International Journal of Latest Engineering and Management Research (IJLEMR)
ISSN: 2455-4847
www.ijlemr.com || Volume 08 – Issue 05 || May 2023 || PP. 01-12

Idea Cycle - Maintenance Management using Agile Tools, Digital Transformation and Hierarchical Process Analysis

Anderson Fernando Lopes[1] (Corresponding Author)
Eduardo Marques Trindade[2] (Professor)
[1](Master's Degree in Technology Development, Institutions: Institute of Technology for Development (LACTEC), in partnership with the Institute of Engineering of Paraná (IEP), Brazil)
[2](PHD in Science, Economist.Institution: Institute of Technology for Development (LACTEC))

Abstract: This work presents the IDEA Cycle Management Methodology (Innovation, Development, Execution and Achievements), implemented and tested in the maintenance and engineering areas of an engine factory, as a new team management methodology, aiming for high performance and sustainable results. The main premises are the autonomy and empowerment of the maintainers in the day-to-day decision making, as well as the use of agile methodologies by Objective and Key Results (OKR's) with Sprints in determined deadlines to complete the demands. Another focus included maintenance projects allied with Digital Transformation and the use of Analytic Hierarchy Process (AHP) to prioritize the Backlog, as well as maintenance projects and initiatives based on Safety, Quality, Delivery, Cost, Environment, People and Digital Transformation (SQDCEP + T). It was concluded that there is a possibility of obtaining good results with the use of this new methodology of teams for the systematization of management. The use of digital transformation tools, multi-criteria and agile methodologies applied in the maintenance area can yield technical, financial, and team development benefits, allowing a different perspective in the planning and strategy of the areas, with prioritization for decision making.

Keywords: Autonomy; Digital Transformation; Agile methodologies; Planning; Maintenance; Engineering; Management.

INTRODUCTION

According to Magaldi (2020), companies are experiencing a turning point, a period that demands extreme changes, generating organizational and economic transformations, altering conventional models worldwide. During the pandemic, digitalization was accelerated by 72% in companies, according to research by The Economist Intelligence Unit (EIU) (2021), requested by Microsoft. The use of innovation in production processes, in order to leverage better results with the use of stratified data from machines and processes, was intensified during this period.

Lean management, and the principles of World Class Manufacturing (WCM) are being explored intensively by companies, with the aim of obtaining faster and more sustainable responses. These philosophies can improve economic results and business competitiveness by solving critical and complex problems, which are daily demands in all types of businesses and organizations.

Ballé (2019) states that the Toyota Production System provides mental models for the development of people-centered solutions, expecting employees to think of ways to work better. Based on this approach, the mobilization to rethink processes and make adjustments and optimizations by strategic areas, both in engineering and operations, were priorities for resuming the production process in a scalable way, as never experienced before the pandemic.

In complex manufacturing environment, decision making can be a daunting task. The Analytic Hierarchy Process (AHP) methodology offers a systematic and rigorous approach to decision making. According to Saaty (1980), the AHP was developed in the 1970s and can be defined as a multicriteria method that is very useful in assisting decision-making, due to its characteristic of distributing weights among pre-established criteria. The author emphasizes that to solve a problem with AHP it is important to measure all factors, whether tangible or supposedly intangible, in a quantitative or qualitative way.

As manufactures seek to rebound from the covid pandemic and handle shifting market conditions, setting clear objectives, and tracking progress against them has become increasingly critical. Objective and Key Results (OKRs) provide a powerful framework for aligning teams and driving performance. Doerr (2019) explains what OKRs mean in his view: "A management methodology that helps ensure that the company focuses efforts on the same important issues throughout the organization." The OKR methodology can be applied to organizations in any sector, both for-profit and non-profit. Strengthening common sense, seeking solutions to problems, and agility in implementation, as well as ease of monitoring actions, make results a consequence and bring

satisfaction to employees, as actions and data are the "North" for achieving objectives, and managers, in this methodology, are more active and can act as coaches and mentors, supporting employees' initiatives.

Therefore, this work covers some pertinent points about the transformations in the factory environment, regarding industrial maintenance management, prioritization, maintenance costs, agile management in the maintenance and engineering department, and ways to manage teams through new methodologies for achieving high performance.

CONTEXT

Implementing a new methodology for team management aiming at high performance and world-class results is not an easy task, especially for companies that are familiar with and apply Lean Manufacturing concepts. On the other hand, it is an opportunity to show organizations that are not familiar with these concepts and this work philosophy, where the pursuit of continuous improvement is something that can never cease, as well as problem-solving, which are constant in day-to-day operations.

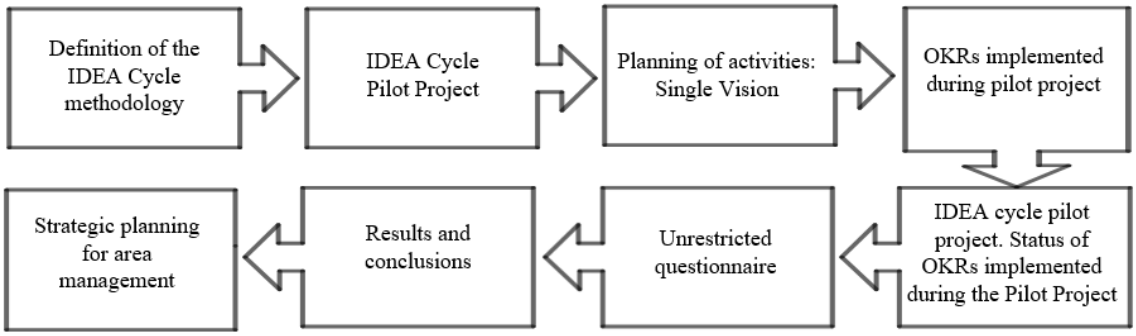
It is understood that team management can be systematized, and, in this way, the use of tools is the complement for the manager to obtain information about the main demands and where employees can have access to the department and organization's strategy with richness in detail, and the IDEA Cycle proposed in this work enables this visibility and innovation.

The culture based on criteria, assumptions, with the use of tools and methodology, aims to support the implementation of projects or activities, seeking to maintain team unity, quality of information, high morale, and good levels of motivation. This case study started in August 2021 and was applied at anautomotive company, in the engine factory located in Curitiba, Paraná state.

IDEA CYCLE METHODOLOGY

For a better understanding of the proposed IDEA Cycle methodology and its implementation stages in this case study, the implementation flowchart is shown in Figure 1.

Figure 1 - Implementation flowchart of the IDEA Cycle methodology pilot project.



The IDEA Cycle Methodology is an acronym for the words Innovation, Development, Execution, and Achievement. This methodology was developed based on the principles of the PDCA Cycle. The main approach of this working method consists of four main focuses: Performance, Transformation, Digitalization, and Agile Methodology. The central point of this methodology is to increase the autonomy and empowerment of the maintenance and maintenance engineering team, seeking to improve engagement and increase synergy between departments, reinforcing the importance of using lean management tools and managerial criteria.

Perform means that day-to-day activities are productive in the constant search for consistent results, eliminating equipment failure causes, adding value to the business and strengthening the guidelines of the organizational group. Transform means evaluating future possibilities, such as working on innovative initiatives with the help of technologies that bring intelligent solutions with support from other areas of the company, in other words, everyone working towards the same goal aligned with innovation. The team's involvement in Industry 4.0 and Digitalization initiatives corroborates the technological moment and the advancement of industrial automation together with digital trends. The consequence is the achievement of a virtuous cycle, achieving results and meeting the expectations of the department and the organization.

The experimentation of agile management in the implementation of maintenance initiatives or projects reverberates a different way of thinking, planning, and executing actions. The practicality, reduction of execution time, and periodic monitoring demonstrate a greater capacity for achievement and backlog reduction, which in turn streamline the department's planning processes. However, the most important aspect of this

process consists of the dedication and application of management criteria, ensuring the principles and values that are the foundation of the concepts presented in the Lean methodology.

For better understanding, the management criteria are presented below:

1. Management Commitment;
2. Clarity of Objectives;
3. Roadmap;
4. Allocation of highly qualified personnel;
5. Organization's commitment;
6. Organization's competences;
7. Time and Budget;
8. Level of detail;
9. Level of expansion;
10. People motivation.

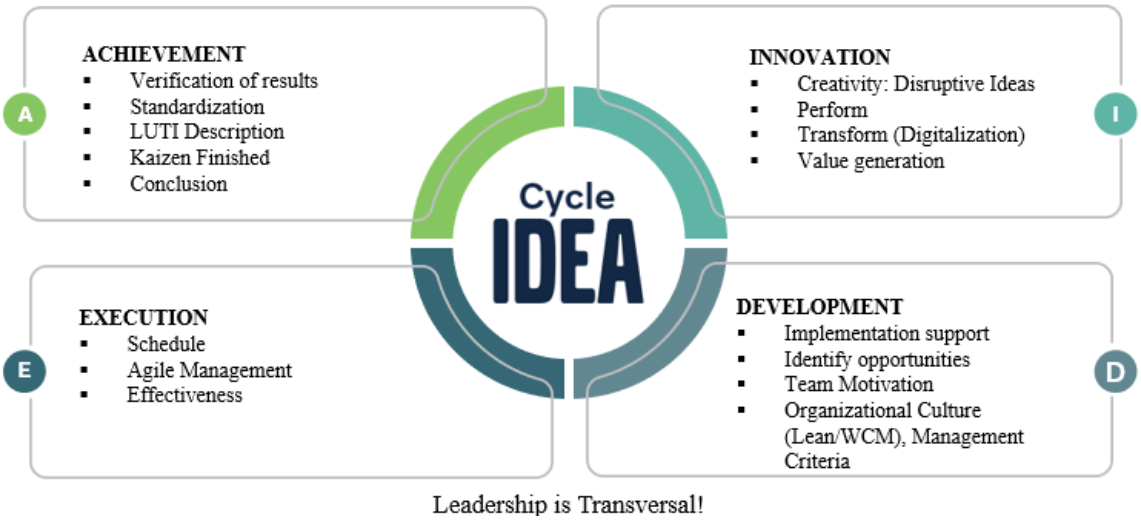
The IDEA Cycle consists of 4 quadrants, which are: Innovation, Development, Execution, and Achievement, described below:

- **Innovation–** Awakening the team's interest in thinking disruptively, experimenting with doing things differently with a focus on "performing" and "transforming", seeking to add value in all actions;
- **Development–** It would be the "how" to support employees in their initiatives, keeping motivation high, seeking to extract the best from each individual, ensuring Lean principles and team management;
- **Execution–** Planning activities with shorter deadlines, using the sprint philosophy and follow-up meetings for course adjustments when necessary;
- **Achievement–** Evaluation of results with the opportunity to record changes in department documents and recognize achievements and progress in initiatives over time.

The figure 2 represents the methodology of the IDEA Cycle. As mentioned, it is an adaptation of the PDCA Cycle, but focusing on different concepts with a view to organizing initiatives. This contributes to high-performance team management achieving results in a structured way, following pre-established concepts by organizations, and thus making supposedly easy to adapt to any type of organizational culture.

In this management model, leadership is transversal, aiming to create protagonism for the team, since the employees have the necessary knowledge to carry out the activities. Thus, they should have professional autonomy for decision-making, considering that there may not always be a manager available to support them, such as on weekends and night shifts. The central idea is to consider that all employees can exercise leadership, even if they do not hold management positions, which is an important and liberating paradigm in terms of professional growth and recognition.

Figure 2- IDEA Cycle.



For a better understanding of the application of the IDEA Cycle methodology, Figure 3 presents a detailed description with flows and stages, along with a brief description presenting the central idea in a summarized and objective way.

Figure 3 – Description of the stages of the IDEA CYCLE.

STAGES - IDEA CYCLE			
IDEA	FLOW	STAGE	GOAL
I	1	Creativity - Disruptive Ideas	Try, experiment, fail... do different to get different results, challenge yourself.
	2	Perform	Perform department activities, identifying new ways/models in order to ensure process stability.
	3	Transform (Digitalization)	Implement projects, initiatives, kaizens using digital transformation tools and technological trends.
	4	Value Creation	Aim for economic gains for the organization and increased productivity. Sustainability improvement. Create innovative sense - Impacting diversity, technology, process and our people.
D	5	Implementation support	Monitor team initiatives and actively participate in the implementation steps and scale when necessary.
	6	Identify Opportunities	Use of management tools to identify opportunities and reinforce the importance using KPIs, management reports, exchange of experience, etc..
	7	Team Motivation	Know the essence of each employee and their potential in order to get the best from each one. Maintain the team's level of motivation and morale high and individual and collective engagement.
	8	Organizational Culture	Ensure an excellent organizational climate and respect at all levels of the organization by applying the Lean/WCM philosophy, managerial criteria.
E	9	Schedule	Have clear and defined deadlines in order to ensure execution without work overload or operational and safety risks.
	10	Agile Management	Application of agile tools with deliverables and defined objectives for the execution of activities/projects.
	11	Effectiveness	Evaluation of the effectiveness of the implementation of actions and compliance with deadlines.
A	12	Verification of Results	Compare the KPI's or target defined for the activity/project and validate or suggest new evaluation/solution.
	13	Standardization	Propose creating Standard work or record in department documents.
	14	Description of LUTI's	Preparation of the LUTI document (L - Learn, U - Use, T - Teach and I - Inspect) for training and expansion of knowledge, when possible.
	15	Kaizen Closure	Complete the developed Kaizen project, for registration and expansion of the improvement.
	16	Conclusion	Recognition of the employee/team and expansion of the activity if possible.

The IDEA Cycle was designed in a simple and instructive way so that it can be implemented in any area or department, such as Quality, Logistics, Engineering, Procurement, Operations, and in different types of businesses. It is easily understood by employees, and is simple and easy to expand horizontally and vertically.

PILOT PROJECT - IMPLEMENTATION OF THE CYCLE IDEA METHODOLOGY IN THE MAINTENANCE AND MAINTENANCE ENGINEERING AREA

The project kick-off was carried out with the management team, the human resources department, the maintenance teams, the maintenance engineering, and also with some guests from the industrial plant. The pilot project to implement the Cycle IDEA Methodology in the Maintenance and Maintenance Engineering area began with a defined deadline for completion in 90 days.

The main objective of this pilot was to put into practice the principles of the Cycle IDEA methodology in routine activities and in initiatives that would require more time and involvement from employees from other departments. For this, it was necessary to prepare the maintenance team for agile methodology training, especially OKRs. There were five sessions with an average duration of 30-40 minutes. All employees in the maintenance and maintenance engineering team participated beforehand.

This understanding of how to use agile methodology is essential so that the team has the discernment and knows how to adopt the proper use of theory in the decision-making process in selecting an activity to be treated as an OKR. Figure 4 presents some initiatives that can be used in this type of pilot project and added to the other ideas that come from the teams.

Figure 4 - Medium-term planning.

MANAGEMENT:	**PLANNING AND EXECUTION:**
Job Rotation for technicians (2022)	Shutdown Planning 2021-2022
IDEA Cycle Pilot Project - Maintenance and Maintenance Engineering	Top 6 Main Failures (2 per Assembly line)
Situational Leadership (Coach with Leaders) and Team	Lubrication Management
Coach & mentoring for technical leaders	Management of maintenance and monitoring kaizens
Introduction to Agile Working Methods (sprints)	Optimization of the TBM (Maintenance Based of Time) plan for CBM (Maintenance Based of Condition) and creation of new CBMs
	Review roadmap for 2022 (Evaluate replace Step to Milestone with OKR)
MATRIX OF SKILLS AND TRAINING:	**BENCHMARK:**
Review of the Maintenance Competence Matrix (New employees)	Benchmark in maintenance
Develop Engeman's Competence Matrix	Calendar for workshop with suppliers (new technologies/recycling)
Training planning for 2022	**PARTNERSHIP UNIVERSITIES:**
Create a training development plan involving PM (Professional Maintenance) and AM (Autonomous Maintenance)	Digital Transformation Projects with HUB IA Senai, POC2, POC3 and POC4
Knowledge multiplication project	Project DMAIC-OP60 (UFPR)
DATA ANALYSIS:	**INTEGRATION**:
Analysis/Calculation and Study of Rework and Productivity	Participation in the AM Calendar Review in OP030, OP170 and OP198
Develop maintenance cost report and weekly follow-up	
Introduction to the use of Reliability Methods	

The crucial moment when it comes to creating OKRs is the importance of describing the objective or defining the problem that you want to solve very well. The descriptions of the KRs need to use an action verb and objectivity to achieve the expected results. The KRs need a coherent goal in relation to the possibility of completion within the specified period, in this case, 90 days. The whole process must be accompanied by a weekly or bi-weekly frequency by those responsible for the OKRs. At this point, three key questions are asked:

1. What has evolved in the OKRs since the last meeting (evolution)?
2. What is the delivery for the next meeting (dedication)?
3. Who can help with the execution of the next KR (escalation)?

Figure 5 presents an example of an OKR implemented in the pilot project.

Figure 5 - OKR example implemented.

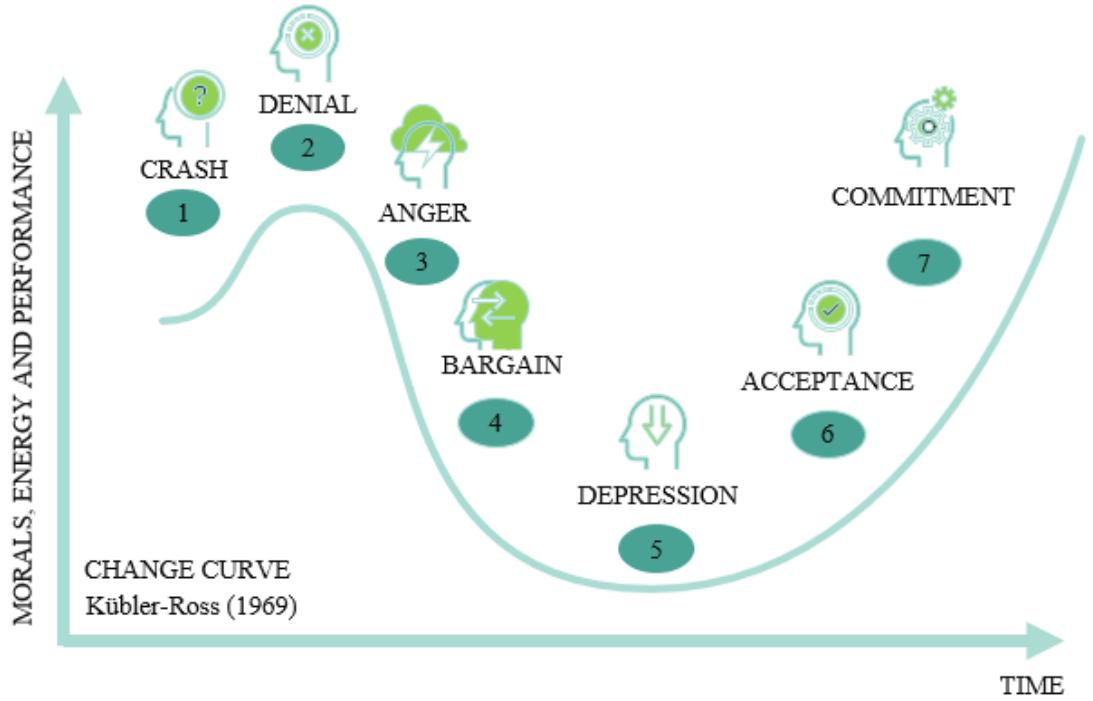
	ID	Quarter	Subject	Objective	Key Objectives	Weight	Responsible	Fom	For	Unit	Actual	Key Objective Progress	Goal Progress
			Responsável :	Jorge Muchinski									
OKR Maintenance 16/2022	M – 16	Q 3	Professional Maintenance (PM)	Revision of steps 0-3 of Machining Machine OP.60AA	KR1: Check the current status os the machine steps using the Checklists (Assessment Step 0 - 3)	13	Silvio K.	0	4	Step	4	100%	100%
					KR2: Structure and organize the tools of each Step within PM standards	13	Jose H.	0	4	Step	4	100%	
					KR3: Validate the revision and implementation of each Step with the PM Team (Step 0-3)	13	Jorge M.	0	4	Step	4	100%	

However, the main objective of a pilot project is to experiment, test, fail and learn for the definitive implementation. This process is very well represented by the Kubler-Ross Change Curve (1969), as it details the inherent phases of human behavior that are present in all moments that require experiencing something new and even unexpected.

The moment of shock is perceived when the challenge arises to leave the comfort zone. Automatically, the brain and body show highly perceptible signs of denial. This feeling, often involuntary, can express some anger or guilt of the individual for going through this process of change. And naturally, the human being initiates the process of bargaining and self-punishment that leads to the state of depression andmental confusion, in the search for understanding and acceptance of the new and extraordinary fact in their life. However, this process of maturation is vital for the human being to be able to perceive that the whole process takes time, as well as physical and mental effort to aim and enhance the resolution of problems, which can be of a personal or professional nature.

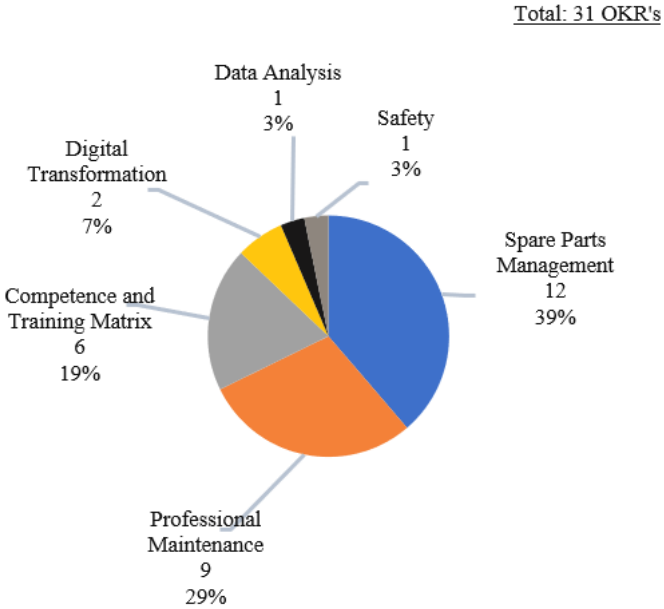
All of Change Curve process was identified throughout the pilot project, varying in time, in scope, well before its start and by the team responsible for conducting and supporting the initiatives. Next, Figure 6 represents this change curve.

Figure 6 - Curve of Change (Adapted from Franciele Maftum's article)



Throughout the pilot project, 31 OKR initiatives were implemented, subdivided as presented in Figure 7.

Figure 7 - Related Areas of OKRs.

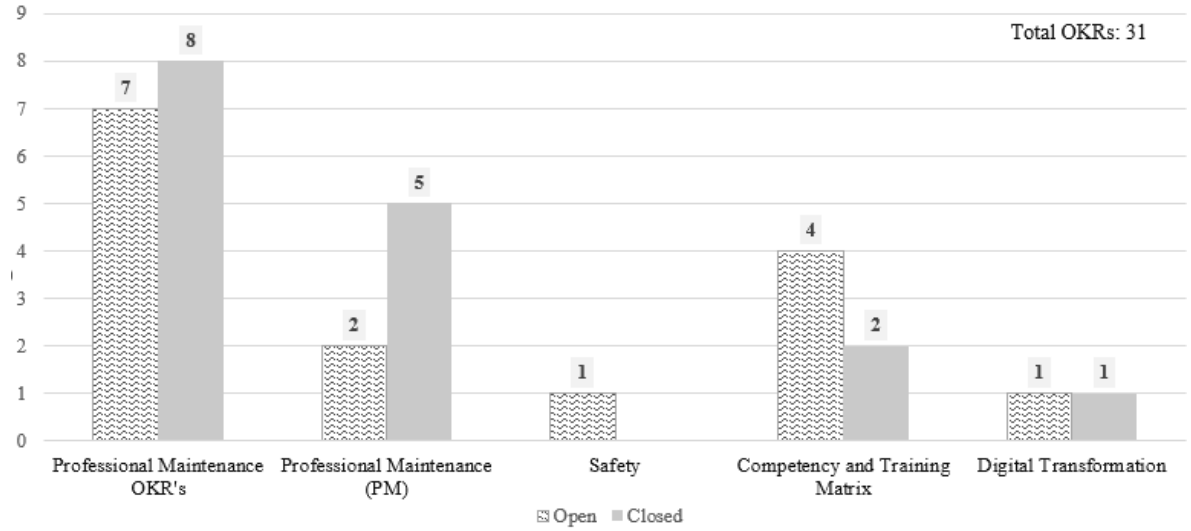


Of these 31 OKR initiatives, the following results were achieved:

- 1 OKR achieved only 25% of the objective;
- 27 OKRs exceeded 50% of the objective;
- 17 OKRs achieved 75% of the objective;
- 8 OKRs achieved 100% of the objective.

Figure 8 below shows the distribution of OKR initiatives by implemented area in the pilot project.

Figure 8 - Distribution and status of OKRs.



Even without the completion of all projects in its entirety, it was possible to obtain financial benefits for the organization. Additionally, an open questionnaire was applied for 37 employees, which is defined as an investigation technique where written questions are elaborated for a specific audience to obtain opinions, interests, expectations, and experiences on a specific subject or practice applied in a test or evaluation capacity.

In this work, questions were elaborated in the form of direct questions, multiple-choice questions, and also in graphical form. Regarding the confidentiality policy adopted in the questionnaire, employees were informed about the purpose of data collection to understand the implementation of the IDEA Cycle pilot methodology, without the ability to identify and disclose data about the respondents.

LESSONS LEARNED FROM THE IMPLEMENTATION OF THE PILOT PROJECT

The pilot project implementation of the IDEA Cycle methodology was very useful in obtaining subsidies for team development regarding the use of agile methodologies using the IDEA Cycle as a way to interpret departmental activities and develop them differently, reinforcing the importance of using lean tools.

Many learnings and perceptions were obtained about agile methodology, especially about the use of OKRs. The initiatives provided greater integration between maintenance departments and maintenance engineering, in the sense of working on projects jointly, increasing synergy. Therefore, positive points and improvement opportunities were identified in this process, as well as important definitions for the next cycles.

Positive points:

- Use of agile methodology to enhance the realization of initiatives;
- Standardized work process;
- Prioritization of activities

Points of attention:

- Maximum of 2 OKRs per person;
- Average of 3 KRs per OKR;
- Partition the OKR for completion in 3 months.

Difficulties encountered:

- Defining the period of the start and end of the quarterly cycle;
- Definition of KR metrics;
- Manage all actions relate to OKR’s every two weeks by the leader.

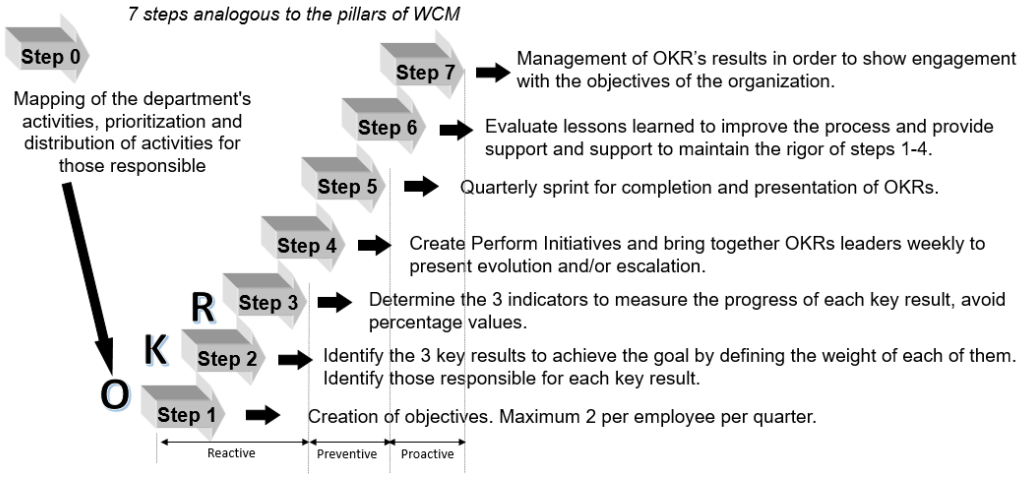
In this work, the importance of this process in the learning of employees and the practical execution of new concepts was observed.

This way, after the lessons learned meeting with the team and the confirmation of the applied learning theory in practice, it was decided to create the "Golden Rules" for the development of OKRs in a maintenance

and maintenance engineering department. The chosen format was the 7-step format, just like how WCM is applied.

Figure 9 below presents the 7 steps for creating OKRs.

Figure 9 - Good practices in conducting OKR´s.



These best practices are an excellent opportunity for teams or individuals who are starting to study agile methodologies, especially with OKRs, as they can facilitate the learning journey, which requires a lot of time for study and practical application.

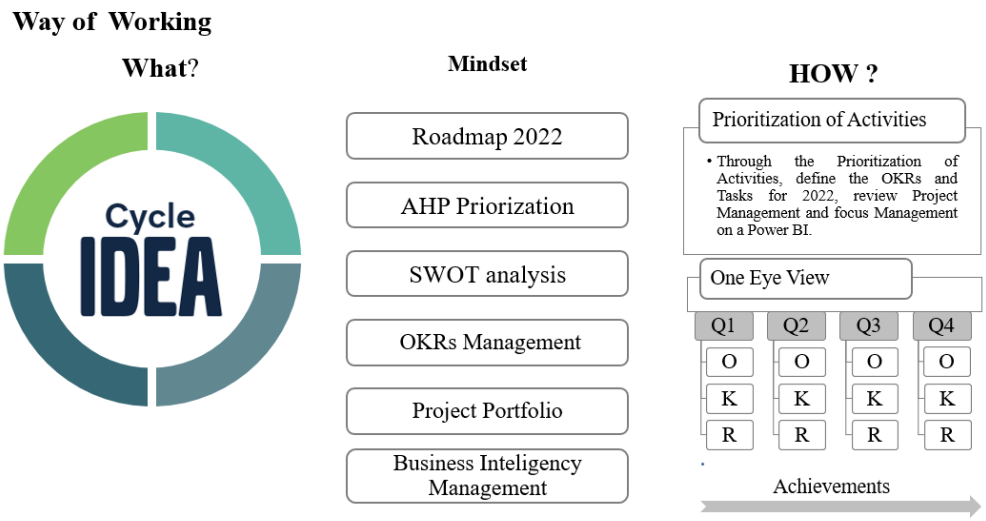
STRATEGIC PLANNING

Based on this initiative, it was possible to develop a robust and consistent plan for the next few years and also to create a roadmap for the maintenance area based on agile management. The knowledge gained from this work was leveraged to design a vision more aligned with new methodologies, digital transformation, and closer management with the team, particularly regarding information and communication handling.

Planning in a different and systematized way, where visual management can facilitate understanding of priorities and monitoring of actions throughout the year, was the motivating point for creating departmental goals and priorities, using multi-criteria analysis through AHP and visual management of activities, along with Microsoft's Power BI platform.

Figure 10 represents the maintenance department's strategy for managing routine demands and projects.

Figure 10 – Maintenance area strategy.

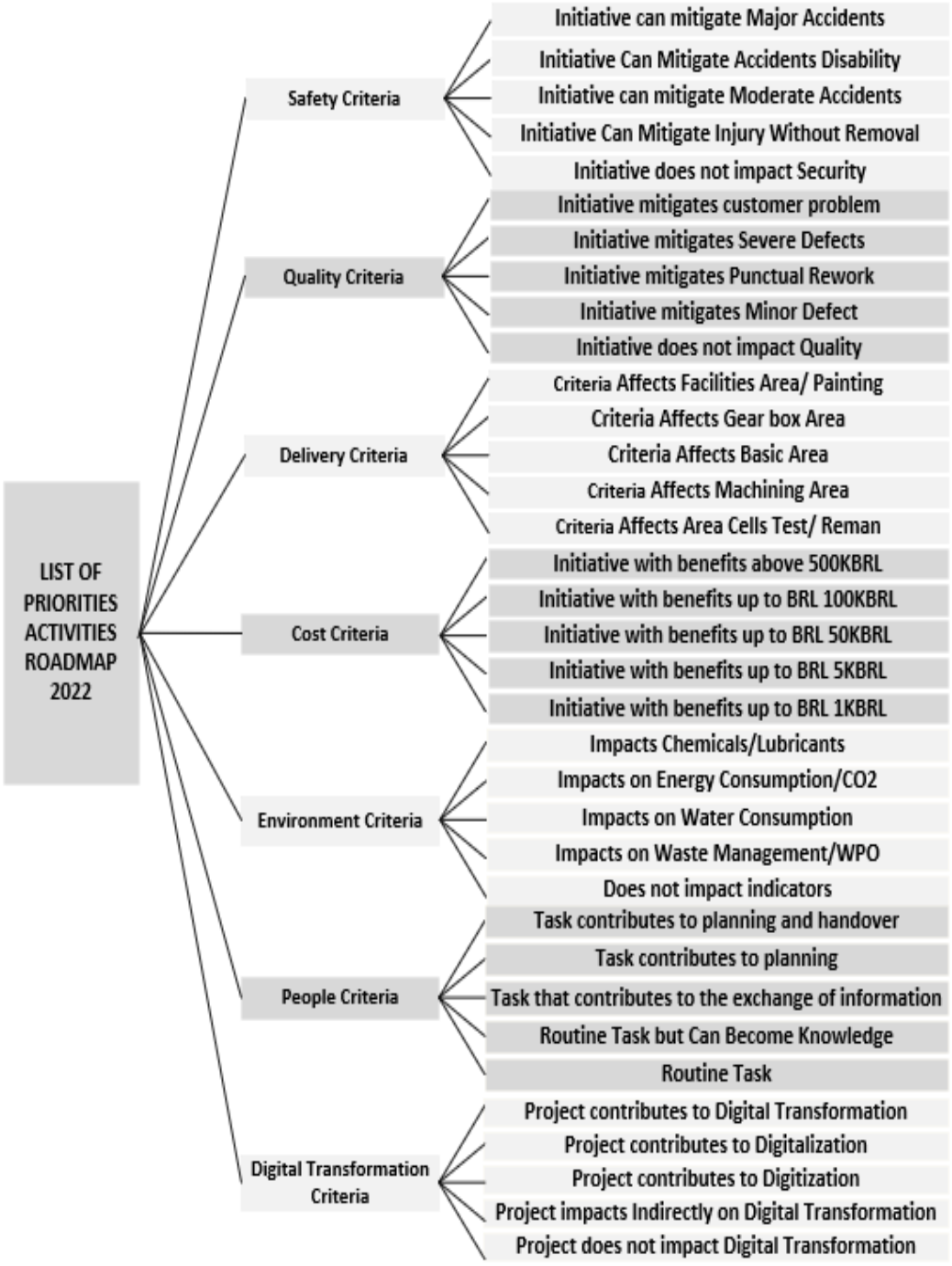


By using the unrestricted questionnaire, it was possible to obtain feedback from the team regarding the IDEA Cycle methodology. Thus, it was decided to maintain the concept and begin future planning, considering the following points:

- Roadmap - A document used as a basis for consolidating projects and criteria for decision making based on AHP and definitions of OKRs to be implemented for the next 3 years;
- AHP prioritization - All 101 activities were prioritized using the AHP methodology. The criteria used were based on SQDCEP (Safety, Quality, Delivery, Cost, Environment, and People), along with the criteria of digital transformation.

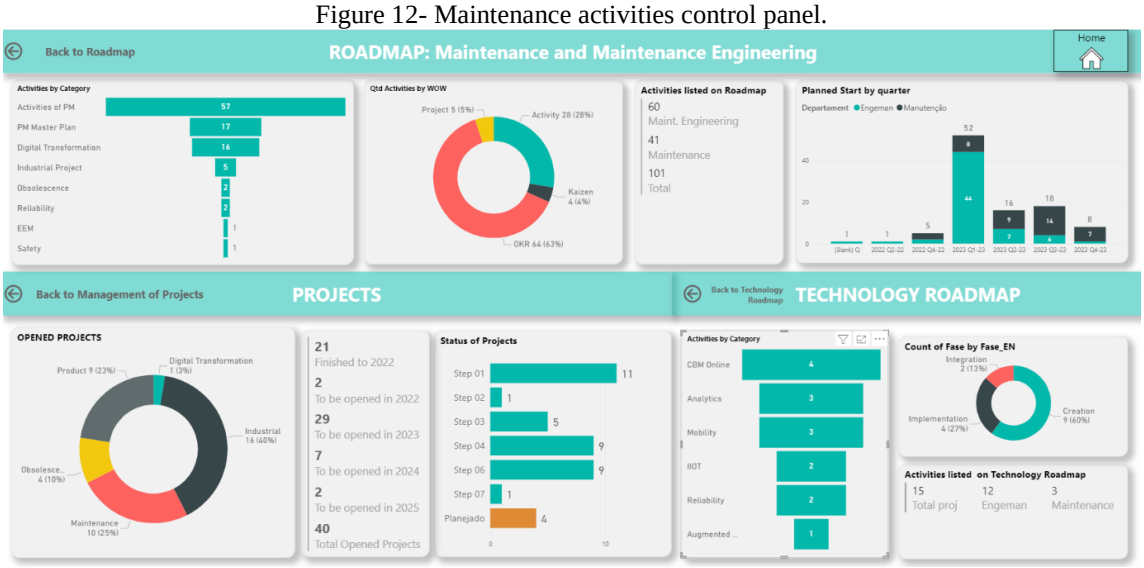
Figure 11 represents the AHP tree developed for this analysis.

Figure 11 – Prioritization list of roadmap activities



- OKR Management - After the AHP analysis, 32 potential activities were identified to be developed through agile management using OKRs and distributed over the 4 quarters;
- Projects Portfolio - This is the concentration of all planned initiatives in the industrial and product area, where the maintenance engineering department has interaction;
- SWOT - The team's SWOT analysis is considered for planning and prioritizing based on departmental risks and team development opportunities;
- BI Management - All departmental initiatives were consolidated into a control panel managed on the Power BI platform. This way, all team members could easily follow up the progress of the activities online. Figure 12 refers to the maintenance activities control panel.

Figure 12- Maintenance activities control panel.



The maintenance and maintenance engineering departments have a range of internal activities and also connections with other areas of the organization. Thus, the AHP analysis was an alternative for prioritizing activities and controlling the team's workload, to avoid fatigue, with good emotional control and risk reduction for employees, as well as bringing leaders closer to a more participatory role in supporting activity execution and escalating problems when necessary. Working in this way, it is possible to predict initiatives per quarter.

The governance of any department is of significant importance for achieving set objectives. With this approach, the IDEA Cycle Methodology contributed to the development of governance strategy, that is, it facilitated the understanding of how to handle tactical and managerial issues more effectively.

Tactical issues are now addressed biweekly and led by the first line manager, team leaders, and maintenance engineering. This management approach enables problems to be escalated more quickly and assertively, both on the horizontal or vertical axis in our organization.

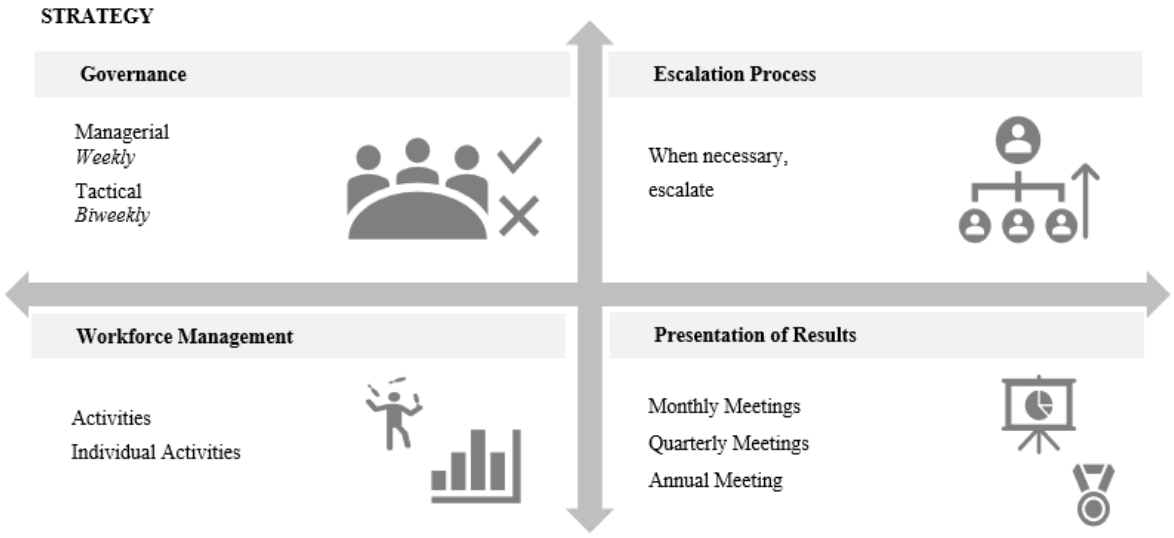
The focus on the employee, as a professional and an individual, is also taken into account so that there is no excessive demand and so that the tasks can be completed within an acceptable period and with support from the organization

The communication approach is divided into four moments: weekly, monthly, quarterly, and annually:

- Weekly - The manager, together with the engineering team, team leaders, and first line manager, discusses issues related to the previous week's results and priorities for the current week;
- Monthly – The first line manager is responsible for presenting the month's results according to the SQDCEP maintenance indicators;
- Quarterly –The Manager presents the organization's quarterly results, such as financial results, indicator analysis and trends, strategy, group information, and overall expectations.
- Annually - The manager presents the main results obtained throughout the year and also the planning and priorities for the following year.

Figure 13 below addresses aspects of the department's governance.

Figure 13 – Governance of the maintenance area.



However, this new way of planning and managing the maintenance area establishes the main premises and vision of the department, based on the main maintenance indicators, maintenance costs, digital transformation, and agile methodology.

With the understanding of the department's objectives by employees, actions can be more easily implemented and aligned with the organization's expectations. This work projected the maintenance department as a protagonist in planning its actions strategically and systematically and connected to the organizational direction, as well as a reference regarding the use of OKRs in management, becoming a benchmark in the group. All materials produced in the IDEA Cycle methodology pilot project were made available to the Lean initiatives team as a source of reference for expansion to other areas.

CONCLUSION

This article addressed the implementation of a new management methodology called the IDEA Cycle, which aims to increase interaction between the maintenance team and the operational and engineering areas. Autonomy and the ability to perform maintenance activities were the main advantages identified in this case study, where it was possible to achieve better organization of activities through focus and direction of actions conducted by them in synergy with other areas of the company.

The IDEA Cycle presented a systemic proposal for the use and application of agile methodology, which was undoubtedly experimented and approved by the team, as there was an understanding that visual management and frequent monitoring of initiatives are truly important for engagement and commitment to delivering agreed objectives, in addition to understanding the organizational strategy and aligning expectations within the maintenance department. Employee autonomy was evidenced by theamount of proposed initiatives and engagement in their implementation while respecting rules and meeting established deadlines.

In general, with this case study, it was possible to consolidate several important and innovative initiatives that are in line with the professional profile expected for the next years within an industry. That is, it was possible to work with elements of People Management, Technological Projects, and Agile Project Management in the maintenance and maintenance engineering area. The expansion of this methodology to other areas is fully applicable and current from the perspective of the tools used. Any area or department can benefit from this research as a basis for implementation.

The application of the Unrestricted Questionnaire allowed for an overall evaluation of the result of the sum of initiatives proposed to the maintenance and maintenance engineering team in relation to a different way of managing teams, aiming for high performance and sustainable results. The team's acceptance was evidenced based on the responses obtained in the questionnaire, thus the continuity of the methodology's use was a natural consequence.

Finally, it is possible to perceive that this project can also contribute to a more holistic view on how to manage the maintenance and maintenance engineering department, observing important points that reflect on the well-being of people, addressing topics related to management methodologies, agile methodologies, digital transformation in maintenance, as well as aligning organizational expectations. Obviously, the use of this new

management methodology will go through adjustments, improvements, and adaptations regarding its use, but it will be a natural process given the maturity of the team and the advancement of future technologies or tools.

REFERENCES

[1] MAGALDI, S.; NETO, J. S. Estratégia Adaptativa: O novo tratado do pensamento estratégico. São Paulo: Editora Gente, 2020.
[2] MICROSOFT. Novo estudo mostra que a preparação digital ajudou as organizações a se adaptarem à COVID-19. [S. l.]: Economist Intelligence Unit (EIU), mai. 2021. Disponível em: <https://news.microsoft.com/pt-br/novo-estudo-mostra-que-a-preparacao-digital-ajudou-as-organizacoes-a-se-adaptarem-a-covid-19/ >. Acesso em: ago. 2021.
[3] BALLÉ, M; JONES, D; CHAIZE, J; FIUME, O. A Estratégia Lean: para criar vantagem competitiva, inovar e produzir com crescimento sustentável. Traduzido por: ARAÚJO, F. Porto Alegre: Bookman, 2019.
[4] SAATY, T. L. The Analytic Hierarchy Process. Pennsylvania, USA: McGraw-Hill, 1980.
[5] DOERR, J. Avalie o que Importa. Traduzido por: MENEZES, B. Rio de Janeiro: Alta Books, 2019.
[6] LIKER, J. K.; MEIER, D. O Modelo Toyota – Manual de Aplicação: Um guia prático para a implementação dos 4Ps da Toyota. Tradução de: RIBEIRO, L. B. Porto Alegre: Bookman, p. 25 e p. 220, 2007.
[7] LIMA, M. A; Barreto, R.C.S. A Inovação tecnológica no Brasil na última década do século XX. Cuiabá: Congresso da SOBER, 2004. Disponível em: < https://www.researchgate.net/publication/280134563_A_INOVACAO_TECNOLOGICA_N
[8] O_BRASIL_NA_ULTIMA_DECADA_DO_SECULO_XX_-_TECHNOLOGICAL_INNOVATION_IN_BRAZIL_IN_THE_LAST_DECADE_OF_THE_TWENTIETH_CENTURY >. Acesso em: 27 Nov. 2021.
[9] MAGALHÃES, F.; GARRIDO, M. RH Ágil – Mais humanos e menos recursos: O desafio da gestão de pessoas nas organizações do século XXI. [S. l.]: K21, 2021.
[10] MALHEIROS, B; MALHEIROS, G. Descomplicando a Aprendizagem – 5 passos que vão mudar a sua forma de adquirir conhecimentos. Rio de Janeiro: RECTO, [201-]. Disponível em: < https://recto.com.br/download/recto-descomplicando-a-aprendizagem.pdf >. Acesso em: Dez. 2021.
[11] UDEMY. Analytic Hierarchy Process (AHP) em Python. Santa Catarina, 2019. Disponível em: <https://www.udemy.com/course/analytic-hierarchy-process-ahp-em-python/>. Curso ministrado pelo professor Edson Pacholok. Acesso em: Nov. 2021.
[12] LOPES, ANDERSON FERNANDO; Management methodology based on obsolescence analysis in engine block machining area. Feb. 2022.