# RISK ASSESSMENT IN THE MANAGEMENT OF CHANGE PROCESS AIMING AT IMPROVING QUALITY AND SUSTAINABILITY IN ORGANIZATIONS – A CASE STUDY

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## ABSTRACT

This paper gives a method for identifying potential risks in the Management of Change (MOC) process in companies' operational environments and proposes a digital process for change optimization. The authors used Analytic Hierarchy Process (AHP) to assess the risks that could affect MOC, generating data for effective decision-making to improve quality, safety, and sustainability. A case study was conducted in the facilities of a jet engine repair station. Experts and professionals from the studied company and others responded to a survey to identify risk factors, and the probabilities of failure were elicited from them accordingly. As a result, a global risk matrix is proposed showing the most impactful risks. Risk responses and a revised digital process for MOC are presented to improve quality and sustainability in the studied company, which can also be used in other companies. The study provides a method to be used by professionals, engineers, and decision-makers to identify risk factors that can impact the company's management of change processes and implement proper risk responses. The contribution is significant since it brings improvement in the quality and sustainability of organizations.

Keywords: Management of Chnges, Risk assessment, AHP, and Sustainability.

## 1. INTRODUCTION

Organizational Change is any movement that makes an organization go through a state of transition to reach a desired future state. It can be in processes, technologies, behaviors, culture, organizational structures, and physical structures. Multiple changes can happen simultaneously. Digital technology makes changes occur faster and faster and requires the agility of companies and people. A systematic process and a set of tools are necessary to lead organizations through changes. Skills and knowledge in the management of change need to be developed because the flexibility to changes is required nowadays. It makes an organization capable of absorbing changes quickly and simultaneously. High technology companies with complex processes, such as jet engine repair stations, are subjected to continuous changes, and the lack of proper management can lead to

critical problems and failures. A case study was conducted in the facilities of a jet engine repair station to identify gaps in the direction of the change process and opportunities for improvement in safety and quality.
By [1] stated that effective MOC involves reviewing all significant changes to ensure that an acceptable level of security is maintained after the change has been implemented. Oakland J. S., Tanner, S. [2] experience shows many Change initiatives fail to deliver. The authors interviewed Senior management in 28 organizations from various industries, including the public sector, over six months and examined several themes covering the triggers for change, planning for change, and Implementing change. The result was a proposal of a framework that can aid organizations that are about to initiate a change program or are in the process of managing change and wish to improve their chances of success. By [1] stated that successful change management is vital to any organization to succeed in the present highly competitive and continuously evolving business environment. The author reviewed some of the main theories and approaches to organizational change management and constructed a new framework for managing change. Oreg, S. [3] proposed and tested a model of resistance to organizational change through a study of 177 employees. The author concluded that personality and context were significantly associated with employees' attitudes towards a large-scale organizational change and with employees' job satisfaction, organizational commitment, and intention to leave the organization. Allen, J., Jimmieson, N. L., Bordia, P. & Irmer, B. E. [4] examined the role of communication in addressing change-related uncertainty for employees. The author discusses the theoretical contributions to the change management literature and the implications regarding effective communication strategies during change. Dijk, R. V & Dick, R.V. [5] stated the resistance to change is a social phenomenon generated and defined through interaction. The authors propose that 'resistance to change' can be understood as employee response to a threat to their work-based identity and can be perceived as a threat to change leaders' work-based identity.
Besides the studies mentioned above, other works about MOC and risk management are as follows: Pereira and Lima [6] proposed a model is needed to estimate the likelihood of engine failure. Pereira et al. [7] stated that operational accidents affect manufacturing industry productivity, and evidence shows that adopting a safety management system can influence economic performance. Pereira, Quelhas, and Lima (2014) [8] stated that a qualitative risk analysis is critical to identify the primary failure cause factors; stakeholders use their knowledge and experience to identify ideas and solutions for redesigning processes. According to Döll et al. [9] , management projects are known for their high failure rate. Freye [10] emphasizes that today corporate leaders' interpretation of institutions is linked to (internal and external) political and economic structural changes and the managers' new professional experience. Earl and Taylor [11] stated that Change Management is a best practice to ensure that health, safety, and environmental risks and hazards are properly managed when an organization changes its facilities, operations, or personnel. The author emphasized that having a properly implemented MOC policy when implementing change can help to make sure that no new hazards are introduced and existing risk levels are not increased.
In recent years, some studies for MOC process optimization and risk management are as follows: Mack and Khare [12] presented the acronym VUCA (volatility, uncertainty, complexity, and ambiguity) becoming more and more popular to denote such a dynamic business environment. For Gerbec [13] changes are a daily reality in the industries, and potential implications on significant hazards must be effectively managed. According to Kliestik et al. [14] , change management is a highly effective method of techniques and can be used to achieve specific objectives of companies that involve data manipulation. Kienbaum [15] confirms this trend. Siong. et al. [16] pointed out that MOC is a process for evaluating and controlling modifications to facility design, operation, organization, or activities. Laskar [17] observed that effective management of the change process includes a systematic review and authorization process for evaluating proposed adjustments to facility design, operations, organization, or activities before implementation to ensure that no unforeseen new hazards are introduced. Grimolizzi- Jensen [18] explained that managing change could help individuals and groups about the change process, thereby improving the chances of the change initiative being successful. Jayatilleke and Lai [19] highlighted that changes in requirements become necessary and inevitable due to changes in customer expectations and business rules and operating environments. Choromides [20] showed that globalization and economic instability had prompted increased organizational changes related to downsizing and restructuring to improve financial performance and corporate competitiveness). Zio [21] stated that risk assessment must be considered to respond to existing and future challenges without forgetting the new systems and innovations that have already arrived in our lives and are coming ahead. Change theories describe how effectively organizations can modify their strategies, processes, and structures (Hussain et al., 2018) [22].

The current followed trend and developments are also studied: Wainwright [23] complements saying changes still need to bring about the expected transformation in the workplace. Still, studying whether the workplace is ready for the worker and how procedural change will be managed is becoming opportune. The findings from Alsharari [24] emphasize that the nature of organizational change is not static; instead, it is dynamic and varying over time. Well-known publications about the management of changes are, for example, the work of Dzigol et al. [25] states that the current conditions of enterprise management are imposing dramatically new requirements for the management system and achieving effectiveness. Pang, Aziz, and Patah [26] emphasized that integrated risk analysis is essential to plan and control risks and hazards brought by the proposed change. The term has become established for the management techniques required to control these processes involved in Change [27]. The current followed trend and developments are also studied.
According to the mentioned research and developments, current solving trends in the literature show that: (1) more and more publications are proposed for managing MOC problems and applications; (2) the researchers not only focus on small and medium changes but also study large changes; and (3) the optimization of management of change process are crucial to avoid risks that could lead to huge financial loss for organizations. Although the above developments have been achieved in recent years, there are still opportunities for MOC optimization. The previous studies listed here dealt with MOC processes and risk management by using different approaches. Most of them are based on qualitative approaches. This paper aims at completing this gap by proposing and describing a method to apply BBN and AHP to assess the risks in the MOC process and define adequate risk responses. This study brings a significant contribution by responding to two relevant research questions:

**Research Question 1:** What are the critical operational risks in the management of the change process that may affect operational safety?

**Research Question 2**: What steps should the studied company take to effectively implement the MOC process?

The paper is structured as follows: Section 2 describes the methodology and previous presents studies on Quality and Sustainability and AHP. Section 3 presents the discussion, and section 4 the conclusion. In the end, the list of references used in this paper is provided.

## 2. DESCRIPTION

This sections presents the methodology used in the conduction of the study and current research about Quality, Sustainability and AHP.

### 2.1 Methodology

Initially, the factors that could cause failures in MOC were identified in state-of-the-art literature on the subject. The search was done in Google Scholar and Operations Management Journals listed in JCR (Journal Citation Reports); the keywords used changed in management, Risk assessment, Operational safety, Critical factors and AHP. A case study was conducted in the facilities of a jet engine overhaul station. The study was conducted based on the method proposed by Baxter and Jack [28]. A process map covering the management of the change process was prepared with help from specialists in the jet engines repair station. All the relevant risk factors identified in the literature research and the process map were listed and used to prepare the survey submitted to industry experts to determine the factors that could lead to a MOC failure. The experts validated the risk factors and assigned a probability score. They classified each risk factor in the probability levels from 1 to 5. The survey respondents had at least five years of experience in their field of work. They were selected to cover all different steps in the process, considering a holistic and multidisciplinary approach to the searched object. The survey addressed risk factors in the MOC processes. One hundred professionals responded to the study, with more than 74% of the participants working in large companies, 11% in medium and 10% in small companies, and less than 5% in micro-companies. The responses were provided by 48% of employees working in the maintenance of aircraft engines, 8% working with other service providers, 20% in product manufacturing, and 24% working in the food industry. AHP Matrix were prepared using the data obtained

from the survey. From AHP the Risk impact prioritization was defined. Responses to the risks were defined and the MOC process map was changed and a standard process was established. Fig. 1 shows the flowchart with these steps.

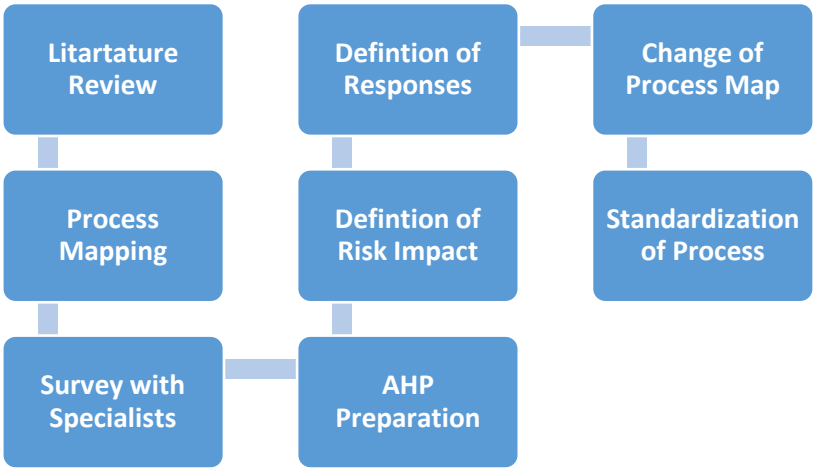


**Fig. 1** – Methodology flowchart

## 2.2 Quality and Sustainability

Rickard, G., & Johansson, P. [29] presented a conceptual model that considers the practical and theoretical implications of stakeholder-oriented management in pursuit of organizational sustainability. The model explains the actual behavior of organizations and the distinction between organizational and global sustainability. Pereira et al. [30] stated that sustainability is related to the needs of stakeholders and the degree to which the hidden needs are met and that the different stakeholders can change as well as the needs of the stakeholders, which implies that the meaning of sustainability also has become dynamic. Lagrosen, Y. and Lagrosen, S. [31] conducted a case study in an innovative manufacturing company based on interviews with employees focusing on their perception regarding quality and sustainability and document studies and observation. The analysis revealed identified dimensions, and the framework that integrates is suggested to be useful for companies. Fundin et al. [32] gathered extensive data during a workshop process by a collaborative brainstorming workshop and an appreciative inquiry with researchers and practitioners about the theme of sustainable development. The process identified aspects in the field and practice that need to be preserved. Deleryd, M. and Fundin, A. [33] stated that additional quality management models that complement current approaches are needed for organizations to successfully manage current, fast-changing environments. The authors propose a generic model for sustainable development based on sequential Delphi studies that support all organizations on their pathway towards sustainable organizational success. Martin et al. [34] proposed a framework centered around the notion of quality-in-use that incorporates two dimensions for understanding quality; form, which covers the constructive or predefined dimension, and scope, which covers the single actor or multi-interested parties' dimension. Carnerud et al. [35] conducted a study that applied data mining and content analysis to the digital archives of eight scientific journals, covering 12,000 research paper abstracts in almost 40 years. The findings show that sustainability came onto the scholarly scene in 1996 and has become an increasingly popular research area. Vandenbrande, W., W. [36] presented a framework that allows companies to advance sustainability using quality management. The author considered the company's maturity level, which allowed the sustainability movement to spread out widely and fast. The author presented a new definition of sustainability that can be used as a starting point for developing quality.

### 2.3 Analytic Hierarchy Process (AHP)

Bhushan and Rai [37] also conducted a noteworthy study about AHP, stating that AHP was developed and extensively studied. It is currently applied for decision-making in several complex scenarios, in which people work together to make decisions and where human perceptions, judgments, and consequences have long-term repercussions. An important study about AHP is the one conducted by Maris et al. [38]. The author stated that multi-criteria programming through Analytic Hierarchy Process is a technique used for decision making in complex environments in which diverse variables or criteria are considered. According to the author, AHP transforms comparisons, often empirical, into numerical values compared. Wu and Fang [39] proposed a novel approach that combined fuzzy Delphi and Fuzzy AHP for detecting competencies via experts' opinions and questionnaires to create the managerial professional framework. Cavallo et al. [40] propose applying the Analytic Hierarchy Process for sustainable urban development by focusing on economic, environmental, and social impact. Hnilica et al. [41] studied the use of multiple-criteria decision-making methods for complex assessment of the work environment using AHP. Her contribution defined the need to assess individual pairs of risk factors conscientiously and responsibly in Saaty's matrix. AHP, as an attribute decision-making tool, has become an essential branch of decision-making since then [42]. To Mu and Pereyra-Rojas [43] to analyze the decision utilizing the analytic hierarchy process, one should create a model for the decision, break down the decision into a hierarchy of goals, criteria, and alternatives, derive priorities (weights) for the requirements. The importance of criteria is compared pairwise concerning the aimed objective to derive their weights. This comparison can use data of human choices or judgments as a form of underlying information. Analytic Hierarchy Process (AHP) approach has been used in the management domain to analyze complex situations and make sound decisions [44]. Fayer [45] study described shortcomings in applying the method that usually comes from the decision-maker. The three significant elements of AHP are hierarchy construction, priority analysis, and consistency verification [46]. The Analytic Hierarchy Process remains a popular multi-criteria decision method (Goepel, 2018). The results obtained using the AHP method are influenced by the credibility of information [47]. Thanks to this Method, a reasonable solution can be reached for situations with many solutions in which specific criteria are formed [48]. The consistency of judgments can then be evaluated to ensure a reasonable level of consistency.
An analytical hierarchy process is an effective risk assessment method in which a questionnaire is used to collect experts' responses [49]. For Lin et al. [50], AHP is widely used in group decision-making (GDM). The Analytical Hierarchy Process method is used from the multi-perspective approach [51]. Aghaei et al. [52] claimed that safety risk management is critical for performing in large projects. Kurek et al. [53] described the use of two methodologies: Principal Component Analysis (PCA) and Analytical Hierarchy Process (AHP). Sienkiewicz-Małyjurek [54] claims the impact of this risk on the effectiveness of joint activities is still underestimated. The results allow a better understanding of issues of risks. In consequence, they indicate risk symptoms are worth keeping track of to prevent ineffectiveness.

## 3. DISCUSSION

The management of the change process map generated during the case study conducted at a jet engine repair station is shown in Fig 2.

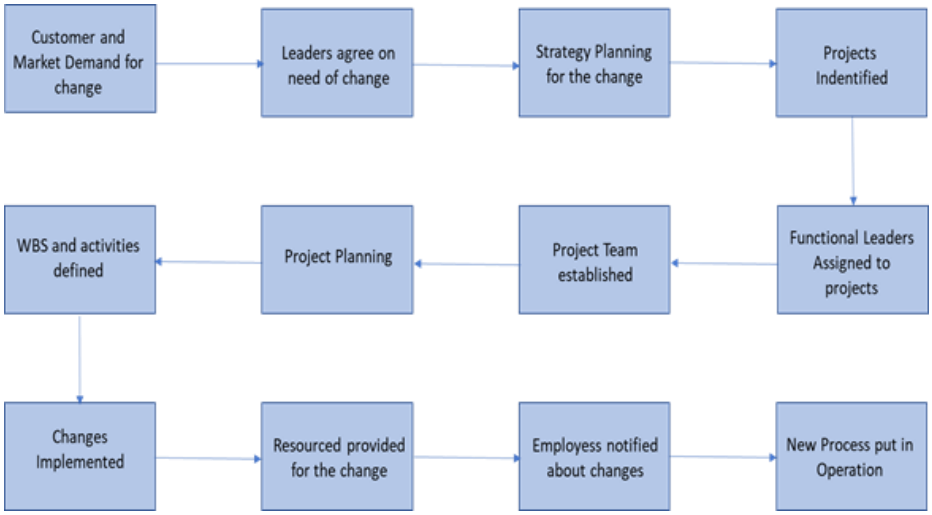


**Fig. 2** – Methodology flowchart

Based on the analysis of Figure 2 and the information obtained from the literature review, the most significant risk factors in the MOC process were defined and classified using an affinity diagram. Table 3 shows the risk factors and the respective categories. The categories of risk factors identified by using the Affinity diagram are: Lack of involvement of Stakeholders, System changes not covered, lack of risk assessment during changes, Lack of standard procedures for Change, Lack of knowledge on the change process, lack of definition of authorization steps (gates), lack of planning, lack of training on MOC, Major system changes not addressed, lack of good teamwork environment, Key position changes not addressed, Restructuring of the organization not considered, Change actions after completion of post-change checks.

The categories are all listed in the left column of Tab. 1 and the associated risk factors in the right column.

| Categories | Risk Factors |
|---|---|
| Lack of involvement of Stakeholders | ✓ Changes are made without the knowledge of all stakeholders<br>✓ Introduction of new technologies / new tools (of any nature) without involving all employees involved. |
| System changes not covered. | ✓ New ideas generate changes in the system and procedures as part of the continuous improvement process and the MOC process is not followed.<br>✓ New software/programs introduced without following MOC process |
| Lack of risk assessment during changes | ✓ MOC not covering operational areas bad performance leading to changes. |

| | |
|---|---|
| | ✓ Internal Investigations result in changes that are not evaluated for Risks |
| Lack of standard procedures for changes | ✓ Internal processes do not cover changes in the economic scenario with an impact on the company's business.<br>✓ Innovations/changes in operational processes or procedures do not follow standard practice. |
| Lack of knowledge on the change process | ✓ Employees are not aware of what process to follow during changes.<br>✓ Employees are not committed to following a standard process for changes.<br>✓ Employees are not using the process for changes regularly.<br>✓ MOC Digital Workflow is not accessible by Employees. |
| Lack of definition of authorization steps (gates) | ✓ Middle Leadership is not informed of changes in operational processes or procedures.<br>✓ Leadership is not involved in changes in operational processes or procedures.<br>✓ Employees are not involved in operational processes or procedures. |
| Lack of planning | ✓ A plan is not prepared for operational failures, which led to transfers of responsibilities.<br>✓ A plan is not prepared for changes in the physical structure, systems, or processes concerning logistics and material storage.<br>✓ Immediate changes were made to meet production demands without following the MOC process. |
| Lack of training on MOC | ✓ Processes or procedures for change management were issued or revised without proper flow down.<br>✓ Employees are not referencing procedures for changes.<br>✓ Employees are not familiar with procedures for changes. |
| Significant system changes were not addressed. | ✓ Significant changes in the operating environment/working conditions not covered in MOC<br>✓ MOC not covering significant changes in training programs.<br>✓ MOC not covering merger, division, expansion, or significant retraction of the company (somehow achieves critical activities for operational safety. |
| Lack of good teamwork environment | ✓ Stakeholders are not committed to changes. |

| | |
|---|---|
| | ✓ Lack of good communication among stakeholders.<br>✓ Lack of motivation of employees involved in the changes |
| Key position changes not addressed | ✓ Changes in Senior Management.<br>✓ Changes in Safety Action Group or Safety Committee.<br>✓ Changes in management levels.<br>✓ Loss of key personnel in areas sensitive to operational safety |
| Restructuring of the organization is not considered | ✓ Changes in the regulatory environment that require changes in structure, responsibilities, processes not covered by the MOC process<br>✓ Infrastructure changes were made without following the required procedure for changes.<br>✓ Lean initiatives that result in changes not covered by MOC. |
| Change actions after completion of post-change checks. | ✓ Actions implemented conflict with the activities defined by the MOC process.<br>✓ Stakeholders are not reviewing changes in actions after MOC completion.<br>✓ The MOC team is not<br>✓ notified of required process changes made after MOC completion. |
| Customers' and suppliers' requirements are not considered. | ✓ MOC is no covering significant changes in customer requirements or expectations.<br>✓ New contracts or contractual revisions are no addressed in MOC. |

**Tab.1**: Categories of risk factors

Experts from the repair station pairwise evaluated risk factors based on the survey and process map. The weight of each identified risk is shown in the last column of Fig. 3. The Weights were color coded as pet Tab 2.

| Impact Level Score | | |
|---|---|---|
| Score | Impact Level | Impact |
| 5 | High | More than 0,16 |
| 4 | Elevated | 0,12-0,16 |
| 3 | Moderated | 0,08-0,11 |
| 2 | Low | 0,04-0,07 |
| 1 | Limited | Less than 0,04 |

**Tab.2:** Categories of risk factors

Fig.3 shows the risk factors and respective weights and impact score level.

| Criteria Comparison Matrix | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Risk Factors*** | Lack of involvement of Stakeholders | System changes not covered | Lack of risk assessment during changes | Lack of standard procedures for changes | Key position changes not addressed | Lack of knowledge on the change process | Lack of definition of authorization steps (gates) | Lack of planning | Lack of training on MOC | Significant system changes were not addressed. | ***Normalized Matrix*** | | | | | | | | | | Weights |
| Lack of involvement of Stakeholders | 1 | 3 | 7 | 3 | 3 | 7 | 3 | 5 | 5 | 3 | **0,30** | 0,09 | 0,52 | 0,14 | 0,08 | 0,46 | 0,11 | 0,31 | 0,25 | 0,10 | 0,23 |
| System changes not covered | 1/3 | 1 | 1/3 | 3 | 5 | 1/7 | 1/3 | 1/7 | 1/5 | 1/5 | 0,10 | **0,03** | 0,02 | 0,14 | 0,14 | 0,01 | 0,01 | 0,01 | 0,01 | 0,01 | 0,05 |
| Lack of risk assessment during changes | 1/7 | 3 | 1 | 5 | 7 | 3 | 7 | 1/3 | 1 | 5 | 0,04 | 0,09 | **0,07** | 0,23 | 0,20 | 0,20 | 0,25 | 0,02 | 0,05 | 0,17 | 0,13 |
| Lack of standard procedures for changes | 1/3 | 1/3 | 1/5 | 1 | 7 | 1/5 | 3 | 1 | 1/3 | 7 | 0,10 | 0,01 | 0,01 | **0,05** | 0,20 | 0,01 | 0,11 | 0,06 | 0,02 | 0,23 | 0,08 |
| Key position changes not addressed | 1/3 | 1/5 | 1/7 | 1/7 | 1 | 1/3 | 3 | 1/3 | 1/3 | 1/3 | 0,10 | 0,01 | 0,01 | 0,01 | **0,03** | 0,02 | 0,11 | 0,02 | 0,02 | 0,01 | 0,03 |
| Lack of knowledge on the change process | 1/7 | 7 | 1/3 | 5 | 3 | 1 | 7 | 3 | 1/3 | 5 | 0,04 | 0,20 | 0,02 | 0,23 | 0,08 | **0,07** | 0,25 | 0,18 | 0,02 | 0,17 | 0,13 |
| Lack of definition of authorization steps (gates) | 1/3 | 3 | 1/7 | 1/3 | 1/3 | 1/7 | 1 | 5 | 5 | 1/3 | 0,10 | 0,09 | 0,01 | 0,02 | 0,01 | 0,01 | **0,04** | 0,31 | 0,25 | 0,01 | 0,08 |
| Lack of planning | 1/5 | 7 | 3 | 1 | 3 | 1/3 | 1/5 | 1 | 7 | 3 | 0,06 | 0,20 | 0,22 | 0,05 | 0,08 | 0,02 | 0,01 | **0,06** | 0,34 | 0,10 | 0,12 |
| Lack of training on MOC | 1/5 | 5 | 1 | 3 | 3 | 3 | 1/5 | 1/7 | 1 | 5 | 0,06 | 0,14 | 0,07 | 0,14 | 0,08 | 0,20 | 0,01 | 0,01 | **0,05** | 0,17 | 0,09 |
| Significant system changes were not addressed. | 1/3 | 5 | 1/5 | 1/7 | 3 | 1/5 | 3 | 1/3 | 1/5 | 1 | 0,10 | 0,14 | 0,01 | 0,01 | 0,08 | 0,01 | 0,11 | 0,02 | 0,01 | **0,03** | 0,05 |
| TOTAL | 3,35 | 34,53 | 13,35 | 21,62 | 35,33 | 15,35 | 27,73 | 16,29 | 20,40 | 29,87 | | | | | | | | | | | |

**Fig. 3** – risk factors and respective weights

The risk categories with the most impact was the *Lack of involvement of Stakeholders* classified as <u>high risk</u> and *Lack of risk assessment during changes, Lack of knowledge on the change process and, Lack of planning* with <u>elevated risk.</u>

Risk responses were implemented to address these high and elevated risks, by adding green box steps to the original process map from Figure 2 to optimize safety, quality, and sustainability in the studied company. Fig. 4 shows the revised process map.

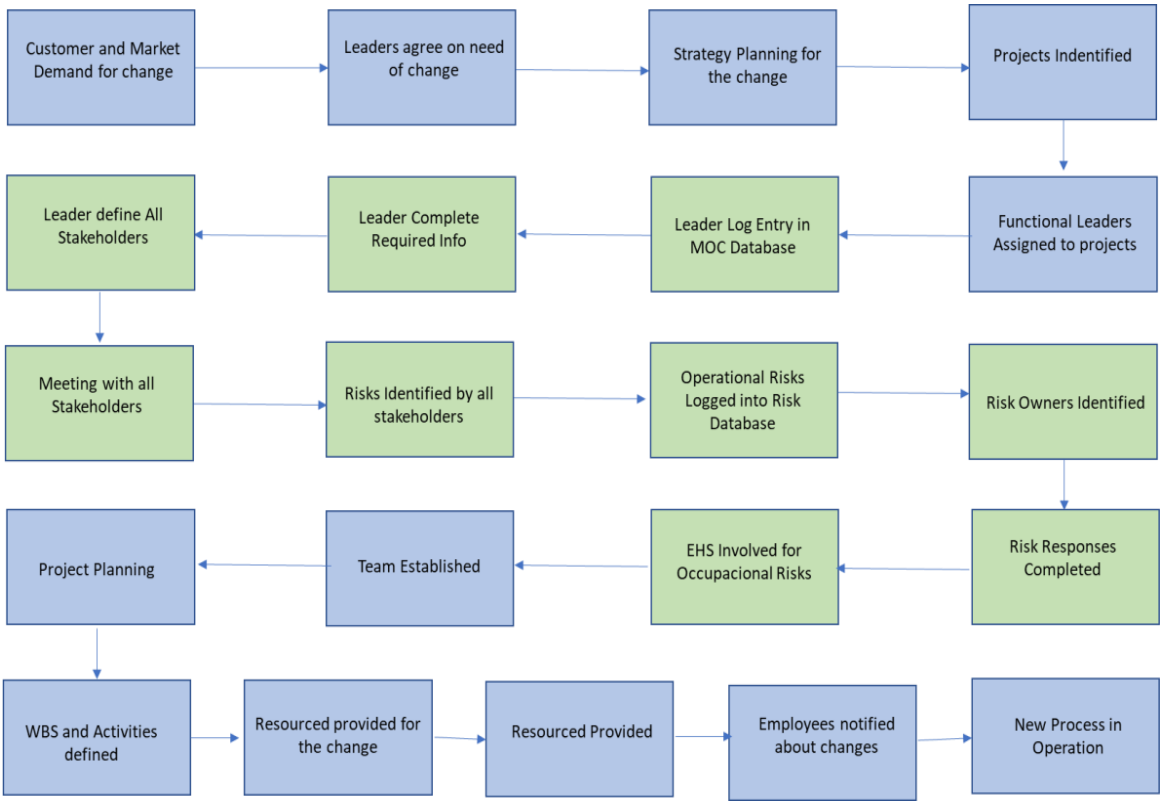

**Fig. 4:** Revised Management of Change process map

The first green box step, named *"MOC leader log an entry into the database,"* is crucial since the entry creates a sense of urgency defining the timing each individual or organization must act. The process initiates with an open and honest conversation with stakeholders. Support from customers and industry stakeholders is required to strengthen the case.

The second green box step, named *"MOC leader completes required information,"* into the database is vital to clearly define change and align it with business objectives. Change management is a process of allocating resources to transform the organization, intending to improve its effectiveness. Several conditions influence the change process, such as company resources, the sector, the need for change, the quality of management, and the current political, economic, social, technological, environmental, and legal scenario. It becomes necessary to promote a change process when the organization does not satisfy the stakeholders; that is, the stakeholders' desire must be well aligned with the shift to be inserted.

The third green box step, *"MOC leader defines all stakeholders,"* needs to be completed to form alliances. Every day, people show resistance to change; bringing people into change, recognizing them, and encouraging them to participate in the change process becomes essential. Identifying the true leaders in the organization, as well as the main stakeholders, is vital. Asking for an emotional commitment from these key people, working on team building within change coalition, checking team for weak areas, and make sure a good mix of people from different departments and different levels within the company is present.

The fourth green box step, named "*Meeting with all stakeholders,"* is also essential to create a vision for Change: Determining the values central to the change. Developing a summary (average of one or two sentences) that captures what is "observed" as the organization's future; Creating a strategy to execute that vision. Talking often about your vision for Change; Addressing people's concerns and anxieties openly and honestly; Applying the idea to all aspects of operations, and Leading by example.

The fifth green box step, named "*Risk identified by all Stakeholders,"* is fundamental to ensure all stakeholders work together to identify all risks. It is crucial to empower people or give them the power, freedom, and information that allow employees to make decisions and participate actively in the organization. By raising risks, the changes will start making part of the culture of the organization. Making continuous efforts to ensure that change and threats are seen in all aspects of the organization will help change a solid place in the organization's culture.

The sixth green box step named "*Operational Risks logged into risk database"* is essential to ensure traceability and to determine the impacts and those affected by the Change: It is necessary to use risk and impact assessment tools, such as FMEA, HAZOP, and AHP to determine which factors will be most impacted or impacted first so that strategies are formed for the creation of the organizational change project.

The seventh green box step, named "*Risk Owners identified,"* allows the owners to create short-term goals in response to the risks identified. A complete analysis of the advantages and disadvantages of potential plans needs to be done.

The eighth green box step, named "*Risk Response completed,"* consolidates improvements. This modified process was implemented in the repair station in the format of a digital workflow.

## 4. CONCLUSION

The target of the study was to identify the critical change management operational risks that could affect operational safety and sustainability. The next step was to propose actions that could be taken to effectively

implement the MOC process. The most important findings were the critical risk factors affecting the process: Lack of involvement of Stakeholders classified as high risk and Lack of risk assessment during changes, Lack of knowledge on the change process and, Lack of planning with elevated risk.

Based on these risks, the initial process map was revised. Response to these risks improved the processes significantly. This is a contribution to the previous findings of other researchers presented in the section literature review since most of them were based on qualitative approaches only and did not cover a quantitative approach using AHP and with a focus on organizational sustainability. This paper aimed at completing this gap by proposing and describing a method to apply AHP to assess the risks in the MOC process and define adequate risk responses by proposing a changed process that could optimize quality, safety, and sustainability. The study was conducted within the facilities of a jet engine overhaul shop, and the result can be generalized to other aviation and non-aviation maintenance shops. The implications are relevant since changes in the operational processes can be conducted in a safer way when adopting the revised process. By following the revised process, operational failures and catastrophic accidents can be prevented.

The proposed methodology revealed some important results, thus contributing to previous studies on the subject and may help to overcome some of the challenges faced by operational leaders and other professionals looking for safety and quality through effective change management. The study was conducted based on the experience and knowledge of experts on the subject. As explained in the Introduction Section, several papers have been published addressing the use of MOC in different domains in the latest years. However, no previous study could be found covering the application AHP to identify risks in the change management process. It is noteworthy here that this paper proposes an optimized approach that could be used in any organization. Changing organizational context encompasses changes in human behaviour, work patterns, and values in response to changes or anticipating strategic, resource, or technology changes. The big challenge is not technological change but a change in the way people think and the organizational culture to gain a competitive advantage.

The first research question is: "what are the critical change management operational risks that may affect operational safety?". It was concluded that the critical change management risks that may affect operational safety are Lack of risk assessment during changes, Lack of knowledge on the change process and, Lack of planning.

The second research question is: "What steps should the studied company take to effectively implement the MOC process?". It is recommended that a company follow the proposed guidance process map for optimizing their MOC process to attain safety and quality. The additional steps in the guidance process map make the process more robust and allow better traceability.

This proposed process can guide the companies that are still under the traditional management of the change process to achieve their safety and quality improvement aims by following the proposed methodology. That helps to significantly impact operational results, such as quality and safety improvement, cost reduction, representing considerable productivity gains and sustainability. Even for companies in other fields, the proposed methodology can enrich their change management program, helping the changing process be more effective. The proposed additional steps in the MOC process, enhanced by improved communication, enable any enterprise to increase productivity through change management. This study shows evidence that the quality of the change management process is affected by several factors, some of which can compromise the reliability and safety of the change process. In this regard, process analysis played a crucial role in understanding and implementing actions to improve it.

This study is significant because understanding the most impactful risk factors in the management of the change process can influence operational managers, engineers, and decision-makers in companies. As evidenced by the results, the modified method can help to optimize the management of change. As expected, the contribution is significant; it is believed that the present study will augment the knowledge of operational managers, engineers, and decision-makers concerning the use of Management of Change to improve the

quality and effectiveness of the working process. In addition to productivity, MOC has increasingly been an essential element of quality and a necessary part of quality systems, mainly in pandemic times when changes occur extremely fast.

Scope for future research: - This study opened some new research avenues for the future. Opportunities for other case studies are abundant. They could be related to a broader application of MOC on specific cases, enhancing the current methodology in use and reducing the risk of failures. One example to be explored would be to create a MOC robust data base integrated with risk management database and artificial intelligence to speed up and improve the process even more..

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