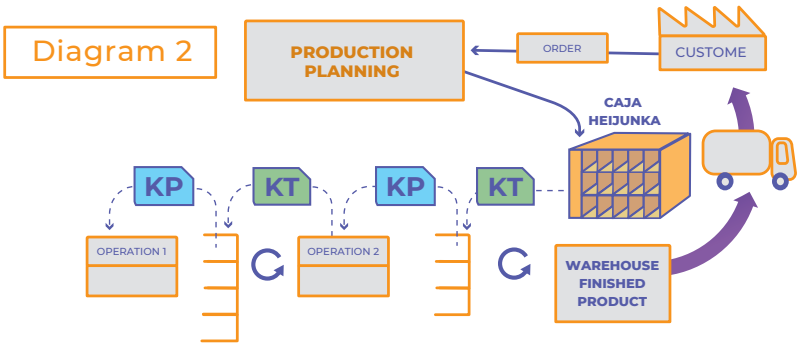
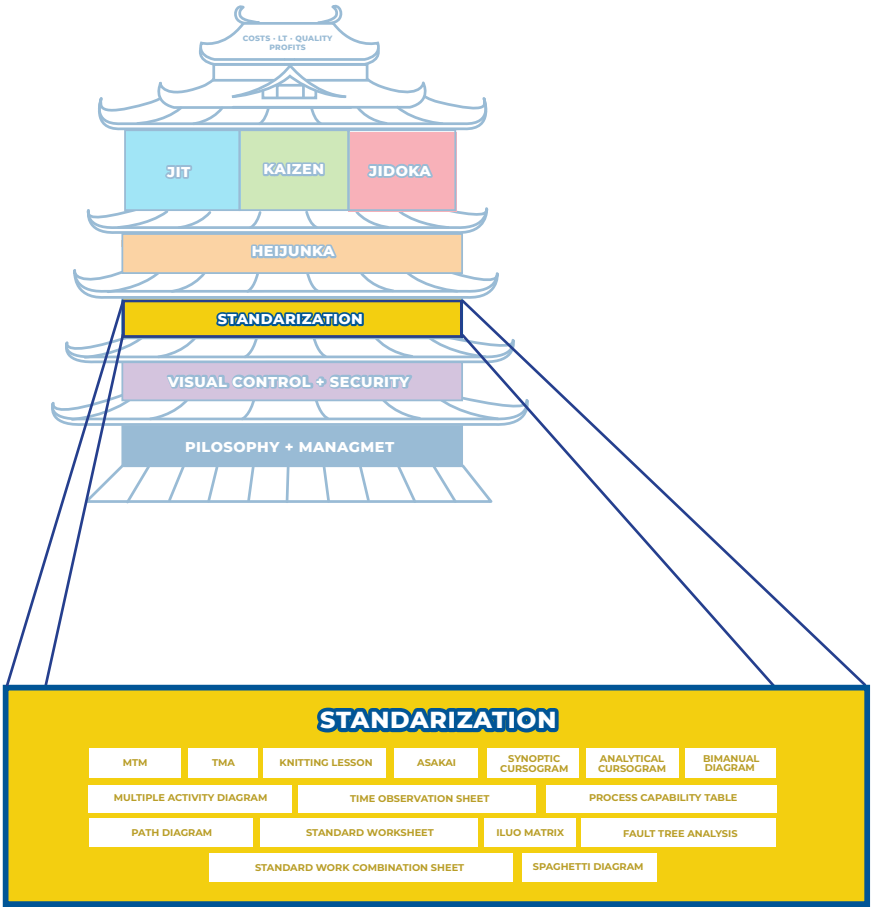


Diagram 2




COSTS - LT - QUALITY
PROFITS
JIT
KAIZEN
JIDOKA
HEIJUNKA
STANDARIZATION
VISUAL CONTROL + SECURITY
PILOSOPHY + MANAGMET
STANDARIZATION
MTM
TMA
KNITTING LESSON
ASAKAI
SYNOPTIC CURSOGRAM
ANALYTICAL CURSOGRAM
BIMANUAL DIAGRAM
MULTIPLE ACTIVITY DIAGRAM
TIME OBSERVATION SHEET
PROCESS CAPABILITY TABLE
PATH DIAGRAM
STANDARD WORKSHEET
ILUO MATRIX
FAULT TREE ANALYSIS
STANDARD WORK COMBINATION SHEET
SPAGHETTI DIAGRAM

STANDARDIZATION

Standardization is part of the basis of the system and refers to the definition of tasks, procedures or parameters that make it possible to obtain stable, predictable and reliable processes, necessary to achieve the expected results and reduce their variability. This section contains C/T/M that allow standardizing, organizing and defining elements in the production system.

STANDARDIZATION

MTM (Methods Time Measurement)

MTM is one of the *"pre-determined"* tools that are part of the work study, which are those that do not involve observation and timing. They allow to establish a time for the development of an activity (standard time of the activity).

The *MTM* decomposes the activity into **basic human movements** previously tabulated with a standard time and from their sum its total time is established.

The recommended procedure consists of 3 steps:

1. Determine the basic movements to be performed in the operation under study.
2. Add the time value given by the *MTM* data tables for each of the movements.
3. Applying a supplement for fatigue, personal needs and unavoidable delays

The advantage of the tool is that it does not invade the operation to determine the time (timing). On the contrary, it has as a disadvantage the difficulty of decomposing the activity into movements and their characteristics (distances and locations).

BASIC MOVEMENTS

- Reach **(R)**
- Rotate **(R)**
- Turn **(T)**
- Apply pressure **(AP)**
- Grab **(G)**
- Position **(P)**
- Release **(RL)**
- Disengage **(D)**
- Eye travel time **(ET)**
- Eye focus **(EF)**
- Leg, body and foot movement Simultaneous movements

STANDARDIZATION

Asakai

Its literal translation into Spanish means "morning meeting". However, it refers to the meeting at the beginning of the working day regardless of when it starts. It is performed at the gemba with the objective of sharing information, with and among team members, on the balance of the previous day's events, the status of the plant floor and the day's goals.

In order to be efficient in the use of time and effective in achieving the objectives, it is recommended that the *Asakai* meet the following characteristics:

- To be carried out in a short period of time (5 minutes).
- Develop it standing in front of the control panels in the work area.
- They must be concrete and structured on the basis of a specific agenda.
- The participation of all those present should be encouraged.

Benefits:

- Allows alignment of individual efforts towards common objectives.
- Ensures team members are aware of plant events through transparent communication.
- Clarifies the responsibilities of each member in relation to the collective work.

朝会

ASA (Morning)

KAI (Meeting)

The *Asakai* practice is usually accompanied by a meeting at the end of the day known as Yuichi, which can be translated as "afternoon meeting", where the most relevant information of the day's events is shared.

TMA (Therbligs Motion Analysis)

It is a tool used to analyze a task in the workplace by recording each of the therblig units for a process.

Therbligs are 18 types of elementary movements required for a worker to perform a manual operation or task. They are divided into two branches: effective and ineffective. Effective ones add value to any operation, while ineffective ones only add cost.

The objective of implementing *TMA* is to optimize manual work by eliminating unnecessary movements.

Basic steps for TMA:

1. Complete the table header with basic information related to the product and process.
2. Make a sketch of the area being studied and take photographs.
3. Observe the operation and all the associated movements several times to become familiar with it.
4. Write down one by one left hand, right hand and sight-related movements.
5. Add, if necessary, a brief explanation in the corresponding column.
6. Assign a therblig to each element of the work.
7. Write the improvement proposals for each of the movements.

THERBLINGS

EFFICIENT			INEFFICIENT		
1		Reach	1		Plan
2		Take	2		Search
3		Move	3		Select
4		Release	4		Inspect
5		Assemble	5		Avoidable delay
6		Disassemble	6		Unavoidable delay
7		Use	7		Place in Position
8		Prepare Position	8		Rest
9		Find	9		Support

Be sure to familiarize yourself with the 18 basic *Therblings* symbols before using the form.

STANDARDIZATION

THERBLINGS SHEET

Process/Operation Name	Comments
Number of Parts	
Cycle Time	

Research	Date	Name

IDEAS KAIZEN	LEFT HAND		THERBLING						RIGHT HAND	
	Work Item	Explanation							Work Item	Explanation

One point lesson (OPL)

It is a short document used for the transfer of simple and specific knowledge and methods for performing a task. The objective of a *OPL* is to enable easy, clear and accurate learning, ensuring that essential information is present where and when it is required, and is therefore often placed in visible locations at workstations.

OPLs can be derived from an operating standard by reinforcing a fragment of it that needs to be transmitted, or they can be the result of an implemented improvement or solved problem that is documented, constituting a first step of standardization.

Essential information for OPL:

- Name of the sector or area to which it belongs.
- Name and signature of those who have prepared, reviewed and approved it.
- Dates of preparation, review and approval.
- Description of the knowledge and/or information to be transmitted. It is advisable to use graphics, images and infographics that simplify interpretation at a glance.
- Name, signature and date of the members of the organization who have been instructed with the OPL

Benefits:

- ✓ Streamlines subject-specific training.
- ✓ Generates evidence: transition from tacit to explicit knowledge.
- ✓ Improved execution of procedures.
- ✓ Standardizes simple processes.
- ✓ Promotes a culture of continuous improvement in the organization.

STANDARDIZATION

ONE POINT LESSON (OPL)		
SECTOR, NAME OF SECTOR / AREA		
PREPARED:	SIGNATURE:	DATE:
REVIEWED:	SIGNATURE:	DATE:
APPROVED:	SIGNATURE:	DATE:

IMAGE OF THE STATE OK	STATUS DESCRIPTION OK

INSTRUCTIONS / CRITERIA / COMMENTS

ONE POINT LESSON (OPL)		
INSTRUCTED	SIGNATURE	DATE

Spaghetti Diagram

The *spaghetti chart* is a tool for analyzing the movement of people or the movement of materials within a process. From this analysis it is possible to identify opportunities for improvement, mainly related to the distances traveled and the physical distribution of the process. It stands out for being a tool of simple construction and use.

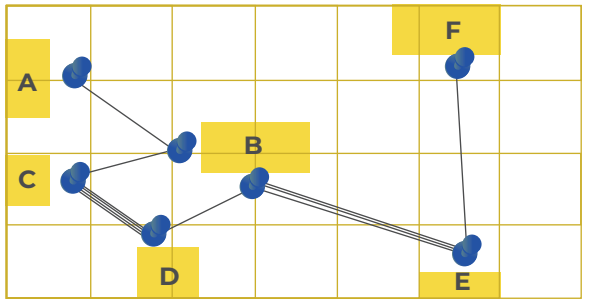
Its use can be divided into four stages:

Preparation: first of all, the object of study must be defined (a person, a product or specific material). Once selected, the scope of the analysis must be established, either in physical terms (e.g. the movement of a product in a specific sector of the process) and/or in time (e.g. the movements during a work shift).

Observation: the actual movements of the object under study must be recorded.

Construction: with the help of a string, the surveyed routes are replicated on a map of the sector. The length of the wire, once the complete path has been traced, is equivalent to the distance traveled by the object under study. For this it is necessary that the plan is to scale.

Analysis: with the diagram constructed, it is possible to analyze the distances traveled and the frequency with which a certain route is made and thus detect opportunities for improvement aimed at reducing or eliminating transfers and movements (activities that do not add value).



The image represents a thread diagram of a production space where the operations of the process (A - F) and the routes or transfers carried out are described.

STANDARDIZATION

Synoptic Diagram

It is a tool for analyzing and documenting a process based on the logical sequence of its main activities (operations and inspections).

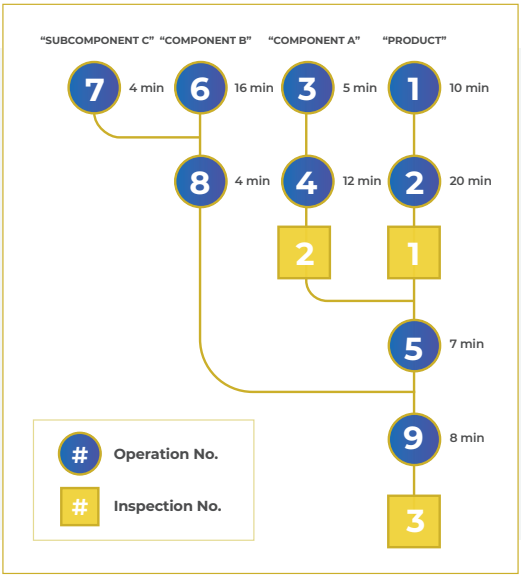
The diagram is built from a main flow of activities and branches where the production stages of the components and subcomponents of the process under study are shown.

The vertical direction of the diagram indicates, from top to bottom, the sequential order of the activities (expressed in turn by a number), while the horizontal direction, from left to right, indicates the coupling of components in the corresponding process instance.

The standard duration of each operation is usually included as additional information.

Benefits:

- It allows a quick and clear understanding of the general characteristics of the process under study.
- It is useful for recording and standardizing work processes.

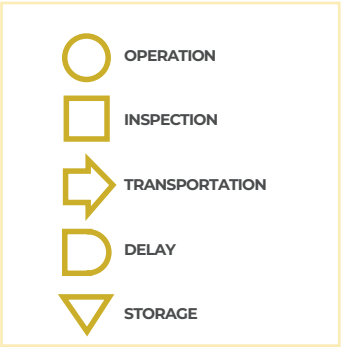


STANDARDIZATION

Analytical Diagram

It is a tool that allows to analyze a process by recording the sequence of activities that compose it. It facilitates the identification of improvement opportunities related mainly to delays and relocations and helps in the evaluation of process change alternatives.

The diagram is constructed by recording the sequence of activities in the process and distinguishing them into five categories:



It can be applied to study a product, the activity of a person or the state of a piece of equipment.

As additional information, the duration involved in each activity and the distance traveled (in the case of transfers) are usually included, along with any observations deemed necessary to correctly interpret the process.

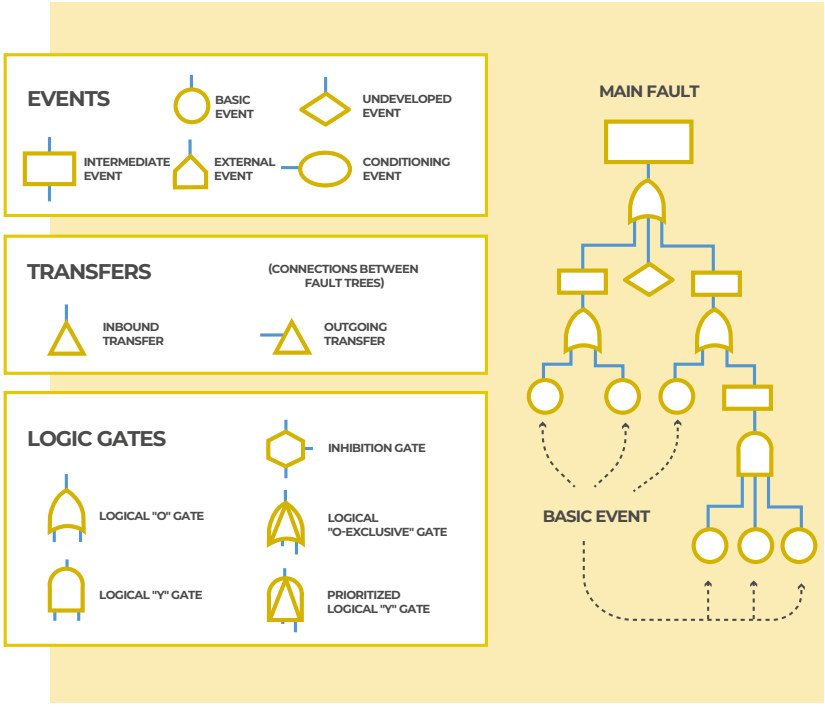
DESCRIPTION	TIME (MIN)	DISTANCE	○	□	⇨	D	▽	OBSERVATIONS
Act. 1	12							
Act. 2	7	20						
Act. 3	20							
Act. 4	4							
Act. 5	6							
Act. 6	5	15						
Act. 7	8							
Act. 8	10	12						
Act. 9								
TOTAL	72	47	3	1	3	1	1	

Fault Tree Analysis

It is a graphical tool, also known as FTA, used to explore failures based on a breakdown of their potential causes and associated sub-causes.

The analysis consists of identifying the "events" (or conditions) that in a chained manner generate the failures, and the "logic gates" that establish the relationships between events. The diagram is constructed starting from the fault to be analyzed (main fault) and continues progressively branch by branch through the events contributing to its occurrence.

To represent specific types of events and logical relationships, there is a standardized symbology, which is shown below:



The tool makes it possible to diagnose the potential root causes of certain failures and to comprehensively understand the performance of a system based on the behavior of its components. In turn, the fault tree analysis makes it possible to perform a probabilistic risk assessment.

Bimanual Diagram

It is a type of flowchart that allows recording and analyzing a process or work method based on the sequence of activities performed by a person with both hands. It is a useful tool when analyzing in detail repetitive and short duration processes, recording the activities that make up a complete work cycle.

The diagram is constructed by recording and distinguishing the activities performed by the person with both hands simultaneously. A meticulous degree of detail in its elaboration improves the analysis instance.

Activities are classified into four categories:

OPERATION
Hold, use, release, etc.

TRANSPORTATION
Hand movements to or from the material or work elements.

DELAY
Inactivity of the hand.

STORAGE
Holding some element of work.

The construction of the diagram is done through a table that is completed in descending order listing the activities performed by each hand in chronological order. Each new row implies a change of activity in one of them.

HAND DESCRIPTION LEFT									HAND DESCRIPTION RIGHT
Act. 1 Left									Act. 1 Right
Act. 2 Left									Act. 2 Right
Act. 3 Left									Act. 3 Right
Act. 3 Left									Act. 3 Right
Act. 4 Left									Act. 4 Right
Act. 5 Left									Act. 5 Right
Act. 5 Left									Act. 5 Right
Act. 6 Left									Act. 6 Right
Act. 7 Left									Act. 7 Right

STANDARDIZATION

Multiple Activity Diagram

It is a tool used to analyze the distribution and development of tasks that make up an operation over a period of time. It is constructed by means of a table in which the activities performed by the machines and/or people involved are recorded. They are represented on the same time scale in order to visualize how they are organized.

When constructing the diagram it is necessary to select the operation to be analyzed, determining the limits, and then go on to identify the elements that compose it (machines and/or people) and thus measure the times of the different activities.

The columns list the machines and/or people involved in the operation, while the rows represent time lapses (hours, minutes, seconds). At the intersection between the two, each activity is plotted according to what or who performs it and at what time. In this way, the active and inactive moments of each column, as well as the existing overlaps, can be easily visualized.

Once the diagram has been constructed, it can be analyzed to identify opportunities for improvement such as: reducing time by combining activities differently or taking advantage of idle time (for example, in maintenance tasks).

The main benefit of the multiple activity diagram is its easy interpretation due to its visual attributes.

TIME (MIN)	MACHINE 1	ASSISTANT	MACHINE 2
1			
2	ACTIVITY 1		
3			
4			
5			
6		ACTIVITY 2	
7	ACTIVITY 3		
8			
9			
10			
11			ACTIVITY 4
12			
13			
14			
15		ACTIVITY 5	

Path Diagram

It is a tool that allows to graphically represent the trajectory of materials and/or people in the physical space where a production process takes place.

There are two types of diagrams:

Material type: represents, on the physical space, the circulation of the material throughout the process.

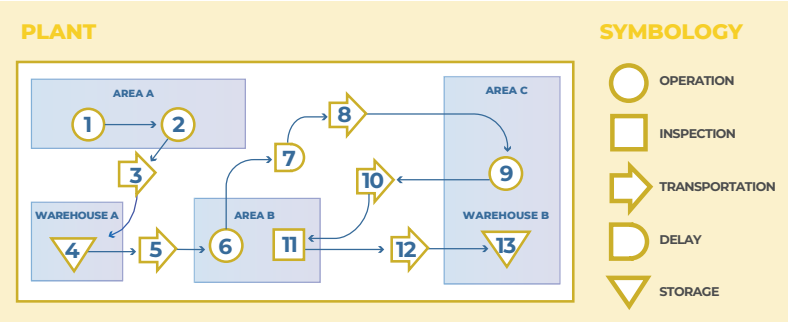
Man type: represents, on the physical space, the movements of people when performing activities.

Steps for the construction of the diagram:

1. Obtain a plan of the plant or section where the process under study takes place (ideally to scale).
2. Draw the layout including areas, workstations, machines and storage spaces.
3. Locate the activities of the process in the place or area where they occur. Each is assigned a symbol representing the type of activity involved (operation, inspection, transport, storage, delay) and is listed according to the sequence of the process.
4. Map the path of the material, person or both. To represent, by means of arrows, the trajectory of materials and/or people according to the sequence of activities in the process. The direction of the arrows indicates the direction of traffic. If the path of more than one element is plotted in the same diagram, they must be represented with different motors.

The application of the path diagram makes it possible to identify:

- Congested areas: points through which multiple materials and/or people circulate.
- The fluidity in the flow of people and materials, determining the progress and setbacks of the process and the points at which it stops or is delayed.
- Opportunities to optimize distribution and/or transportation.



STANDARDIZATION

Time Observation Sheet

It is a tool used to record the activities and times associated with an operation. Its main objective is to define the standard time for its execution, and it is used at the beginning of the standardization processes, since the resulting information is required in subsequent analyses.

Methodology of use:

1. Define the operation to be studied.
2. Divide the operation into activities (usually measured in seconds), separating manual work from machine processes.
3. Define the number of duty cycles or samples to be recorded (observations).
4. Measure and record times.
5. Calculate average or most representative observed time.
6. Add these times together to determine the total operation time.
7. Calculate the total standard operation time taking into account time for personal needs, unavoidable work delays and person fatigue.

The standardized structure of the tool facilitates and organizes the registration process and avoids the omission of information in the definition of standards.

TIME OBSERVATION SHEET

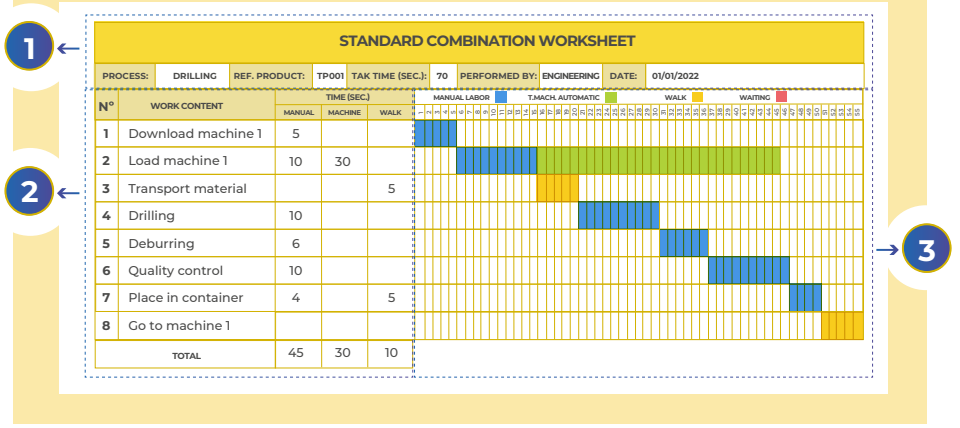
OPERATION: LATHING		PRODUCT: AA2						DATE: 22/2				RESPONSIBLE: MARCELA T.	
		OPERATION:										Operating Time	Time Automatic Machine
		1	2	3	4	5	6	7	8	9	10		
1	Download/upload/ operate machine	9	10	9	10	10	10	11	9	10	10	10	6
2	Remove burr	5	6	5	5	5	5	5	5	6	6	5	
3	Deposit on shelf	3	3	3	3	4	4	3	4	3	3	3	
4	Rotate part/ operate machine	6	7	7	7	6	6	7	7	7	7	7	4
5	Wait											4	
TOTAL OPERATION TIME												29	10
ADDITIONAL (personal needs, unavoidable work delays and personal fatigue)												5	
TOTAL OPERATION STANDARD TIME												44	

Standard Combination Worksheet

It is a tool that allows to visualize the times involved in the activities that make up a work cycle, performed by a person, a machine or a combination of both. It allows to study the set of activities, their sequence and relationships, and can be used to detect improvement opportunities to reduce the total time. At the same time, it serves as a tool for standardization and communication of the work method.

It consists of a sheet divided into 3 sections:

1. **General data:**
   Enter the reference information of the operation and the product being analyzed.
2. **List of activities and times:**
   The activities performed by the person and the associated times classified as: manual time, machine time or walking time are placed sequentially from top to bottom.
3. **Diagram:**
   In a double-entry table (activities/time), the times involved in each activity are plotted according to their logical sequence, differentiating the type of activity (manual, automatic machine, walking, waiting).



N°	WORK CONTENT	TIME (SEC.) MANUAL	MACHINE	WALK
1	Download machine 1	5		
2	Load machine 1	10	30	
3	Transport material			5
4	Drilling	10		
5	Deburring	6		
6	Quality control	10		
7	Place in container	4		5
8	Go to machine 1			
TOTAL		45	30	10

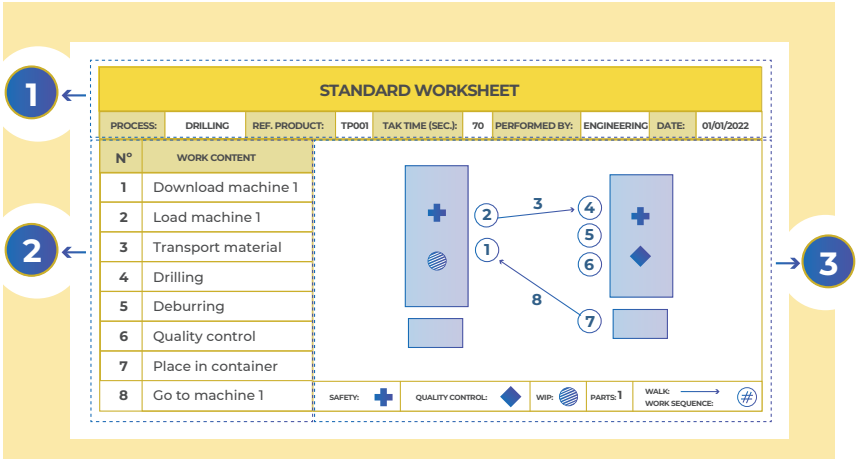
STANDARDIZATION

Standard worksheet

It is a tool that contains the essential descriptive information of a work cycle to define its standard: sequence of activities, associated times (Takt Time and Cycle Time) and standard amount of material in process (WIP). In addition to being used to define and document the standard, it is useful as a tool for communication and training regarding the work method.

There are several formats in which the amount of information included varies, with the essential content being the following:

1. **General data:**
   Enter the reference information of the operation and the product being analyzed.
2. **List of activities and times:**
   The activities performed by the person are placed sequentially from top to bottom. In some cases it may include their associated times.
3. **Diagram:**
   It is a scheme of the physical layout of the workstation in question. It marks the sequence of activities, the standard quantity of material in process and its distribution, the locations where safety precautions must be taken and those where quality controls are performed.



Process Capacity Table

It is a tool used to calculate and define the production capacity of an operation or set of operations. It allows to evaluate if the process can satisfy the quantity required by the demand and is often used for the design of manufacturing cells whether they include manual labor, machine labor or a combination of both.

The table has an upper section containing the reference information of the operation or process being analyzed. Below it is the table itself, in which each row refers to an operation of the process. To calculate the capacity of each operation, the base time of a work cycle is obtained first. In the case that the operation combines manual and machine work, the base time is made up of the automatic machine running time and the manual time that is performed while the machine is not running (in series).

$$\text{BASE TIME} = \text{MANUAL SERIAL TIME} + \text{AUTOMATIC MACHINE TIME}$$

Then, if applicable, the frequency time associated with the tooling change must be obtained. This is the apportionment of the standard tooling change time among the parts that can be produced in the time between tooling changes.

$$\text{FREQUENCY TIME} = \frac{\text{TIME OF 1 CHANGE}}{\text{NO. OF PIECES BETWEEN CHANGES}}$$

Finally, the daily capacity of each operation is obtained by calculating the ratio between the time the process has available to operate and the complete time of a work cycle. The latter will be the sum of the previously calculated base time and frequency time.

$$\text{DAILY CAPACITY} = \frac{\text{DAILY OP. DISP. TIME}}{\left(\text{BASE TIME} + \text{FREQUENCY TIME}\right)}$$

In the case of manufacturing cells, in which there is continuous flow between operations, the one with the lower capacity value will be the limiting one for the entire cell.

STANDARDIZATION

PROCESS CAPACITY TABLE

PROCESS:	CELL A	PRODUCT REF.:	TP001	TAK TIME (SEC.):	70	DAILY OP. TIME DISP. (SEC.):	25,200	PERFORMED BY:	ENGINEERING	DATE:	01/01/2022

No.	OPERATION	MACHINE	BASE TIME			TOOL CHANGE			DAILY CAPACITY (U/DAY)	OBSERVATIONS
			T. MANUAL SERIAL (SEC.)	T. AUTOM. MACHINE (SEC.)	BASE TIME (SEC.)	T. MANUAL SERIAL (SEC.)	T. AUTOM. MACHINE (SEC.)	BASE TIME (SEC.)		
1	Op. 1	M1	10	40	50	0	0	0	504	
2	Op. 2		45	0	45	0	0	0	560	
3	Op. 3	M3	8	35	43	300	10	2	560	
4	Op. 4	M4	20	35	55	150	5	2	442	
5	Op. 5	M5	25	40	65	500	10	1,2	380	Cell constraint

Time required for the production of 1 unit (25 sec. manual time and 40 sec. machine time).

Number of parts produced between tooling changes.

Tooling change time.

Pro-rated tooling change time for each unit produced (10 min. for 500 units).

ILUO Matrix

It is a tool used in the management of people to identify their level of knowledge and mastery of the knowledge and skills required by a process.

The name *ILUO* comes from the way in which the different levels of formation are graphically represented. The number of lines that make up each letter indicates the level of each person, generating the following scale:

Level I: the person is in the process of training to acquire that knowledge or skill, therefore, the person is not yet in a position to carry out the task.

Level L: the person is able to carry out the task with supervision by a trained person.

Level U: the person has sufficient knowledge to perform the task in compliance with the defined standards.

Level O: the person has sufficient knowledge to perform the task in compliance with the defined standards and the ability to train other collaborators.

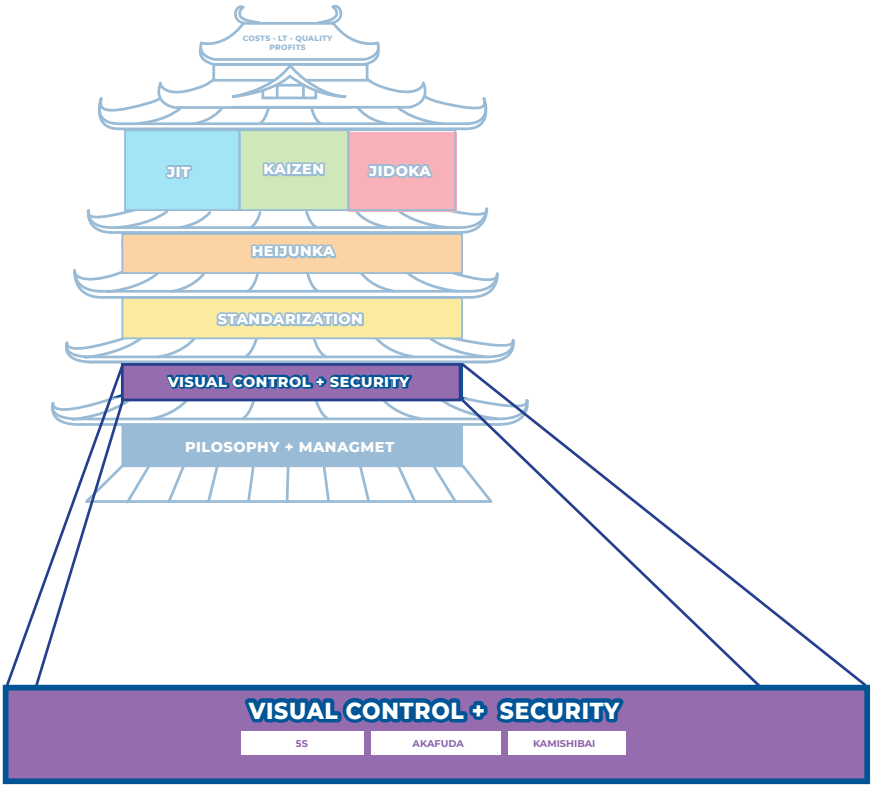
The matrix is constructed by listing the people involved in the process, whose names are placed in the rows. The knowledge and skills required by the process are then identified, listed and placed in the columns. Subsequently, the evaluation criteria for each of these knowledge and skills are defined, and once they have been evaluated, the acronym corresponding to each person's level of training is placed in each cell.

Having the matrix is useful for:

- The person in charge of the process can configure the operation dynamically, assigning tasks according to people's skills.
- Plan training priorities to ensure the highest possible degree of flexibility of the process according to the versatility achieved by the people involved.

STANDARDIZATION

	Knowledge 1	Skill 1	Knowledge 2	Knowledge 3	Knowledge 4
People 1					
People 2					
People 3					


COSTS - LT - QUALITY
PROFITS
JIT
KAIZEN
JIDOKA
HEIJUNKA
STANDARIZATION
VISUAL CONTROL + SECURITY
PILOSOPHY + MANAGMET
VISUAL CONTROL + SECURITY
5S
AKAFUDA
KAMISHIBAI

VISUAL MANAGEMENT + SAFETY

Safety and Visual Management are part of the foundation of the house. They refer to the care of working conditions, both in terms of safety and in the organization and management of spaces and equipment.

In this section you will find the C/T/M used in the identification of deviations and controls to establish and ensure compliance with working conditions.

VISUAL MANAGEMENT & SAFETY

5S

The 5S is a tool designed to improve the conditions of order, cleanliness and organization of workspaces. Its name comes from five Japanese words that describe each of the stages:

VISUAL MANAGEMENT & SAFETY

SEIRI
SORT

It involves identifying two groups of elements: those who are necessary to carry out the activities within the processes (materials tools, etc.), and those that are not, which should be removed.

SEITON
SET IN ORDER

It consists of establishing the arrangement in which the necessary elements must be located so that finding, using and replacing them is a quick, simple and functional process for the tasks being performed.

SEISO
SHINE

It includes identifying and eliminating sources of dirt, establishing cleaning routines and ensuring that all work elements and installations are in optimal conditions of conservation.

SEIKETSU
STANDARDIZE

It implies the definition and implementation of guidelines and work standards that are visible and understandable by all the people in the organization, in order to easily distinguish deviations from what has been established.
.

SHITSUKE
SELF-DISCIPLINE

It involves defining the dynamics and internal work procedures to carry out the actions of the previous stages, working permanently in accordance with the established the established standards the commitment of the people in a sustainable system.

This tool, implemented with an integral methodological framework, allows to increase the efficiency and effectiveness of the organization thanks to the standardization and continuous improvement of the processes. This implies integrating and raising awareness of all the people in the organization in the improvement processes, actively participating in the search for quality, productivity and the rational use of material resources.

5S is usually one of the first tools to be implemented in improvement processes since it does not require preconditions and, in general, its successful implementation is the prerequisite for the implementation of other Concepts, Tools and Methodologies.

VISUAL MANAGEMENT & SAFETY

Kamishibai

It is a management tool based on a system of cards that facilitates the identification of situations and their communication. Each card has two sides, one green and one red, representing the status of the defined procedures (audits, tasks, activities, among others). These cards are accompanied by a board where they are visually arranged.

It can be used in two ways:

Process auditing

Provides a guide to systematize the Genba walks of the leaders. Its purpose is to ensure proper compliance with safety, quality and operational standards.

Initially the cards are all arranged together and at the time of the audit one is chosen at random. At the end, the card is placed on a board on the green side in case of conformity and on the red side otherwise.

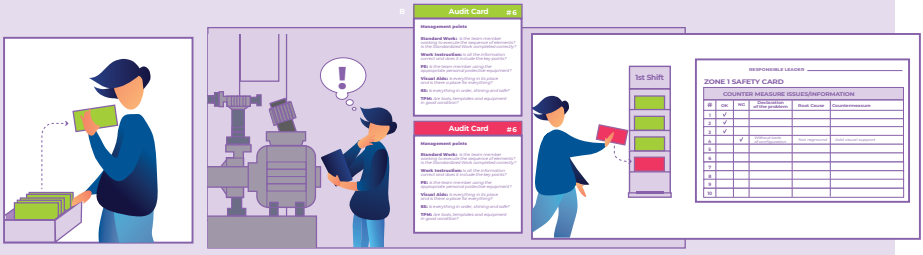
Management of planned activities in the plant

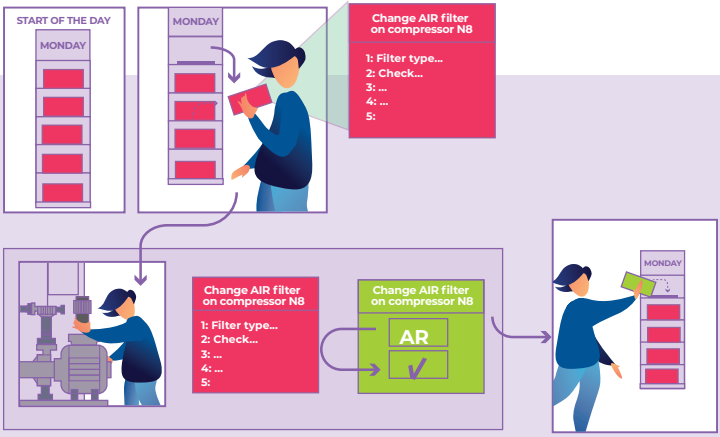
Its purpose is to monitor the fulfillment of tasks within a defined time frame.

At the beginning of the stipulated period, for example a working day, all the cards representing the tasks to be performed are placed on the red side, indicating that they are pending. As they are completed, the cards are switched to the green side.

.

VISUAL MANAGEMENT & SAFETY





VISUAL MANAGEMENT & SAFETY

Akafuda

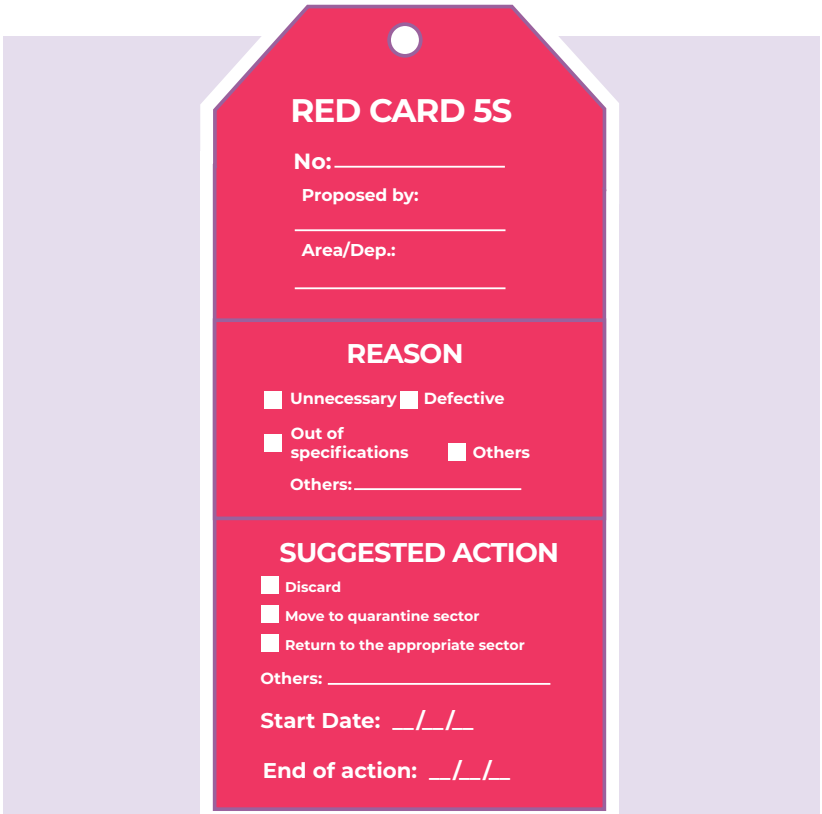
It is a term of Japanese origin that translates as *Red Card*.

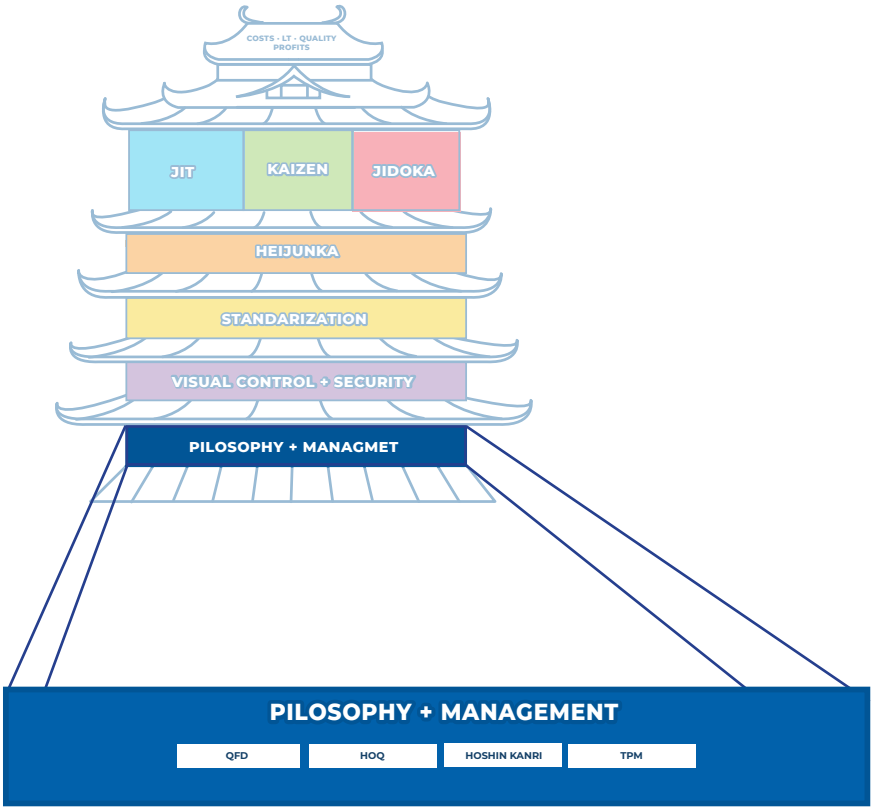
The function of an *Akafuda* is to point out and identify elements present in the workspaces that require revision. It is a useful tool in situations in which a person realizes the need to take an action but the decision to do so does not depend exclusively on him/her.

The use of red cards requires a common work dynamic that is known to all members of the organization. Generally, its use is associated with the implementation of the 5S tool.

Features:

- It can be used by anyone in the organization.
- It functions as a monitoring and communication tool.
- It points out the element and the suggested action.
- Easy to complete and interpret.
- Size and color for easy identification at a glance in the workspace.


RED CARD 5S
No:
Proposed by:
Area/Dep.:
REASON
Unnecessary
Defective
Out of specifications
Others
Others:
SUGGESTED ACTION
Discard
Move to quarantine sector
Return to the appropriate sector
Others:
Start Date: __/__/__
End of action: __/__/__


COSTS - LT - QUALITY
PROFITS
JIT
KAIZEN
JIDOKA
HEIJUNKA
STANDARIZATION
VISUAL CONTROL + SECURITY
PILOSOPHY + MANAGMET
PILOSOPHY + MANAGEMENT
QFD
HOQ
HOSHIN KANRI
TPM

PHILOSOPHY AND MANAGEMENT

In the foundations of the house are those aspects associated with the philosophy and management of the system that allow defining the strategies to achieve the vision and mission through leadership and resource management.

This section contains the C/T/M used to achieve the organization's strategic objectives.

PHILOSOPHY AND MANAGEMENT

QFD (Quality Function Deployment)

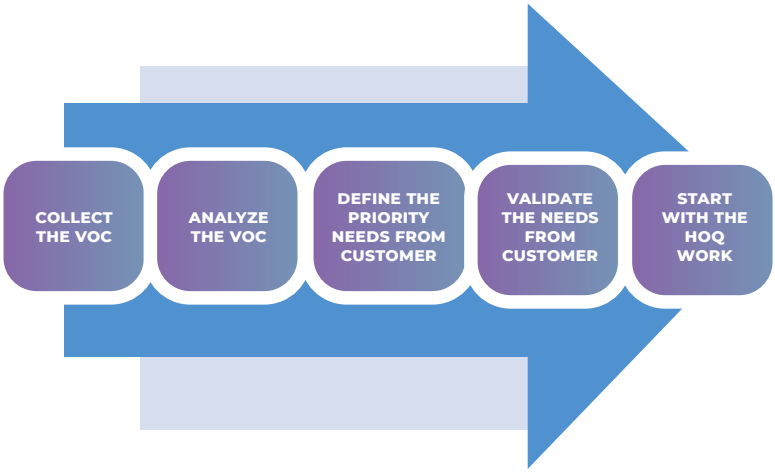
It is a method of planning, developing and managing services and products based on customer needs and expectations and their impact on them.

It allows us to evaluate which products and services (or which aspects of them) are most valued by customers and, with their results, to feed the decision-making process in order to manage them.

The objective is to provide quality solutions through the alignment between customer needs and expectations, the products and services offered, and the processes involved in their production and/or provision.

To be effective, the starting point of *Quality Function Deployment* must be the identification of customer requirements, described with clarity and specificity, prioritized and validated to build what is called the *"Voice of Customers"* or VOC. The VOC should then be used to plan the development, management and improvement of services and products to ensure that it meets the identified requirements, and, in this way, quality is achieved.

This method is operationalized through the implementation of tools, primarily the *House of Quality* (HOQ).



PHILOSOPHY AND MANAGEMENT

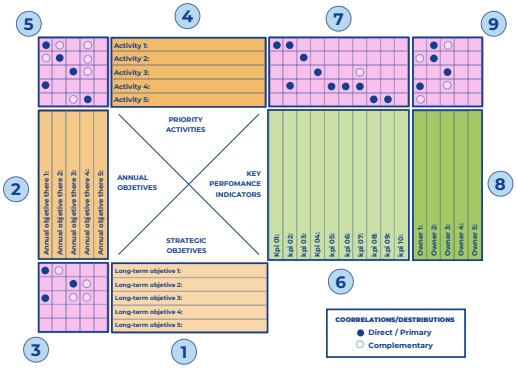
Hoshin Kanri

These are two terms of Japanese origin that can be translated as compass or direction *(Hoshin)* and management or administration *(Kanri)*. It is a strategic planning methodology used to achieve the cooperation of all the people in the organization for the purpose of achieving long-term strategic goals. Its main objective is to ensure that the entire organization is oriented in a single direction, aligning operational management with strategic direction.

Hoshin Kanri establishes a way to formulate cascading objectives, plans and goals for the entire organization. In addition, it contemplates indicators to evaluate the effectiveness of plans and the fulfillment of objectives, and the assignment of responsible parties in relation to goals and processes.

A planning matrix with the following structure and sequence of steps is used for its development:

1. Strategic objectives are placed according to the company's vision.
2. Annual objectives are established and aligned with the strategic objectives.
3. Correlations between annual and strategic objectives are identified.
4. Priority activities are defined to achieve the annual objectives.
5. Correlations between activities and annual objectives are identified.
6. Key indicators are assigned to monitor the activities.
7. Correlations between indicators and activities are identified.
8. Those responsible for the execution of the activities are assigned.



As additional benefits to the alignment of the organization's areas with the strategy, this methodology allows guiding the improvement processes by encouraging the participation of people and the decentralization of responsibilities.

PHILOSOPHY AND MANAGEMENT

HOQ (House of Quality)

It is one of the tools involved in Quality Function Deployment (QFD) to graphically represent the relationships between customer requirements, products and services, and the processes to produce or deliver them. In this way, it allows to identify possible gaps between what is expected and what is offered, as well as to analyze and monitor how the product or service (or aspects thereof) impacts the consumer's needs.

The matrix has the shape of a house (hence its name) composed of seven sectors:

1. The Voice of Customer

It contains a prioritized list of customer requirements (what they need and what they expect from the product or service), which are gathered through various market research techniques.

2. Competitive Evaluation

It draws from two sources:

- The survey of the level of customer satisfaction with the company's products and services and those of the competition.
- Strategic objectives for product or service development or modification.

3. Technical Specifications

It contains a description, in technical language, of the characteristics of the product or service.

4. Relationship Matrix

It is a matrix that represents the strength of the relationship between the voice of the customer and the technical characteristics from the development team's perspective.

5. Technical Correlations

It is a matrix that represents how and with what intensity the technical characteristics of the product or service are related to each other.

6. Technical Competitiveness

It contains a comparative analysis of the company's product performance and that of the competition from the perspective of the development team.

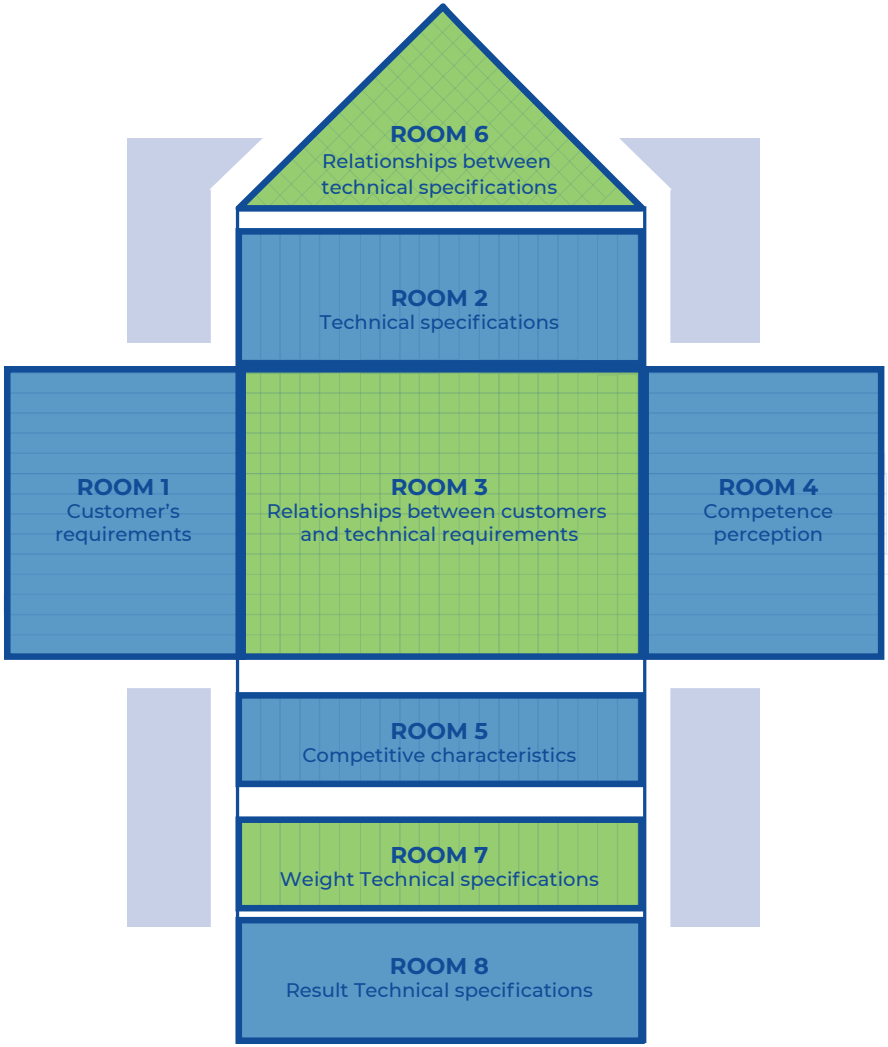
7. Information for Decision Making

It contains three types of information:

- The order of relevance of the technical specifications according to the customer's wishes and needs.
- Comparative information regarding the technical performance of the competition.
- Technical performance objectives.

The House of Quality is a dynamic tool and the information and analyses contained therein must be reviewed and updated periodically. In this way, they allow the organization's strategic objectives to be focused on the development or improvement of products, services and associated processes, concentrating efforts on those characteristics with the greatest impact on customer satisfaction.

PHILOSOPHY AND MANAGEMENT



PHILOSOPHY AND MANAGEMENT

TPM (Total Productive Maintenance)

It is a management system focused on equipment maintenance. Its implementation is proposed from an integral perspective that contemplates the development of people and teamwork.

Its main objectives are:

- To obtain reliable, predictable and safe production processes.
- Increase equipment availability.
- Maximize the capacity utilization of the equipment during its life cycle.

The fulfillment of these objectives is achieved by eliminating losses and involving all people in active roles in equipment maintenance tasks.

TPM identifies 16 major losses that negatively affect productivity, and which must be addressed.

8 Major Machinery Losses

1. Losses due to breakdowns
2. Setup and adjustment losses
3. Losses due to tool changes (replenishment of supplies)
4. Start-up losses (achieve conditions)
5. Losses due to "short" stoppages and no-load movements
6. Speed reduction losses
7. Losses due to defects and rework
8. Planned shutdown losses

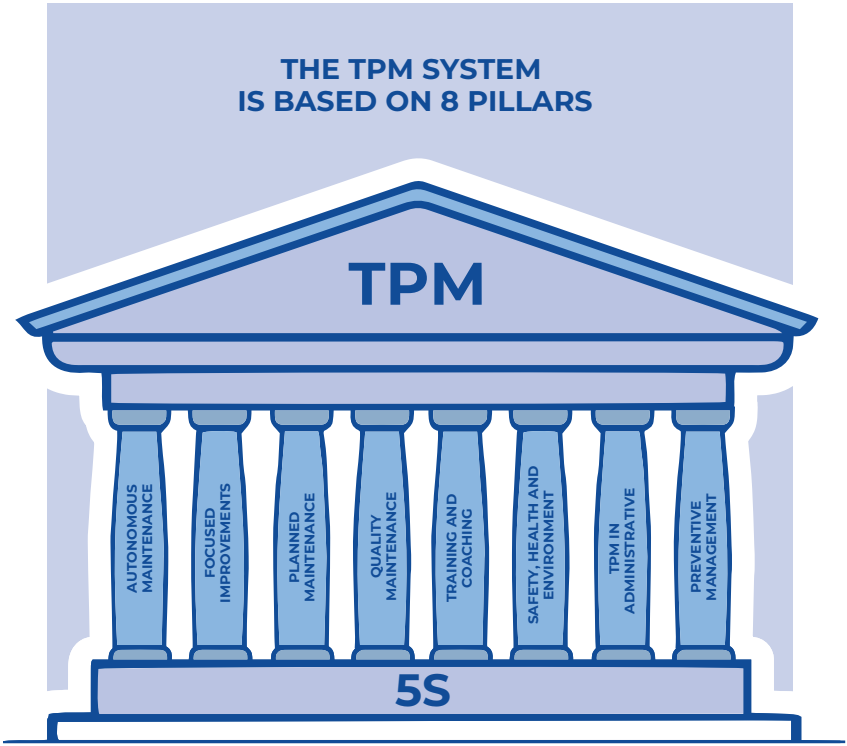
5 Significant Labor Losses

1. Control losses
2. Losses due to movement
3. Line organization losses
4. Losses due to lack of automated systems
5. Measurement and adjustment losses

3 Significant loss of materials

1. Energy losses
2. Mold, fixture and tooling losses
3. Performance losses

PHILOSOPHY AND MANAGEMENT



ALPHABETICAL INDEX

ALPHABETICAL INDEX

Q

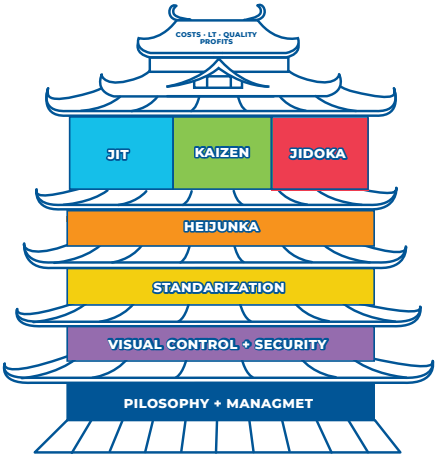
R

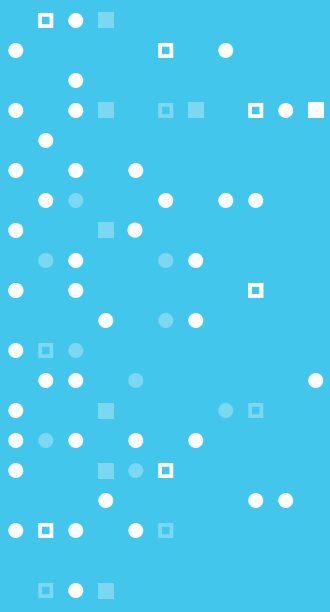
S

T

V

Y





The TG GLOSSARY aims to provide the reader with a first approach to the kaizen environment with a material for those who are taking their first steps in this subject.

The use of the TG GLOSSARY provides the advisors with a reference guide to put into practice concepts, tools and methodologies used during technical assistance and training in Management Technologies.

It is very gratifying for INTI's Management Technology Network to generate, within the framework of the TANGO Kaizen project, publications that facilitate the development of people who are, in the end, the ones who lead the transformation of the organizations in which they implement productivity improvements.

Our country's goal is that continuous improvement becomes the distinctive value of the local industry.

TG GLOSSARY

Continuous Improvement Environment Definitions
INTI MANAGEMENT TECHNOLOGY NETWORK

INTIArg
@intiargentina
@INTIargentina
INTI
canalinti

www.inti.gob.ar
consultas@inti.gob.ar
0800-444-4004

JICA Argentina
www.jica.go.jp/argentine/espanol/index.html

ISBN 978-950-532-546-7

INTI 65 Años 1957-2022 Instituto Nacional de Tecnología Industrial
Ministerio de Desarrollo Productivo Argentina
KT
PPJA Partnership Programme Japan Argentina
Ministerio de Relaciones Exteriores, Comercio Internacional y Culto Argentina
JICA