Área temática
9. Operações e Logística

Título
***SHOP FLOOR MANAGEMENT* FOR STRUCTURED PROBLEM SOLVING: CASE STUDY IN THE INDUSTRIAL PRODUCTION LINE OF POWER TRANSFORMERS AND REACTORS**

Resumo

Na indústria, os problemas se manifestam de diversas formas, seja o atraso na entrega de uma peça ou a oscilação no tempo de ciclo de operação de uma máquina. O facto é que os problemas são comuns à realidade de uma empresa, que deve ser capaz de lidar com eles de forma eficiente com o apoio dos colaboradores que estão envolvidos no processo. Neste contexto, o Shop Floor Management (SFM) ajuda a gerir pessoas e processos, uma vez que ajuda a criar uma ligação direta com o local de trabalho - o gemba. A SFM baseia-se em cinco áreas de atividade: deteção de anomalias, estabelecimento de reuniões de rotina, resolução estruturada de problemas, estabilização de processos e normalização de documentos e instruções. Este estudo de caso descreve o projeto de implementação do SFM numa empresa de produção industrial de transformadores e reactores de energia, com o objetivo de responder à questão de investigação *"Como é que a implementação do Shop Floor Management assegura a solução estruturada de problemas recorrentes na produção industrial?"*. Após o acompanhamento integral da consolidação do SFM na área piloto de enrolamento, verificou-se que a resolução estruturada de problemas permite à organização identificar e atuar sobre a causa raiz de um problema. No que diz respeito aos benefícios relacionados com a melhoria do processo, esta estrutura assegura que os colaboradores recebem apoio ativo da liderança e são envolvidos e formados para se tornarem solucionadores de problemas, corrigindo e eliminando consistentemente os desvios.

Palavras-chave: *Shop Floor Management*. Solução estruturada de problemas,. *Gemba*

Abstract

In industry, problems manifest in various forms, be it the delay in the delivery of a part or the fluctuation in the operating cycle time of a machine. The fact is that problems are common to the reality of a company, which must be able to deal with them efficiently with the support of employees who are involved in the process. In this context, *Shop Floor Management* (SFM) helps manage people and processes as it helps to create a direct connection with the workplace – the *gemba*. SFM is based on five fields of activities: detection of abnormalities, establishment of routine meetings, structured problem solving, stabilization of processes, and standardization of documents and instructions. This case study describes the SFM implementation project in an industrial production company of energy transformers and reactors, aiming to answer the research question "*How does the implementation of Shop Floor Management ensure the structured solution of recurring problems in industrial production?".* After fully monitoring the consolidation of the SFM in the winding, pilot area, it was found that structured problem-solving enables the organization to identify and act on the root cause of a problem. Concerning the benefits related to the process improvement, this structure ensures that employees receive active support from leadership and are involved and trained to become problem solvers, thereby consistently correcting and eliminating deviations.

Keywords: *Shop Floor Management* . Structured problem solving. *Gemba* .

1 Introduction

The process of organizational development makes the company increasingly resort to standardization as a means of coordinating the work of its employees. This is because management standardization ensures that employees know exactly what is expected of them and act accordingly. With a well-educated team, identifying problems and providing solutions for the organization becomes increasingly common (MINTZBERG, 1979; MEDEIROS; WIMMERSBERGER & MIRANDA, 2015).

In this context, there is an appropriate methodology to standardize the management of people and processes, so that workers feel able to perform their duties effectively, finding satisfactory solutions to routine problems in the company. This methodology, known as *Shop Floor Management* (SFM), refers to a management model centered on factory production and maintains a direct connection with the workplace, in this case, the factory floor (TRIPATHI et al, 2022; HANDYSIDE , 1997).

The main function of SFM is to sustainably increase efficiency and quality in production. To consistently pursue this objective, leadership actively allocates itself to the area where value is truly created – in manufacturing – as problem-solving mentors. Furthermore, to certify the standardization of management, the SFM is based on five fields of activities: detection of abnormalities, establishment of routine meetings, structured problem solving, stabilization of processes, and standardization of documents and instructions (MATERNA et al; 2019 ; MEISSNER et al; 2018).

In this context, this case study describes the SFM implementation project in an industrial production company of energy transformers and reactors, aiming to answer the research question "*How does the implementation of Shop Floor Management ensure the structured solution of recurring problems in production industrial?".* To this end, the five activities that make up the *Shop Floor Management cycle* were monitored during the implementation period of this methodology and the main results recorded were presented and discussed in section 4 of this document.

This work demonstrates that, with Shop Floor Management, the culture of problem-solving can be disseminated among workers, since this methodology enables management standards, activities and the qualification of each employee to become a better problem-solver. In this way, any problem that occurs will be analyzed to identify the root causes and be able to offer a sustainable solution (MEISSNER et al; 2018).

Individuals who are not trained to solve problems will not understand what is causing the difficulty, which obstacle is the reason for the conflict that needs to be eliminated and, therefore, will not be able to remove it. It is therefore important to ensure management that leads the team to excellence and promotes autonomy to resolve unforeseen events (DOSTÁL, 2015).

Yet, through the descriptive, comparative and qualitative analysis of the implementation of SFM in the company studied, it was possible to list the benefits of the methodology for management, for the team subordinate to it and, as a result, for the organization as a whole. It is worth considering that the main objective of Shop Floor Management is to continuously improve the competence and quality of the corporation (MATERNA et al; 2019).

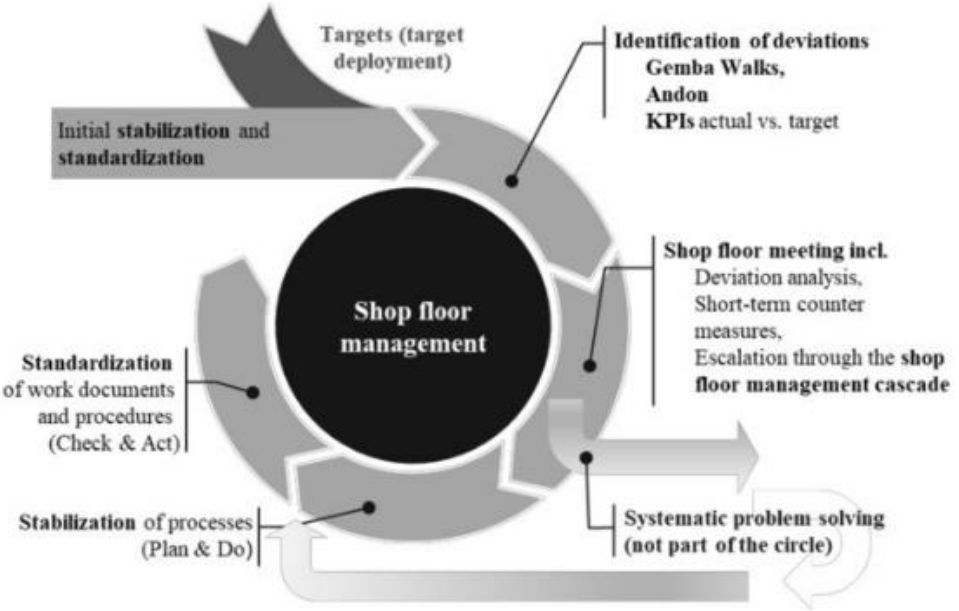
2 **Shop Floor Management**

Originating in Japan, Shop Floor Management is based on three pillars: gemba, genbutsu and gentitsu. These pillars, known as the “Three Reals” refer, respectively, to the real scene, the real thing, and the real fact. The objective is to strengthen the culture of visiting the “real scene”, to see the “real thing” and understand the “real fact” to address real problems and be able to solve them (SUZAKI, 1993).

As a result, SFM encourages the development of factory supervisors into methodical coaches for their co-workers so that employees know precisely what is expected of them and proceed accordingly. In this way, Shop Floor Management is essential to achieve quality and efficiency in production, as it standardizes the training of managers as mentors in problem-solving (MINTZBERG, 1979; MATERNA et al; 2019; CHRISTIAN et al; 2015).

To guarantee management standardization, the SFM is supported by a cycle of five fields of activities that are worked on mutually and are disseminated throughout all areas of production: detection of abnormalities, establishment of routine meetings, structured problem solving, stabilization of processes and standardization of documents and instructions (MEISSNER et al; 2018), (see Figure 1)

Figure 2: Shop Floor Management Cycle



Source: Adapted from MEISSNER et al (2018)

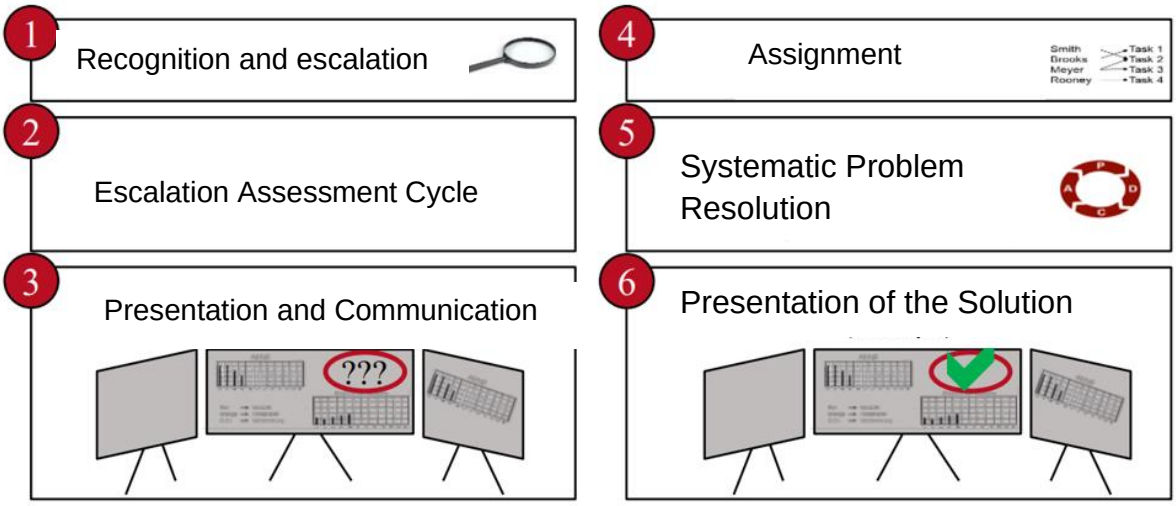
2.1 **Structured Problem Solving**

In the industrial scenario, a problem can range from the lack of a screw to the breakdown of machinery, considered a production bottleneck (AMORA, 2003). Regardless of the circumstance, the basis for problem-solving remains the same and is based on the PDCA cycle: plan, do, check, and act. According to Soliman (2020, p. 5), the process of structured problem solving must follow the following steps: Define the problem in relation to the ideal (planning); Break down , or detail, the problem into manageable pieces (planning); Find the root cause of the problem (planning); Define goals for achievement (planning); Select the appropriate solution among different countermeasures (planning); Implement the action plan (do); Review the results as expected (check); Examine what went wrong, adapt, adjust and redo the cycle (act).

As a complement, Christian et al. (2015) demonstrate that a structured problem-solving process that takes into account shop floor management must be systematized as follows (see Figure 2):

1. Recognition and Escalation: When an issue is identified by an operator, it will be escalated to the team leader due to its complexity, as defined in the criteria.
2. Escalation Assessment Cycle: the leader assesses the magnitude of the problem in question and considers whether there is a need to escalate to the next level of the hierarchy.
3. Presentation and Communication: here, the leader communicates the problem to be analyzed with the rest of the team and support areas, through regular communication meetings.
4. Assignment: after being communicated, the problem is assigned to whoever must resolve it. This step is considered extremely important for the systematic progress of the solution to be developed.
5. Systematic Problem Resolution: this phase represents the structured solution process, with the help of the PDCA cycle.
6. Presentation of the Solution (Prevention): this ends the resolution of the problem, presenting the solution found during the regular communication meeting. Now there is a new focus: preventing the problem from occurring again.

Figure 2: Systematic Structured Problem Solving with Shop Floor Management.



Source: Adapted from CHRISTIAN et al. (2015).

Thus, it should be noted that problem-solving begins with the recognition of an occurrence and ends only when it is possible to find a satisfactory solution that leads to a desired target pattern/state. Problems must be seen as an opportunity for improvement and associated only with a structured solution, where employees receive active support from leadership and are involved in the process as problem solvers (CHRISTIAN et al; 2015; MATERNA et al; 2019).

3 **Methodology**

To detail the implementation of *Shop Floor Management* in a company in the energy sector, exclusively in the unit destined for the manufacture of transformers and reactors, this study is classified as research of an applied nature, with a qualitative approach. For that, a case study was conducted using the inductive scientific method, based on observation and recording analysis (EISENHARDT, 1989).

The qualitative perspective of this study was based on the exploration and demonstration of the understanding of four employees of the company under study, see Table 1.

Table 1: Selected Interviwees.

Interviewees	Organization's Role
1. N1	Production Leader.
2. N2	Winding Supervisor.
3. N3	Electrical assembly coordinator.
4. N4	Production manager.

Semi-structured interviews were carried out with each employee in their respective workplaces. They were selected because of the acessibility, long term experience (at least 7 years in the company) and widely known expertise in their working sectors. Full monitoring was also carried out during the nine months of implementation of the SFM, starting in February 2023, detailing its objectives and tools. With this, a comparison *as is – to be* was established, in which the as *is* scenario is the description of the context before implementation, and *to be* scenario is the description of the scenario from the implementation of *Shop Floor Management*.

To ensure that the organization could achieve management standardization, the SFM presents five fields of activities, which were following in the study: detection of abnormalities, establishment of routine meetings, structured problem solving, stabilization of processes and standardization of documents and instructions. Based on this, the project studied was structured into ten steps, which are presented in Table 2, as well as their respective relationships with the SFM cycle (MEISSNER et al; 2018).

Table 2: Stages and Objectives of the SFM Implementation Project.

Stage	Description	SFM cycle
1. Awareness	Present project concepts.	-
2. Indicator Tree	Unfold key indicators.	Abnormality detection.
3. Leaders' standard agenda	Structure the schedule for carrying out all regular communications N1 to N4.	Establishment of routine meetings.
4. Deviation escalation criteria	Escalation criteria determine who must be informed in the event of a deviation, to guarantee the necessary support during the execution of routines.	Structured problem-solving.
5. Development of tables (physical or virtual).	Establish Visual Management requirements for Regular Communications N1 to N4.	Detection of abnormalities and establishment of routine meetings.
6. Process coaching	Coach in leadership tasks.	Stabilization of processes and standardization of documents and instructions.
7. Process confirmation	Show the importance of standardization and periodic verification of work performance.	Process stabilization.
8. Go&See Troubleshooting	See the process in a standardized way, with step-by-step Problem Solving.	Structured problem-solving.
9. Implementation monitoring + coaching execution	Define roles and responsibilities in the project implementation process.	-
10. Change management	Apply a structured process and tools to drive the people's side of change to maximize project or initiative results.	-

4 **Results**

4.1 ***As is***

The need to develop *Shop Floor Management* in the company studied arose from the perception of non-optimization of results due to the non-alignment of strategic objectives and the different management methods of the business units. This means that the tasks performed in the production area did not achieve their full potential results due to the lack of connection between the monitoring of reported actions and strategic indicators, coupled with a disorganized management approach.

Under the analysis of the current state, it was verified as a condition characterized by the dedication of leadership N3 (coordination) and N4 (management) to many hours of meetings, as well as a high concentration of indicators to be managed by these two levels. Regarding the analysis of cause and impact factors, the non-standardization of management methods was notable, given the lack of criteria for escalating themes and problems, resulting from a failure in intra-organizational communication.

The production manager (N4), when interviewed, stated that before the SFM implementation, there was no standard between factory leadership meetings and support areas, such as quality, logistics and planning. According to him, when a critical issue was raised, there was a lack of efficiency in its handling due to the lack of clear criteria for escalating problems.

For the production manager (N4), the main expectation was that the project could promote the maturity for regular communication between the areas, a change in culture and mindset, idealizing an environment in which problems are dealt efficiently and objectively. The production leader (N1), when interviewed, also shared the same expectation, believing that SFM could help not only the factory, but the entire organization to achieving positive and lasting results.

4.2 **To be**

Shop Floor Management implementation project in the company studied was based on the feasibility of an integrated and standardized management model, aligning processes and strategic indicators. As for the future state, the purpose focused on reproducing the SFM in all areas of operation, following an action plan composed of ten steps that were developed throughout the project, as explained as follows.

Awareness (step 1):

In this initial phase, the objective included the presentation of the concepts that permeated the project: what is *Shop Floor Management* and what is its contribution to problem-solving. Thus, it was possible to share that the SFM, acting directly on gemba, develops and encourages leadership to take on a mentoring position to ensure that their team performs as expected and achieves quality and efficiency in production, becoming capable of sustainably resolve any adversities that may occur (MINTZBERG, 1979; MATERNA et al; 2019; CHRISTIAN et al; 2015).

Indicator tree (step 2):

This step was dedicated to analyzing and unfolding the key indicators that must be monitored by management at all hierarchical levels. To ensure standardization, five pillars were defined to cover the organization's indicators. They are: safety, quality, delivery, cost, and people.

To define these indicators, a workshop session was held with the leadership of all areas of the factory, including pre-assembly, sheet cutting, core assembly, winding, special processes, final assembly, *Insulation Kit Center* and industrial engineering. Together, the managers analyzed the impact of each organizational indicator on production and chose the ones they would like to monitor regularly in their respective team meetings. From N1 to N4, the indicators were selected to maintain coherence in reporting and share information between the bordered levels.

Leaders' standard agenda (step 3):

Team meetings are extremely important for the process of structured problem-solving in SFM. This allows the employee to communicate if they have identified a problem in production and to suggest actions to contain it, starting a process that aim sustainable solutions to different problems in the factory(CHRISTIAN et al; 2015).

Therefore, this activity endeavored to structure the times for regular communications from N1 to N4, taking into account production availability. To this end, alignment sessions were held with leadership to understand their meeting routine, the content covered, and where these meetings should take place (at the factory or remotely).

Deviation escalation criteria (step 4):

This topic relates to the problem escalation assessment cycle proposed by *Shop Floor Management*. In other words, after identifying the problem, this is the stage of the structured solution process in which the leader must assess the magnitude of the problem in question and consider whether there is a need to escalate to the next level of the hierarchy or not (CHRISTIAN et al; 2015).

To develop the criteria for escalating deviations, the aim was to understand the critical issues that needed attention when reported. With this, a board was created containing six statements: safety (EHS), factory supply, product engineering, maintenance, quality and people. In light of these topics, concerning reasons or situations were detailed, as well as instructions for employees who identify the problem. The individual having the initial contact with the occurrence is considered the initiator, who must follow the outlined steps and proceeding according to instructions until the deviation is contained and resolved.

With the well-established criteria for escalation, in the case of identifying an occurrence, the leader can make sure whether there is a demand to take the issue to the next hierarchical level or whether the leader has permission to commit to resolving the deviation encounter, contributing to efficiency and quality in production. Furthermore, this processprovides factory employees with a greater sense of responsibility in the face of functional and disciplinary issues that may arise in production (CHRISTIAN et al; 2015).

Framework development (step 5):

This stage is linked to the detection of abnormalities because, with visible management of key production indicators, it is possible to better understand the current context and identify sudden deviations. It is possible to follow the steps to analyze any problems that may arise and resolve them effectively.

Given this, the factory leadership dedicated itself to developing visual management tables for regular communications between N1 to N4. With the indicators selected in phase two, from the indicator tree, it was possible to develop a process monitoring model that included safety, quality, delivery, cost, and people in production.

For N1, considering the agility that must be observed in the first-level meeting, a checklist was created with questions whose answers alternate between “yes” and “no”. If a deviation is identified, it is highlighted and described so that the leader can analyze the need to escalate it or not. If leadership resorts to escalation, they must sort the problem into top 1, top 2 and top 3 to report it to the next hierarchical level according to its magnitude.

As for boards at levels N2, N3 and N4, the pattern remains the same: each tab in the file is destined for a pillar of the indicators proposed by the SFM. In addition, the table also includes a tab for notices and another exclusively prepared for the top 3 problems arising from the previous level, another focused on recording the action plan, and a last one listing process confirmations.

Process coaching (step 6):

Process coaching focuses on providing a structured feedback approach to regular factory communications, promoting change in leaders' roles, behaviors and effectiveness in conducting team meetings. To this end, a form was developed to be used as a guide and, with the form in hand, the project focal point was responsible for following all meetings N1 to N4, highlighting the main points and aligning their own perspective to the point of view of the accompanied leadership.

- **Process confirmation (step 7):**

The process confirmation stage sought to certify the importance of standardization and periodic verification of work carried out in accordance with the execution of control tasks vital to the leadership routine. Based on this, in individual sessions with winding management, each leader was concerned with listing and adding to the visual management table the activities that require regular monitoring.

- **Go&see troubleshooting (step 8):**

At this point, the SFM implementation project brought together employees and winding leaders in practical *Go&See training* as a step-by-step process for structured problem solving, based on the PDCA cycle, which is broken down in the *Go&See* form , involving the structured collection of information in the workplace – in *gemba* – aiming to identify and eliminate the root causes of the problem. The objective of this activity is based on instructing the employee to form their own image of the situation, understanding the process and creating a connection with daily work.

The first topic of the *Go&See form* is aimed at describing the problem, identifying the detection point and seeking to visualize the target condition to be reestablished for the correct application of root cause analysis. To do this, the form suggests answering the following questions regarding the problem: *What? How much? When? Who? It is like?*

Next, the form moves on to a brief action plan aimed at containing the problem. Here, immediate action is suggested to curb the deviation, appointing someone responsible for the activity and a deadline for its execution. As a complement, it is suggested to analyze the point of cause using the pattern filter, a tool that aims to identify whether the pattern in the procedure exists, is clear, is respected and if there were a pattern, it would be possible to prevent the problem from happening. If the answer to both questions is “yes”, structured problem solving must be continued; if not, the area must promote improvements in the process in question.

The next step is characterized by cause analysis, which is developed through hypotheses, until the root of the deviation is found. These hypotheses must be based on the “6Ms”, which encourage a broad view of the problem:

1. Measurement: causes related to measurement systems (measuring and calibration instruments) and process management (goals, responsibility and consequences).
2. Method: procedure-related causes.
3. Labor: causes related to the training, attitude and physical and psychological conditions of employees.
4. Environment: causes related to the environment.
5. Machine: causes related to machines, tools and systems.
6. Raw material: causes related to the material or various inputs, including information.

In view of this, it is possible to investigate the potential causes of the deviation and, consequently, define the corrective actions that will solve the root cause of the problem, implementing an action plan directed to someone responsible for executing it within the determined deadline.

Thus, *Go&See* promotes a neutral perception regarding the case to be addressed, since clarity about the problem is only created when visiting the place where the problem occurs, observing precisely what happened and identifying the real problem. According to the winding supervisor and the area coordinator, the proposal brought by *Go&See* boosts autonomy in the search for solving recurring problems in the operation.

Implementation monitoring + coaching execution (step 9):

Moving towards the completion of the implementation of *Shop Floor Management* , this phase encourages the recording of full monitoring of the focal point through the execution of process coaching (step 6). Here, we sought to attend meetings at all levels of coiling, using as a guide the form proposed by coaching which, when completed, was stored and used as a history and comparison of the evolution and improvement of regular communications.

- **Change management (step 10):**

The last step of the project proposes driving the human side of the change to maximize the results of the SFM. To this end, conversation sessions were held with management and winding operators with the purpose of aligning expectations, identifying points for improvement and attention, and providing support to the pilot area of Shop *Floor Management consolidation .*

At this point, it is worth returning to the production manager's speech, who states that his hope in relation to the project is based on working on the company's maturity, transforming the culture and mindset (thinking) regarding structured problem solving, since that the SFM awakens the sense of “business owner”, involving employees in the process as great problem solvers.

5 **Conclusion**

This work aimed to monitor and describe the implementation of SFM in an energy transformer and reactor production industry. To this end, it clarifies the five basic activities of the SFM and sought to answer the research question: “How does the *implementation of Shop Floor Management ensure the structured solution of recurring problems in industrial production?”*

The winding area of the studied company was selected for monitoring and recording the consolidation of *Shop Floor Management* , considering the progress of SFM implementation in the section, which became a pilot in the unit. In this way, an analysis was prepared *as is – to be* with the aim of describing the context before and after the implementation of the SFM in the area. The benefits resulting from the SFM were the training of employees in identifying, analyzing and solving problems; description of its processes and tools, as well as the perception of the winding leadership in relation to the implementation of the methodology.

The SFM implementation project in winding therefore followed ten steps, which were detailed in the *to-be analysis*. These highlighted the main results of each stage. It is worth highlighting that the activities developed through *Shop Floor Management* complement each other and work on different aspects of structured problem solving: from detecting the abnormality through comprehensive management of indicators to identifying and solving the root cause of the problem, in carrying out *Go&See* .

The process of organizational development encourages the organization to resort to standardization as a means of coordinating the work of its employees, making sure that the operation performs as desired once it is aware of the expected conditions. And with a well-oriented team, it is possible to identify problems and offer sustainable solutions to them.

Therefore, it can be said that *Shop Floor Management* ensures a structured solution to problems, based on the culture of developing a sense of responsibility regarding functional and disciplinary issues of production. The way it is structured is based on “seeing the problem” as an opportunity for improvement, in which employees receive active support from leadership and are involved and trained to become problem solvers, permanently correcting and eliminating deviations.

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