

Selecting the Proper Model for Risk Management

Navid Jamshidnejad¹

¹Master of Science in Project Management, Amirkabir University of Technology, Tehran, Iran.

¹n.jamshidnejad@aftermail.ir

Abstract

The sets of activities performed across all organizational levels can include the opportunities, risks, and uncertainties that may affect goal realization, prompting executives to identify and manage them at different levels within a risk management framework. Risk management requires steps and measures that can be best taken by following the models and standards developed by different researchers and institutes based on extensive experiences and studies. However, the review of these studies and instructions indicated considerable differences and similarities, something which can cause confusion in the selection of the best risk management model to address current needs and organizational conditions. With a thorough review of literature, this paper analyzes the studies, models, and standards of risk management and highlights their differences in definitions and processes. Finally, a solution is offered to select the right model which can properly satisfy the current needs for risk management.

Key-words: Risk, Uncertainty, Project Risk Management, Portfolio Risk Management, Organizational Risk Management.

1. Introduction

Risk management is a must in achieving the desired results at any organizational level. Given the background to this topic in the management literature, many standards and models have been developed for risk management. Reviewing these standards and models would highlight their abundant differences, similarities, and unique features which can cause confusion in making the right selection in proportion to the desired goals. According to the observation and comparison of various standards and models developed for risk management, they are distinguished by three main factors: (7).

- Difference in risk definition

- Difference in the quantity and centralization of risk management processes
- Difference in organizational levels of risk management execution

These three areas of difference are taken into account to analyze and compare researchers' opinions with regard to definitions and processes existing in risk management.

2. Research Methodology

This retrospective applied-descriptive study adopted a rationalistic conclusion-oriented approach. The desk method was then employed to meet the identified research need by reviewing the previous studies of models and standards developed for risk management and describing their differences in definitions and processes. Finally, a solution was offered to select the right model which could properly satisfy the current need for risk management.

3. Definition of Risk

The risk identification process is known as the first risk management procedure in most models and standards. The prerequisite to risk identification is to have a clear definition of risk; therefore, it is essential to define risk correctly and thoroughly. The early effect of selecting different definitions of risk on the identification of risks in a project would be the extraction of a list of various risks in terms of quantity and nature.

If the number of identified risks is smaller than the number of real risks, the project is exposed to any unknown hazards which could prevent project success. In addition, some existing opportunities for project success are disregarded and left unexploited. If the number of identified risks is greater than the number of real risks, some of the risk management attempts are wasted. Moreover, wrong strategies can be adopted to confront risks. This could jeopardize the chance of a project to achieve goals.

If a false definition leads to a list of risks with a vague cause-and-effect chain, it will be difficult and even impossible to make attempts at risk management. However, it is necessary to have comprehensive information regarding the origin of risks and the effect of risk confrontation strategy implementation in order to evaluate and respond to risks. According to Teller & Kock (2013), "risk transparency" is one of the two major elements affecting the quality of risk management process implementation. This element can express the existing capability to identify major risks, risks of current dependencies, and sources of risk.

The comparison of different studies indicated three major areas of differences in risk definitions, described as below.

1. Risk as an Event or Outcome

Different references have given different definitions of risk. PMI (2017) defined project risk in PMBOK Standard as an unexpected state or event that would have positive or negative effects on one or more project objectives such as project scope, schedule, cost, and quality. This definition is consistent with what has been presented in the standard Prince2 (2017). According to the definition presented by the International Organization for Standardization (ISO) in the document issued by ISO Guide 73 (2009), a risk refers to the effect of uncertainty on goals, whereas effectiveness is defined as deviation from expectations. In other words, there are two inconsistent definitions of risk, *i.e.* a risk is sometimes defined as an event, whereas it is defined as an outcome of uncertainty some other times (9) (12).

According to Chapman (2001), this difference lies in the difference between the views of industrialists and those of experts of natural hazards because these two groups encounter risks of different natures. As a result, the first group sees risks as phenomena or processes, whereas the second group sees risks as outcomes of hazards (12).

It is essential to ensure that a person responsible for risk identification considers the distinction between definitions of risks and lists of different risks resulting from these various definitions. In fact, this could prevent the lists of risks (obtained from the risk identification process) from turning into a confusing combination of events and effects. If this happen, it will be really difficult to execute other processes of risk management (12). Accordingly, the relationships of cause, event, and outcome of a risk were introduced in Prince2 (2017) as the cause of a risk would result in the event of risk which would consequently affect goals.

2. Risk as a Hazard (Negative Effect) or an Opportunity (Positive Effect)

In another comparison of existing definitions of risk, some researchers have merely considered the hazards which would have negative effects on goals, whereas others have also considered opportunities which would have positive effects on goals. In addition, some research

approaches are ambiguous and unclear in determining the nature of risks regarded as opportunities or hazards. (7, 10, 19)

It is important to consider opportunities in addition to hazards because a project manager can link the existing opportunities to strategies and make certain plans to use them as much as possible in order to mitigate the effects of hazards or create some benefits for the project (3).

3. Existing Knowledge of Event

In the face of an event, there is scant information regarding its event occurrence and potential effects. Based on the available knowledge for occurrence of an event or its features and effects, four categories were classified in Cleden, M. D. (2012) to state that only one group would belong to what is normally known as risk. The categories are as follows: (our knowledge about an event-our knowledge about the effects of the event occurrence)

- Known-Known (Pure knowledge)
- Unknown-Known (Untapped knowledge)
- Known-Unknown (Risk)
- Unknown-Unknown (Pure uncertainty)

Comparing risk and uncertainty, De Meyer (2002) and Platje & Seidel (1993) believed that sources of uncertainty would be more general than risks. It is inevitable to consider uncertainties beyond risks, especially in the projects which have an environment of rapid developments because managers need to go beyond risk management, which is based on certain rules and techniques for planning, and take actions that are more inclined toward flexibility and learning (uncertainty management) (13).

PMI (2017) in PMBOK, adopted an approach to encounter risk and uncertainty by considering the reserves. Contingency reserves are considered to respond to the events that are identified, analyzed but are not actively manageable (known-unknown or risks) and management reserves are considered to encounter the events about which information of their nature, incidence, and effects are not available but, through past experiences and historical information, we know they can potentially affect the project (unknown-unknown) (10). Contingency reserves are determined through the calculation of probability and effect of risk events, whereas management reserves are

determined through managers' judgments and mainly as a percentage of project costs and time. The series of project uncertainties are addressed as the total project risk.

Loch (2006) and De Meyer (2002) presented the following classification of project uncertainties based on uncertainty features (13):

1. Instability: In such conditions, project managers can plan for a complete project based on the sequence of activities; however, timespans of activities or project completion time might change.
2. Predicted uncertainty: This category matches the identified risks.
3. Unpredicted uncertainty: This category matches the unknown-unknown category.
4. Chaos: The projects are unpredictable, do not start with logical and stable hypotheses and specific goals, and have an uncertain basic structure. For example, the conditions in which a technology is variable or undeveloped studies are the main project goals. Under such uncertainty, a project is often finished with the results that are totally different from the initial project intentions.

Therefore, uncertainty management is much more important than risk management in some projects. In this regard, Perminova (2008), Cleden (2009), and Ward & Chapman (2003) supported the use of uncertainty management instead of risk management. Uncertainty management does not merely concern the management of hazards, opportunities, and relevant concepts but refers to discovering and perception the origin of project uncertainty before trying to manage the project. It also has no presumptions regarding what is appropriate or inappropriate (13, 33).

It is necessary to consider that no event is certain and that all activities are always prone to some uncertainty; therefore, if an event has an occurrence probability of above 80%, according to Mulcahy, R. (2010), it should be considered as a certain event.

According to a review of literature, some researchers and standards have pointed out the known-unknown nature of risk, whereas some others did not determine what type of uncertainty is risk. To conclude and facilitate the perception of differences in various studies regarding the definition of risk, table 1 classifies risk definition of some standards and articles based on 3 categories mentioned before. (27, 32, 31, 10, 21, 29, 30, 9, 17, 2, 25, 19, 24, 28, 23, 1, 26)

Table 1 - Classification of Risk Definitions

Author	Risk Definition	Event or consequence			How to affect			Type of uncertainty	
		Event	consequence	Unclear	Merely negative	Negative and positive	uncertainty	The known- the unknown	indeterminate
Institute of Electrical and Electronic Engineers (2020)	The likelihood of an event, hazard, threat, or situation occurring and its undesirable consequences; a potential problem.	*			*			*	
Chapman (2001)	An event, which should it occur, would have a positive or negative effect on the achievement of a project's objectives	*				*		*	
Al-bahar & Carndall (1990)	The exposure to the chance of occurrences of events adversely or favorably affecting project objectives as a consequence of uncertainty.	*				*		*	
Project Management Institute (2017)	An uncertain event or condition that, if it occurs, has a positive or negative effect on one or more project objectives	*				*		*	
Grande-Bretagne. Office of Government Commerce (2017)	An uncertain event or set of events that, should it occur, will have an effect on the achievement of objectives. A risk is measured by a combination of the probability of a perceived threat or opportunity occurring, and the magnitude of its impact on objectives. Risks can have either a negative or positive impact on objectives if they occur.	*				*		*	
International Organization for Standardization. (2009)	Effect of uncertainty on objectives, positive and/or negative, often characterized by reference to potential events and consequences or a combination of these.			*		*			*
Baloi & Price (2003)	The likelihood of a detrimental event occurring to the project.	*			*			*	
Del Cano & De la Cruz (2002)	An uncertain event that, if it occurs, has a positive (opportunities) or negative (threats) effect on a project objective.	*				*		*	
Webb (2003)	Risk is a situation in which he possesses some objectives information about what the outcome might be. Risk exposure can be valued either positively or negatively.			*		*		*	

Table 1 - Classification of Risk Definitions

Author	Risk Definition	Event or consequence			How to affect			Type of uncertainty	
		Event	consequence	Unclear	Merely negative	Negative and positive	uncertainty	The known- the unknown	indeterminate
Australian Government, Department of Defense, Estate and Infrastructure Group (2017)	An activity or event that will have an impact on the achievement of a business objective	*					*	*	
Canadian Standards Association (1997)	The chance of injury or loss as defined as a measure of the probability and severity of an adverse effect to health, property, the environment, or other things of value.		*		*			*	
AIRMIC, A., & Irm, A. (2010).	Effect of uncertainty on objectives, may be positive, negative or a deviation from the expected, and is often described by an event, a change in circumstances or a consequence.		*			*			*
British Standard, B. S. (2019)	Uncertainty inherent in plans and the possibility of something happening (i.e a contingency) that can affect the prospects of achieving business or project goals. Such contingencies could make the result more or less satisfactory.			*		*			*
Association for Project Management (2014)	An uncertain event or set of circumstances that, should it occur, will have an effect on achievement of one or more of the project's objectives.	*					*	*	
Standards Australia & Standards New Zealand (2004)	The chance of something happening that will have an impact on objectives. A risk is often specified in terms of an event or circumstance and the consequences that may flow from it. Risk may have a positive or negative impact.	*				*		*	
Office of Deputy Assistant Secretary of Defense Systems Engineering (2017)	Potential future events or conditions that may have a negative effect on achieving program objectives for cost, schedule, and performance. Risks are defined by the probability of an undesired event or condition and the consequences, impact, or severity of the undesired event, were it to occur.	*			*			*	
Standard, E. C. S. S. (2008)	Undesirable situation or circumstance that has both a likelihood of occurring and a potential negative consequence on a project			*	*			*	

Number and Centralization of Risk Management Processes

Different standards and models of risk management have processes of similar patterns with different details. These differences are related to comprehensiveness in determining the process, details of activities and problem-solving approach in proportion to the environmental features in which a model is developed. For better perception, Table 2 presents risk management processes in some of the most important standards. Plan, identify, evaluate, treat and control were known as the major processes shared by these standards.

Table 2 - Comparing Processes of Risk Management Standards

		Standards					
		ISO 31000 (2018)	IEEE 16085 (2020)	AS/NZS 4360 (2004)	BS6079 (2019)	CAN/CSA-Q850-97 (1997)	IRM & AIRMIC (2010)
Processes	Plan	Establishing the context	Plan and Implement Risk Management	Establish the Context	Context	Initiation	Establishing the Context
			Manage the Project Risk Profile				
	Identify	Risk Identification	Perform Risk Analysis	Identify Risks	Risk Identification	Preliminary Analysis	Risk Identification
				Analyse Risks	Risk Analysis		
	Evaluate	Risk Analysis	Perform Risk Analysis	Evaluate Risks	Risk Evaluation	Risk Estimation	Risk Analysis
		Risk Evaluation		Risk Evaluation	Risk Evaluation	Risk Evaluation	
	Treat	Risk Treatment	Perform Risk Treatment	Treat Risks	Risk Treatment	Risk Control	Risk Treatment
						Action/Monitoring	
	Control	Monitoring and Review	Perform Risk Monitoring	Monitor and Review	Maintain Database Communicate and Explain/Monitor/Effectiveness of Process/Review Objectives/Update Plans	Risk Communication	Monitoring and Review
	Others	Communication and Consultation	Evaluate the Risk Management Process	Communicate and Consult		Risk Communication	Communication and Consultation

Table 2 - Comparing processes of risk management standards

		Standards					
		PRAM Guide (2010)	PMBOK (2017)	DoD Risk Guide for DAP (2017)	ECSS MST-80C (2008)	Australian Defence Risk Management Framework (2017)	PMI Standard for Portfolio Mng. (2017)
Processes	Plan	Initiate	Plan Risk Management	Process Planning	Define Risk Management Implementation Requirements	Establish the Context	Develop Portfolio Risk Management Plan
	Identify	Identify	Identify Risks	Identification	Identify and Assess the Risks	Identify Risk	Manage Portfolio Risks
	Evaluate	Assess	Perform Qualitative Risk Analysis	Analysis		Analyze and Evaluate the Risks	
			Perform Quantitative Risk Analysis				
	Treat	Plan Response	Plan Risk Response	Mitigation/Correction	Decide and Act	Treat the Risks	
		Implement Response	Implement Risk Response				
	Control	Manage Process	Monitor Risks	Monitoring	Monitor, Communicate and Accept Risks	Monitor and Review	
Others	-	-	Communication and Feedback	-	Communicate and Consult	-	

Proportion to Different Organizational Levels

Another difference of standards is their proportion to a level of organization at which risks are managed. This difference can be analyzed in two aspects, the first of which includes the goals which

the management seek to achieve at these levels. The second aspect includes different managerial requirements and process at these levels. Accordingly, some standards merely explain risk management processes to the project level, whereas some others consider the infrastructural aspects required to apply risk management processes at higher levels including the portfolio and the organization. This has led to the development of risk management models and standards at three managerial levels including project risk management, portfolio risk management, and organizational risk management, each of which has unique features.

1. Project Risk Management

Regarding the importance of risk management in a project, running the project without concentrating actively on risk management would resemble moving toward more problems caused by unmanaged threats (10). To show the importance of this topic, Santos and Cabral (2008), ranked risk management as the fourth important knowledge area (of 10 project management knowledge areas proposed in PMBOK). Project risk management adds an attitude toward project risk to the outputs of other project management processes and increases their values. Project risk management plays a key role in creating logical expectations for completion dates and project costs even. Project risk management should be implemented in all projects. The level of details, tools, and resources needed for project risk management should be determined with respect to project specifications and values they can add to outputs (15). The goal of project risk management is not to completely avoid risks in activities, for it is impossible. Managers accept some of the risks based on their willingness to accept risks in return for a benefit or the amount of risk which they can tolerate.

2. Portfolio Risk Management

The main idea of portfolio management is to mitigate the total risk through diversification which is an equivalent to the well-known expression stating “not putting all eggs in the same basket” (4). Comparing risk management advantages of portfolio with those of the project would be a way of perceiving the importance of portfolio risk management. Accordingly, Pellegrini (1997) introduced the advantages of portfolio risk management over project risk management as higher transparency of results to senior managers, possibility of project prioritization, possibility of resource management, possibility of better planning, and better identification of dependencies. According to Olsson (2008), considering risks in the portfolio would have this benefit that the risks of a single project which can

be seen as a single event will be identified as a procedure or a common risk in the portfolio. In this case, a comprehensive risk mitigation action can be adopted. Therefore, the reason why portfolio managers fail to take actions for portfolio risk management can be identified as unawareness of portfolio risks, unawareness of the need for an holistic view, lack of experience, lack of time, and inability to justify the necessary costs (6). In the project portfolio environment, risk management of single projects would be insufficient. The portfolio risk management approach supports the alignment and redistribution of resources among projects, improves the capacity to encounter risks, and expands the existing information for decision-making. Integrating the information obtained from the risk management of independent projects, portfolio risk management can identify the risks emerging simultaneously in different projects and avoid duplication of efforts to analyze them and prepare responses (6). This is consistent with investment in solving the original cause than responding to problems. For instance, investing in quality management will have a better cost-effectiveness in comparison with the corrective actions required to compensate for the low quality.

Known as a process of guaranteeing portfolio goal achievement, portfolio risk management depends greatly on how to define portfolio goals. According to the literature review, the goals of creating project portfolios are known as project success, projects risk level balance, better exploitation of organizational resources, align the projects with organization strategy, and better exploitation of opportunities resulting from project execution (5,6).

As discussed earlier, project risks are only the components of portfolio risks due to portfolio extensiveness, interactions of portfolios with organizational strategies, and presence of projects with interdependencies (*e.g.* in common resources). As a result, portfolio risks exceed the total risks of projects. To better show the effects of interdependencies of project risks in a portfolio, a model was proposed by Olsson (2008) to identify portfolio risks through three steps: analyzing risks of every project solely, analyzing and comparing risks of a project with those of other projects, and combining risks of different projects collectively. In other words, portfolio risks are classified as two categories, *i.e.* “risks of components” including projects and operations and “structural risks” pertaining to the formation and interactions of components.

3. Organizational Risk Management

It is necessary to identify differences between business risk management and executive risk management pertaining to uncertainties existing in the execution of activities performed by a business to achieve the desired results and goals (7). Accordingly, a series of standards called enterprise risk

management (ERM) have been developed. These standards include the methods and processes employed by organizations to manage threats and seize opportunities. Identifying and tracking risks and opportunities dynamically, organisations create and retain values for the stakeholders of organizations including owners, employees, legislators, and the entire society. ERM can also be employed to develop a risk-based approach to organizational management, integration of ideas and concepts, internal control, and strategic planning. In fact, ERM was designed to identify the needs of different stakeholders who would like to ensure the correct management of a wide range of risks facing complicated organizations (8). These risks can be classified as four categories, each of which contains a series of internal and external factors. These four categories are infrastructural risks (*e.g.* communication infrastructure, supply chain structure, employee skills, and information systems), financial risks (*e.g.* rate of interest, currency exchange rate, fraud, and debts), market risks (*e.g.* technology development, competitive atmosphere, and contracts), and credential risks (*e.g.* sales return and environmental controls) (19).

As discussed earlier, organizational risk management analyzes the risks which an organization faces at a macro level. In fact, organizational risk management reaches portfolio management in planning the strategies employed by the organization to achieve its goals. In other words, organizational risk management plays a central role in determining the portfolio formation strategies as the tools for achieving organizational goals and consequently selecting the projects.

Table 3 presents the applications of some of the most important standards to conclude this section and facilitate the perception of differences between models in proportion to risk management at project, portfolio, and organizational levels.

Table 3 - Comparing the Applications of Risk Management Standards at different Organizational Levels

Project	Portfolio	Organization	Standard
		*	ISO 31000 (2018)
*		*	IEEE 16085 (2020)
		*	AS/NZS 4360 (2004)
*	*	*	BS6079 (2019)
		*	CAN/CSA-Q850-97 (1997)
		*	IRM & AIRMIC (2010)
*			PRAM Guide (2014)
*			PMBOK (2017)
*			DoD Risk Guide for DAP (2017)
*			ECSS MST80C (2008)
		*	SDD RMF RMP (2017)
	*		PMI Standard for Portfolio Mng. (2017)

4. Conclusion

As discussed earlier, differences of risk management models were highlighted. As an instruction to select the right risk management model, it is recommended to select the model with the following features:

1. Considering both opportunities and hazards: It is important to consider risks by paying attention to both positive and negative effects and identifying all risks including the identification of opportunities and hazards. As a result, a better judgment of the project, portfolio, or organizational status would be made. Considering only the threats would prevent a realistic judgment and use of maximum capacity for achieving goals.
2. Considering other existing uncertainty types along with risks: The risks which are commonly discussed in the literature (known-unknown uncertainty type) cover only a group of uncertainties existing in activities. Disregarding other uncertainty types would ignore some of the existing hazards; besides, some of the hidden opportunities would be lost. Therefore, it is necessary to execute uncertainty management beyond risk management. It should also be considered that some risk management models expand the risk definition scope and include other uncertainties in risks, something which could cause ambiguity in concept of risk and disturb the execution of risk management processes.
3. Giving correct definitions of cause, event, and effect of risk: A risk event includes cause and effect. Considering the cause of a risk or the effect of a risk instead of the event of a risk would confuse the execution of risk management processes.
4. Proportion to the organization level at which risks should be managed: Since there are different management goals at different organizational levels (project, operations, portfolio, and organization), risks are inherently characterized by different attributes. Therefore, different tools and processes will be employed to manage risks.
5. Proportion to the features of the atmosphere in which risks should be managed: atmosphere features are evaluated by measuring industrial requirements, experience and capability of the team in risk management, number of risks, and organizational culture. For instance, it is not justifiable to select a model that requires many processes for risk evaluation and needs to produce many documents in a small project or organization with only a few risks.

References

- Office of Deputy Assistant Secretary of Defense Systems Engineering, (2017). *Department of Defense Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs*. Deputy Assistant Secretary of Defense, Washington DC
- Australian Government, Department of Defence, Estate and Infrastructure Group (2017). Service Delivery Division Risk Management Framework- Risk Management Process. Department of Defence, Australia
- Price waterhouse Coopers, L.L.P. (2004). *Enterprise Risk Management: Integrated Framework*. Committee of Sponsoring Organizations of the Treadway Commission.
- Han, S.H., Diekmann, J.E., Lee, Y., & Ock, J.H. (2004). Multicriteria financial portfolio risk management for international projects. *Journal of construction engineering and management*, 130(3), .346-356
- Project Management Institute. (2017). *The standard for portfolio management*. Newtown Square, Pa: Project Management Institute.
- Teller, J., & Kock, A. (2013). An empirical investigation on how portfolio risk management influences project portfolio success. *International Journal of Project Management*, 31(6), .817-829
- Raz, T., & Hillson, D. (2005). *A comparative review of risk management standards*. Risk Management.
- Enterprise Risk Management Committee (May 2003). “*Overview of Enterprise Risk Management*” (PDF). Casualty Actuarial Society
- Del Cano A. and De La Cruz, M.P. (2002). “Integrated Methodology for Project Risk Management.” *J of Construction Engineering and Management*, Vo.128, Issue. 6, PP .473-485
- Project Management Institute (2017). *A guide to the project management body of knowledge (PMBOK guide)*. Project Management Institute.
- Santos, F.R.S.D., & Cabral, S. (2008). FMEA and PMBOK applied to project risk management. *JISTEM-Journal of Information Systems and Technology Management*, 5(2), 347-364. <http://www.scielo.br/>
- Mehdizadeh, R. (2012). Dynamic and multi-perspective risk management of construction projects using tailor-made Risk Breakdown Structures (Doctoral dissertation, Université Paris-Est Marne la Vallée).
- Petit, Y. (2012). Project portfolios in dynamic environments: organizing for uncertainty. *International Journal of Project Management*, 30(5), .539-553
- Olsson, R. (2008). Risk management in a multi-project environment: An approach to manage portfolio risks. *International journal of quality & reliability management*, 25(1), .60-71
- Project Management Institute (2009). *Practice Standard for Project Risk Management*. Project Management Institute.
- Project Management Institute (2019). *The Standard for Risk Management in Portfolios, Programs, and Projects*. Project Management Institute.
- Webb, A. (2003). *The project manager's guide to handling risk*. Gower Publishing, Ltd
- International Organization for Standardization (ISO) 31000. (2018). *Risk management—Guidelines*.

- AIRMIC, A., & Irm, A. (2010). *Structured approach to Enterprise Risk Management (ERM) and the requirements of ISO 31000*. The Public Risk Management Association, London, UK.
- Mulcahy, R. (2010). *Risk Management, Tricks of the Trade for Project Managers*. RMS Publications, Inc., Minneapolis.
- Grande-Bretagne. Office of Government Commerce. (2017). *Managing successful projects with PRINCE2*. The Stationery Office.
- Ullman D.G., H. Levine (2009). “*Five Key Decisions for Portfolio Optimization.*”
- Standards Australia & Standards New Zealand. (2004). AS/NZS 4360: 2004: risk management.
- British Standard, B.S. (2019). *Project management - principles and guidance for the management of projects (BS 6079:2019)*. British Standards Institution, London
- Canadian Standards Association. (1997). *Risk management: Guideline for decision-makers (CAN/CSA-Q850-97)*. Canadian Standards Association, Rexdale, Ontario.
- Standard, E.C.S.S. (2008). *Space Project Management-Risk Management (ECSS-M-ST-80C)*.
- Institute of Electrical and Electronic Engineers (2020). IEEE 16085-2020 - ISO/IEC/IEEE International Approved Draft Standard - Systems and Software Engineering - Life Cycle Processes - Risk Management. New York: IEEE.
- Association for Project Management (2010) *Project Risk Analysis & Management (PRAM) Guide*. 2nd edn. High Wycombe: APM.
- ISO Guide. 73: 2009. (2009). *Risk management vocabulary: International Organization for Standardization*.
- Baloi, D., & Price, A.D. (2003). Modelling global risk factors affecting construction cost performance. *International journal of project management*, 21(4), 261-269.
- Al-Bahar, J.F., & Crandall, K.C. (1990). Systematic risk management approach for construction projects. *Journal of construction engineering and management*, 116(3), 533-546.
- Chapman, R.J. (2001). The controlling influences on effective risk identification and assessment for construction design management. *International Journal of Project Management*, 19(3), 147-160.
- Cleden, M.D. (2012). *Managing project uncertainty*. Gower Publishing, Ltd.