Evelopment of a model of accelerated integration of high-performance work teams related to the systematic methods of quality control and continuous improvement in the automotive industry

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UNIVERSIDAD IBEROAMERICANA PUEBLA ®

DEVELOPMENT OF A MODEL OF ACCELERATED INTEGRATION OF HIGH-PERFORMANCE WORK TEAMS RELATED TO THE SYSTEMATIC METHODS OF QUALITY CONTROL AND CONTINUOUS IMPROVEMENT IN THE AUTOMOTIVE INDUSTRY.

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ADVANCED MANUFACTURING ENGINEERING

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SUMMARY

To be competitive in the automotive industry, it is necessary to maximize the quality of the products and the efficiency of the processes, the best use of the available resources and the least waste of each one of them; That is why everyone, procedure, work instruction and management system in the organization needs to be aligned with common goals.

In the following work, it is intended to expose how all the resources available in the organization can be aligned to the same objective; in this case, the objective was to reduce customer complaints.

To achieve this, it was necessary to know how the operators and the support team relate to internal procedures, and the impact that their behaviors have.

Through the Design Thinking methodology, digital solutions were proposed that seek the collaboration of key employees at different levels: to quickly and efficiently form high-performance operating teams that are at the same time aligned with quality and continuous improvement systems, and to facilitate the management of the faults presented in the productive floor from the time they are reported until they are properly closed.

The analysis of this project was carried out during 2020, the first proposals and tests were carried out during 2021, and by November 2021 important data began to be collected; based on user feedback, more than 300 versions were made for digital applications. For now, the proposal is in the last phase of the methodology, so we will be able to see the reduction in customer complaints probably from the first quarter of 2023.

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CHAPTER I. INTRODUCTION

Background

Schaeffler Germany

> The foundation for the company as it is today laid in 1946 when brothers Dr. Wilhelm Schaeffler and Dr.-Ing. E.h. Georg Schaeffler founded Industry GmbH. The company's rise began in 1949 when Dr. Georg Schaeffler invented the needle roller bearing cage. In 1999 was the acquisition of all Luk shares and in 2003 INA, Luk and FAG formed Schaeffler Group. [1]

Schaeffler México

"In 1976 starts Aftermarket activities thru Implementos Universales and in 1988 Luk is introduced with the RepSet concept". [2]

"The main products are clutch systems, transmission components, torsion dampers, valve train systems, camshaft phasing units, and electric drives". [3]

The Schaeffler divisions are Automotive Technologies, Automotive Aftermarket and Industrial.

> The Automotive Technologies division develops and manufactures groundbreaking products for engine, transmission, and chassis applications based on internal combustion engines as well as for hybrid and electric vehicles.
>
> The Automotive Aftermarket division delivers components and complete repair solutions to the automotive spare parts market worldwide. Schaeffler supports garages with overarching system understanding and comprehensive services for complex repairs.
>
> The Industrial division supplies products such as rolling and plain bearings, linear and direct drive technology as well as services such as maintenance products and monitoring systems to customers from different industrial sectors, through direct sales and a global network of certified distribution partners. [4]

"In México there are four plants: Schaeffler México, S. de R.L. de C.V., Schaeffler Transmisión Huejotzingo, S de R.L. de C.V., Schaeffler Automotive Aftermarket Mexico S. de R.L. de C.V and Schaeffler Transmisión Puebla, S de R.L. de C.V." [5]

In the current project, it will be focused initially in the Schaeffler Puebla plant. The main products are dry clutches, double clutches, and their components. Therefore, the processes involved are machining, heat treatment, stamping and finally assembly.

Problem statement

1. The current quality and continuous improvement systems, consider the originated problems in the shopfloor and it exist tools to eradicate them, nevertheless for some reason, they have not been totally effective.

2. The indirect and direct team effort from every department are not completely align to the production indicators.

For example:

- Currently the periodical operator evaluations only consider the theoretical part but not the practical one.
- The current stablished indicators (OEE, customers complaints, deliveries, production stoppages, etc.), don't have the same importance for every team member from the support departments (Maintenance, quality, logistic, production).

Problem delimitation

- Pilot in the machining and quality area in Puebla plant.
- Digital platform development to the failure management.
- Data source connection (Sharepoint365, Audits system, User data, Alert issues operator system, Department indicators, Ideas for improvement system).
- Digital dashboard development.
- Training to the personal involved.
- Permeate the initiative program with the internal programs in the company.

General objective

Unify and digitalize the current failure following system and internal complaints as well as collaborative effectiveness indicator creation per operator according to its skills and knowledge.

Specific objectives

- Generate a digital identification, following up, solution and control system for the current internal problem-solving model.
    - Digital platform development to the failure management.

    - Quality and Industrial Engineering agreement.
    - Trials and system adjustments.
    - Training to the personal involved.

- Generate a digital competencies model for the operator based on the current internal model in the plant, adding the operator skills in the shopfloor and knowledge.

    - Competence system development.
    - Quality and Human resources agreement.
    - Trials and system adjustments.
    - Training to the personal involved.

- Bind data and develop the dashboard.

    - Define structure.
    - Bind data.
    - Create dashboard.
    - Training to the personal involved.

Justification

Based on the Puebla and Huejotzingo plants lesson learned data base, it was observed that during 2019 and 2020 years, the 67 percentage of the customer complaints depend on the shopfloor work made directly at operational level; some systematically examples are the work instructions unknown and machines adjustments, the incorrect handling material, lack of following up to the issues reported, among others.

With this Project, it pretends to reduce the 50% of customer complaints, the 50% of internal complaints and 50% of Near misses.

CHAPTER II. THEORETICAL FRAMEWORK

The way in which the interaction between people, methods and technology develops in the work carried out on the production floor, largely defines the quality of the products offered to customers.

It is therefore necessary to know the economic impact generated by good and bad quality, some common systematic methods to solve the causes of problems and the way in which we can outline the efforts of the main members of the organization to give more value to the product.

QUALITY *COSTS*

The first thing we need to know is what are quality costs? How can we categorize them?

> … are a measure of the costs specifically associated with the achievement or non-achievement of product or service quality– including all product or service requirements established by the company and its contracts with customers and society. Requirements include marketing specifications, end-product and process specifications, purchase orders, engineering drawings, company procedures, operating instructions, professional or industry standards, government regulations, and any other document or customer needs that can affect the definition of product or service. More specifically, quality costs are the total of the cost incurred by (a) investing in the prevention of nonconformance to requirements; (b) appraising a product or service for conformance to requirements; and (c) failure to meet requirements.
>
> The most common format for categorizing quality costs is the Prevention– Appraisal– Failure (PAF) model:

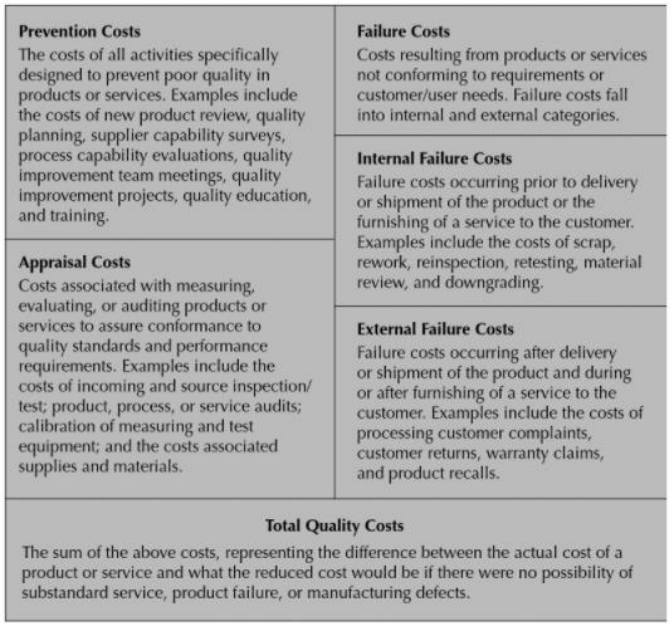


Figure 1. Quality costs by categories *[6]*

Now that we know what costs are involved in Prevention– Appraisal– Failure, we can exercise strategies to reduce them:

The strategy for using quality costs is quite simple:

(1) take direct attack on failure costs in an attempt to drive them to zero;
(2) invest in the "right" prevention activities to bring about improvement;
(3) reduce appraisal costs according to results achieved;
(4) continuously evaluate and redirect prevention efforts to gain further improvement.

This strategy is based on the premise that:

- For each failure there is a root cause
- Causes are preventable
- Prevention is always cheaper

Figure 2. Cost issue impact *[6]*

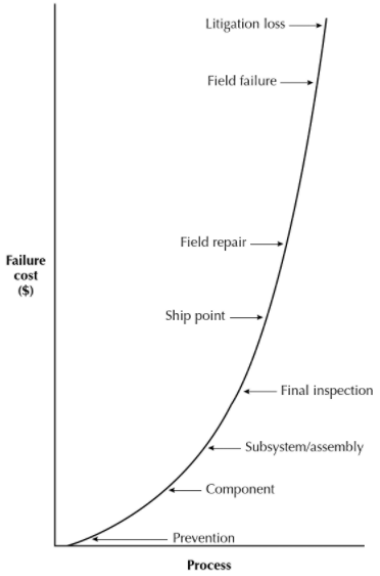


Figure 3. Failure cost and point process *[6]*

Since every dollar of quality cost saved can have a positive effect on profit, the value of clearly identifying and using quality costs should be obvious. By minimizing quality costs, quality performance levels can be improved. [6]

5 STAGES IN THE DESIGN THINKING PROCESS

Design Thinking is a design methodology that provides a solution-based approach to solving problems. It's extremely useful in tackling complex problems that are ill-defined or unknown, by understanding the human needs involved, by re-framing the problem in human-centric ways, by creating many ideas in brainstorming sessions, and by adopting a hands-on approach in prototyping and testing.

…the five-stage Design Thinking model proposed by the Hasso-Plattner Institute of Design at Stanford (d.school). d.school is the leading university when it comes to teaching Design Thinking. The five stages of Design Thinking, according to d.school, are as follows: Empathies, Define (the problem), Ideate, Prototype, and Test.

1. Empathies: The first stage of the Design Thinking process is to gain an empathic understanding of the problem you are trying to solve. This involves consulting experts to find out more about the area of concern through observing, engaging and empathizing with people to understand their

experiences and motivations, as well as immersing yourself in the physical environment so you can gain a deeper personal understanding of the issues involved. Empathy is crucial to a human-centered design process such as Design Thinking, and empathy allows design thinkers to set aside their own assumptions about the world in order to gain insight into users and their needs.

2. Define (the Problem): During the Define stage, you put together the information you have created and gathered during the Empathies stage. This is where you will analyze your observations and synthesize them in order to define the core problems that you and your team have identified up to this point. You should seek to define the problem as a problem statement in a human-centered manner.
   To illustrate, instead of defining the problem as your own wish or a need of the company such as, "We need to increase our food-product market share among young teenage girls by 5%," a much better way to define the problem would be, "Teenage girls need to eat nutritious food in order to thrive, be healthy and grow." …
   The Define stage will help the designers in your team gather great ideas to establish features, functions, and any other elements that will allow them to solve the problems or, at the very least, allow users to resolve issues themselves with the minimum of difficulty…
3. Ideate: You should pick some other Ideation techniques by the end of the Ideation phase to help you investigate and test your ideas so you can find the best way to either solve a problem or provide the elements required to circumvent it.
4. Prototype: The design team will now produce a number of inexpensive, scaled down versions of the product or specific features found within the product, so they can investigate the problem solutions generated in the previous stage. Prototypes may be shared and tested within the team itself, in other departments, or on a small group of people outside the design team. This is an experimental phase, and the aim is to identify the best possible solution for each of the problems identified during the first three stages. The solutions are implemented within the prototypes, and, one by one, they are investigated and either accepted, improved and re-examined, or rejected on the basis of the users' experiences. By the end of this stage, the design team will have a better idea of the constraints inherent to the product and the problems that are present, and have a clearer view of how real users would behave, think, and feel when interacting with the end product.
5. Test: Designers or evaluators rigorously test the complete product using the best solutions identified during the prototyping phase. This is the final stage of the 5 stage-model, but in an iterative process, the results generated during the testing phase are often used to redefine one or more problems and inform the understanding of the users, the conditions of use, how people think, behave, and feel, and to empathize. Even during this phase, alterations and refinements are made in order to rule out problem solutions and derive as deep an understanding of the product and its users as possible.

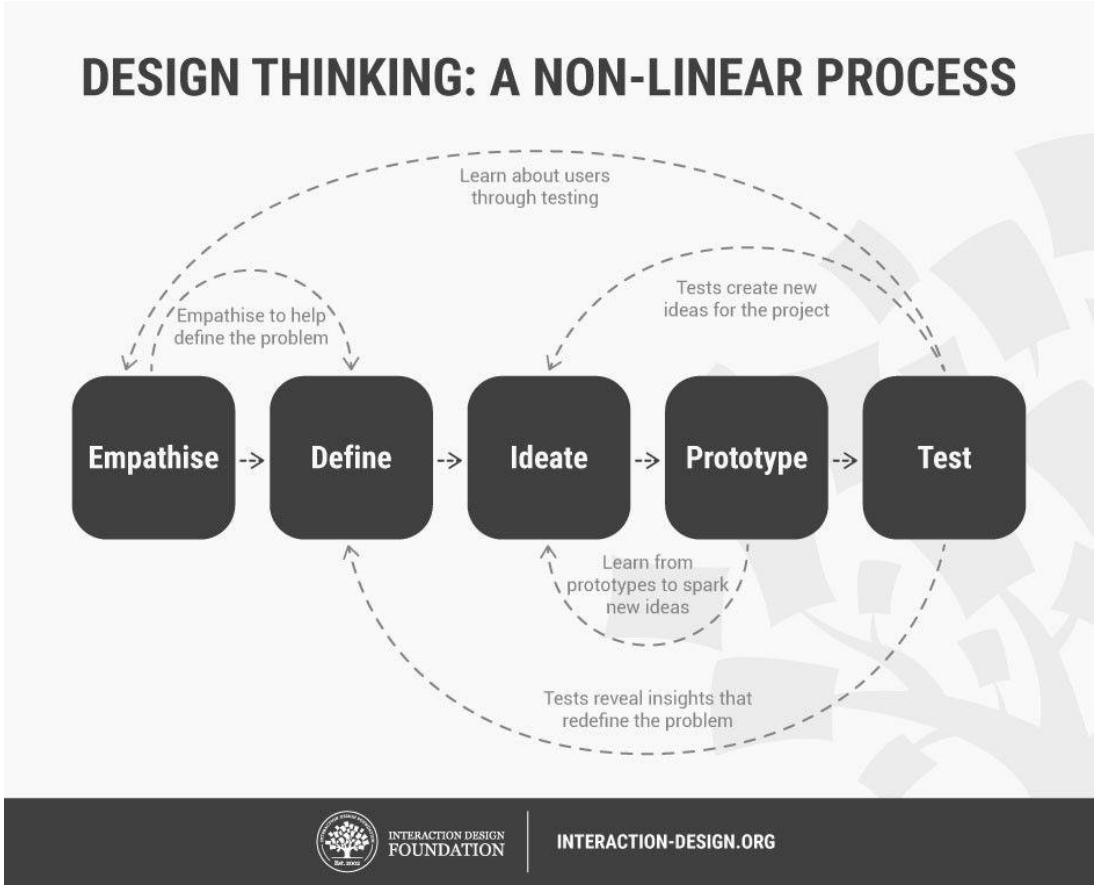


Figure 4. Five stage design thinking model [7]

It is important to note that the five stages are not always sequential – they do not have to follow any specific order and they can often occur in parallel and be repeated iteratively. As such, the stages should be understood as different modes that contribute to a project, rather than sequential steps. However, the amazing thing about the five-stage Design Thinking model is that it systematizes and identifies the 5 stages/modes you would expect to carry out in a design project – and in any innovative problem-solving project. Every project will involve activities specific to the product under development, but the central idea behind each stage remains the same. [7]

PDCA CYCLE

To solve a problem, it is of utmost importance, to know what causes it, by confirmation, not just to assume that this or that is the solution:

> Simply defined, a problem is a deviation from a standard. Failing to see the elements that are intrinsic to a problem can cause us to lose focus on how to solve the problem. For example, a common step to most people is to jump into a solution before analyzing what is really causing the problem. Another mistake is not identifying the standard or not understanding its deviation. Typical assumptions like these can cause the best-intentioned team to lose focus and get lost along the problem-solving effort. [8]

PDCA origin and concept.

Before naming the PDCA cycle as we currently know it, let's read a little about how it started, who was the main author and what is its true essence:

> In Out of the Crisis, W. Edwards Deming provided a diagram designated as "The Shewhart Cycle." This is what Deming said about it:
>
> The perception of the cycle shown came from Walter A. Shewhart. I called it in Japan in 1950 and onward the Shewhart cycle. It went into immediate use in Japan under the name of the Deming Cycle, so it has been called ever since.
>
> Deming's original depiction of The Shewhart Cycle is a six-step, numerically identified process in which the words "plan," "do," "check," and "act" do not appear boldly as in later PDCA depictions. These are the six steps. Keep in mind that this is a quality improvement process:
>
> 1. What would be the most important accomplishments of this team? What changes might be desirable? What data are available? Are new observations needed? If yes, plan a change or test. Decide how to use the observations.
>
> 2. Carry out the change or test decided upon, preferably on a small scale.
>
> 3. Observe the effects of the change or test.
>
> 4. Study the results. What did we learn? What can we predict?
>
> 5. Repeat Step 1, with knowledge accumulated.
>
> 6. Repeat Step 2, and onward.
>
> PDCA is a concept, cycle, procedure, flow diagram, process, model, and methodology– all for continual improvement." [9]

PDCA structure.

Currently, the concept follows a very natural flow and standardization has helped it to be adopted by many companies to solve many of the well-known waste in production processes. The continuous improvement structure is:

The plan stage involves identifying gap to goal, analyzing root issues and barriers, and formulating countermeasures and strategies. It is the analysis and strategy formulation stage.

The do stage involves developing executable implementation processes, communicating the plan, and executing the plan. It is the implementation stage.

The check stage involves monitoring the progress of plan implementation and measuring results. It is the impact evaluation stage.

The act (or adjust) stage involves standardizing effective strategies or countermeasures, identifying further improvement possibilities, spreading best practices, and starting the PDCA cycle again.

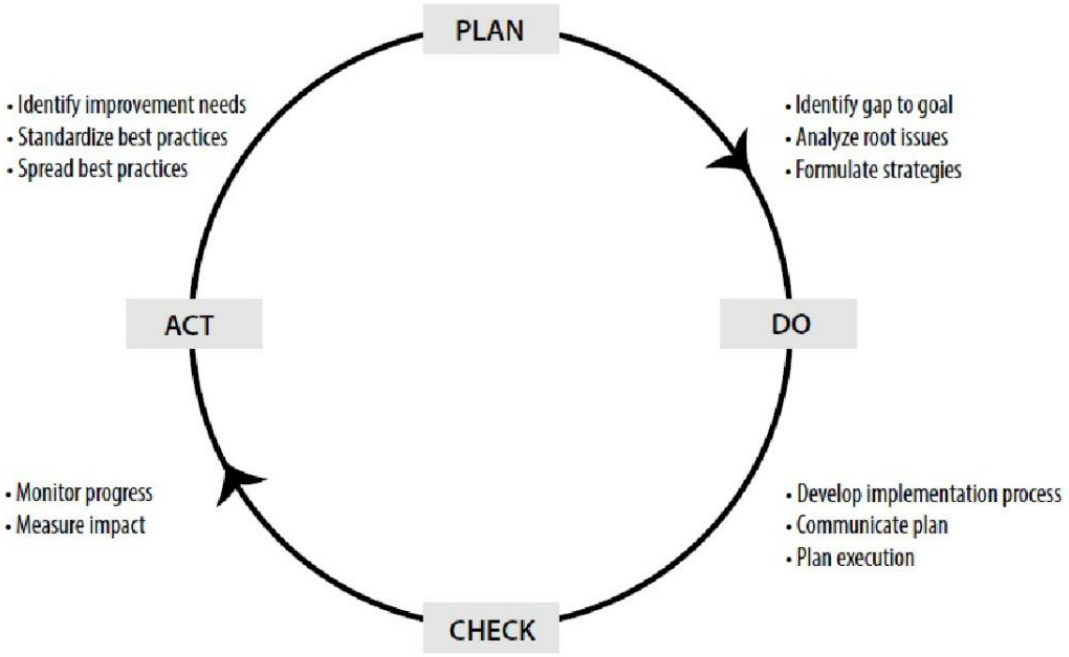


Figure 5. PDCA cycle. *[10]*

Increasing efficiency by eliminating waste is one of the key values of CQI. In the thinking behind the Toyota production system, there are three kinds of waste: muri (waste through unreasonableness or overburden), mura (waste through inconsistency or unevenness), and muda (waste through bad outcome; Ohno, 1988). The PDCA cycle addresses the three types of waste and improves quality and efficiency. The plan stage seeks to avoid muri through analysis and strategic planning. The do stage seeks to avoid mura through thorough and consistent plan implementation. The check stage seeks to avoid muda through outcome evaluation. The act stage allows teams to make improvements and spread them throughout the organization (Sutherland, 2014). [10]

8DS STRUCTURE

Another methodology to solve problems is the 8Ds, this one, lands the essence of the PDCA cycle and includes other tools to help find the root cause, such as the Ishikawa diagram and the 5 why's. The structure of the 8 disciplines is as follows:

The 8Ds are:

1. Select an appropriate team
2. Formulate the problem definition
3. Activate interim containment
4. Find root cause(s)
5. Select and verify correction(s)
6. Implement and validate corrective action(s)
7. Take preventive steps
8. Congratulate the team.

D1 Management is responsible for assembling a team that has relevant knowledge and experience to address the issue.

D2 The team will precisely detail the problem.

Who? Who is complaining? What? What are they complaining about? When? When did it start? Where? Where is the problem occurring? Why? Why is this problem occurring (an educated guess)? How? How did this problem occur (an educated guess)? How? How many problems (measurable and magnitude)?

D3 All nonconforming material must be isolated from the customer.

D4 Finding the root cause. Team brainstorming event Five whys process Flowchart Checklists and check sheets Fishbone diagram.

D5 Several corrections may be discussed. It is essential that the correction(s) be realistic, practical, cost- effective, and robust against process variability.

D6 Validate the correction on a large production scale. The team needs to ensure the correction does not create other issues. All changes need to be documented and all procedures updated.

D7 The team should monitor whether the improved process is meeting all team goals set at the onset. The lessons learned from this effort should now be leveraged on similar processes. All quality control systems should now be in place and validated.

D8 Once the team task is completed and results meet all customer requirements, the team needs to be formally recognized and thanked by the management. [11]

HUMAN RESOURCES MANAGEMENT PRACTICES AND ORGANIZATIONAL COMMITMENT

Turning now to the human part, the following article shows a study on the positive impact on the activities that the company carries out in favor of the growth of employees, such as recognition, evaluations and that in the end stimulates employee commitment.

To analyze the relationship between the variables included in the study, correlations and multiple-regression statistics were used. The findings from the study support the variables (choice, training, performance evaluation, promotion, performance-based rewards, information sharing, job security and human resources management system).

Training and Organizational Commitment

In research about HR practices, training is defined as an important practice that has a large impact on competitive power. According to studies, organizations investing heavily to training, pick the fruits of this investment in the improvement in individual and organizational performance Bartel (2000). The investments done in training practices and the expected results listed by organizations has pointed researchers to different perspectives about the subject. In that context, the present work has determined a positive correlation between training and organizational performance (Collings et al. 2010). Moreover, many studies about organizational performance and organizational commitment of employees show that the training and development practices given by organizations, offers them the opportunity to improve the skills and performances of their employees (Delaney and Huselid 1996). In the recent literature studies, training is evaluated in the basis of its relation to organizational commitment. Many studies show that with training, an increase in the employees' level of organizational commitment has been observed.

Performance evaluation and organizational commitment

Performance evaluation, which is generally considered an important HR practice, is an official procedure that is normally carried out as an interview once in a year and is prepared after careful consideration; and it is a platform that helps employees discuss their past performance and their future needs with their employers and design their future action plans Murphy and Cleveland (1995). With the new developments in business administration, performance evaluation is not a simple tool that records and documents employees' performances anymore. It is now evaluated as a strategic approach that is not only responsible for the individual performances of employees, but also for the relationship between the headquarters and branch offices and between the employees themselves Singh (2004). In the existing literature, a training and performance-based compensation relationship has been revealed between performance evaluation and different parts of HRM systems. If executed appropriately, in any organization, the performance evaluation system will allow the determination of the performance levels and skills of employees; as well as realizing the deficiencies of the people who are found out to need training Locke, Latham and Smith (1990). This fact emphasizes performance evaluation practices as an important factor in any organization. In research, performance evaluation HR practices that positively influence the improvement of employee skills and expertise are predicted. The number of studies supporting the argument that individual performance depends on skill, motivation and opportunity have dramatically increased in time. According to social exchange theory, investing in the wishes of employees will cause the workplace behavior of the employees to be more positive in any organization Cropanzano and Mitchell (2005). This will cause an increase in the motivation level of employees and in the end, the employees doing their best to the advantage of the company and having a wish to maintain their commitment Kuvass and Dysvik (2009). According to this, it is expected that performance evaluation results should be in a direction that will make the employees feel competent and successful (Fey et al. 2009) and a more motivated and dedicated workforce will be obtained.

Promotion and Organizational commitment

Another important factor that can be related to performance evaluation is promotion. According to this, institutions prefer methods that will help employees to advance within the organization and promote individuals from within the organization. According to Guest's (1997) view, the existence of career development opportunities in the organization has a positive correlation to the employees' organizational commitment since the employees believe that they can advance their careers in the organization they belong to. Emphasizing intra-organizational career opportunities related to promotion will ensure that there is an understanding of justice and rightfulness in the organization and increase their commitment levels (Fey et al. (2000). Emphasizing the provision that everyone has just and equal rights for promotion will not only help organizations to hold on to their qualified employees but also to increase their commitment levels.

Confirmed studied hypotheses

With the above, the study suggests seven confirmed hypotheses:

- H1: Organizational choice practices are positively correlated with organizational commitment.
- H2: In any organization, there is a positive correlation between the employee training practices and organizational commitment.
- H3: There is a positive correlation between HR performance evaluation practices and organizational commitment.

- H4: In any organization, there is a positive correlation between the promotion opportunities and organizational commitment.
- H5: In the performance of any organization, there is a positive correlation between the basis rewards and organizational commitment.
- H6: There is a positive correlation between information sharing practices and organizational commitment.
- H7: There is a positive correlation between job security and organizational commitment. [12]

EMPOWERMENT

The word empowerment is a term that has taken on more importance over the years because company administrators have understood that truly committed and mature people can give more value to production processes; But to have such, they need to want and be satisfied. Below is shown from a psychological point of view, how you can work to bring employees to that required level of satisfaction to be able to confidently give the authority to make decisions and obtain their benefits.

Usually, there are three reasons people don't get the job done. Regardless of what reasons people may give, the answer may be one of these three:

1. They don't know how.
2. Something or someone keeps them from it.
3. They don't want to.

Highly motivated workers who work to their fullest potential while producing excellent quality and product, … This kind of work is called 'commitment.'

Every worker wants to feel good about doing his or her job. That's called "employee satisfaction." Employee satisfaction is made up of several factors, but they can be related to five levels of need (survive, security, belong, prestige and self-fulfillment) first described by a psychologist in the 1960s, Abraham Maslow. Maslow said that each person has the same needs and that we all spend each day satisfying one or more of those needs.

Ten qualities that people want most from their jobs

1. To work for efficient managers
2. To think for themselves
3. To see the end result of their work
4. To be assigned interesting work
5. To be informed
6. To be listened to
7. To be respected
8. To be recognized for their efforts
9. To be challenged
10. To have opportunities for increased skill development.

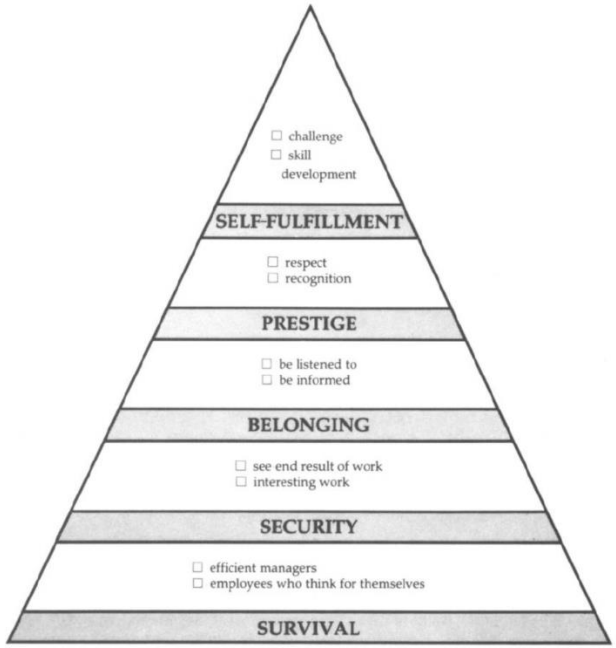


Figure 6. Qualities that people want most and Maslow five levels needs. *[13]*

Power and authority

To empower means to give power and authority to someone. That power can be defined as the power to judge, act and command.

Judge

The first phase of empowerment is to build good judgement. Empowered employees don't rise from the dust. They come from a work environment rich in a number of vital qualities, and shared information is one of them. The more information employees have about the company and its goals on a daily basis, the more they feel a part of the company and the better they are able to judge what works and doesn't work for the goals of the organization.

Act

The second phase of empowerment is to let the employee do the task. Judgement is in place because of good information and skill level and now it's time to act. The job has been described thoroughly. Now the performer takes off the runway. The supervisor stands back and watches. The wings wobble a bit, the flight pattern may not be quite clear, but the supervisor stands back and watches for self-correction.

Command

The worker needs to be able to respond to new situations and obstacles quickly– in short, to command. What does that mean? It means commanding needed resources, asking people to help, changing things that don't work. If the worker has been well-trained with the needed information, good judgement at this phase should be no problem. The best way to show this phase at work is for the supervisor to model it. The way the supervisor asks, explains, corrects, praises and thanks become the model for the others in the group. The better the model the better the results from others. " [13]

Benefits and concerns of empowerment.

FEATURES	BENEFITS	CONCERNS
1. Task is explained to employee and walked through process.	Employee learns new task, grows in skill. Someone is free to do other things.	Supervisor loses control.
2. Task is given to employee to complete, make decisions, take responsibility.	Employee learns to carry out tasks unsupervised:	Employee won't do it right. ("I'll get blamed.")
3. Employee repeatedly does task well.	Quality of work for company is repeated.	Employee will want more responsibility/money or will get bored.
4. Employee is given new tasks.	Loyalty, morale rises, productivity increases.	Supervisor or other person may be replaced.

Figure 7. Benefits of empowerment. [13]

BEHAVIOR

Not only the fact of working on the empowerment of people is enough for the business and personal growth of workers. It is also, as confirmed by the study: "HUMAN RESOURCES MANAGEMENT PRACTICES AND ORGANIZATIONAL COMMITMENT", explained above, a review of the performance of the activities carried out by the employee.

The focus on behavior, as we will be seeing in the following paragraphs, discriminates the fact of being able to change the person in terms of attitudes or personality and is outlined to the behavior that individuals take regarding the consequences of the actions taken.

This will make, almost naturally, the behaviors become habits and threaten the organizational culture, expecting positive results for the company and the worker.

When organizations face problems with costs, quality, productivity and attendance, these problems often stem from ineffective patterns of behavior that the organization is unwittingly encouraging. To prevent and stop these problems, a behavioral approach to managing people is often the most effective.

One advantage is that employees become aware of precisely what behavior is expected of them. It may be thought that employees are already aware of what behavior is required, but this is often not the case. This may appear strange, but it is, in our experience, very common. Even 'simple' jobs, such as that of a bartender or cleaner may benefit from an analysis in behavioral terms. It is, for example, often not clear as to whether bartenders, or their managers, are fully aware of what customers expect of a 'good' bartender. Young people, often students, are taken on as bar staff and put behind the bar with little or no instruction as to how to deal with customers. Managers often comment that 'it should be obvious' what is expected of them. One of the authors, tired of poor service, analyzed in behavioral terms what customers expected of a 'good' bartender. Talking to pub customers, it became apparent that one of the main annoyances, especially in crowded pubs, is getting noticed by the bartender so as to be served, hopefully, in your proper place in the queue. Often, in customers' perceptions, the bartender finishes serving a customer and then serves either the person standing immediately behind, or the one who shouts loudest, irrespective of whether or not it was their turn. A specification of the precise behaviors required was, therefore, suggested, that included the following. A good bartender:

1. acknowledges people arriving at the bar for service,
2. indicates to them their place in the queue, and
3. serves them in that order.

This was tried out by one of our post-graduate students who worked part-time in a bar. She followed the behaviors specified above to see what would happen. Although it was not possible to measure customer satisfaction directly, it was thought that the level of tips would provide an indirect indication of any change. She monitored, therefore, the level of tips before and after the behavior change. Until she implemented the change her tips had been very close to the average for other staff in the bar. Very shortly after the change was implemented her tips had tripled.

Just the correct specification of behavior may, therefore, lead to improved performance.

The danger of phrasing problems in personal, and global, terms is that problems expressed in this way are perceived as threatening. Such global descriptions are perceived as an attack upon the person's identity. If I am described as 'lazy' or 'selfish', for example, I may well resist this description of myself 'as a person' and respond accordingly. Such traits are relatively stable and difficult to change – hence the defensive reaction. If, on the other hand the problem is expressed in specific behavioral terms the threat is much reduced. To be told that what you did on a specific occasion made someone else feel under-valued is more useful. You may, for example apologize for the behavior, explain that it was not what you had intended, and promise that it would not happen again. As another example, we all, on occasion, behave stupidly. That does not, however, mean that we are stupid. Interestingly, in their training, teachers are often taught to 'criticize the behavior, not the child', a technique that parents, and managers, might be well advised to adopt. Concentrating on what people 'do' rather than 'who they are' may help overcome problems more easily.

Even positive generalizations may pose problems, as Carol Dweck (1999) has shown. Her research, and that of her co-researchers, has demonstrated the problems associated with praising children for being 'clever'. Whilst the child is doing well there are no problems. The problems arise when things go wrong, as they inevitably will. When the child is faced with failure, their self-perception of themselves as being 'clever' is threatened. As with personality, there is little one can do to improve one's 'cleverness'. The child may often, therefore, avoid such situations in the future, so as to avoid further threats to

their self-image. If, on the other hand, the successes are attributed to 'effort', rather than 'ability', then there is something they can do to improve their future performance.

On the positive side there may also be advantages to specifying the precise behavior required. For example, a law in England, dating from 1947, does not allow fireman, even if they are part-time, to serve beyond the age of 55. This is, presumably, because a fireman's job is very physical. This has meant, however, that the fire service has lost possible part-time recruits. In one situation a person was turned down because he was too old. This was despite the fact that he was an extremely fit marathon runner. Recruiting on the basis of what someone has to be able to do, rather than how old they are, is perhaps more sensible.

Assumptions

Over the years there have been many different sets of assumptions, concerning individual's motivation at work, made by managers (and by consultants and writers on management). These can be an arranged in a rough historical sequence, which is also one of increasing complexity.

- Motivations:
  - Rational/economic motivation: The underlying assumption is that people's motivation is entirely economic and that they are rational in the way they set about fulfilling their financial needs.
  - Social motivation: This lead to an emphasis in management on designing and rewarding effective work teams. This refers to the fact that any change in conditions will often give rise to (at least temporary) improvements in performance, even when there appears to be no logical reason for the change.
  - Self-actualization: … Maslow (1954) … to be highly motivated, people needed to feel that their work is worthwhile and that it contributes to their development. Under these assumptions effective managers have to make sure that their workers understand the importance of their tasks and how they fit into a larger whole, and design work that is meaningful and provides opportunities for development.

Motivation is complex. The reality is, of course, that all the above assumptions can be valid in different circumstances. It may well be that in the 1920s the most pressing need for many people was simply the need to obtain necessities for survival. As economic circumstances improved, other needs, such as affiliation, develop. To be followed later by esteem and self-actualization, as suggested by Maslow's (1954) hierarchy of needs. If motivation is looked at in this way, it becomes obvious that the whole of society is not at the same level at the same time, furthermore any individual will have different needs at different times, or several at the same time.

We have seen above how a manager's assumptions about people may well determine his/her approach to managing. This is linked to an aspect of psychology, which goes under the heading of attribution theory, which deals specifically with how we attribute causation to events.

Attribution theory suggests that there are two main types of explanation for the causes of behavior. This is the case whether we are considering management or any other context. The first of these two types of explanation is one that is accepted, almost without question, by the 'man in the street'. It is that a person's behavior is caused by characteristics such as their personality or their attitudes. Thus accidents, for example, are perceived as being caused by people being 'accident-prone', 'foolhardy', or 'negligent'. In attribution theory terms these explanations are referred to as internal attributions because they refer to internal characteristics of the individual concerned. Contrast this sort of internal explanation with the second type. This sees behavior as being caused not by internal, but rather by external factors. Because, as we will see, there is a strong tendency for us to prefer explanations of the first type, we will consider a little further the explanation of behavior as being externally caused.

- Personality: Unfortunately, if we see behavior as being caused by traits there is little that we can do to change them. A person's personality is very stable over long periods of time and is very resistant to change. Changing a person's personality is something that is likely to require expert help, a long time, and the commitment of the individual concerned.
- Attitudes: The relationship between people's attitudes and their behavior is less than perfect. … the relationship between attitudes and behavior is more complex than a simple 'attitudes cause behavior'. 'Attitude is the psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor.' Something stimulates a person's attitude, which then expresses itself in certain ways. These different ways in which the attitude expresses itself have typically been classified by psychologists into cognitive (thought), affective (emotional) and conative.
    - The effects of attitudes on behavior: The main reason that attitudes are considered important is that they are thought to be a strong, if not the strongest, influence in determining how people behave.
    - The effects of behavior on attitudes: There is, however, considerable evidence to show that, under certain circumstances, behavior can have a considerable influence on attitudes. There are two main theories that explain this effect, those of cognitive dissonance, and self-perception theory.
        - Cognitive dissonance theory: a discrepancy between attitudes and behavior will produce psychological tension. This tension will then produce a psychological drive, the purpose of which will be to reduce, or eliminate, the tension. If you want to induce attitude change, get the person to undertake behavior at variance with their attitude. But in doing so, make as little use of external inducements as possible. In this way the person will not be able to justify their behavior to themselves in terms of the inducements. Their only option is to change their attitudes.
        - Self-perception theory: Suggests that we infer our own attitudes in much the same way as we infer the attitudes of others – by observing our own responses to the attitude object and then inferring what our attitudes must be!

Traditional approaches to changing behavior

As might be expected these have mainly been aimed at changing employee attitudes, something that it is extremely difficult to do, or at enhancing motivation.

- Training: One problem with all training is that it is completely ineffective unless the individual(s) concerned really want to be involved. They must want to acquire the skill that is being developed. Training is a cooperative activity requiring the active participation of both the trainer and the trainee. If the trainee does not wish to participate little learning will take place.
- Coaching: is usually aimed at practical issues such as developing future plans or developing specific skills. It can be very effective since it overcomes many of the disadvantages of training programs. There is usually a high level of involvement and activities can be tailored to suit the individual. This is a good way of dealing with specific issues for the individual manager, but would be far too expensive, in most cases, to use widely throughout an organization.
- Counselling: The advantages and disadvantages are similar to those for coaching. Both are very dependent on the skill of the coach or the counsellor and on the willingness of the individual to acknowledge possible deficiencies and their willingness to work at improving them.
- Mentoring: Can be an effective method for developing staff, but depends on the commitment, skill and knowledge of the mentor. A good mentor will provide both coaching and counselling.

- Incentive schemes: Many organizations use various sorts of bonus systems to reward good performance. These are based on the superficially sensible idea that if people see that there is a reward for good performance, they will be more highly motivated.
- Punishing poor performance: Suffice it to say here that it is a very problematic area and is unlikely to be effective. For legal reasons it is also extremely difficult to apply any sort of sanctions in organizations so that it is now rarely if ever used.
- Getting rid of poor performance: If individuals who are not performing can be removed from the organization this does, at first sight, seem to solve the problem. However, there could again be considerable legal difficulties and costs involved. There is also another factor: the organization has possibly invested considerable time and money in recruiting the individual, there may also have been training costs and investment in salary paid. It seems a pity to lose all this if there is an alternative.

Habits

What are far more important, from a behavioral perspective, are habits. Much of our day-to-day behavior is controlled by habits. This means that we do not have to consciously think about our behavior – it comes almost automatically. Driving is a common example of behavior that is largely under the control of habits. These habits have to be learned but once acquired, we can carry out the required behaviors almost without thinking about them. Put simply, habits are learned. It is, in fact, an assumption of behaviorism that the vast majority of our behaviors are learned, rather than being instinctive. Assuming that most behaviors are learned can give us some optimism about the possibility of changing inappropriate behaviors. If behavior is learned it can also be unlearned, and new, more appropriate, behaviors put in their place. The important question is, therefore, how behavior is learned.

…in operant conditioning the behavior is influenced by the events that follow it…

Consequences are at the heart of operant conditioning. Indeed, a single phrase which perhaps encapsulates the central premise of behaviorism is that 'behavior is a function of its consequences'. Whether or not a behavior will be repeated and become habitual or whether it will stop, rarely to appear again, will depend upon the consequences that follow the behavior. This can be summed up fairly easily in two, apparently obvious, statements.

- Only behavior that is rewarded will continue.
- Behavior that is not rewarded, or is punished, will cease.

Types of consequences

Behavior is a function of its consequences and consider what consequences are possible, and how they might be summarized. These consequences can be that, as the result of behaving in a particular way:

1. we receive something nice.
2. something nasty is taken away.
3. something nice is taken away.
4. we receive something nasty.

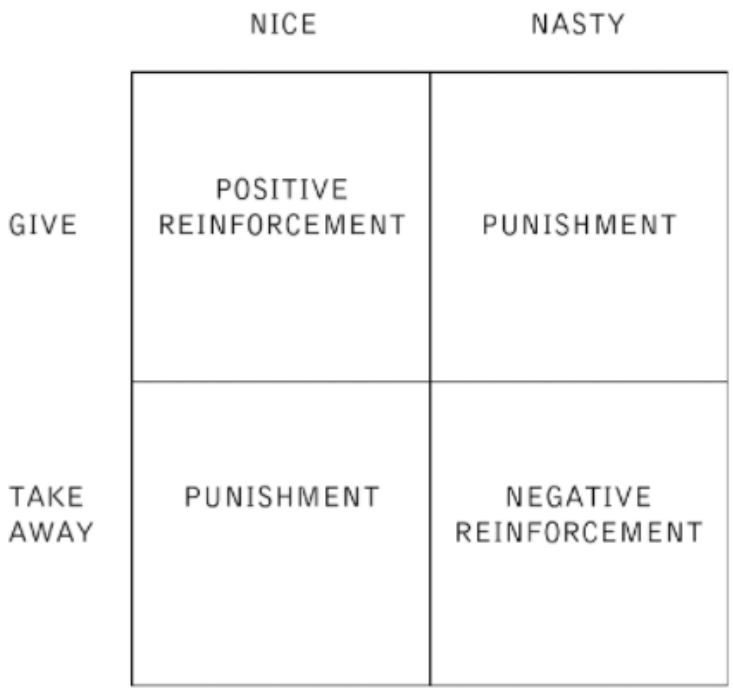


Figure 8. Types of consequences. *[14]*

It is important to realize that reinforcement, by definition, leads to behavior either being maintained or increasing. Reinforcement leads to behavior being reinforced!

Positive Reinforcement:

Most people, we find, are fairly happy with positive reinforcement, it is, perhaps, common sense that people will tend to repeat behaviors for which they have received something nice.

Negative Reinforcement:

We find it unpleasant when a baby cries. If, by picking the baby up, we stop it crying, we will pick it up the next time it cries. Stopping the crying negatively reinforces our behavior of picking the baby up, as it stops the nastiness.

At a very basic level eating when hungry is as example of negative reinforcement, as is taking an aspirin when you have a headache. In both cases unpleasant feelings stop as a result of the behavior.

Punishment:

A good example from everyday life is of imprisonment, which combines both the two forms. It can either be seen as receiving something nasty (the prison environment), or the taking away of something nice (freedom). Unfortunately, however, imprisonment also provides a good example of why punishment is often an ineffective technique for changing behavior.

Almost all managers will own up to regularly driving above the legal speed limit and occasionally going through traffic lights on 'deep amber'! Both these behaviors are, of course, illegal and can be punished by fines (removal of something nice), or points on the driving license (getting something nasty), and yet they continue. What does stop such behaviors is the presence of traffic cameras that are known to be operative. Most of the time drivers make the quite reasonable assumption that the possibility of them getting caught is very low. The presence of cameras, however, increases the certainty of being caught very considerably. The certainty of being punished has an important influence on behavior.

This is a very important point for anyone who is trying to reduce or eliminate undesirable behavior. Unless the behavior can be punished every time it occurs the punishment is unlikely to change the behavior. In most cases, therefore, punishment is not an effective way of trying to change behavior.

…The general rule is that the more immediate the consequence, the more effect it will have. This applies to both positive and negative consequences.

…what initiates the behavior. As we have seen, much of our behavior is habitual, and often carried out with a minimum of conscious effort. Habits are, therefore, often very efficient. Complex patterns of behavior can be executed automatically, allowing attention to focus on the new or unusual. Obviously, however, the habit needs to take place only when the circumstances are appropriate. Part of the learning of a new behavior pattern, therefore, involves recognizing the environmental cues that indicate that the new behavior pattern is appropriate. In behavioral theory these cues are usually referred to as antecedents, as they occur before the behavior. They are also referred to as antecedents so as to make a nice mnemonic ABC – antecedents, behavior, consequences.

In behavioral terms, however, antecedents are much more precise. In behavioral terms an antecedent is something that not only comes before but also initiates (or inhibits) the behavior. Many events will precede a particular behavior, but only a few will be the cues that trigger it.

Motivational effects of attribution

Weiner (1985) has suggested that attributions can have a motivational effect. This effect is the result of the emotions generated by our attributions for success or failure.

For most people, attributions associated with success are easiest to explain. These are normally internal attributions such as ability and/or effort. The first 'primitive' emotion of happiness is followed, therefore, by a feeling of pride. If others were perceived as having helped, feelings may also be of gratitude. Attributions for failure, on the other hand, are rather more complex and, it could be argued, more important in managerial terms.

Using Cognitive influences to improve performance

… self-efficacy, have an important influence on performance. One of the major ways in which self-efficacy has these effects is through its influence on the goals that people set for future performance. The setting of these goals, and the development of plans for their achievement, plays an important part in self-management. Whilst self-management techniques can be used in order to achieve goals we have been set by others, in many cases self-management involves deciding what these goals shall be. The setting of goals requires therefore:

- choosing what goals and standards to apply
- preparing a plan of action
- taking action
- evaluating the results of the action.

Changing culture

- … culture change is a long and complicated process and will take time.
- … best done in a series of steps or stages, gradually moving from the existing culture to the new.
- Define the behavior which will characterize the culture you are trying to create.
- How can the new behavior be reinforced? What existing behavior needs to change?
- What reinforcement is keeping this going and how does this need to be changed?
- Identify the best place to start – which section or department is likely to respond best to the planned changes?
- Determine how best to extend the project through the organization. In what sequence will departments become involved?
- Remember that the whole project will be much more likely to succeed if employees are involved at all stages. They should participate in defining the behaviors and in the methods of reinforcement. This will involve some training in the theory and techniques of the behavioral approach.
- Finally, be prepared for the project to evolve and change as time goes on. This will be particularly so, as more people become involved and make contributions.

Applying the behavioral approach

1. identify the behavior;
2. measure the behavior;
3. functionally analyze the behavior, i.e. identify the consequences and antecedents of both the desirable and undesirable behaviors;
4. intervene to change the behavior;
5. evaluate to determine whether or not behavior and performance have changed in the desired direction. [14]

DIGITALIZACION

In the current era, it is very difficult to think that we can work without the benefits that technology brings, and it is therefore essential to join industry 4.0; by gathering information, analyzing it and getting the most out of it and in the fastest way. This way the company will be able to be more competitive in the market because it will be using all its resources in the most efficient way:

> Digital Manufacturing (DM) has evolved from Computer Integrated Manufacturing (CIM), which was developed in the 1980s when the reduced cost of computing meant computers could be used extensively for machine and automation control, planning and scheduling. CIM has worked as a connection between manufacturing, systematic science, and other related issues, and these merge into the manufacturing industry. From the combination of organizational sciences, such as Total Quality Management, Concurrent Engineering and Lean Manufacturing; with engineering science of CIM emerged the concept of digital manufacturing that highlighted the need for a more collaborative product and process design. …the so-called 'nine pillars of technological advancement', encompass: Additive Manufacturing, Autonomous Robots, Big Data & Analytics, Cloud, Cybersecurity, Horizontal and Vertical System Integration, Internet of Things, Digital Simulation, and Augmented Reality. These technologies are directly or indirectly related to DM at different stages of the manufacturing life cycle, and impact it in terms of design, implementation, use or management.

Cloud

> The emergence of cloud computing represents a fundamental change in the way IT services are developed, deployed, scaled, updated, maintained, and paid for. Cloud computing is a style of computing where scalable and elastic IT-related capabilities are provided as a service to external customers using Internet technologies [15,16]. The National Institute of Standards and Technology (NIST) define the following three service models related to cloud computing also known as the SPI model: Software as a Service – SaaS; Platform as a Service – PaaS; and Infrastructure as a Service – IaaS. IaaS provides users with computing and network resources such as high-performance servers, cloud storage, and wireless networks. PaaS provides a development environment or a platform that allow users to develop and manage cloud-based applications without building and maintaining the infrastructure. The main role of cloud technology in DM is to enable data to be collected, processed, treated, and accessed in an integrated and real-time manner. It has been used as the basis for several DM systems and life cycle stages covering, from product engineering and plant design, where it has a role of intra-departmental and intra-organizational integration, to ramp-up for operation and production management phases, where the cloud supports collection and makes data available in real-time for simulation, commissioning, and operations management.

Big data and analytics

> The manufacturing industry generates more data than any other sector. The more complex a manufacturing operation is, the higher value is captured from big data and analytics. Operations managers use advanced analytics to explore historical process data, identify patterns and relationships among discrete process steps and inputs, and then optimize factors that have the greatest effect.
>
> …many manufacturing plants possess an abundance of real-time shop-floor data and the capability to conduct sophisticated statistical assessments. Instead of backwards-looking reporting on past events, data is being used to predict trends and anticipate needs. Moreover, vertical, and horizontal value chain integration increases data accuracy. A single source of data across all applications can provide reliable and actionable real-time information and more seamless communication among supply chain partners as well as across product generations. One key role of analytics in DM is to correlate data to verify the influence of certain variables (not necessarily pre-selected) in the production system. This helps scenario modelling by correlating otherwise unseen variables. It also provides conditions for analyzing existing patterns (such as process and resource failure), to improve predictions of simulation models. [15]

CHAPTER III. HIGH-PERFORMANCE WORK TEAM PROPOSAL MODEL

METHODOLOGY

Next, I will describe the way in which the problem was identified, the proposed solution to it, the results of the tests in the pilot areas and the improvements to the proposed system, through the Design Thinking methodology:

- Define the problem: Detection of what are the core problems of the claims thru the proposed Model of Systemic Causes Prioritization.
- Empathize: Understanding of the current systems for continuous improvement and effectiveness in operational personnel at Schaeffler Puebla.
- Ideate: Proposals of the system improvement effectiveness.
- Prototype: Experimenting with the proposed solution system in pilot trials.
- Test: Higher scale testing and improvement of proposed systems.

a. DEFINE THE PROBLEM

As previously mentioned, during 2019 and 2020, 49 complaints were recorded in the company's lessons learned data base, mostly from external customers. For each one of them, a root cause analysis was carried out, permanent actions were performed, and they were verified to prevent them from happening again; yet again and again they repeated themselves. The problem did not lie in how they solved the problem, or what robust actions they implemented, because they were repeated in different productive areas of the corporate; this pointed to a systematic problem. But it was not only a systematic problem, because there are already current procedures in the corporate that try to mitigate each of them, but also their effectiveness.

Below is a model developed by the author of this document to calculate the prioritization of systematic causes to propose global solutions that mitigate them.

The model consists mainly of obtaining information on the claims, their causes, the current procedures that mitigate them and the operational or administrative levels that are involved in each one of them, then classifying them by the aforementioned items, giving them a weight according to the number of claims involved and finally summarize the data already quantified as shown in Figure 9.

MODEL OF SYSTEMIC CAUSES PRIORITIZATION

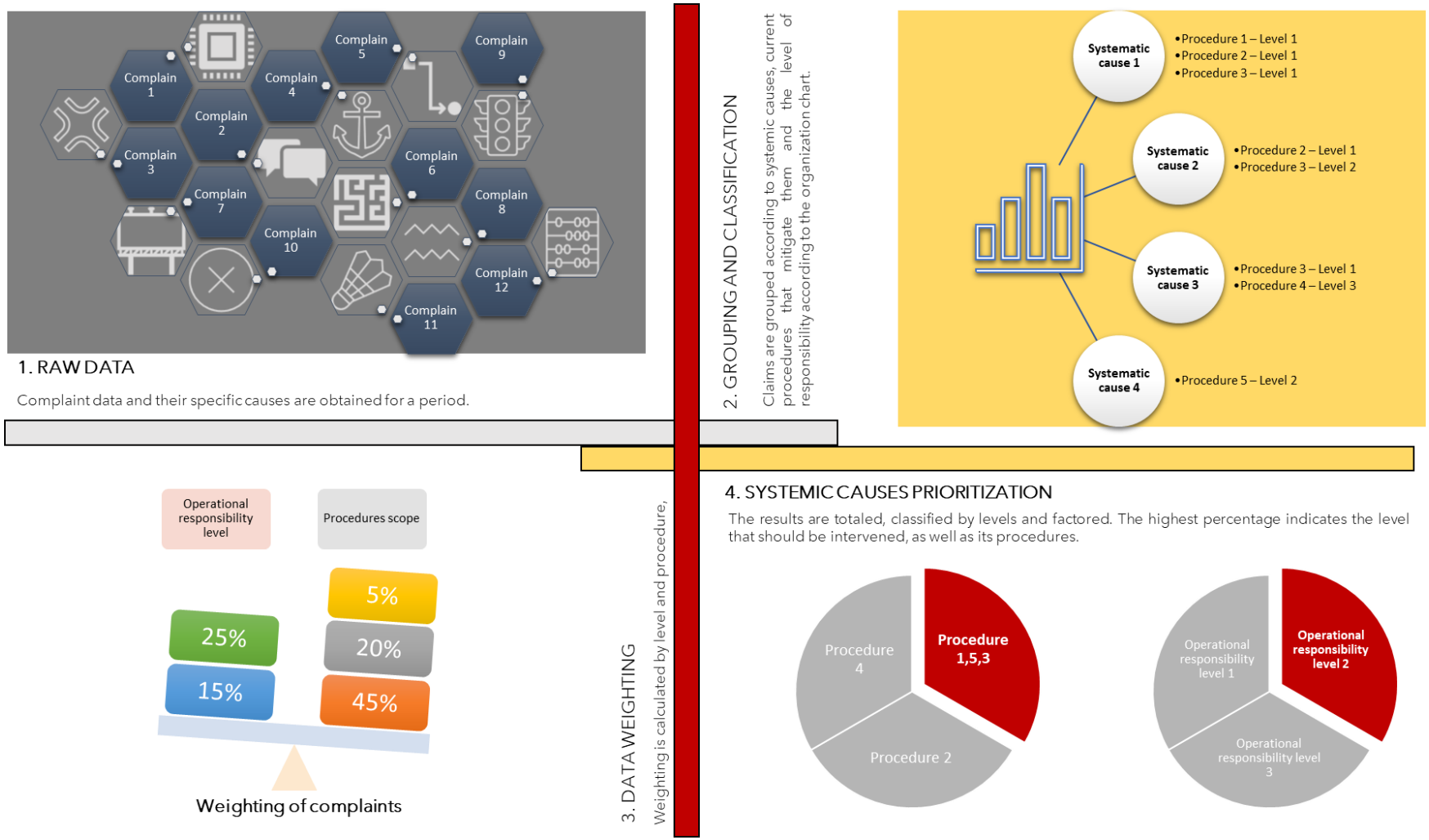


Figure 9. Overview of the Systemic Cause Prioritization Model (own elaboration)

Once the phased model is understood, Figure 10 shows the step-by-step detail as an example. This same model will be applied to the case study.

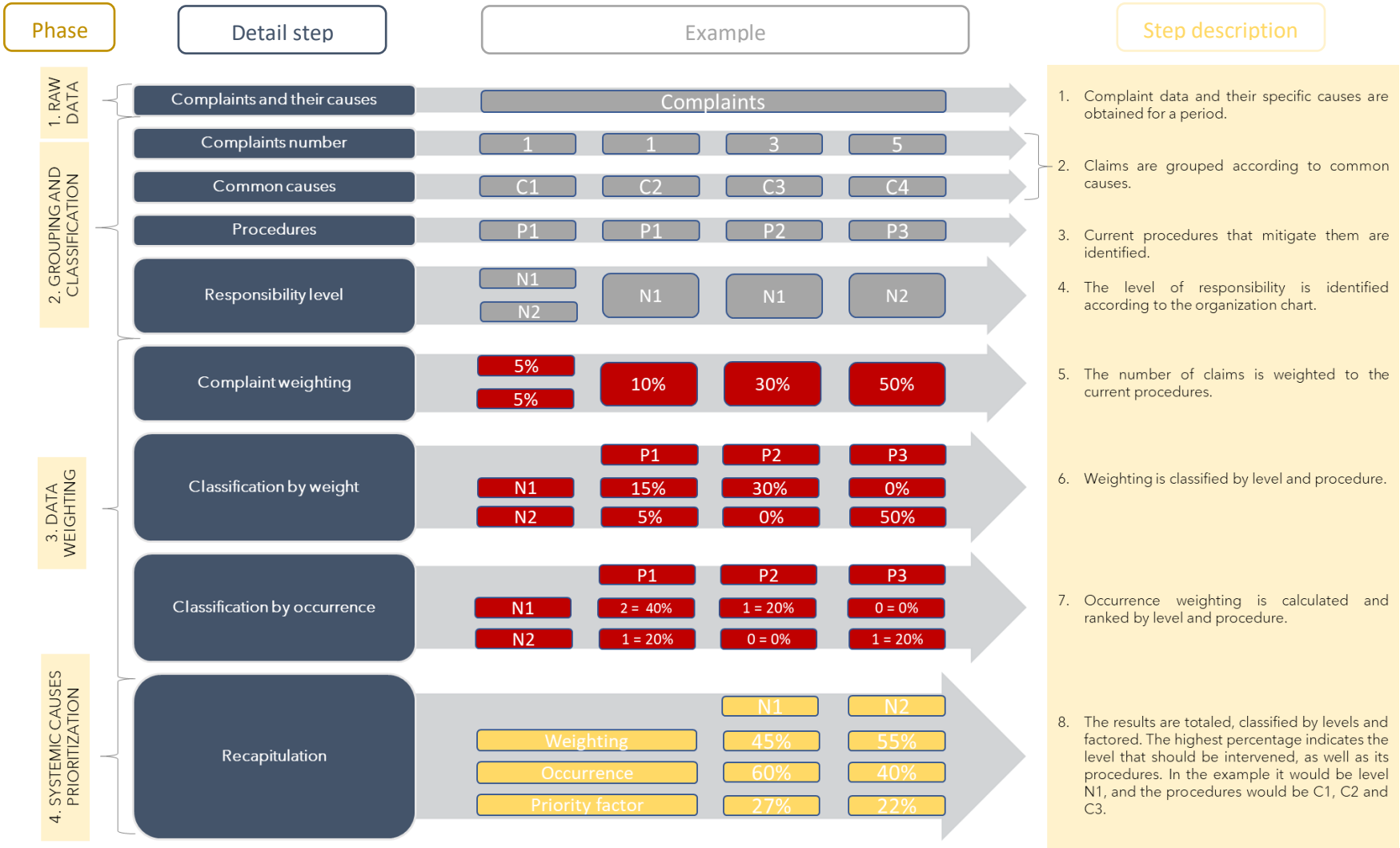


Figure 10. Example of the Systemic Cause Prioritization Model (own elaboration)

Table 1 shows the causes of the grouped claims. These claims were classified into 6 common causes and the percentages come from the total number of claims: 49 in a two-year period. These first data will serve as the basis for the other calculations that will be described below.

Complaint descriptions	Instructions were missing, unclear, or not followed correctly.	Lack of maintenance or follow-up to previously reported failure.	Incorrect, wrongly taken, or unknown tool/parameter.	Improper material handling, mixing of components and/or assemblies	Failures in PFMEA, DFMEA or drawings were not considered.	Process changes or instructions without notifying those involved.
Common causes	Non-specific instructions.	Lack of follow-up to known topic / omission.	Incorrect parameters / tools.	Problems with material flows.	Failures not identified in time.	Lack of communication.
Quantity	11	11	8	8	7	4
Percentage	22,4%	22,4%	16,3%	16,3%	14,3%	8,2%

Table 1. Common causes of external claims (Own elaboration).

Phase 2: Grouping and classification

The current procedures whose objective is to avoid the common general causes were identified (a Boolean evaluation is considered, 1 for those that are related and 0 for those that are not as shown in Table 2).

	Common causes	Non-specific instructions.	Lack of follow-up to known topic / omission.	Incorrect parameters / tools.	Problems with material flows.	Failures not identified in time.	Lack of communication.
	Quantity	11	11	8	8	7	4
	Percentage	22,4%	22,4%	16,3%	16,3%	14,3%	8,2%
Current Applicable Procedures	Process release / Product release	0	0	1	1	0	0
	Identifications / documentation	1	0	1	1	0	0
	Operative training	1	1	1	1	0	0
	Daily failure monitoring	0	1	0	0	0	0
	Communication	0	0	0	0	0	1
	PFMEA/DFMEA	0	0	0	0	1	0

Table 2. Identification of current procedures that help control common causes in the quality management system, marked in orange (Own elaboration).

Afterwards, the responsibility of each procedure was identified according to a level (Operator, support, or shared area) and its weight in the common causes of complaints, as shown in Table 3.

			Direct responsibilities:		Operator	Support areas	Shared	
	Common causes	Non-specific instructions.	Lack of follow-up to known topic / omission.	Incorrect parameters / tools.	Problems with material flows.	Failures not identified in time.	Lack of communication.	Weight of each procedure per claim
	Quantity	11	11	8	8	7	4	
	Percentage	22,4%	22,4%	16,3%	16,3%	14,3%	8,2%	
Current Applicable Procedures	Process release / Product release			1	1			2
	Identifications / documentation	1		1	1			3
	Operative training	1	1	1	1			4
	Daily failure monitoring		1					1
	Communication						1	1
	PFMEA/DFMEA					1		1

Table 3. Identification of responsibility by level (light blue-operational, strong blue-support areas, purple-responsibility shared between the operational and support levels) (Own elaboration).

In the same way, according to the percentage of claims due to common cause, each procedure that mitigates it was divided into equal parts, as shown in Table 4.

			Direct responsibilities:		Operator	Support areas	Shared	Weight of each procedure per claim
	Common causes	Non-specific instructions.	Lack of follow-up to known topic / omission.	Incorrect parameters / tools.	Problems with material flows.	Failures not identified in time.	Lack of communication.	
	Quantity	11	11	8	8	7	4	
	Percentage	22,4%	22,4%	16,3%	16,3%	14,3%	8,2%	
Current Applicable Procedures	Process release / Product release			5,4%	5,4%			2
	Identifications / documentation	11,2%		5,4%	5,4%			3
	Operative training	11,2%	11,2%	5,4%	5,4%			4
	Daily failure monitoring		11,2%					1
	Communication						8,2%	1
	PFMEA/DFMEA					14,3%		1

Table 4. Average weighting of the claim percentage between the number of procedures involved (Own elaboration).

In summary, we have from the occurrence perspective that 50% of the claims (25 claims), fall directly on the activities that are under the responsibility of the operator, 33% (16 claims) share the responsibility with the support area and 17% (8 claims) falls directly on the support area.

In the same way, but from the weight perspective, the impact where the operational level is involved is 38% (19 complaints), 39% (19 complaints) is shared between the operational level and the area support and 22% (11 claims) of the support area as shown in Table 5.

		Total	Operator		Support areas		Shared	
	Focusing		Occurrence	Weight	Occurrence	Weight	Occurrence	Weight
	Percentage	100%	50%	38%	33%	39%	17%	22%
	Equivalent Quantity	49	25	19	16	19	8	11
Current Applicable Procedures	Process release / Product release	2	2	10,9%				
	Identifications / documentation	3	1	5,4%	2	16,7%		
	Operative training	4	3	22,1%	1	11,2%		
	Daily failure monitoring	1			1	11,2%		
	Communication	1					1	8,2%
	PFMEA/DFMEA	1					1	14,3%

Table 5. Summary of the impact by occurrence and weighting (Own elaboration).

As a result, the project approach is based on the highest percentages of the occurrence factor (O) * Weighting (W), that is, in the procedures that involve shared activities and those of the operator individually, as shown in Table 6. In addition, a 77.6% reduction in the number of claims is expected as shown in Table 7.

	Operator		Support areas		Shared	
	O	W	O	W	O	W
Percentage	50%	38%	33%	39%	17%	22%
Factor (O*W)	19%		13%		4%	

*Table 6. Factor O*W to determine priority study groups (Own elaboration).*

Common causes	Non-specific instructions.	Lack of follow-up to known topic / omission.	Incorrect parameters / tools.	Problems with material flows.	Expected reduction in the number of claims with the project implementation
Quantity	11	11	8	8	38
Percentage	22,4%	22,4%	16,3%	16,3%	77.6%

Table 7. Projection of the benefit by mitigating the common causes (Own elaboration).

By identifying the common causes, we also identify the procedures to study. The new O*W classification is then as described in Table 8.

		Direct Responsibilities:			
		Operator	Shared (operator and support areas)		
	Common causes	(1) Non-specific instructions.	(2) Lack of follow-up to known topic / omission.	(3) Incorrect parameters / tools.	(4) Problems with material flows.
Current Applicable Procedures	Process release / Product release				
	Identifications / documentation				
	Operative training				
	Daily failure monitoring				

Table 8. new classification of procedures, causes and levels of responsibility based on the proposed model of prioritization of systematic causes (Own elaboration).

With the above, we then see the claims not only qualitatively but quantitatively and where more than 70% of our claims come from activities that are not completed on the production floor despite being documented in internal procedures. But what is the cause that does not allow our procedures to be totally effective?

b. *EMPATHIZE*

Current corporate systems

To answer this question, it is necessary to know how the current corporate systems in Puebla are developed and interrelated. And to do so, I will summarize the common causes of complaints in 2:

A. The following of instructions (1), correct parameters (3) and flows and identification of materials (4), described in table 4 (which are shared by the operational and support levels). Those are a matter of training and compliance with instructions.
B. The monitoring of failures is a matter of monitoring capacity, involvement and commitment in the production floor and support areas.

Current operator efficiency system

a) Training and compliance with work instructions.

1. The way in which the operational staff development system works has to do with:
   i. the time they have been working in the company,
   ii. theoretical knowledge of the machines that operate,
   iii. general theoretical knowledge of the company and other topics and
   iv. the good or bad attitude they present.

   all this in established periods of time. The result of these items determines the level of the operator and therefore its annual leveling as shown in Figure 11.

2. Regarding the training, the topics that will be taught by the operators are planned and if any extra is requested by the superior of the operators, it is programmed.

Advantages: There is a ranking that evaluates theoretical knowledge and years of experience, which results in a theoretical preparation of the operator. The operator can be trained with general and specific topics in the plant regardless of the current ranking.

Disadvantages: The practical part is not evaluated on the production floor; this causes inconsistencies between an operator who contributes more and one who contributes less on the line; the way of evaluating gives an unrealistic perception of the value of the operator for the company. The operator is not trained according to his real need.

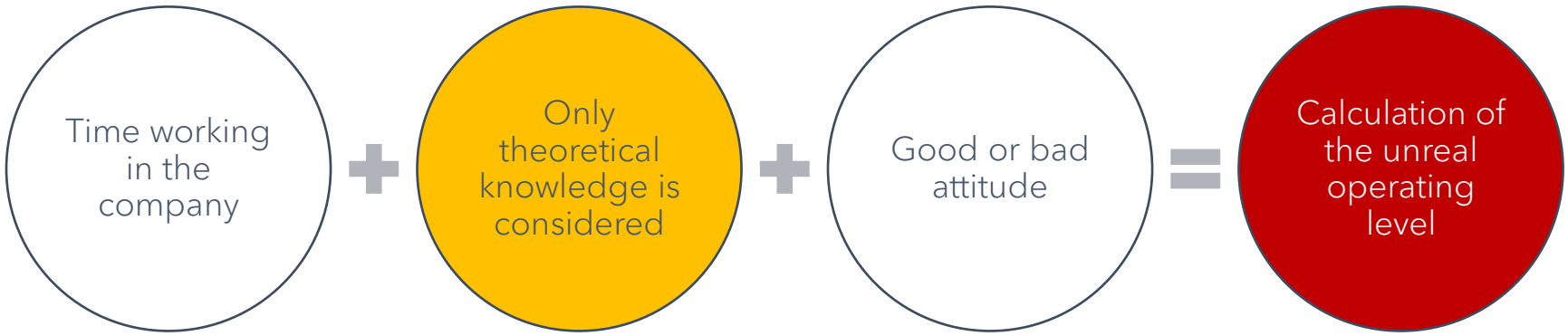


Figure 11. Diagram of the current operating level calculation (Own elaboration).

Conclusion: the current operator efficiency system doesn't evaluate the adequate operator attributes, which affects directly to the manufactured product and cause:

- operator performance is not focus to the corporate objectives.
- training courses don't satisfy the real operator training needs.

Current problem-solving system

b) Capacity to monitor failures.

1. There is a system that drives the operational staff mainly to detect problems in the product that could not be detected by the current controls:
    i. Operator finds a defect.
    ii. Containment actions are carried out.
    iii. The operator is rewarded (virtual coins).

2. There is a system that helps carry out containment actions and with which tasks are followed up through emails:
    i. A problem is found.
    ii. Containment actions are carried out.
    iii. A decision is made about the material.

3. There is an escalation and management system for problems on the floor. They are mainly based on informative meetings and display of indicators. Task cards are also created for those responsible and if there is a more complex issue, a PDCA is started.
    i. There is some problem or indicator out of goal.
    ii. Tasks are created to solve it.
    iii. Improvements in indicators are expected.
    iv. Topics are escalated.

4. There is a system that when there is an internal claim or between plants, depending on its severity, a PDCA or 8Ds is opened to resolve it. Currently a database is managed in excel.
    i. Claim.
    ii. Containment actions.
    iii. Permanent actions.

5. In the SAP system we place deviations, and our system indicates that there must be a person in charge, actions to avoid the failure and a commitment date.
    i. Deviation is made.

ii. Risk is assessed.
iii. The customer is informed.
iv. The cause is solved.

6. There is a layered audit system that consists of distributing the areas of the company with different audit levels where findings and those responsible are assigned.
    i. An area is audited.
    ii. Findings are assigned to a person in charge.
    iii. Finding is closed by placing the action.

7. There is a system that encourages employees to introduce improvement ideas that have a positive impact on the process or product, receiving a bonus for their contributions.
    i. There is an area of opportunity.
    ii. A person responsible for implementation is assigned.
    iii. The operator is rewarded.

Advantages: There are identification and containment measures that avoid sending non-standard parts to the customer, there are methodologies to solve the root cause of problems and audits to verify the documentary status of the production lines.

Disadvantages: Mostly it focuses on the identification and containment of failures without giving too much importance to permanent actions and their verification as shown in Figure 12. When more complex analyzes must be carried out, the same system makes the monitoring fall to a single collaborator, who generally does not have the hierarchical capacity or time to complete the analysis in its entirety.

Figure 12. Diagram of the current failure management system (Own elaboration).

Conclusion: the current problem-solving system doesn't contemplate the step by step follow up failures closely, which cause that:

- only containment actions are performed.
- isn't easy to handle each failure appropriately.
- failures are repetitive.

After identifying the systematic problems, we will center them in the users [7] and also reinforce their behavior [14] to eliminate the common causes of customer complaints as shown in Table 9.

Common causes of complaints:	Training and compliance with work instructions.	Capacity to monitor failures.
Problem statement in a systemic manner:	the current operator efficiency system doesn't evaluate the adequate operator attributes, which affects directly to the manufactured product and cause: • operator performance is not focus to the corporate objectives. • training courses don't satisfy the real operator training needs.	the current problem-solving system doesn't contemplate the step by step follow up failures closely, which cause that: • only containment actions are performed. • isn't easy to handle each failure appropriately. • failures are repetitive.

Problem statement in a human-centered manner:	The operator's behaviors and growth interests need to be aligned with the company's objectives.	At each stage of problem solving, all contributions from the responsible multidisciplinary team need to be completed and timely.
Global task:	Create a solution in the current system where the operator's skills can be harnessed and rewarded, and their weaknesses can be properly addressed and trained.	Create a solution in the current system where all the support areas can collaborate in each of the problems, from the failure report to the verification of the efficiency of the actions.

Table 9. Systematic and human-centered manner problem statements.

c. *IDEATE*

Once we knew the problem statements, below are shown some ideas to create the solutions we needed to eliminate the common complaints causes:

We are going to start with the common cause: Training and compliance with work instructions.

The question might be, how can we create a solution where, through operator skills, their growth interests are highlighted, and behavior aligns with company goals?

The ideas to solve the problem are shown in Figure 13.

About the common cause: Capacity to monitor failures.

The question might be, how can we create a solution where, through an effective collaboration and a follow-up, the failures reported can be closed appropriately?

The ideas to solve the problem are shown in Figure 14.

ADVANTAGE	IDEA
The real objectives of production are considered.	• The practical part is considered in their evaluations, not just the theoretical one.
The time factor allows operators to be always alert.	• Practical evaluations can be divided into timeless and temporary, where the input of the timeless ones comes from audits, casual findings, ideas for improvement, etc., and the temporary ones are scheduled.
Paperless and save time to capture data and avoid capture errors.	• Be a digital platform.
More objective weighted evaluations.	• The evaluations are weighted: The theoretical part 20%, temporary practical part 80%, timeless practical part will have extra scores (positive or negative).
Genuine knowledge is assured.	• Theoretical evaluations can have mobile answers to prevent cheating.
Fair and transparent treatment for operators.	• Operators will have to digitally sign to agree to the results.
Trends can be seen, and areas of opportunity can be detected for certain individuals or for entire groups to schedule appropriate training.	• Data can be viewed by department or operator.

Figure 13. Ideas to solve the question: how can we create a solution where, through operator skills, their growth interests are highlighted, and behavior aligns with company goals?

Ideas to create a solution for the common cause: Capacity to monitor failures.

ADVANTAGE	IDEA
Paperless and a generation of a database to centralize all the information.	• Be a digital platform and that it be used by all plant people in the shopfloor.
Having a close follow-up of each reported failure.	• It is possible to know the progress by phase of the problem, to assign tasks by responsible and having automatic reminders and that can be escalated to different people.
Easy visualization of the failure status to identify and take right decisions.	• Graph the number of failures, their status and the economic impact of each of them.
Giving the required importance to each of the reported failures.	• Keep the entire team informed that there is a new failure and when the claim is closed.

Figure 14. Ideas to solve the question: how can we create a solution where, through an effective collaboration and a follow-up, the failures reported can be closed appropriately?

d. *PROTOTYPE*

Two applications mainly were used to perform the prototypes, PowerApps and Power BI (among other from Microsoft package).

Work team effectiveness management

The project of the common cause: Training and compliance with work instructions was named "Work team effectiveness management". The prototype started with a simple interface where the support team registered some contributions or findings by operator as shown in Table 10. This gathering data was at machining production area (fifteen operators were audited and three took the theoretical test) and in this prototype phase there were 326 app versions to fulfill the user experience feedback.

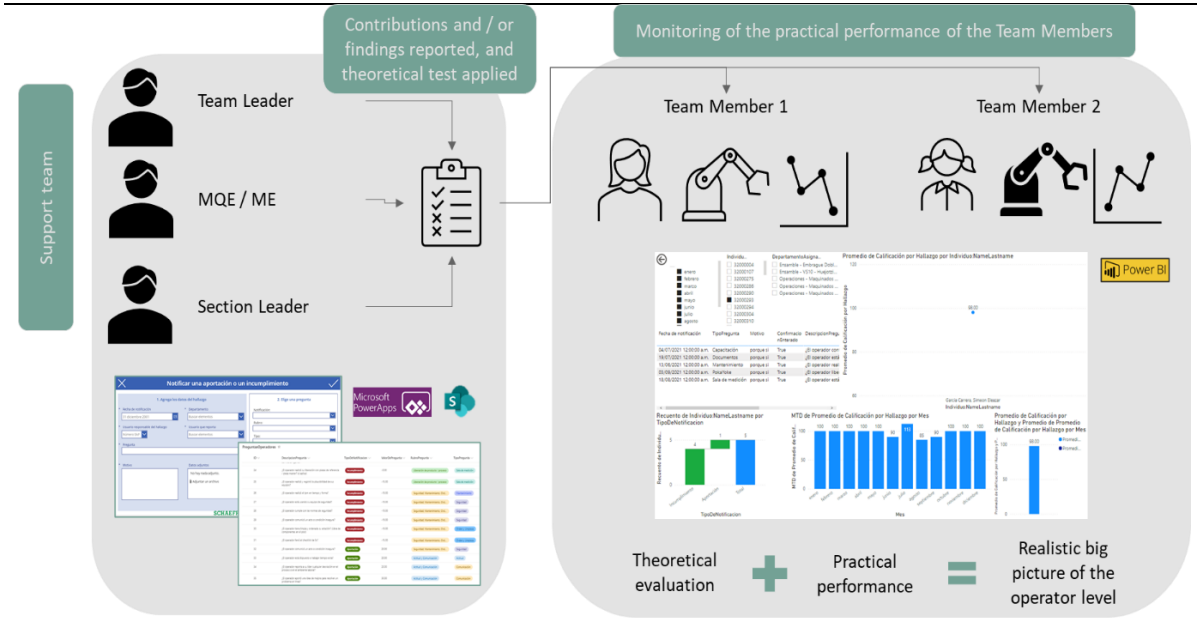
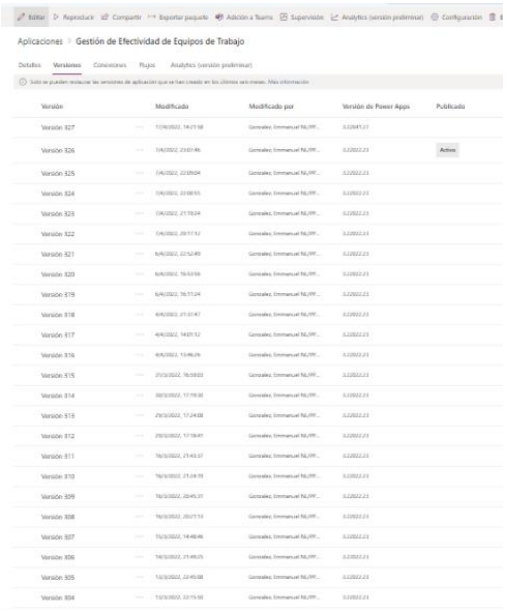
Prototype proposal	Versions history (from PowerApps platform)
	

Table 10. Work team effectiveness management prototype

The project of the common cause: Capacity to monitor failures, was named “Failure management”. The prototype started with a simple interface where an affected department opened a claim and through a distribution list, inform all the people of the responsible department, which started to find the root cause and propose actions with reminders help. After that the actions proposed were checked and a lesson learned was completed, as shown in Table 11. This gathering data was at assembly production area (two failures were tested) and in this prototype phase there were 376 app versions to fulfill the user experience feedback.

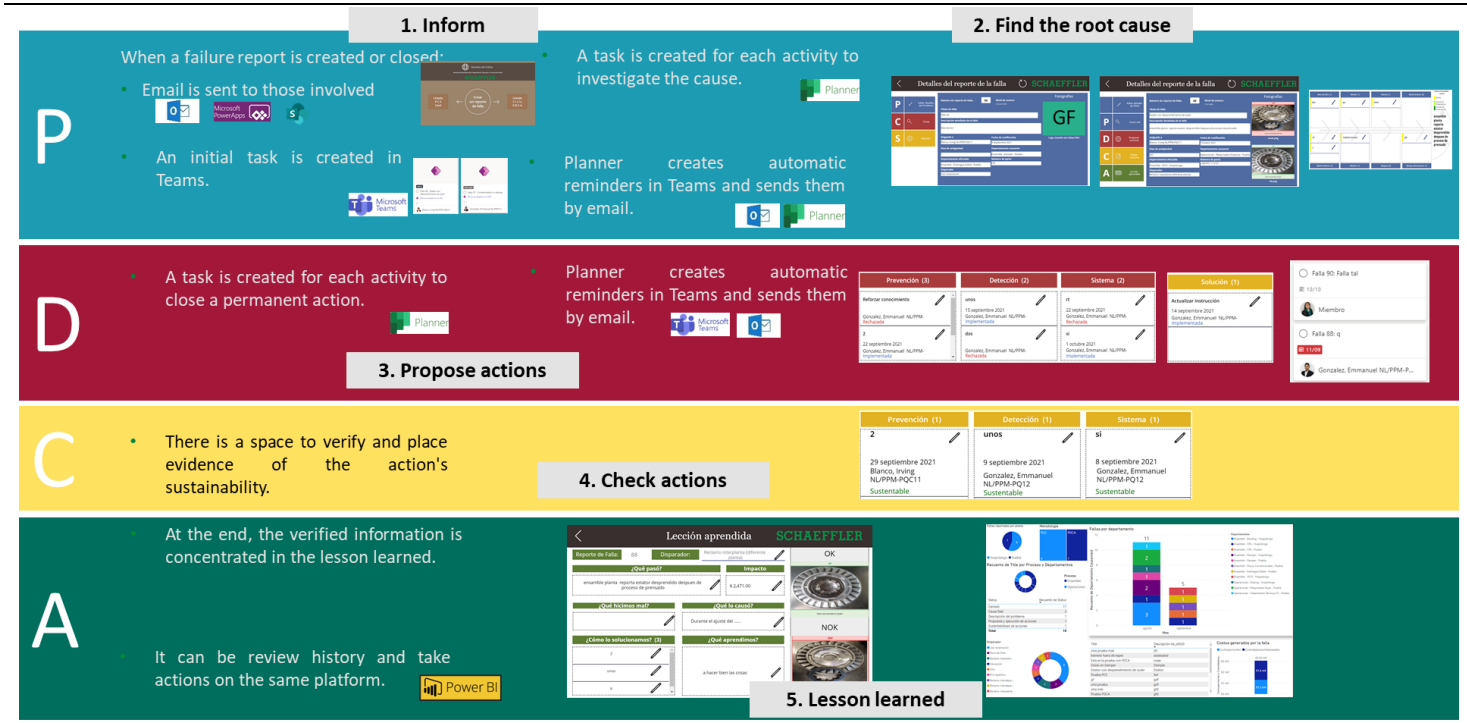
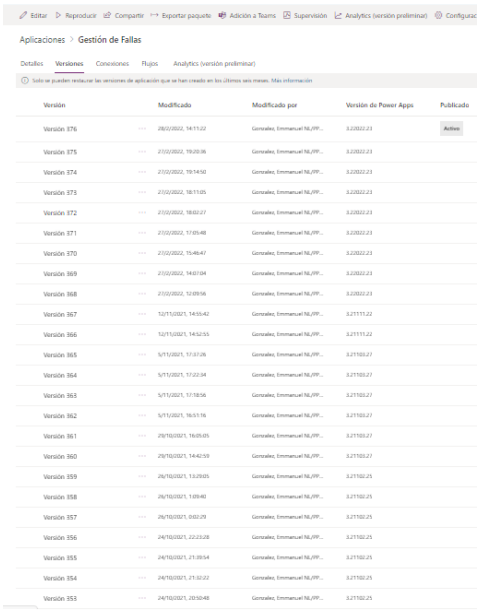
Prototype proposal	Versions history (from PowerApps platform)
	

Table 11. Failure management prototype

e. *TEST*

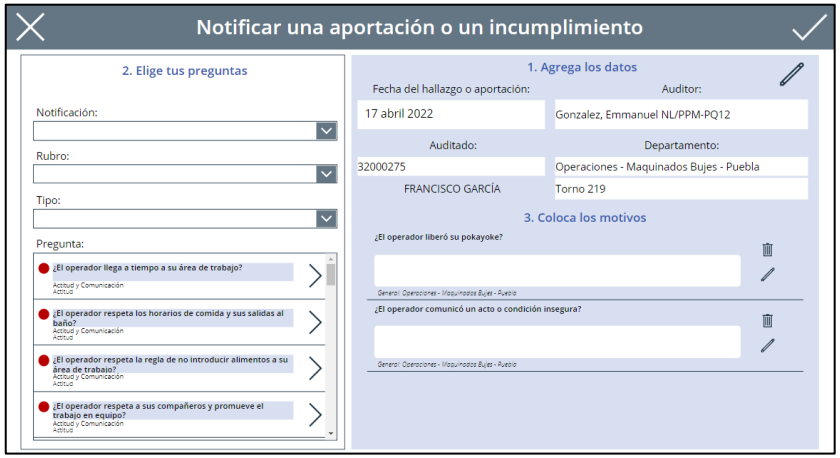
Work team effectiveness management application test

On 2022 calendar week 18, it's planned to make a big test for one machining production area, which involves about 120 operators and all the gathering data will take place for 6 month long. If there's not a big change in the application, all the machining department will adopt the new way of performance evaluation for the operators, and after that one year of roll out, all the plant Puebla and very likely the Huejotzingo Plant are going to work on this model.

Then after 326 app versions, in Table 12 it can be seen the last version for the test phase:

1. Notify a finding or contribution

- Search the operator, auditor, and the machine he/she is working on.
- Add the finding or contribution.



- Depending on the severity, some points (positive or negative) will be added

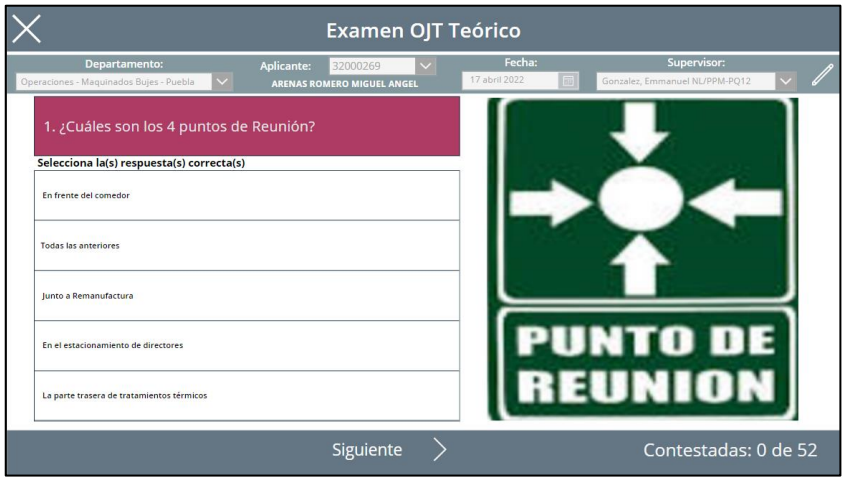
2. OJT Audit

- Search the operator, auditor, and the machines to be evaluated.
- Evaluate with a range from 0 to 4 or NA.

- A score will be saved it.

3. Theoretical test

- Search the operator, auditor, and the department.
- Operator must answer the questions.



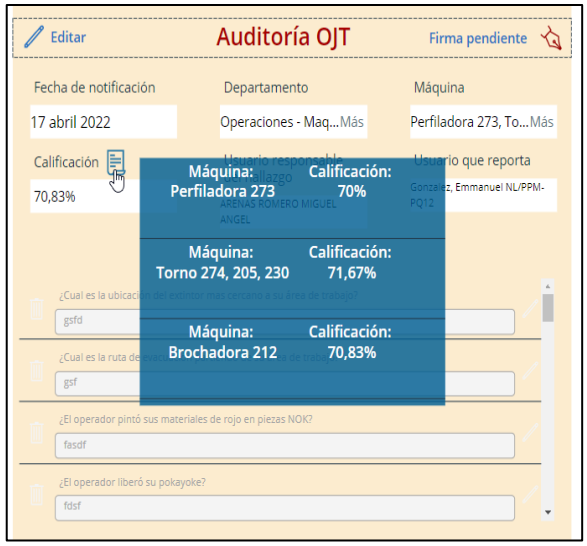
- A score will be saved it.

4. There's an option to edit the evaluation reasons and to visualize the results.

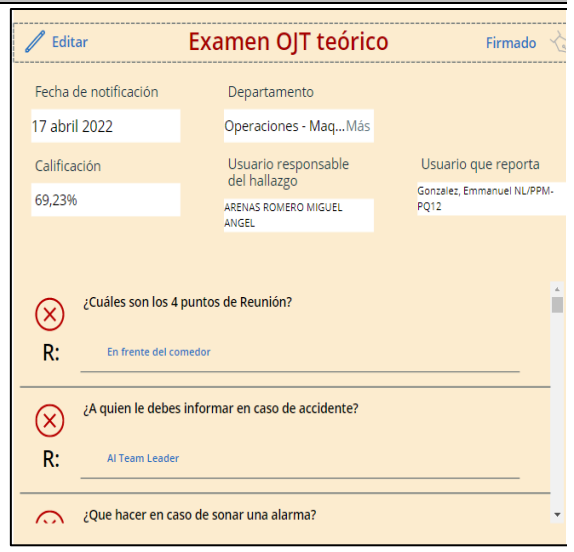
Only the one with admin rights can delete an evaluation when needed.

- Edit a justification of a finding or contribution.

- Visualize the score for machine evaluated.



- Visualize the answers of the theoretical test.



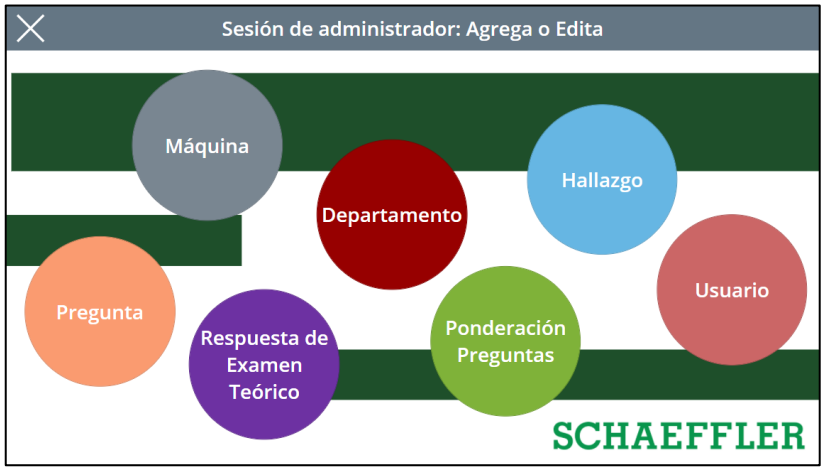
5. Admin can add or edit every attribute on the app	
• Change or edit machines, departments, finding, users, etc.)	• Check with charts the total score per operator.
	

Table 12. Work team effectiveness management application test

Since 2021 calendar week 45, application have been tested in Puebla and Huejotzingo plants. It's planned that on 2022 calendar week 22, Irapuato Plant can work their problems on the platform. Until now, from the 56 failure reports, 38 are just informed, 10 already found the root cause, 1 have all the actions applied, 1 have all the actions verified, and 6 have been totally closed with a lesson learned filled out.

Then after 376 app versions, in Table 13 it can be seen the last version for the test phase:

1. Create a failure report

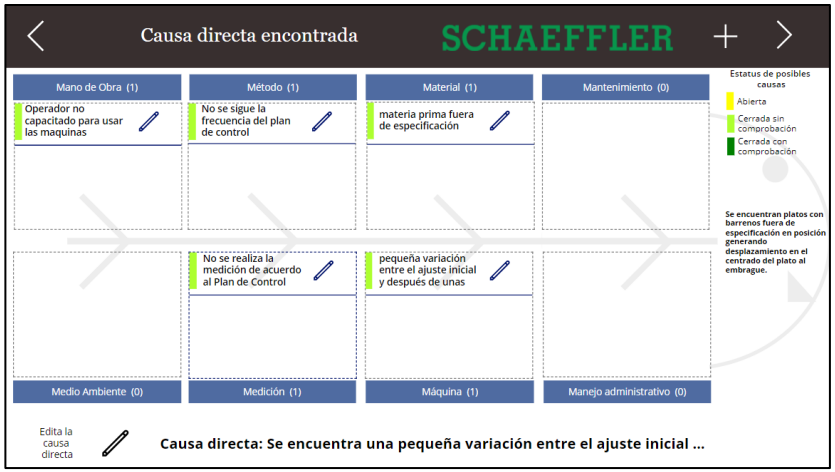
- The user is informed about which methodology is the best for the issue.
- Basic data is filled out to keep the record. An email will be sent to the responsible department.

2. Edit / update a PDCA

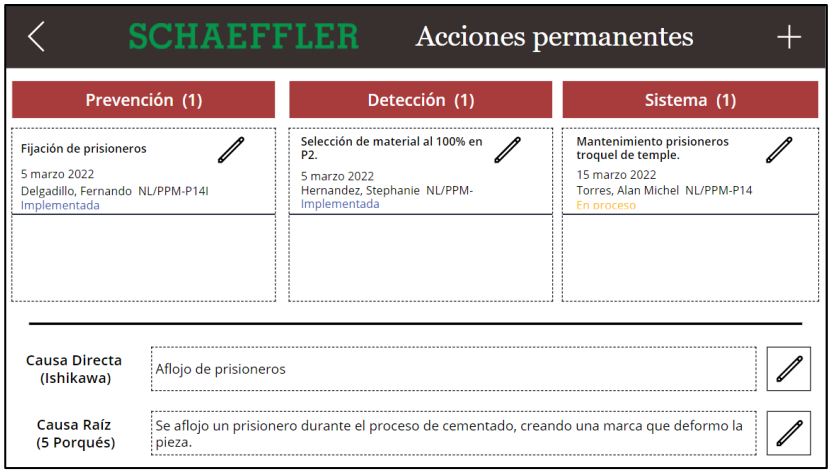
- The user search for the failure of interest.

- User can edit the basic data or go the phase of interest.

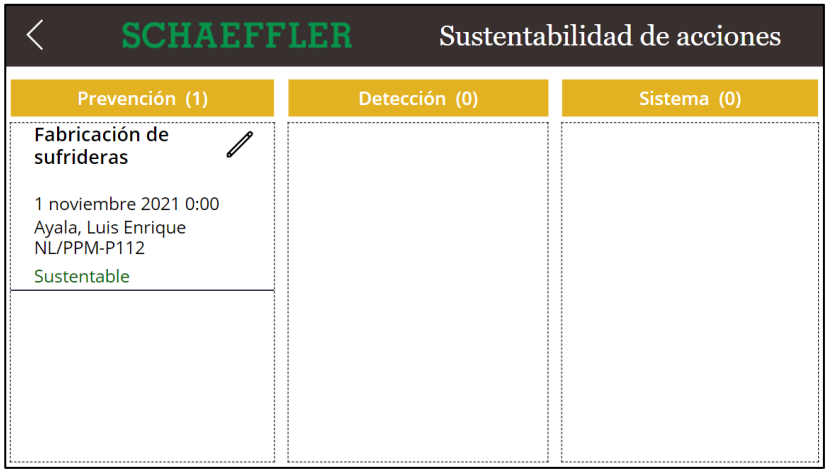
- Root cause is identified with the help of tasks and reminders of Planner (Microsoft).



- Permanent actions are performed with the help of tasks and reminders of Planner (Microsoft).



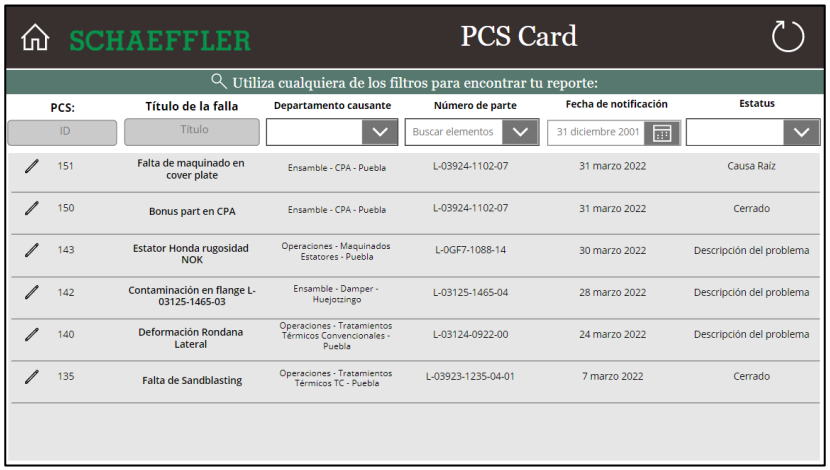
- Actions are verified by an auditor.



- Lesson learned is filled out and all the departments involved are notified.

3. Edit / update a PCS (Internal methodology)

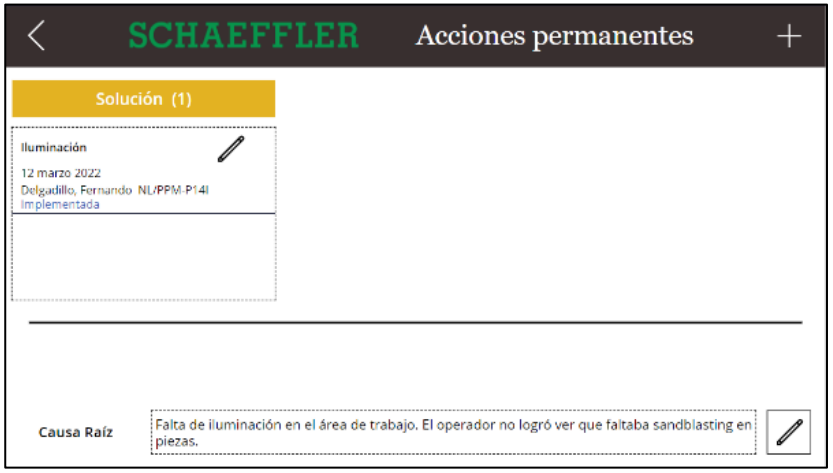
- The user search for the failure of interest.



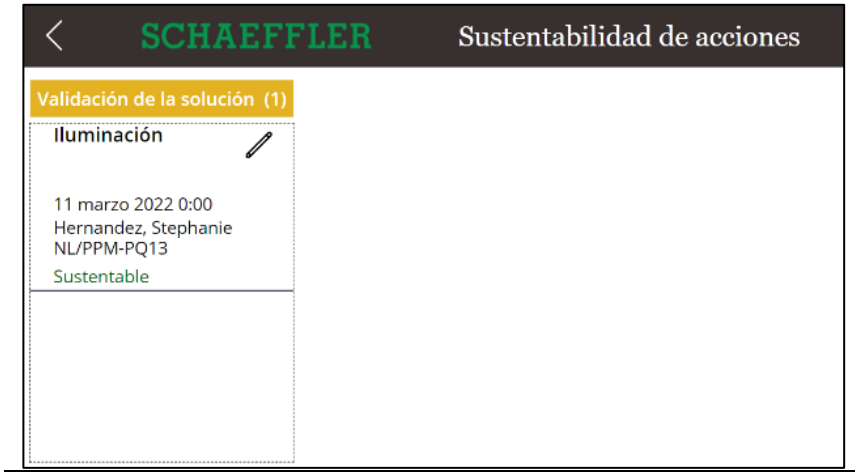
- User can edit the basic data or go the phase of interest.

- Root cause is written.

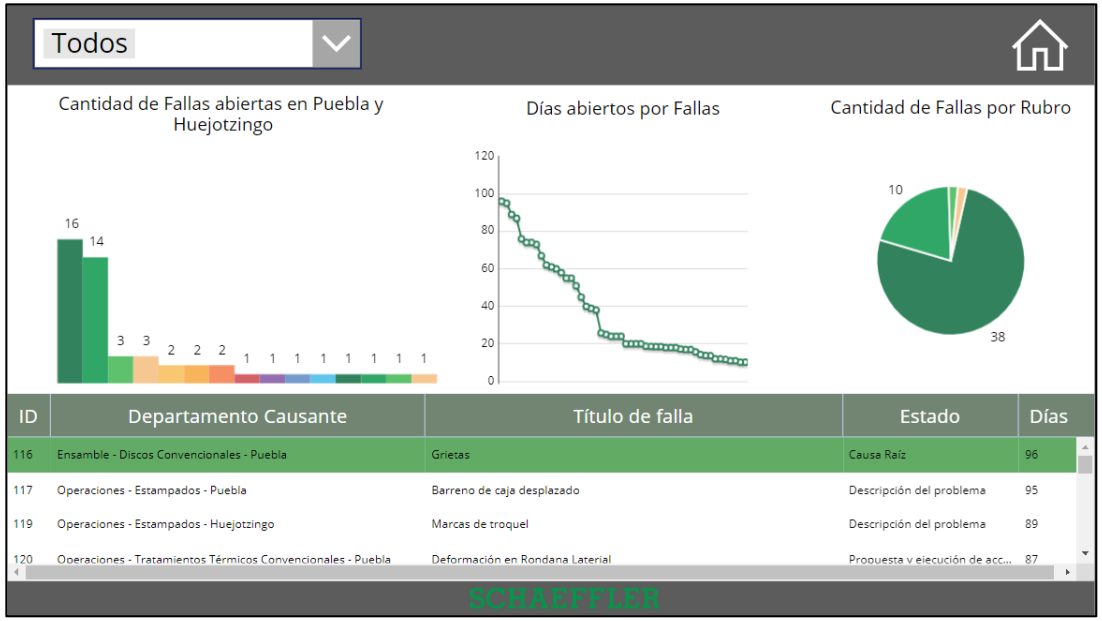
- Permanent actions are performed with the help of tasks and reminders of Planner (Microsoft).



- Actions are verified by an auditor and all the departments involved are notified.



4. View Charts



It can be seen the failures opened, the days opened, the progress phase and a detailed table.

Table 13. Failure management application test

CONCLUSION

Due to complaints from our customers for poor quality, we have had significant financial losses. Therefore, we use the Design Thinking methodology.

- First, we define the problem: With the data collected from these claims we were able to obtain two major causes with the help of the model of systemic causes prioritization:
    - Training and compliance with work instructions
    - Capacity to monitor failures).
- Later, we empathize with users through knowledge of current systems where we discover that:
    - the current operator efficiency system doesn't evaluate the adequate operator attributes, which affects directly to the manufactured product.
    - the current problem-solving system doesn't contemplate the step by step follow up failures closely.
- Upon completion, we ideated solutions to the following questions:
    - how can we create a solution where, through operator skills, their growth interests are highlighted, and behavior aligns with company goals?
    - how can we create a solution where, through an effective collaboration and a follow-up, the failures reported can be closed appropriately?
- With these good ideas, we make digital prototypes as a solution to the questions:
    - We made the proposal design to reinforce the behaviors that we require from the operators on the production floor.
    - We designed a collaborative solution that included one the most complete methodology such as 8Ds.

And finally in the last phase of testing, we are generating a lot of data to be able to make decisions after several improvements thanks to user feedback.

Roll out phase is taking place and the positive results we are expecting (reduction of customer complaints, internal complaints, near misses and Internal Audits) can be viewed at the first quarter of the next year. Depending on that results we can start thinking in a way of adding the courses to the data base to automatically assign the training the operator needs to improve its knowledge.

Also, colleagues from North America are interested with the proposal applications, so whether the application can be applied in other plants or maybe IT can develop an application, not only local but regional.

Due to the above, I see it as extremely important to know how to identify the real problem by knowing the true needs of the user; In this case, my job at Schaeffler is practically as a user and therefore I understood those needs very quickly. Afterwards, it is just as important to know how to ask the right question to start ideating solutions, which could take a few weeks. As a next step it is vital that if digitization is required to be added to the project there must be proper training and many hours of self-study and finally a great support team as multiple tests needed to be performed on the system.

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