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# Strategic Risk Management in Engineering

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***Abstract*** *— Risk management theme is broad. The study of risks, although it has been treated more recently, with modern techniques and specific methodologies, as well as analyzes aided by mathematic modeling and predictability resources, became possible with the advent of computing. The concept of risk can be better understood through the ABNT-ISO (2018) standard, which tells us that risk is the effect of uncertainty on the organization's objectives. Engineering risk management must strive for excellence in project management and quality maintenance, in addition to ensuring an environment conducive to the development and improvement of production methods.*

***Keywords*** *— **risk, management, engineering.***

## I. INTRODUCTION

The study of risks, although it has been treated more recently, with modern techniques and specific methodologies, as well as analyzes aided by mathematic modeling and predictability resources, became possible with the advent of computing. The concept of risk can be better understood through the ABNT-ISO (2018) standard, which tells us that risk is the effect of uncertainty on the organization's objectives.

The engineering projects consider an entire technical and scientific basis to identify, evaluate and control the risks that exist throughout its development and consequently minimize them.

Tavares et al (2001) believes that faced with a multiple and varied set of events that can influence companies, there is an urgent need to know how to decide, in order to choose the best path and to take advantage of what, until now, was a source apprehension and fear.

According to Sánchez (2008), risk is conceptualized as the contextualization of a danger situation, that is, the possibility of the materialization of the danger or an event unwanted occur.

According to ISO 31000: 2018, risk management involves the systematic application of policies, procedures and practices for communication and consultation activities, establishment of context and assessment, treatment, monitoring, critical analysis, registration, and risk reporting.

In the historical context, foreseeing the future was a gift intended only for oracles and diviners who held a monopoly over all human knowledge and had the ability to make predictions about possible future events. However, due to the development capacity of the human being to think, analyze and make his own decisions and responsibilities, assuming the consequences of his acts and attitudes, this prognosis started to be studied in the mathematical and statistical context giving rise to the development of risk perception. (BERNSTEIN, 1997 apud BENTES, 2007)

Stefano et al (2020) believes that the introduction of new technologies created new opportunities, but also increase numbers of variables that need to be evaluated. Due to that, these risks need to be accounted, managed, and treated accordingly to their specificities.

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According to Gregório et al (2013), the performance of an organization is closely related to the dominance over its respective processes and activities, its strategic positioning and relationship in the environment where it operates, the adequacy of its products / services to the needs and desires of its customers and other interested parties, the fulfillment of requirements normative and legal, as well as its ability to improve its processes and products / services in a continuous and innovative way.

In a pragmatic approach, understanding risk is associated with statistical study and its use as a science. It is obvious that humanity has always faced different dangers, be it the involuntary risks resulting from catastrophes, earthquakes, volcanic eruptions, hurricanes - whether those associated with wars, the vicissitudes of everyday life or even volunteers, resulting from what we now call “style of life". However, these events were not referred to as risks, but rather referred to as hazards, fatalities, “hazards” or difficulties, not least because the word risk was absent in the vocabulary of the ancient languages. (SPINK, 2001 apud BENTES, 2007)

De Bakkeret al. (2010) separate project risk management into two approaches: i) that of assessment, where information about the history of failures and their causes in past experiences is used in checklists or used to assemble the project structure futures and manage their risks; ii) management, which considers the risk management of a particular project.

## II. STRATEGIC RISK MANAGEMENT

Risk management aims primarily to promote better conditions in productive environments. Many companies disregard limits to meet the purely financial interests of production. Ruppenthal (2013), defines risk management as a methodology that aims to increase the reliability of an organization with respect to factors related to predicting, prioritizing, and overcoming obstacles to achieve your goals goals.

According to Silva (2012), risk management will not remove all risks from projects; its main objective is to ensure that risks are managed in the most efficient way. The client and his project manager must recognize that there are certain risks that must be insured by the customer and that obviously should be considered in the project time and cost estimates.

The risks arising from the most diverse projects in the field of engineering will always exist, however it is necessary to know them. For this, evaluation and control techniques are used, if it is desired to achieve satisfactory results in general terms in the enterprise.

Dinizio e Martins (2020) believes that risk management presupposes a plan capable of enabling the investigation of the risks of the organizational project, beginning for the identification, analysis of specific risks of the design and treatment approaches, as well as for the monitoring, control and monitoring of risks, if defined those responsible updating the plan and how often risks should be reported

Paté-Cornell (2002) explains that risk analysis in engineering is performed for two reasons: to demonstrate that a system is sufficiently secure or to establish priorities in terms of risk management, identifying weaknesses and optimizing allocation of resource.

In civil construction companies, disbelief as to trying to manage something that is unknown and uncertain leads managers to treat risk management as something expensive and unnecessary. (ALMEIDA E MOTA, 2008) For Cooke-Davies (2003), construction companies have a low degree of maturity in risk management, and generally have a resistance to accepting complex risk analysis techniques.

Silva (2012) understands that management is essential for construction, as it acts in the early stages of the project, studying and reflecting what are the strengths and weaknesses of it. Before acting and starting to develop projects it is. It is fundamental to define procedures and action plans, which allow the detection of possible problems and anticipate responses to them.

Souza and Ripper (2009) understand the failures generated in engineering works permeate causes, however still within the scope of the project it is possible to highlight the specification of elements of inadequate designs, lack of compatibility between structure and architecture, specification inadequate materials, insufficient or wrong detailing, unworkable construction details, the lack of standardization of the representations until the sizing errors.

According to Morano (2003), the use of risk analysis techniques in the implementation of construction projects is still incipiently applied in the industry Brazilian construction companies.

It can be said that risk management and quality management are interconnected. Quality Management refers to the process of identifying and managing activities to meet the organization's quality objectives. The main objective of quality management is to achieve

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competitiveness by improving quality performance (LEONG et al, 2012; CAGNIN et al, 2015).

To Almeida e Mota (2008), the identified risks need to be explored to be categorized and thus prioritized. This categorization refers mainly to the risk dimension and the objectives affected.

Palomo (2007) states that risk can be measured through the product of probability with the impact related to the risk event and that for this one must discover in addition to the objectives affected, the degree of impact and the likelihood of it occurring.

In view of the great importance of assessing the risks involved in engineering, risk management studies, as well as adequate standardization and use of assessment and control tools can assist managers in the decision making of their enterprise. It can be said that the risk assessment proposes to systematize knowledge and uncertainties about phenomena, processes, activities and systems under analysis, aiming to estimate potential dangers and threats, their causes and consequences, creating conditions to distinguish what is tolerable and acceptable and compare options for decision making (AVEN, 2011; ROSA and TOLEDO, 2015).

The elements "communication and consultation" and "monitoring and critical analysis" are considered agents of continuous action in the risk management process. Communication and consultation involve internal and external stakeholders, aiming to consider their points of view, knowing their objectives through planned involvement (PURDY, 2010; ROSA and TOLEDO, 2015)

Lopes (2015) states that the depth and level of analysis of technological threats will depend on the particularities and specific situations of the evaluation site. Anyway, this stage requires detailed knowledge of the operational and maintenance situation of the equipment and systems, as well as existing safety devices.

It can be said that a series of small and unpredictable failures can lead to the occurrence of catastrophic events. Mainly because complex technologies are found in the industry and demand management practices also with a high level of complexity, the possibility of accidents becomes real and inherent in such industrial activities (PERROW, 1984; LOPES, 2015).

Risk management in engineering must also be concerned with identifying potential areas prone to disasters. Patrícia et al (2014) understands that the characterization of areas susceptible to disasters and the constant registration of occurrences that tell the history of the place, avoiding wrong decisions, is an imposing, especially given the specific climatic and geomorphological conditions of municipalities and regions, however, most Brazilian municipalities lack banks structured data that includes the history of occurrences, a powerful tool for research and early diagnosis of risks and disasters.

KEZNER (2009) understands that the qualitative analysis methodology applied to risks is commonly used to estimate the severity of uncertainty, probability of occurrence situation and consequences arising from the fact. These analysis outputs are important for structuring a risk analysis and mapping matrix that is essential for the follow-up and monitoring of the project.

## III. CONCLUSIONS

Engineering risk management must strive for excellence in project management and quality maintenance, in addition to ensuring an environment conducive to the development and improvement of production methods.

The manager must stick to the results found during the identification and subsequent assessment of risks. Kleindorfer and Saad (2005) understand that prevention is better than cure in the field of risk management. This fact is relevant, mainly because it is linked to the reduction of human and financial losses in engineering, in general.

The main objective of risk assessment is to help understand the factors that lead to the occurrence of a specific risk, while providing information on their impact, in order to avoid them or reduce the effect of their consequences by contingency strategies (ZSIDISIN et al., 2004 apud ).

We can say that risk management in the engineering field is associated with investment in strategic and preventive actions. Therefore, companies that are concerned with planning their actions well and adopt efficient management mechanisms are collaborating for the well-being of not only them but also those who depend on them.

It can be said that the risks will always be inserted in the engineering projects and the prevalence of these risks will be associated with the levels of demand and responsibility of the managers. The use of risk identification, assessment and control techniques are important for the achievement of the project and maintenance of minimum acceptance levels, thus guaranteeing safety and quality.

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