The Use of Quality Tools to Improve the Risk Management Cycle in the Shaping of the Work Environment

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Abstract. For any efforts to improve working conditions that are guided by risk assessment to be effective, it is critical to rely on accurate information and ensure that any improvement measures taken can be assessed and modified at any stage. Success in achieving the desired effects depends on the use of appropriate tools to help the organization improve its ability to achieve intended outcomes. The paper indicates that is particularly vital to deploy proper instruments to assess, select, and supervise activities so that the work environment to be managed in an orderly manner on the basis of risk management cycle guidelines. The corrective measures will then contribute to the achievement of the intended improvement outcomes in the work environment and possibly provide the organization with competitive advantages. The article discusses based on literature sources the use of tools traditionally associated with quality engineering. Based on relevant literature and field observations in manufacturing organizations, it assesses the option of using quality tools at each stage of risk management. The article focuses on the possibility of achieving outcomes consistent with a particular stage of risk management. Many of the tools discussed in the article can be used to improve the measures attributed to various stages of management, enabling organizations to garner benefits that are characteristic of that management stage rather than the type of tool used. The study refers to the possibility of using the tools for specific activities related to the shaping of the work environment.

Keywords: Improvement · Work environment · Safety · Elimination of hazards and nuisances · Risk management

1 Introduction

Any risks occurring in a work environment, the majority of which are inextricably linked with an organization's processes, require solutions that will mitigate their impact on workers and the severity of the damage they may cause. Such risks may ultimately reduce worker efficiency. Any improvement measures should be designed accordingly to the nature of both the issue at hand and the resulting non-compliance and reflect the magnitude of potential consequences [1–3]. The improvement measures undertaken in response to an issue should be adequate for the nature of the problem, as identified, and ensure effective improvement. This requires that proper account be taken of all

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factors that affect the manufacturing process. Such factors include conditions related to workplace equipment and the individual predispositions of workers assigned to perform work. Moreover, due to an increasing complexity of processes, organizations need to constantly search for solutions to ensure continuous process improvements [4].

The study provides a broad view of the analyzed problem. In particular, close oversight and efforts to identify the need for improvement measures are required where the performance of work may generate high risks caused by particularly hazardous conditions, poor work organization and the use of equipment poorly adapted to needs. The nature of particular issues needs to be recognized to develop responses that will effectively eliminate risks and ensure the safe performance of work. Worker safety during the operation of processes is central to any successful improvement [5, 6]. Improvement measures should not only be guided by risk assessment, but also ensure the effective use of systemic activities included in the occupational risk management loop. Thereby, improving the management process.

Responses to risks may be guided by the ISO 31000 standard [7], which is designed to increase the effectiveness of improvement measures. This is particularly helpful where efforts to improve working conditions are expected to additionally help reduce the costs of risk mitigation [8–10]. An added benefit is a favorable perception of improvement measures by the organization's workers and management. Contributing to the reduction of burdens, including financial burdens related to the failure to ensure working conditions, that provide the efficient implementation of tasks and effectively limiting the potential burdens [11–13].

Research to date is based mainly on the use of single tools to analyze specific problems. It is also possible to consider combining tools in order to obtain optimal conclusions [7].

2 Nature and Characteristics of Risk-Management-Guided Improvement Measures

The main purpose of improvement measures is to effectively protect any individuals who may be exposed to hazards. A possible secondary aim may be to reduce the costs of having a work environment that is poorly adapted to the needs of the workers and any other persons entering production floor. Regardless of the reason why they are taken, improvement measures must reflect the nature of any non-conformities [2, 14].

Risk management guidelines allow one to effectively implement well-justified improvement measures. Such guidelines establish new standards in the implementation of improvement measures, helping organizations to de-ploy them in an orderly and duplicable fashion, ultimately contributing to their greater effectiveness and superior overall outcomes [4]. Such outcomes may include reductions in harm to humans, i.e. any direct adverse impacts of hazards on the health and life of workers [15]. They can also easily be measured against relevant financial costs. This is a consequence of determining the level of burdens, which transfer "human consequences" into financial losses.

The use of measures based on occupational risk assessment allows organizations to respond exclusively to the status quo found at the time of assessment and the circumstances that may arise in the near foreseeable future. To successfully achieve long-term improvements, organizations must identify their issues precisely and roll out solutions

and measures that will guarantee stable improvements and offer flexibility to accommodate future changes. This makes the deployment of improvement measures a dynamic activity that involves constant responses to changing conditions [14, 16]. One may therefore view it as a process focused on the continuous improvement of the solutions in place that can be readily equated with the PDCA cycle known in quality engineering. A proper sequence of measures that duly account for improvements of a specific nature will support ongoing modifications accordingly to changes in the environment. Obtaining information about the current state of the work environment should be treated as a factor significantly contributing to ensuring the conditions for the effective performance of professional tasks [17]. The inclusion of the human aspect allows for an individual look at the analyzed issues [15].

To effectively manage occupational risks, organizations only need to recognize the "initial state", as found at the time they first assess their work environment, and ensure the option to perfect their original solutions. Their responses will be evaluated on the basis of the effects of their improvements. Indirectly described by reference to the improvement effects achieved.

The factors affecting an organization's ability to deploy the measures included in its risk management loop are shown in Fig. 1.

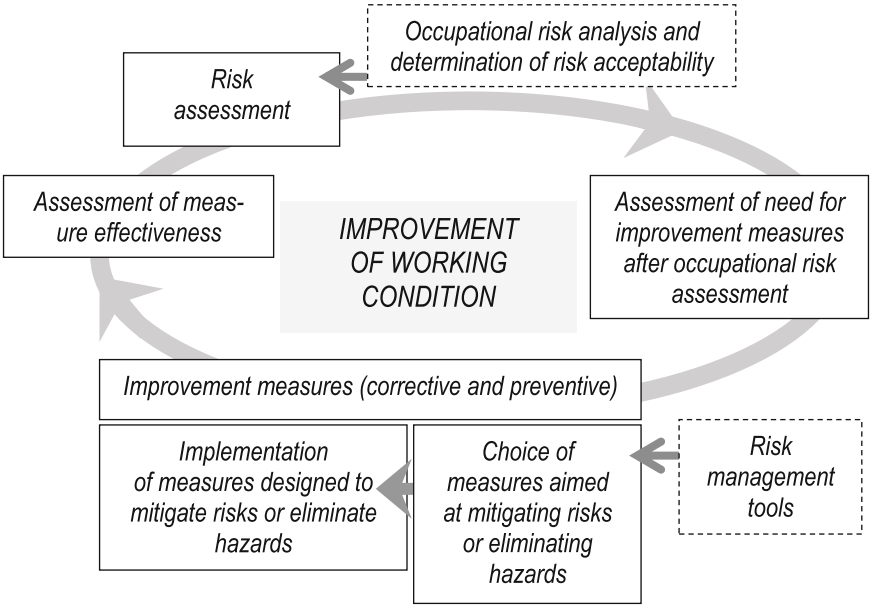

Fig. 1. Occupational risk management loop. Source: Own work.

The response included in the management loop begins with risk assessment. Its purpose is to assess the existing state, or the so-called "starting point", and support decisions that may affect enterprise performance in the long term. Given the considerable uncertainty as to potential future events and their consequences, inaccurate assumptions

may be reached leading to misguided choices of measures intended to reduce future risks to an acceptable level. Response effectiveness will therefore largely depend on ongoing monitoring of task performance aimed at bringing risks down to an acceptable degree well into the future [14, 18, 19].

Any improvement measures adopted in line with the risk management methodology to lastingly shape working conditions should recognize key aspects of continuous improvement. These include the requirement to [19, 20].

- Lay the groundwork for management by way of policy formulation and goal setting,
- Select and adopt organizational arrangements that include activity planning and account for mutual relations, responsibilities and rules necessary to roll out solutions as adopted,
- Manage risks in accordance with the adopted action plan that lays down the preconditions to be met to ensure effectiveness,
- Embed risk management procedures in the strategic and operational policies and practices of the organization.

The improvement measures that follow the risk management methodology need to conform to all the above guidelines and be reassessed at every stage of deployment [18]. Any failures to apply such principles may prevent the achievement of the intended outcomes and consequently impede the elimination of non-compliances.

3 Occupational Risk Management

3.1 The Nature of Effective Occupational Risk Management

Risk management combines management and monitoring functions. In practice, risk management should be ensuring the effectiveness of solutions applied in order to eliminate hazards or reduce the consequences of their impact. The main goal of the used activities is to ensure the safety of employees and preventing hazards that may occur in the business, related to the performed tasks affecting the safety and health of the population living in the vicinity of the plant. This applies to the internal and external context of the organization's operation. One should also not forget about the prevention of hazards to the natural environment.

Any improvement measures taken in an environment ridden with hazards and nuisances should be guided by tried-and-tested practices that are known to be both feasible and effective. For the response to existing risks and nuisances to be effective, it is crucial to adjust it for the nature and severity of the non-compliances that evoked that response in the first place, and the feasibility of its deployment in the specific work and business environment [4, 19]. Such a response should be seen as an attempt to reduce accident rates and the incidence of work-related diseases as well as improve working conditions, thus contributing to a reduction in burdens, particularly those resulting from failures to ensure the safe performance of work.

Risk management helps one to make effective decisions in conditions of uncertainty [21]. Any improvement measures based on risk management guidelines require the consideration of prerequisites for effective management. These include the efficiency

and effectiveness of the measures taken [21], which is achieved by the proper use of resources, including information [22]. To accomplish the intended outcomes of systemic occupational risk management, organizations should [5, 23]:

– Put in place and maintain hazard identification and risk assessment procedures,
– Regularly assess the methodologies they use and their risk assessment findings,
– Get the workers involved in evaluation activities and, in particular, con-sider their opinions on the nature of non-conformities and on the need for and the required scope of improvement measures,
– Take measures as planned to ensure the suggested solutions are deployed consistently with stakeholder expectations.

Effective risk management measures must extend to all areas of an organization's operations, including its [21]:

– Internal environment, in which the organization pursues its goals,
– External environment, within which the organization operates.

Both the external and internal factors should also be considered when determining the extent of risks and identifying risk features (risk priority determinants) in view of the existing risk policy [21, 24]. Accordingly to the complexity of measures, adequate tools should be selected that best facilitate their deployment and are most likely to secure the achievement of intended out-comes [7].

All such measures are to ensure that the adopted risk management methodology achieves the intended improvement effects.

3.2 Use of Tools to Improve the Efficiency of Improvement Measures

Choosing the right improvement actions is a complex and difficult activity, especially in organizations that do not have sufficient facilities to carry out the indicated actions [25]. Obtaining the intended effects of the change requires the use of tools, measures and methods of improvement appropriate for the area of the working conditions shaping. Whether corrective or preventive, improvement measures must be aligned with the profile of non-conformities and be applied adequately to the severity of risk and the impacts of nuisances. It is vital to consider the circumstances in which a non-compliance occurs and the actual impact they have on the workers.

Conducting improvement actions taken solely on the basis of a description of the current condition is not always sufficient to effectively improve working conditions. [26]. In addition, it is necessary to take into account factors related to human characteristics [27, 28].

When undertaking improvement measures, one must assess the likelihood of achieving the intended outcomes, and therefore use a procedure that will allow one to use the available tools to identify and describe non-conformities and plot a path towards intended outcomes. Such tools should assess the actual need for any selected improvement measures, support their correct choice and application, define how the improvement measure should be used and verify the end results of improvement [23, 29].

The selection of appropriate tools can be based on the normative guidelines indicated in EN IEC 31010 [18] and ISO 31000 standards [21]. But the ultimate criterion for selecting them should be the need for get a specific information.

The quality engineering tools that can be used for this purpose are described in Table 1.

Table 1. Quality engineering tools used in risk management.

Stage of risk management	Sample quality engineering tools	Description of outcomes appropriate for specific risk management stage
Assessment of the need to use for improvement measures	(1) Histogram, (2) Fishbone Diagram, (3) Check sheet, (4) Pareto Diagram, (5) Affinity Diagram, (6) Fault Tree Analysis, (7) Requirements table, (8) Stratification (9) Suzuki Method (10) FMEA	The tools make it possible to: - identify the causes of non-conformities and indicate appropriate preventive measures, - identify areas that require immediate action and improvement, - identify detailed requirements, - collect the available data and organize it to obtain necessary information
Selection of measures that mitigate or eliminate risks	(1) Pareto Diagram, (2) Fishbone Diagram, (3) Matrix Data Analysis, (4) Affinity Diagram, (5) Interrelationship Diagram, (6) Process Decision Program Chart, (7) Suzuki Method, (8) Prioritization Matrix, (9) Scatter Diagram, (10) Relationship Diagram, (11) "Why-Why" Diagram	The tools make it possible to: - determine the need for specific measures, - indicate the best course of action to eliminate a non-compliance, - design a response to multiple non-conformities, - choose the right improvement measures, - guide corrective and preventive measures, - identify the achievable benefits
Deployment of measures that eliminate or mitigate risk	(1) Flowchart, (2) Arrow Diagram, (3) Process Map, (4) Top-Down Flowchart, (5) Deployment Flowchart (6) Pareto Diagram	The tools make it possible to: - identify mutual links between the measures taken, - present details of measures being taken and thereby facilitate their rollout, - indicate the structure of tasks performed and mutual interactions among their components, - make the perception of activities more accurate

(*continued*)

Table 1. (*continued*)

Stage of risk management	Sample quality engineering tools	Description of outcomes appropriate for specific risk management stage
Assessment of effectiveness of undertaken improvement measures	(1) Value Added Analysis, (2) Histogram, (3) Control Chart, (4) Customer Satisfaction Index Method	The tools make it possible to: - evaluate the effectiveness of measures and identify options for their improvement, - identify the need to improve the measures being taken, - assess worker satisfaction with the changes made

Source: Own work based on [1, 4, 14]

4 Discussion

4.1 The Benefits of Using Tools Designed to Improve the Efficiency of Occupational Risk Management

The main purpose of introducing risk management and the use of tools to improve risk management is to obtain benefits derived from the applied improvement actions. Identified risk factors define the need and define the scope of activities [3]. The potential benefits can be measured based on the increased capacity to effectively eliminate such irregularities in the work environment as arise in the performance of work [4, 30]. Such an increase is achieved as a consequence of risk assessment and of a traditional rollout of improvement measures that does not rely on the continuous improvement cycle. Ensuring the possibility of verifying the activities as part of risk management requires the use of objective criteria for assessing the achieved effects.

By managing risks and doing so to an ever higher quality standard, an organization stands to secure benefits that are tantamount to the effects of selecting and employing quality tools that are adequate to a given stage of risk management (see: Table 1, Column 3). Influencing the effectiveness of the improvement actions. Such benefits include [5, 29]:

- Improved chances of achieving desired improvement objectives,
- Support for proactive business management that is responsive to changes in the work environment,
- Raised worker awareness of the need for proper risk handling,
- Improved identification of irregularities and risks and improved opportunities with due account taken of all existing conditions (internal and external),
- Improved principles to govern the performance of manufacturing and ser-vice activities and the resulting improvements in such performance,
- Greater stakeholder confidence in the organization, which is recognized as caring about its workers, its internal work environment and the external environment in which it operates,

– An improved system for the monitoring of impacts on the environment and the workers,
– Improved measures taken to reduce potential losses,
– Better performance in occupational safety, including lower costs of accidents.

Should be considered that the necessary condition for effective occupational risk management is the use of information from verified sources, observations, prognosis and opinions. When obtaining information, one should take into account the feedback that indicates the possibility of discrepancies affecting the perception of risk and estimating its level. It is imperative that the obtained information describes the current state in the most complete and adequate manner. Effective management of occupational risk requires [6, 16–18, 31]:

– Conducting activities related to shaping working conditions in accordance with the safety policy adopted in the organization, defined by the company's top management,
– Basing the improvement activities carried out on the exhaustive analysis of the causes of accidents, near-accidents and work-related diseases,
– Identification of the requirements defining the scope and nature of the necessary improvement actions, allowing for compliance with the applicable legal and normative regulations,
– Planning activities to eliminate or reduce the occurrence of hazards and their implementation in a manner consistent with the principles adopted in the company, based on the guidelines of the safety policy,
– Ensuring monitoring of the improvement activities, aimed at verifying the effectiveness and obtaining the possibility of introducing changes and modifications contributing to the improvement of the possibility of obtaining the desired effects,
– Conducting reviews of the improvement actions to indicate the directions of necessary changes, consistent with the needs resulting from the experience acquired during their implementation.

By deploying risk mitigation measures comprehensively, an organization is enabled to develop a consistent risk mitigation policy. The available scientific studies indicate many of the effects obtained, which primarily relate to the effectiveness of the used tools. However, every action that reduces a risk comes with a financial cost. Risk management allows one to apply an evaluation algorithm that is helpful in identifying and applying the most effective solutions [32]. In this sense, integrating occupational risk management into existing processes will improve their implementation and help to increase long-term benefits, thus providing the company with a competitive advantage [33]. This approach may vary depending on the model and tool employed to assess both the circumstances at hand and the workers' capacity to perform their tasks. In many cases, it requires a variety of tools, not just one. The implication of several tools allows for a broader look at the analyzed problem, obtaining objective comments.

5 Conclusion

Occupational risk is an integral part of every professional activity. It cannot be ignored unless the solutions in place already ensure full protection of workers. In an effort to find a way to mitigate the negative impact of risks on workers and increase the effectiveness of improvement measures, an organization may follow management guidelines that will allow it to modify working conditions by focusing on the management factors that are designed to in-crease management effectiveness.

Risk management should be viewed as a way to ensure occupational safety by improving the effectiveness and efficiency of risk elimination or mitigation with a view to improving working conditions. By incorporating occupational risk management into existing processes, one will improve their performance and help increase long-term benefits, thus providing the company with competitive advantages.

Risk management should be recognized as part and parcel of organization-al improvement whose outcomes depend on the effective performance of critical measures. The success of this process requires ongoing adaptations to changing conditions. The use of tools to identify the problem, indicate improvement actions that are reasonable to take, and evaluate the results obtained. This is the way to achieve this goal.

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