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Operational risk categorization in project-based organizations: A theoretical perspective from a project portfolio risk lens

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Abstract

Project-based organizations have their processes based on project, program and portfolio approach, they work within a multi-project environment and their core activities are carried out through project execution under an integrated organizational project management. Therefore, operational risks in project-based organizations are directly related to the project risk management. Thus, in project-based organizations risk management is not only about project risk management, because literature also shows that risk management applied to each project in an isolated way is not enough for systemic risk management in project portfolio and organizational context. This paper, based on a systematic literature review on project portfolio risk management, identifies project portfolio risk categories proposed in previous studies, and proposes and describes four categories associated to operational risk in project portfolio context: project portfolio management level, environmental conditions, project interactions and internal processes. The categories proposed for operational risk in project-based organizations under project portfolio approach are oriented to risk management focused not on the operational risk of each isolated project, but on the project portfolio management. The results can be considered a partial contribution towards building conceptual elements to support project portfolio management process.

Keywords: Operational risk; project-based organizations; project portfolio risk categorization.

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1. Introduction

The risks associated with variations in core activities of an organization are considered as operational risk. Operational risk management is a field that is gaining importance within researchers and practitioners [1]. From the perspective of project-based organizations, such as software development, construction or innovation and development centers, their operational or core activities correspond to projects execution. Thus, in this context, risk management corresponds to the analysis of the project execution risks for decision making in different organizational levels [2]. Therefore, the management of operational risks in project-based organizations is directly related to the project risk management. As such, the literature shows that a project risk management approach can be developed through several processes, namely risk management planning, risk identification, risk assessment, risk response and risk monitoring and control processes, being the risk management planning process cross-cutting to all other three processes. Risk identification is considered a key process since it defines and characterizes risks [3, 4], establishing the information necessary to pursue the following risk management processes.

Current economy is substantially projectified, being around 40% of the global economy related to project based organizations, generating a significant increase in the level of adoption of project management approaches, techniques and tools for producing products and services [5]. Project-based organizations work within a multi-project environment under an integrated project management context. Several attempts to conceptualize project-based or project-oriented organizations have been made for over two decades, generating different names for this type of organizations [5]. Gemünden, Lehner, and Kock [6] define that a project-based organization is characterized by the customized nature of the demand from its customers, while a project-oriented organization is based on an organizational strategy of management by projects. Miterev, Mancini, and Turner, [5, p. 481] define “project based organization as one which makes the strategic decision to adopt project, program and project portfolio management as business processes to manage its work, and which views itself as being project-oriented”. In the research presented in this paper, we adopt this last definition.

In this regard, a project-based organization is considered both as a permanent organizational unit or structure within an organization or as a whole organization that incorporated a multiple project approach as its management approach [5]. A project-based organization is able to cope with emerging properties associated to multi project environment, developing the necessary knowledge in order to face risks and uncertainties [7]. Risk management applied to individual projects is not enough, given that the interdependencies between projects cannot be ignored, neither their integrated management. A more holistic vision should be favored, such as the project portfolio’s risk perspective [2, 8]. Thus, identifying risk categories is important because the risk management of each category requires different capacities, techniques and tools in order to support an adequate risk management process [2, 9]. Some authors have identified project portfolio risk categories such as cultural and climate risks and risks related to contracts, among others. Most of those publications refer to generic project portfolios like Hofman *et. al* [8] or focused on specific project portfolios such information technology portfolios like Drake and Byrd [10], but did not define a project portfolio approach focused to identify operational risk in project-based organizations.

Therefore, this research work aims at developing a theoretical risk categorization of the operational risks in project-based companies, through a project portfolio’s risk lens. As such, it seeks to contribute to the identification of operational risks process in project-based companies, under a holistic approach. The remaining paper is organized as follows. Section 2 presents the definition of main concepts related to the research topic. Section 3 presents the methodology followed, namely it describes the literature search and the classification developed, and how the final proposed project portfolio risk categories were established. Section 4 presents the results, detailing the path taken from the project portfolio risk categories identified in the literature till the four categories here proposed, and their description. Finally, Section 5 presents the conclusions and some highlights for further research.

2. Main concepts

2.1. Risk and uncertainty

Establishing the difference between the concepts of risk and uncertainty is of the greatest importance because this conceptual difference determines the risk management scope, as well as it defines the characteristics of the risk assessment and the response strategies design [4, 8, 11, 12]. From a conceptual perspective, the distinction between risk and uncertainty was proposed in 1920 by the economist Frank Knight [9]. The author defined that the variability that can be quantified in terms of probabilities is best thought of as risk, while variability that cannot

be quantified at all is best thought of as uncertainty. In this regard, two perspectives for risk analysis have been identified in the literature. A first perspective poses that risk and uncertainty represent outcomes; a second perspective poses risk as a consequence of uncertainty, being this second approach quite popular [8]. In both approaches the risk is characterized by its measurable attributes, like a probability distribution, occurrence likelihood or impact [4, 11-13].

This research is rooted on the first perspective, focusing on the component of risk as outcome, defining thus, that the uncertainty analysis is out of the scope of this research. One way for evaluating the risk is associated with the exposure concept, which indicates the amount or measure of impact on expected results, or the volatility or variability of results, due to changes in risk factors. Risk factors are considered as the different variables that influence or generate, directly or indirectly, exposure [9, 14].

2.2. Operational risk

Market risk, credit risk, liquidity risk, and operational risk are four risk categories associated to risks of a loss to a firm or portfolio [15]. “Unlike market and credit risk, operational risk is so wide in source, frequency and severity which makes it more and more sophisticated and less measurable” [16, p. 607]. According to [16], Basel Committee defined operational risk as the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. Operational risk is widely discussed in the context of finance and insurance [17]. However, operational risk management lately has been centered on operational flexibility applications in specific industries [18], and it is considered internal to the firm [15]. Thus, operational risk is related to probability of unexpected events occurring as a consequence of variations in the regular performance of a company [19].

Generally, the project portfolio risk management focuses on the risks associated with the business phase, related to commercial and market factors among others; however, operational risks must also be incorporated because the results associated to the operational phase may have a negative effect on the expected project portfolio results or on the organization’s objectives [20, 21].

2.3. Project portfolio risk management

From a project management perspective, the Association for Project Management defines risk as “an uncertain event or set of circumstances that, should it occur, will have an effect on the achievement of the project’s objectives” [22, p. 156]. The effect of risk management at the project level has been studied, evidencing positive impacts on the success of each individual project [23]. However, the literature also shows that managing risks only at the level of projects is not enough, so integrated risk management as one of the project portfolio management processes emerged as an alternative holistic approach that allows higher effectiveness in risk management, and also focus on the most relevant risks for the portfolio [8, 23-25].

Authors, such as Sanchez and Robert [26], Carvalho et al. [27], Hofman et al. [8], Teller and Kock [25] and Teller et al. [23] among others, have suggested that project portfolio risk management (PPRM) is a young and emerging domain, identifying this field as one of the fundamental areas of work and research in project portfolio management. Project portfolio risk management is focused in incorporating the effect of information, projects, risks and resources interactions in order to consolidate risk management activities, avoiding duplication of resources and efforts, balancing of portfolio risk profile, and reducing negative risk impacts on the project portfolio objectives [8, 23, 28].

3. Methodology

Two stages were carried out in order to identify project portfolio risk categories related to operational risk. The first stage was associated to literature search and classification (data collection). The second stage was focused in analysis of project portfolio risk categories identified in the literature (data analysis). In stage one a structured and systematic literature search was carried out. In this regard, different authors synthesize a structure and systematic literature review process in four phases, (1.1) planning and scope definition, (1.2) conceptualization of topic, (1.3) searching, evaluating, and selecting literature and, (1.4) literature analysis [29], [30]. In phase 1.1 it was defined that only articles published in scientific journals should be considered because this type of publications generally correspond to research finished and they represent a reliable and qualified information source; these articles should have included PPRM as their main topic or, if the main topic was not PPRM their main objective should have shown a specific and explicit relation with PPRM; it was also defined that the literature search would be done

using SCOPUS and Web of Science -WoS- databases, considering they cover a wide extension of peer-reviewed and high quality scientific journals. In phase 1.2 works related to PPRM in portfolio execution context and works related to PPRM in project portfolio selection context were identified. For papers related with PPRM in portfolio execution context, since it is a topic scarcely tackled [3, 23], the year filter would not be applied, while for PPRM in project portfolio selection context the year filter would be 2015 onwards, because it is a specific topic with a high number of publications, and according to Dobrovolskiene and Tamošiuniene [31] earlier works are generally included in the latest research.

In phase 1.3, an iterative evaluation of different search equations was carried out and results showed that the equation that best grouped the publications about PPRM was the search equation “project portfolio” and “risk” in keywords, title and abstract. The keyword "project-based organization" was not included because the objective of this research was to obtain an alternative vision of the risk in this type of organizations; besides, the integration between results of this study and operational risk categories identification for project-based organizations from complementary perspectives was left as part of future studies. 349 publications were identified in SCOPUS and 121 in WoS. Contrasting the results of both sources, selecting only publications in Scopus or WoS scientific journals, and analyzing the publication year, the abstract, introduction and the conclusions of each article, identified which publications met the selection criteria defined in the previous phase. A total of 73 publications were selected. In phase 1.4, the literature was analyzed within an inductive and qualitative research approach. The analysis led to identifying the publications that explicitly had identified or proposed project portfolio risk categories. Thus, project portfolio risk categories were identified in 11 publications.

Stage two was carried out in three phases. In phase 2.1 the project portfolio risk categories identified were analyzed considering the characteristics of operational risk, identifying categories that do not pertain to operational risk. In phase 2.2, based on thematic analysis, project portfolio operational risk categories were established from a theoretical perspective and hierarchical relations between categories were defined. Categories definition was based on analysis of complementarities and differences between the risk categories related to operational risk. For this phase, some works like Ghasemi *et. al* [3] and Hofman and Grela [4] were fundamental as guides to obtain the final categories defined. Finally, in the last phase each risk category was characterized.

4. Results

4.1. Risk categories identified in previous studies

From project portfolio risk, the concept related to ‘systematic risks’ and ‘non-systematic risks’, derived from the modern portfolio theory, is presented as the basic conceptual factor with regard to the project portfolio's risks [10, 32]. The project portfolio non-systematic risk corresponds to the inherent risks to each project, while the systematic risk is related to the project portfolio exposure to environmental conditions and market conditions, corresponding to risks that affect the portfolio in a global way. However, the systematic risk has two specific visions in the literature, on one side, it is exclusively associated with ‘environmental factors’ [32], and on the other side, besides the factors of the environment, it includes the effect of ‘risks interaction and project interactions’ [10].

In a complementary way, other structures related to project portfolio risk categories were identified or proposed by different authors. Table 1 shows a summary of general project portfolio risk categories identified in the literature, and not only categories related to operational risk. These categories are associated to project portfolio's risk sources, without representing a specific relation regarding the extent of impacts over the portfolio in a general way or only over some projects of the portfolio. As such, the risk categories identified in Table 1 can be considered an input for risk identification processes from the project portfolio perspective. Risk categories related to ‘systematic risks’ and ‘non-systematic risks’ establish the level (project or portfolio) at which the portfolio can be impacted by the risks identified. This categorization allows decision-makers to define, in turn, the organizational level responsible for each type of risk in order to establish a structured project and portfolio risk management process.

Table 1. Risk categories identified in literature under project portfolio lens

Ref.	Context	Project portfolio risk categories
[33]	General project portfolios	(1) External risks associated to sources of risk derivative from the project portfolio interaction with the context, and (2) the sources of risk related to the project portfolio interaction with internal processes are associated to risks of the organization.
[4, 8]	General project portfolios	(1) Structural risks, associated with the composition of a group of projects and the potential interdependencies among components. (2) Component risks are project risks that the project manager needs to adjust to the portfolio level for information or action. (3) The overall risk considers the interdependencies between projects.
[34]	General project portfolios.	(1) Fund arrival rate, (2) technical risk, (3) ratio of completion time and average, (4) financial risk, (5) quality risk, (6) transportation availability, (7) legal exposure, and (8) political impact.
[4]	General project portfolios. Based on most important areas forming the source of project portfolio risk	(1) Unpredictable phenomena appearing in the portfolio environment and changes in the basic parameters of projects and programs implemented, (2) problems with the availability of resources, irregularities in processing, (3) aggregating and distributing information, as well as improper transfer of knowledge, (4) conflicts between the portfolio manager and the middle and top management, as well as the lack of involvement of top management, (5) improper portfolio structure resulting from mistakes in prioritization that fail to guarantee the achievement of strategic goals, (6) improper management of the life cycle of projects and programs and the problems with the flow of products, and (7) problems with financing stability and the financial liquidity of the portfolio.
[35]	General project portfolios. Case study: company producing steel sheets.	(1) Changes in inflation rate, (2) change currency, (3) subsidy, (4) changes in government policies, (5) international restrictions, (6) complexity of design, (7) lack of skilled manpower, (8) risks related to contract, (9) changes in the scope and running time, and (10) weather conditions.
[11]	General project portfolios. Application for IT portfolio	Internal interactions of a project portfolio composes by (1) benefit interaction, (2) resource interaction, and (3) technology interaction.
[3]	General project portfolios. Application for a construction portfolio.	(1) Portfolio-level risks, (2) project interdependency risks project composes by (2.1) value interdependency, (2.2) resource interdependency, (2.3) accomplishment dependency, (2.4) outcome dependency, and (3) risks of each independent project.
[10]	Information technology (IT) project portfolios	(1) Strategic alignment risks, (2) organization and management risks, (3) cultural and climate risks, (4) project relationship risks, and (5) financial risks.
[36]	Based on software development portfolio case study	(1) New product (scope), (2) project performance, (3) changes in processes, (4) need for customization, (5) new customers and new market (scope change), (6) changes in agreements with third-party suppliers (scope change), (7) structural reorganizations, (8) technology, and (9) change in business strategy.
[36]	Based on financial services portfolio case study	(1) New interpretations of the norms (scope change), (2) changes in the norms (scope change), (3) project performance, (3) portfolio budget reduction, (4) technology, (5) organizational change, and (6) changes in strategy.
[37]	New product development (NDP) portfolios	(1) Lack of sufficient resources to achieve the objectives of NPD project, (2) suppliers that are not able to deliver the required materials, and (3) competitors who develop the similar product first.
[38]	Oil project portfolios	(1) Political risk, (2) environmental risk, (3) technical risk, (4) trade risk composes by finance risk and tariff risk, and (5) economic risk composes by price risk, exchange risk, and inflation risk.

4.2. Project portfolio operational risk categories proposed

Based on the information provided by different authors, a recollection of portfolio risk categories was established (Table 1). As defined in the methodology (Section 3), risk categories unrelated to operational risks were discarded. For this, risk categories such as fund arrival rate, change currency and portfolio budget reduction, among others, were not considered as part of operational risk analysis. In addition, according to the information described in section 4.1, two different levels of risk categorization could be considered. The first one is associated to risk sources and, the second one relates to risk impact level represented by ‘systematic risks’ and ‘non-systematic risks’ categories.

Subsequently, risk categories were analyzed and compared with each other, in order to standardize the different existing classification. The qualitative and comparative analysis performed resulted from a sequential cumulative approach. By comparing the first two authors, a first standardization of the definition was obtained, identifying common risk categories and hierarchical relations between risk categories. This preliminary result was the basis for the next comparison enabling to complement the previous resulting definition and so on and so forth until a final cumulative definition, was reached. Resulting from this analysis four specific portfolio risk categories were

defined, under which more specific sub-groups of portfolio risks sources were classified. Table 2 describes the main aspects that characterize each risk category, according to the abovementioned steps.

Table 2. Project portfolio operational risk categories from risk sources perspective

Category	Description
Project portfolio management level (based on [3, 4, 10])	Cover aspects related to aggregating and distributing information in an inadequate way among decision levels, improper sharing of knowledge between stakeholders, lack of transparency or quality of information. In general, it is associated to aspects that leads to the making of wrong decisions by portfolio manager, as well as by other maker-decisions related to management of project portfolio.
	Other group of aspects that are part of this category is related to inadequate management of culture and organizational climate, such as conflicts between decision-makers, conflicts between stakeholders, loss of knowledge and skills due to lack of stability of staff, recurrent operational approach changes, low cooperation level among project teams, and low cross-trained staff to support changes during portfolio execution, among other aspects.
	Lack in project portfolio management capacities is the third component of this category, generating an inadequate prioritization between portfolio components, low decision-making capabilities in order to face risk management process, to incorporate efficiently organizational changes in portfolio management, and to balance portfolio components, resources and capabilities available in each planning and execution period.
Project interactions (based on [3, 4, 10, 11, 37])	Resource interdependency is an important risk source in project portfolio context. Resource interdependency can generate errors in resource allocation, lack of sufficient resources required for attaining the objectives, technology interdependences and conflict between project managers. Thus, delays in one project may affect the start of some activities of another project because the resources required are not available.
	Some projects are undertaken because if made in combination with other projects generate some benefits (programs), like cost reduction, scale economies, or knowledge generation. However, it should be considered that failure, delays or cancellation of one of these projects generate negative effects on the other projects, and therefore, the success of one component has impact on the success of the other project. In the same way, the relation between projects where developing one of them depends on one or more outputs from another project, must also be considered.
Environmental conditions (based on [4, 34-36, 39])	Include aspects associated to supplier and contracts. Supplier and contracts capacity for delivering the required products and services, changes in agreements with suppliers and contracts, and changes in the competitive environment and business strategy of suppliers and contracts, are part of this category.
	The effect of new norms or changes in current norms, changes in the competitive environmental, or changes in weather conditions correspond to a second group of aspects that should be considered.
Internal Processes (based on [4, 34-36, 38])	Changes in the basic parameters of projects and programs, like changes in the scope and schedule can be considered part of this category. These changes could be associated to complexity of design or need for customization of some products or processes for specific projects or programs.
	Another aspect that must be considered is associated to the projects and programs management life cycle process, which might incorporate problems related to flow and quality of products, project performance, changes in processes, irregularities in processing, irregularities in raw materials, lack of manpower skills, changes in technical conditions, among others.

Finally, a specific relation between the two risk categorization levels identified was established. Based on qualitative analysis, it was identified for each risk source category (Table 2) if risks that compound it could have impacts on the project portfolio in a general way, and hence, if each risk source category can be considered as source of 'systematic risk'. Risk source categories related to 'non-systematic risk' refer to risk sources that generate impacts only for one or some projects, but those impacts do not affect the project portfolio performance in a systemic way. It was identified that some risk source categories generate impact both in a systemic and non-systemic way for the portfolio. Fig. 1 illustrates the relationship between both levels.

Thus, 'environmental conditions' can generate risk at both systemic and non-systemic category, because these risks type can affect one or some projects in an isolated way, but in other cases they can also generate conditions that impact the whole portfolio in a systemic way. Similar situation was identified in relation with the 'internal processes' category. Risk at 'project portfolio management level' and risk related to 'project interactions' can be considered exclusively systematic risk sources because these types of risk always affect the portfolio performance in a global way, not only to each project in an isolated way.

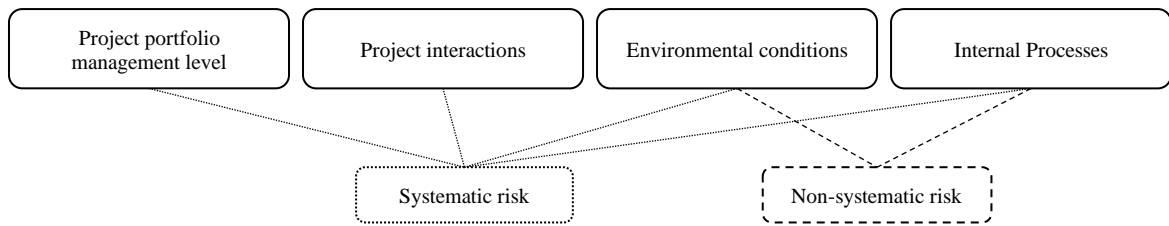


Fig. 1. Operational risk categories proposed under project portfolio lens

5. Conclusions

The conducted research, based on systematic literature review and qualitative analysis, allowed to identify that project portfolio risk sources can be classified as ‘systematic’ and ‘non-systematic’, and that four operational risk portfolio categories should be considered in order to characterize and ultimately assess project portfolio risk: ‘portfolio management level’, ‘environmental conditions’, ‘project interactions’, and ‘internal processes’ (see Fig. 1).

Risk management applied to project portfolio management has been highlighted as a necessary perspective for environments in which each project is not managed individually. Although this approach might add greater complexity, it is also highlighted that it can generate greater efficiency and greater positive impact on project portfolio management objectives [3, 12]. In this regard, the identification of risk categories carried out in the research here reported is an input to improve and support the operational risk identification process in project-based organizations. The categories defined could be used for operational risk categorization process in other types of organizations, however, prior to their use in other contexts, it is necessary to carry out at least a theoretical validation in order to ensure that those categories and their composition represent environment and characteristics of each type of organization.

The main contribution of this paper is to allow decision-makers to obtain a different perspective of operational risk in project-based organizations, allowing them to integrate portfolio risk management under a holistic and integrated risk management perspective. In this regard, the categorization proposed represent a contribution in terms of conceptual elements related to project portfolio risk management processes that allow supporting an adequate project portfolio management.

The categories identified and their composition does not include yet a list of potential risks for each one. Therefore, for further research, an operational risk identification process could be carried out in order to identify and classify specific risks in each category; this research could incorporate both information from literature review and expert judgement. Additionally, empirical research may contribute to refine and validate the categories proposed in this paper and their composition, providing an operational portfolio risk structure that can be used by portfolio managers, and other decision-makers in project-based organizations, for supporting their operational risk management processes.

As the emphasis of this work was to study risk in a specific organizational context, namely project-based organizations, all the previous works analyzed were focused on project portfolio risks, leaving aside works related to other types of risk that could be considered, for example, operational risk categories identified in other contexts such as operational risk in manufacturing companies or operational risk in supply chains. This could be considered a limitation, since other contexts could enrich the study. Thus, future relevant research is foreseen, conducting studies that incorporate these other operational risk perspectives, allowing for a more complete understanding of operational risk from a project portfolio perspective, even for project-based organizations.

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