

Risk Management: A Parallel Between ISO 31000 (2018) and the PMBOK Guide (2017)

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Abstract

Risk management has proven to be a strategic factor in management and control decisions. Successful risk management focuses on understanding risk management-oriented methods and being able to quickly assess and find a solution to the specific situation. Risk management practices aim to increase the likelihood of success in strategic objectives, anticipate, recognize, and respond to changes, thus promoting an efficient operation. However, implementing a risk management standard without a detailed plan can become a hindrance for organizations. In this context, the aim of this paper is to make a comparison between the approach of the most recent versions of ISO 31000 (2018) and the PMBOK Guide (2017) regarding risk management, to evaluate similarities and differences between tools and techniques employed in each phase of risk management, through a descriptive and qualitative bibliographic research methodology. This work contributes as an initial study for companies that are awakening to good risk management practices and presents, in a structured way, the tools and techniques used in the two standards, including the complementary IEC 31010 standard, allowing better decision making.

Keywords

Risk Management, Project Management, PMBOK, ISO 31000, Risk Analysis.

1. Introduction

Project management is not a newly created management strategy. It has been used for years in the most diverse sectors, and some of the results of its application range from Olympic Games to large engineering works such as the Panama Canal. Project results are achieved by leaders' application of traditional, well-tested practices, as well as newly created innovative practices. Managers aim to satisfy customers and the people involved in the project through a set of key skills, which are constantly evolving today (PMI 2017).

Organizations are becoming increasingly competitive due to the advance, mainly, of information technology, which innovates and makes business possible with fewer resources, less time, and higher quality. Moreover, in a moment of crisis like the current one, investing in well-structured projects made by competent teams has stood out as a way to stay in the market. The adoption of project management has been gaining more and more ground in recent years because organizations need to serve customers well, making the best use of resources and time to offer products and/or services that generate customer satisfaction (Ferreira et al. 2013).

Business activities, including project management, involve dealing with a high degree of risk. Decisions within projects are not made with full confidence in the results. During the execution of the whole project, there will always be a risk and events might occur which alter the expected result, both for a better and for a worse situation. Thus, the need for risk management stands out as a form of proactive risk control, with the aim of increasing the probability of success in strategic objectives, minimizing losses, preventing damages and accidents, and providing an efficient operation (Hrytsenko et al. 2021).

The Project Management Body of Knowledge (PMBOK), a manual of best practices in project management proposed by the Project Management Institute (PMI), has defined that "Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning and implementation, and controlling risk on a project". Any project manager who follows the PMBOK (2017) is aware that risk management is one of the ten knowledge areas that must be applied to achieve success in projects. The main goal of management is defined as

"increasing the likelihood and/or impact of positive risks and decreasing the likelihood and/or impact of negative risks in order to optimize the chances of a successful project" (PMI 2017).

The ISO 31000 standard (2018) developed by ISO (International Standards Organization) differs from other ISO standards in that it is not certifiable. The main difference in risk management approach between PMBOK and ISO 31000 is that the standard establishes risk treatment in the broadest sense, while the guide is focused on risks in projects. In addition, ISO 31000 is complemented by IEC 31010 (2021), since the latter provides a wide variety of techniques to be applied in the risk assessment process. ISO 31000 meets the understanding that all activities in organizations of all types and sizes have risks, and that these risks must be identified, analyzed, and quantified before they can be addressed.

The adoption of standards and best practices established in recognized models is the way to establish a structured approach to risk management. Applying recognized models is a way to prevent organizations from being suffocated by bureaucratic instruments and procedures that convey the false impression of the existence of a risk management system, but that, in practice, do not guarantee the desired benefits (Aven and Flage 2020). Crnković and Vukomanović (2016) indicate that there is a large number of professionals with a lot of experience and little knowledge in modern risk management theories, thus they tend to use methods that do not provide clear and objective results.

Being aware of the risks, being able to assess them, and then dealing with them efficiently is paramount to achieving quality results. In a competitive context, in which any waste generates great impact, managers are required to lead the team to achieve goals effectively and efficiently. Although risk management is widely studied, it is not yet widely applied (Crnković and Vukomanović 2016). Therefore, the aim of this paper is to approach risk management both from the perspective of the PMBOK Guide and the ISO 31000, in order to discuss risk management in projects. The paper contributes as an initial study for companies that are awakening to good risk management practices and presents in a structured way the tools and techniques used in the two standards, including the complementary IEC 31010 standard. In practical terms, comprehending the tools and techniques employed in each phase of risk assessment allow better decision making, clearer and more objective when the managers select which standard and methodology to follow.

This paper, in addition to the introduction, consists of the following sections: 2. Literature Review; 3. Methods; 4. Results and Discussion, and, finally, 5. Conclusion.

2. Literature Review

This section presents the main concepts associated with the topic of Risk Management, focusing on the approach from the perspective of the PMBOK Guide (2017), as well as the ISO 31000 standard (2018).

2.1 Risks

Considering the context in which companies are inserted - high competition, economic uncertainties, globalized markets, and changes aimed at continuous improvement - it is essential to understand the concept of 'risk'. Companies have focused strongly on customer satisfaction, that is, on serving and, above all, retaining customers. Authors Olechowski et al. (2016) indicate that adherence to risk management principles is shown to be a significant factor in improving cost, schedule, and more stable project execution goals. Although project managers are aware of risk management best practices, empirical validations to support their application are lacking (Olechowski et al. 2016).

The Brazilian Institute of Corporate Governance (Instituto Brasileiro de Governança Corporativa - IBGC) (IBGC 2007), when presenting the concept of risk, adds and notes that risk "is inherent to any activity in personal, professional, or organizational life, and may involve losses as well as opportunities," that is, risk is an uncertainty that can also result in positive outcomes. When the risk is properly identified, managed, treated and monitored, the external and internal adverse effects, called threats by many authors, are neutralized more quickly because targeted actions are applied (Olechowski et al. 2016).

Some studies consider risks and uncertainties to be synonymous words. However, it is known that there are conceptual differences between them. Knight (1991) was one of the first authors to be concerned with such concepts. According to the author, uncertainty is a situation to which either no probability distribution can be associated, or only a subjective probability distribution can be associated. That is, uncertainty means that a decision may lead to several different results, whose probabilities are immeasurable; and risk is conceptualized as a situation for which an objective

probability distribution can be associated to the results, that is, risk is the possibility that a decision may imply different results (Almeida et al. 2019). Alessandri et al. (2004), in their studies on the subject, converge on the same concept of risk and uncertainty as Knight (1991), as shown in Figure 1.

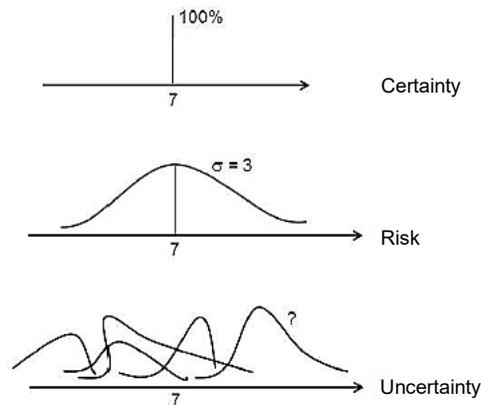


Figure 1. Difference between certainty, risk, and uncertainty
Source: Adapted from Alessandri et al. (2004)

To deal with risks and increase the chance of achieving goals, organizations adopt from informal to highly structured and systematized approaches to risk management, depending on their size and the complexity of their operations (Almeida et al. 2019). There is no way to completely avoid the risks. Managing activities using risk management techniques is what must be done so that the threats from the risk do not impact the project. Thus, risks affect projects, which can be either negative as a threat or positive as an opportunity.

2.2 Risk Management in the PMBOK

The PMBOK Guide is a PMI publication aimed at addressing project management. It describes characteristics of project management and the main topics such as life cycle, knowledge areas, and processes. The PMBOK views project risk as "an uncertain event or condition that, if it occurs, will have a positive or negative effect on one or more project objectives", that is, risk can directly affect the results and success of an organization. From this perspective, risk is presented as a result of one or several causes and as causing impacts. An important factor to be considered is that all the knowledge areas used by the PMBOK for project management are integrated, in such a way that the needs and aims of the projects are more clearly defined, which helps the process of identifying the project risks (PMI 2017).

The latest version of the PMBOK presents a procedural methodology for risk management in projects that integrates seven sequential actions, as listed below. While table 1 provides an overview of the project risk management processes, each of the processes is simplified in the diagram by inputs and outputs.

- 1) Plan Risk Management: define how to conduct risk management activities;
- 2) Identify the Risks: identify general and individual risks, and document the characteristics;
- 3) Perform Qualitative Risk Analysis: prioritize individual risks for further analysis or action, through concurrence and impact probability;
- 4) Perform Quantitative Risk Analysis: analyze numerically the combined effect of general and individual risks, and also the sources of uncertainties;
- 5) Plan Risk Responses: develop alternatives, select strategies, and agree on actions to deal with general and individual risk exposure;
- 6) Implement Risk Responses: implement agreed-upon risk response plans;
- 7) Monitor Risks: monitor the implementation of agreed-upon risk response plans, track identified risks, identify and analyze new risks, and assess the effectiveness of actions throughout the project.

Table 1. Overview of project risk management
Source: Adapted from PMI (2017)

Project Risk Management		
	Inputs	Outputs
1. Risk management planning	<ul style="list-style-type: none"> • Project opening term • Project management plan • Project documents • Company environmental factors • Organizational process assets 	<ul style="list-style-type: none"> ✓ Risk management plan
2. Risk identification	<ul style="list-style-type: none"> • Risk management plan • Project documents • Agreements • Procurement documentation • Company environmental factors • Organizational process assets 	<ul style="list-style-type: none"> ✓ Risk register ✓ Risk report ✓ Project documents updates
3. Perform qualitative risk analysis	<ul style="list-style-type: none"> • Project management plan • Project documents • Company environmental factors • Organizational process assets 	<ul style="list-style-type: none"> ✓ Project documents updates
4. Perform quantitative risk analysis	<ul style="list-style-type: none"> • Project management plan • Project documents • Company environmental factors • Organizational process assets 	<ul style="list-style-type: none"> ✓ Project documents updates
5. Risk response planning	<ul style="list-style-type: none"> • Project management plan • Project documents • Company environmental factors • Organizational process assets 	<ul style="list-style-type: none"> ✓ Change request ✓ Project management plan updates ✓ Project documents updates
6. Risk response implementation	<ul style="list-style-type: none"> • Project management plan • Project documents • Organizational process assets 	<ul style="list-style-type: none"> ✓ Change request ✓ Project documents updates
7. Risk monitoring	<ul style="list-style-type: none"> • Project management plan • Project documents • Work performance data • Work performance reports 	<ul style="list-style-type: none"> ✓ Work performance information ✓ Change requests ✓ Project management plan updates ✓ Project documents updates ✓ Organizational process assets updates

According to the PMBOK Guide, there are two risk levels that exist in any kind of project, namely: individual project risk and overall project risk. The former is "an uncertain event or condition that, if it occurs, will cause a positive or negative effect on one or more project goals" and the latter is "the effect of the uncertainty of the project as a whole, arising from all sources of uncertainty, including individual risks, representing the exposure of stakeholders to the implications of variations in the project outcome, whether positive or negative" (PMI 2017).

The importance of monitoring and managing risks during the course of the project, ensuring project progress and risk handling, is noteworthy. To do this, the project team needs to know the level of exposure to risks and define acceptable limits. There are situations in which project stakeholders may decide to assume risks because exposure to some risks may bring better results than those obtained under predictable conditions (Aven and Flage 2020).

2.3 Risk management in the ISO 31000 standard

ISO 31000 (2018) provides guidelines for risk management for organizations of all types, unlike the PMBOK perspective, which is applied directly to projects. The document is proposed with the aim of being used and applied throughout the life of the organization and in any activity that includes decision making at all levels; moreover, it is intended to be a master guide for risk management. The standard focuses on risk management as a way to create and add value to processes, and aims to improve performance, innovation, and the achievement of goals (ISO 2018).

The approach to risk management according to ISO 31000 is divided into:

- a) Risk management principles: they are the basis for managing risks effectively, which must be based on an integrated, structured and comprehensive management, as well as personalized, inclusive, dynamic, with clear and available information, considering the human and cultural factors, besides aiming at continuous improvement.
- b) Risk management framework: it supports the integration of risk management activities, and it depends on the support, mainly, of the top management (leadership and commitment) performing the integration, design, implementation, evaluation, and improvement of risk management.
- c) Risk management processes: it is an essential part of decision making, and it is integrated into the structure, operation and process of the organization. The process phase is divided into communication and consultation, scope, context and criteria, risk assessment, risk treatment, and monitoring and reporting.

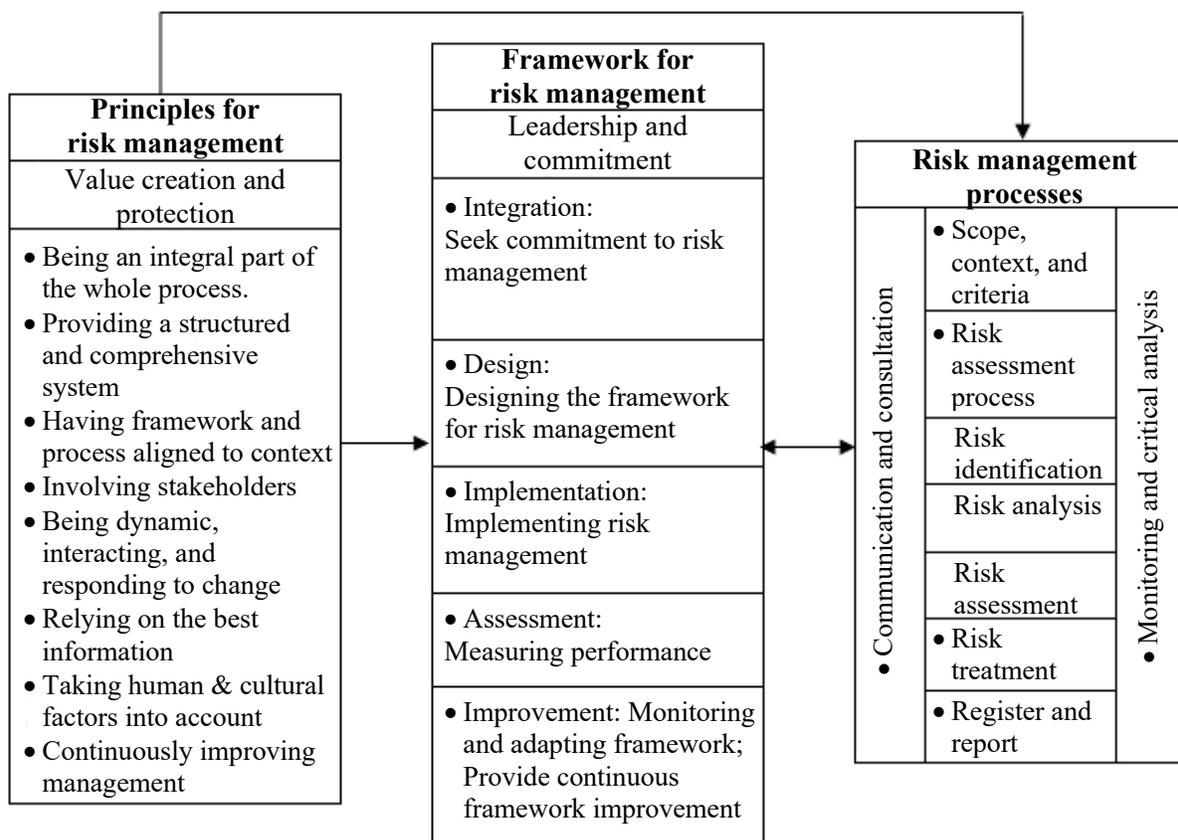


Figure 2. Relationship between risk management principle, framework and process
Source: Adapted from ISO 31000 (2018)

Risk is defined by the standard as "the effect of uncertainties on objectives". In general, any activity is influenced by both internal and external factors, making the achievement of the organization's goals uncertain (ISO 2018). Considering that the purpose of ISO 31000 is to harmonize risk management processes, the approach is quite broad and can be applied at all levels of the organization, including strategies, decisions, operations, processes, products, projects, and services, as can be seen in Figure 2. In addition, it is sometimes referred to as an umbrella standard, because there are several references in the risk management field that align with this standard, such as ISO 9000, 27000 and 28000 (Proença et al. 2017).

ISO 31000 has been criticized by some authors for being abstract in some terms and definitions, as well as for the lack of a mathematical foundation (Almeida et al. 2019). However, the aim of the standard is to provide guidelines for risk management. ISO/IEC 31010 (2021), with a new version published this year, complements the general standard. It provides several techniques for the risk assessment process, such as the Delphi Technique and Failure Mode and Effects Analysis. Besides, it emphasizes that the techniques can be adapted, combined and applied in a wide variety of situations, when there is a need to understand uncertainty and its effects (ISO 2021).

2.4 Comparative Analysis between ISO 31000 and the PMBOK Guide

It is noteworthy that, while reading the two documents cited, more similarities than differences were noticed. The comparative analysis between the two approaches is represented in Table 2.

Table 2. Comparative Analysis between ISO 31000 and PMBOK
Source: The authors

ISO 31000 (2018)	PMBOK (2017)
<ul style="list-style-type: none"> • Risk management is perceived as a philosophy, which can be applied in any organization and at any level of management, that is, it is a generic standard that can be adapted as needed. 	<ul style="list-style-type: none"> • Risk management is addressed with project-focused applicability.
<ul style="list-style-type: none"> • It has 6 processes • Communication and consultation • Scope, context and criteria • Risk assessment process • Risk treatment • Monitoring and critical analysis • Register and report 	<ul style="list-style-type: none"> • It has 7 processes • Risk management planning • Risk identification • Qualitative risk analysis • Quantitative risk analysis • Risk response planning • Risk response implementation • Risk monitoring
It is based on PDCA (plan, do, check, act) to establish the relationship between the components and the risk management framework	It is based on PDCA (plan, do, check, act) to establish the relationship between the components and the risk management framework
Not certifiable	Certifiable
Risk analysis can be qualitative, quantitative, or a combination of the two.	Risk analysis is qualitative and quantitative.
Complemented by ISO 31010 with techniques for risk assessment	Contains techniques in the document itself

3. Methods

This study used descriptive and qualitative research in order to perform a comparative analysis between the risk management approaches provided by ISO 31000 and by the PMBOK guide, as well as to interpret the results obtained. In addition, a search for studies related to the topic of this study was conducted through bibliographic research to describe the risk management models and concepts addressed in the ISO 31000 standard and the PMBoK guide. Finally, a comparison was made between the techniques suggested by ISO 31010 and the PMBOK, summarized in Appendix A.

4. Results and Discussion

The purpose of this paper was to compare risk management, in the most recent versions, both from the perspective of the PMBoK Guide and of ISO 31000, in order to discuss risk management in projects. Through the comparative analysis, it is possible to observe a lot of similarities between the approaches, although there are different names for similar concepts. The main difference in the risk management approach between the PMBoK and ISO 31000 is that the standard defines risk treatment in the broadest, most generic sense, and as adaptable to the context, that is, it can be adjusted to the needs of the situation to which it is applied. On the other hand, the guide is focused on project risks, which means it aims to apply the entire methodology specifically to projects.

It is noteworthy that both methodologies use PDCA for continuous improvement, but only PMBOK is certifiable. In some situations, companies choose to hire professionals that are certified by the PMI, given the visibility in following methodologies that are certified and recognized in the market. Because the PMBOK structures risk management into processes of inputs, tools, and outputs, in addition to ordering the steps, it facilitates its application, since risk management is very dependent on the experience and know-how of the person responsible for applying it. In cases where the team has little or less experience, its applicability becomes more accessible, since the tools by which the outputs are produced from the inputs are already explicit.

On the other hand, ISO/IEC 31010 (2021), complementary to ISO 31000, describes the techniques used in risk assessment in great detail, containing applications, benefits, and limitations, as well as references for further study in case the reader seeks deeper knowledge of the technique. Therefore, it is suggested that the application of the standards together is more appropriate for more experienced teams in terms of risk management. Appendix A shows a non-exhaustive comparison of the techniques suggested by the PMBOK and ISO 31010 for risk assessment and treatment.

The fact that the PMBOK guide suggests both qualitative and quantitative risk analysis provides a better understanding of the risk than when only qualitative methods are applied, since ISO 31000, due to its flexibility, leaves it up to the manager to choose to apply both methods concurrently or only one of them. However, the description of the techniques in ISO 31010 is clearer and more objective. Finally, it should be noted that the PMBOK guide is a robust and complete manual for projects, so it is necessary to analyze the context in which the company operates and the project's characteristics, such as size, complexity, and importance, and only then choose which methodology to follow: the standard and its complement, or just the guide.

5. Conclusion

The research in this paper aimed to compare the approach to risk management from the perspective of the PMBOK Guide (2017) and the ISO 31000 standard (2018), from the most recent versions of both documents. IEC/ISO 31010 (2021), as a complementary standard, improves the understanding of the uncertainty and its implications on decisions, and brings several tools and techniques applied to risk management, as shown in appendix A. To obtain the data for this paper, bibliographic research was conducted in order to gather information about the topic and also to consolidate knowledge in the area of project management with a focus on risk management.

The study, mainly, demonstrated the similarities between the two documents analyzed, despite different nomenclatures in the processes. It is noteworthy that both methodologies are developed with the PDCA methodology, that is, they aim for continuous process improvement. The use of either of the two methodologies for risk management is sufficient to meet the strategic objectives of companies in risk control and treatment, although the standard is not certifiable. As a suggestion, the choice of method should be linked to the characteristics of the work group and context where it is applied.

Risk management is considered to be a critical factor for success in operations, and one of the biggest challenges for many organizations. It helps in the establishment of strategies and in decision making, so this subject is relevant and should be given attention due to its peculiarities throughout the project or process. Efficient and effective projects require the engagement of the team involved and the adjustment of the organizations' culture with a focus on managing risks and improving the level of risk management maturity.

It is significant to consider the probabilities of risks so as to make decisions with greater certainty, and proactive risk control by all stakeholders is required. Also, it is emphasized that, to increase the chances of success in projects, organizations can adopt the project framework in order to better structure business management and, in particular, to monitor risks and act at the most opportune moment for the organization.

Finally, the paper contributes as an initial study for companies that are awakening to good risk management practices and presents in a structured way the tools and techniques used in the two standards, including the complementary IEC 31010 standard. The comparison between the techniques suggested by the documents analyzed provides guidance for selecting the techniques to be applied in risk situations, especially in risk assessment and treatment. Applying acknowledged models is a way to prevent organizations from being suffocated by bureaucratic instruments and procedures that convey the false impression of the existence of a risk management system, but which, in practice, do not guarantee the desired benefits.

References

- Alessandri, T M., Ford, D. N., Lander, D. M., Leggio, K. B., and Taylor, M., Managing Risk and Uncertainty in Complex Capital Projects, *Quarterly Review of Economics and Finance.*, vol. 44, no. 5, pp. 751–767, 2004.
- Almeida, R., Teixeira, J. M., Da Silva, M. M., and Paulo Faroleiro, A Conceptual Model for Enterprise Risk Management, *Journal of Enterprise Information Management*, vol. 3, no. 5, pp. 843–868, 2019.
- Aven, T., and Flage, R., Foundational Challenges for Advancing the Field and Discipline of Risk Analysis, *Risk Analysis*, vol. 40, pp. 2128–2136, 2020.
- Crnković, D., and Vukomanović, M., Comparison of Trends in Risk Management Theory and Practices Within the Construction Industry, *Elektronički časopis građevinskog fakulteta Osijek*, vol. 12, pp. 1–11, 2016.
- Ferreira, B. A. de A., De Almeida, J. de O. R., Leão, P. R. C., and Silva, N. P. G., Gestão de Riscos Em Projetos: Uma Análise Comparativa Da Norma ISO 31000 e o Guia PMBOK, 2012, *Revista de Gestão e Projetos*, vol. 4, no. 3, pp. 46–72, 2013.
- Hrytsenko, L., Boiarko, I., Tverezovska, O., Polcyn, J., and Miskiewicz, R., Risk-Management of Public-Private Partnership Innovation Projects, *Marketing and Management of Innovations*, vol. 2, pp. 155–65, 2021.
- IBGC, Guia de Orientação Para Gerenciamento de Riscos Corporativos, *Brazilian Institute of Corporate Governance*, 2007
- ISO, *ISO 31000:2018 - Risk Management - Principles and Guidelines*, International Organization for Standardization, 2018.
- ISO, *IEC 31010:2019 - Risk Management - Risk Assessment Techniques*, International Organization for Standardization, 2021.
- Knight, F. H, *Uncertainty and Profit*, University of Chicago Press, 1991.
- Olechowski, A., J. Oehmen, W. Seering, and M. Ben-Daya, The Professionalization of Risk Management: What Role Can the ISO 31000 Risk Management Principles Play?, *International Journal of Project Management*, vol. 34, no. 8, pp. 1568–1578, 2016.
- PMI, *A Guide to the Project Management: Body of Knowledge*. 6th ed., Project Management Institute, 2017.
- Proença, D., Esteves, J., Vieira, R. and Borbinha, J, Risk Management, A Maturity Model Based on ISO 31000, *Proceedings of IEEE 19th Conference on Business Informatics*, pp. 99–108, Thessaloniki, Greece, July 24-27, 2017.

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Biographies

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Appendix A - Table comparing the tools and techniques used in risk assessment and treatment between PMBOK and ISO 31010

Comparison of tools and techniques used in risk assessment and treatment between PMBOK and ISO 31010				
PMBOK	Identification	Qualitative analysis	Quantitative analysis	Planning and implementation of answers
ISO	Identification	Analysis	Assessment	Risk treatment
Decision tree analysis		ISO	ISO/PMBOK	
ALARP/SFAIRP			ISO	ISO
Bow Tie Analysis		ISO		ISO
Alternatives analysis				PMBOK
Event Tree Analysis		ISO		
Fault tree analysis		ISO		
Layer of Protection Analysis (LOPA)		ISO		ISO
Cause-consequence analysis		ISO		
Root cause analysis	ISO/PMBOK	ISO		
What-if scenario analysis	ISO	ISO		
Human reliability analysis (HRA)	ISO	ISO	ISO	
Cost-benefit analysis		ISO	ISO	PMBOK
Document analysis	PMBOK			
Analysis of strengths, weaknesses, opportunities and threats (SWOT)	PMBOK			
Impact analysis		ISO		
Bayesian Analysis		ISO		
Assumptions and constraints analysis	PMBOK			
Hazard and operability (HAZOP) analysis	ISO			
Sensitivity Analysis / Tornado Diagram			PMBOK	
Multi-criteria analysis			ISO	PMBOK
Failure Mode and Effect Analysis (FMEA)	ISO	ISO	ISO	
Hazard Analysis and Critical Control Point (HACCP)	ISO	ISO	ISO	ISO
Risk Probability and Impact Assessment		PMBOK		
Brainstorming	ISO/PMBOK			
S-curve		ISO	ISO	
Ishikawa Diagram	ISO			
Pareto Chart			ISO	ISO
FN (Frequency-Number) Diagram		ISO	ISO	
Expert Interviews/Opinion	ISO/PMBOK	PMBOK	ISO/PMBOK	PMBOK
Risk index		ISO	ISO	ISO
Checklists	ISO/PMBOK			
Reliability-centered maintenance			ISO	ISO
Consequence matrix			ISO	
Probability and Impact Matrix		PMBOK		

Bayesian Networks		ISO		
Monte Carlo simulations			ISO/PMBOK	
Delphi Technique	ISO			
Game theory		ISO	ISO	
Value at Risk		ISO	ISO	