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Project Portfolio Risk Identification-Application of Delphi Method

Mariusz Hofman, Grzegorz Grela

(Maria Curie-Sklodowska University, Maria Curie-Sklodowska 5, 20-031 Lublin, Poland)

Abstract: This paper presents the results of a study conducted within the framework of a research project concerning project portfolio risk identification. Based on the available literature, the risks were separated, named, described and categorized as a list. An expert evaluation conducted with the Delphi method of this list of risks constituted the next step. Following the evaluation, the coefficients of convergence of expert opinions were established for particular evaluation dimensions. The final list of risks was then developed, constituting the subject of empirical work for the following stages of the research project.

Key words: risk management; risk identification; expert consensus; Delphi method

JEL code: M2

1. Introduction

The presented study addressed issues related to identifying the risks associated with project portfolio execution. This study had two basic goals, the first constituting the indication of the theoretical foundations required to identify risks related to project portfolio execution. Based on the available literature on the subject, the team identified those areas constituting multi-project risk sources, and hence identified the associated risks. This resulted in a list of project portfolio risks. The second goal was constituted by the presentation of the adopted research methodology and the results obtained from the expert evaluation of the list of project portfolio risks, based on the Delphi method (the evaluation included the correctness of names, descriptions and categorization of the risks, as well as the completeness of the risk list). This part of the study concentrated on those issues of expert consensus that determined the final list of project portfolio risk.

2. Project Portfolio Risk Identification — Theoretical Issues

While addressing the issues of risk in portfolio management, one should take into account two important aspects. The first is constituted by the understanding of risk as a derivative of increased uncertainty accompanying the simultaneous implementation of many projects (Project Management Institute, 2004, p. 238). Distinction of the terms of risk and the uncertainty is an opposite view. For example, Perminova claims that "risk refers to events subject to known or knowable probability distribution, while uncertainty is a situation for which it is not possible to specify numerical probabilities (Perminova O., Gustafsson M., Wikström K., 2008, pp. 73-79; De Meyer A.,

Mariusz Hofman, Ph.D., Assistant Professor, Maria Curie-Sklodowska University; research areas/interests: project management, process management. E-mail: mariusz.hofman@umcs.lublin.pl.

Grzegorz Grela, Ph.D., Adjunct Professor, Maria Curie-Sklodowska University; research areas/interests: project management, process management. E-mail: grzegorz.grela@umcs.lublin.pl.

Loch H., Pich T., 2002, pp. 60-67; Knight, Frank H., 2012). The second important aspect to be considered is the treatment of identified risk as an event that generates not just threats but also opportunities (Olsson R., 2008, pp. 60-71; Sanchez H., Robert B., Pellerin R., 2008, pp. 97-109; Project Management Institute, 2008, p. 85).

The Project Management Institute indicates the main categories under which the portfolio risk can be identified. The first is the component risk related to the level of risk associated with each single portfolio element. The second is structural risk, which is a derivative of a specific portfolio composition, i.e. the number, complexity and structure of the portfolio elements. The third is general risk, which is a derivative of other factors, including relations among the portfolio elements and changes in the environment, efficiency of portfolio management, and changeability of strategic assumptions. It is one of the consequences of the relations found among portfolio elements (Aritua B., Smith N., Bower D., 2009, pp. 72-79). Many studies attest that risk management is not properly included in the multi-project management processes in the context of achieving strategic goals (Sanchez H., Robert B., Bourgault M., Pellerin R., 2009, pp. 14-35; Sanchez H., Robert B., 2010, pp. 64-73). Olson emphasizes that the risk management processes present in the organization are often insufficient, as they usually concentrate on the issues of risk identified on the level of individual projects. In addition, he indicates areas of improvement for such processes, including the exchange of knowledge between projects, monitoring of relations among the portfolio elements, and the measurement of efficiency of the risk management process (Olsson R., 2007, pp. 745-752). Some of the available studies concern the issue of the risk management of a portfolio of projects implemented by engineering and construction operators (Caron F., Fumagalli M., Rigamonti A., 2007, pp. 569-578). These studies address the issues of appropriate risk diversification in the context of maximization of the cash volume created in the project (Ghim Hwee N., Tiong R., 2002, pp. 351-363). In addition, there are studies on IT project portfolio risk management. Proper risk management of such portfolios results from the specificity of IT projects and concerns those areas of IT and human resources, as well as the relevant flow of knowledge (Jun L., Qiuzhen W., Qingguo M., 2011, pp. 923-933).

Many studies recommend risk identification process formalization, while drawing attention to the open and objective criteria of such a process, its clear rules and transparent procedures (Martinsuo M., Lehtonen P., 2007, pp. 56-65; Patanakul P., Milosevic D., 2009, pp. 2216-2233). In turn, Kwak and Stoddard claim that identification constitutes a key action in the risk management process (Kwak Y., Stoddard J., 2004, pp. 915-920). Cooper indicates that project portfolio risk identification should concentrate on two areas, the first being the area of risk arising from the relations between the portfolio elements, while the second one concerns the area of risk constituting a derivative of portfolio element diversity (Cooper R., 2008, pp. 213-232). In this statement, the attempt to categorize in terms of the general and structural risk is visible. Therefore, a correctly conducted identification should enable one to define the risk arising from the portfolio structure and the character of its elements, as well as the relations among the elements concerning resources and knowledge (Teller J., Unger B., Kock A., Gemünden H., 2012, pp. 559-600). The available studies indicate that a significant level of difficulty may be experienced while identifying the relations among the portfolio elements (Sanchez H., Robert, B., Bourgault M., Pellerin R., 2009, pp. 14-35). Other available studies indicate two approaches to risk identification in multi-project management. The first is identification based on the analysis of relations among the portfolio elements, while the second is identification based on considering a portfolio to be a system operating in a specific environment (Sanchez H., Robert B., Pellerin R., 2008, pp. 97-109). In turn, Teller indicates the impact of risk identification on other aspects of project portfolio risk management (Teller J., Kock A., 2013, p. 824).

3. Applied Research Methodology

Within the framework of the first stage of the research project, the research hypothesis assuming that “there is a possibility of identifying risks appearing in multi-project management” was verified, and Figure 1 presents the adopted scheme. While preparing for the risk identification process, significant difficulties were found related to the performance of that task concerning risk identification, as well as evaluation with regard to the correctness of conducting that identification. The first unknown was the question whether it was possible to separate the portfolio risks at the same level of detail, especially as the available studies included only very generally formulated indications concerning those areas forming risk sources in multi-project management. The second difficulty was the fact that the adopted research method required the team being able to communicate the non-numerical variables and the wordings describing the names and characteristics of the proposed risks.

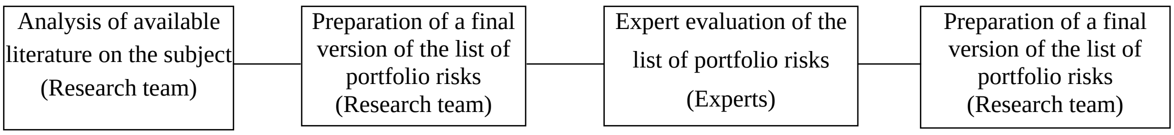

Figure 1 Scheme Used for Project Portfolio Risk Identification and Evaluation

3.1 Determination of the List of Risks — Analysis of the Literature

The analysis of the literature on the subject included those publications concerning project portfolio risk issues. This resulted in the selection of the seven most important areas forming the source of project portfolio risk. These are indicated below (Pender S., 2001, pp. 79-87; Kutsch E., Hall M., 2010, pp. 246-249; Pennypacker J., Dye L., 2002; Cooper R., Edgett S., Kleinschidit E., 2002; Kendall G., Rollins S., 2003; Rajegopal S., McGuin P., Waller J., 2007, pp. 134-136; Payne H., 2009, pp. 72-79; Meskendahl S., 2010, p. 809; De Reyck B., Grushka-Cockayne Y., Lockett M., Calderini S., Moura M., Sloper A., 2005, pp. 527-528; Blichfeldt B., Eskerod P., 2008, pp. 359-363; Jonas D., 2010, pp. 822-824):

- unpredictable phenomena appearing in the portfolio environment and changes in the basic parameters of projects and programs implemented within the framework of the portfolio, i.e., the scopes, schedules and budgets constituting their derivative (Pender, 2001; Blichfeldt & Eskerod, 2008),
- problems with the availability of resources, their proper allocation and relevant quality, as well as improper balancing of resources within the framework of the portfolio (Pender, 2001; Pennypacker & Dye, 2002; Cooper and team, 2002; Blichfeldt & Eskerod, 2008),
- irregularities in processing, aggregating and distributing information, as well as improper transfer of knowledge within the framework of the portfolio (Pender, 2001; Cooper and team, 2002),
- conflicts between the portfolio manager and the middle and top management, as well as the lack of involvement of the latter in portfolio execution (Dereyck et al., 2005; Payne, 2009; Jonas, 2010),
- improper portfolio structure resulting from mistakes in prioritisation that fail to guarantee the achievement of strategic goals (Pennypacker & Dye, 2002; Kendal & Rollins, 2003; Blichfeldt & Eskerod, 2008; Meskendahl, 2010),
- improper management of the life cycle of projects and programs and the problems with the flow of products within the framework of the portfolio (Rajegopal et al., 2007),
- problems with financing stability and the financial liquidity of the portfolio (De Reyck et al., 2005).

The study concentrated on the separation of risks within the framework of the above-indicated areas, determining a name for each of them, specifying the risk description and classifying the risk in one of the three categories suggested in the literature on the subject (component risk, structural risk and general risk). Separation of risks in a way that provided all of them with a description at the same level of detail constituted a significant difficulty at this stage of the study.

Table 1 List (Names without Descriptions) of Risks Identified by the Research Team

Component risk	Structural risk	General risk
1.1 Unpredictable, significant changes in the project or program environment 1.2 Change in the attitude of key project or program stakeholders 1.3 Significant change in the basic parameters of particular portfolio elements 1.4 Improperly defined priorities for particular portfolio elements 1.5 Problems with the flow of information and communication within the framework of the portfolio elements 1.6 Ignoring the risks by the portfolio element managers 1.7 Lack of developed methodical standards within the scope of portfolio element management 1.8 Improperly functioning Steering Committees for projects, groups of projects and programs 1.9 Conflicts among the managers of projects, groups of projects and programs 1.10 Conflicts among the portfolio element managers and company's senior manages 1.11 Improper competencies of the managers of projects, groups and programs	2.1 Too large a portfolio 2.2 Significant portfolio fragmentation 2.3 Overly complicated hierarchical structure of the portfolio 2.4 Significant portfolio homogeneity 2.5 Too great a portfolio diversity 2.6 Incompatibility of the portfolio structure with the parent organization strategy 2.7 Improper portfolio balance	3.1 Lack of transfer of information and knowledge among the portfolio elements 3.2 Lack of control of the life cycles of projects and programs 3.3 Lack of the availability of resources necessary to complete works within the framework of the portfolio 3.4 Key resources involved at the same time in particular portfolio elements 3.5 Multiple relations of resources among the portfolio elements 3.6 Relations between the products generated by the portfolio elements 3.7 Problems with gaining access to the portfolio-financing capital 3.8 Non-balanced portfolio cash flows 3.9 Breakdown of portfolio financing 3.10 Inconsistency of the strategy of key elements with the portfolio strategy 3.11 Conflicts among the goals of projects and programs implemented within the framework of the portfolio 3.12 Conflicts among the portfolio managers and the portfolio element managers 3.13 Lack of involvement of middle and top management in the portfolio implementation 3.14 Lack of relevant competencies of the portfolio manager and the lack of portfolio support structures

Source: own study

The original list prepared by the team was composed of thirty-two project portfolio risks, including eleven risks in the component risk category, seven risks in the structural risk category, and fourteen risks in the general risk category. Table 1 includes the names of the risks on the original list of risks. Due to the constraints related to the size of this paper, it does not include a description of each risk from the list. That list was then subject to expert evaluation.

3.2 Expert Evaluation of the Project Portfolio Risk

An expert evaluation was conducted using the Delphi method formula (Linstone H., Turoff M., 1975, pp. 229-235; Linstone H., Turoff M., 2011, pp. 1712-1719). Four experts were invited to participate in it, constituting major authorities from the academic environment holding extensive academic achievements in the area of project management. The expert evaluation of the list of risks developed by the study was conducted from March to July 2014 and involved six evaluation rounds. Each assessment round lasted for two weeks and was moderated by a designated member of the project team. The criteria of selecting the experts had to ensure competent assessment as well as a critical view of the conceptual value of the list of risks (i.e., correctness of the proposed names and descriptions, proper classification of risks and the level of completeness of the list of risks). The research methodology adopted by the team assumed a compromise between providing the experts adequate freedom to modify (or submit new proposals) the names and descriptions of risks, add risks and move risks within the categories as required and acquire information on how to adjust the available statistical tools to suit the assessment of expert consensus. As the study involved no closed multiple-choice answers, and the variables were of a nominal character, the majority of available statistical methods (i.e., chi-square, Kendall coefficient or Spearman correlation coefficients) (Von der Gracht H., 2011, p. 1532) were unsuitable for consensus evaluation. In addition, the specificity of the data acquisition process (possibility of adding new risks by experts) did not allow for the use of Fleiss' kappa (Fleiss J. L., 1971, pp. 378-382; Fleiss J. L., 1981). Due to the above limitations, the research team decided to use an authorial method for the analysis and interpretation of the acquired data.

In the course of those six evaluation rounds, the experts assessing the original list proposed adding two risks to the component risk category, one risk to the structural risk category, and two risks to the general risk category. In the next rounds, all experts supported the proposition of adding those risks to the list. One risk (3.5) was described by the experts as a phenomenon not having the character of a risk and removed it from the list of risks (although there was no complete consensus with regard to this, with three experts for removal and one having a different opinion, suggesting keeping the risk on the list). A list of 36 risks was developed after the expert evaluation.

3.3 Expert Consensus Assessment

The empirical data obtained during the expert evaluation were compiled in order to verify their convergence. It was decided that the experts' recommendations should be arranged in five levels, creating an ordinal scale with regard to their convergence:

(1) No consensus (each expert proposed a different recommendation)

(2) 2:1:1 (three different recommendations, with two experts agreeing with each other)

(3) 2:2 (two different recommendations, with pairs of experts agreeing with each other)

(4) 3:1 (two different recommendations, with three experts agreeing with each other)

(5) Complete consensus (four identical recommendations, all experts agreeing with each other)

Table 2 Sample Coding of the Expert Consensus within the Scope of Risk Name (for the Component Risk Group)

Risk/Round	I	II	III	IV	V	VI
Risk 1.1	1	2	2	3	2	2
Risk 1.2	2	4	5	5	5	5
Risk 1.3	1	2	4	4	4	4
Risk 1.4	4	4	5	5	5	5
Risk 1.5	4	3	3	4	4	5
Risk 1.6	4	3	3	3	4	5
Risk 1.7	5	5	5	5	5	5
Risk 1.8	5	5	5	5	5	5
Risk 1.9	4	3	3	3	5	5
Risk 1.10	5	5	5	5	5	5
Risk 1.11	2	3	4	5	5	5
Mean	**3.4**	**3.5**	**4.0**	**4.3**	**4.5**	**4.6**

In the above format, the expert consensus was recorded within the three parameters proposed by the team, i.e., name and description of the risk and the correctness of risk assignment to one of three categories. The adopted description was appropriate from the point of view of the consensus description; however it did not allow for a comparison of the level of expert consensus in the view of more aggregated dimensions, which are constituted by particular risks, evaluation rounds and risk categories. The coefficient of convergence was defined in order to conduct a collective analysis of the level of convergence, by assigning the numerical values from the range [0,1] to the above levels as follows:

- non-convergence of expert opinions (1) – 0.00
- convergence of expert opinions on the 2:1:1 level (2) – 0.25
- convergence of expert opinions on the 2:2 level (3) – 0.50
- convergence of expert opinions on the 3:1 level (4) – 0.75
- full convergence of expert opinions (5) – 1.00

In order to facilitate the interpretation of the level of convergence of the expert opinions, the ranges that could be taken by the value of such a defined coefficient were described. They are characterized below:

- – non-convergence of expert opinions
- 0.00-0.25 – very low convergence of expert opinions
- 0.25-0.50 – low convergence of expert opinions
- 0.50-0.75 – medium convergence of expert opinions
- 0.75-1.00 – high convergence of expert opinions
- – full convergence of expert opinions

The application of such an approach enabled the presentation of the aggregated level of expert consensus, allowing for its comparison within the framework of rounds and categories. It is a frequently applied measurement used to describe the level of consensus of experts conducting an evaluation with the Delphi method. A more complicated coefficient, such as APMO (Average Percent of Majority Opinions), could not be applied to determine the convergence, as the formula of its calculation assumes answer indication in the form of a polarized opinion (i.e., full convergence or full non-convergence), which was impossible in the case of acquired empirical data (Von der Gracht H., 2011, p. 1532).

While analyzing the expert evaluation according to the above-described method, the level of convergence of expert assessments was determined within the framework of particular evaluation rounds and risk categories. The level of expert consensus was determined separately for the risk name, risk description and the correctness of classifying each risk to one of three categories. Figures 2, 3 and 4 illustrate the expert consensus in particular rounds.

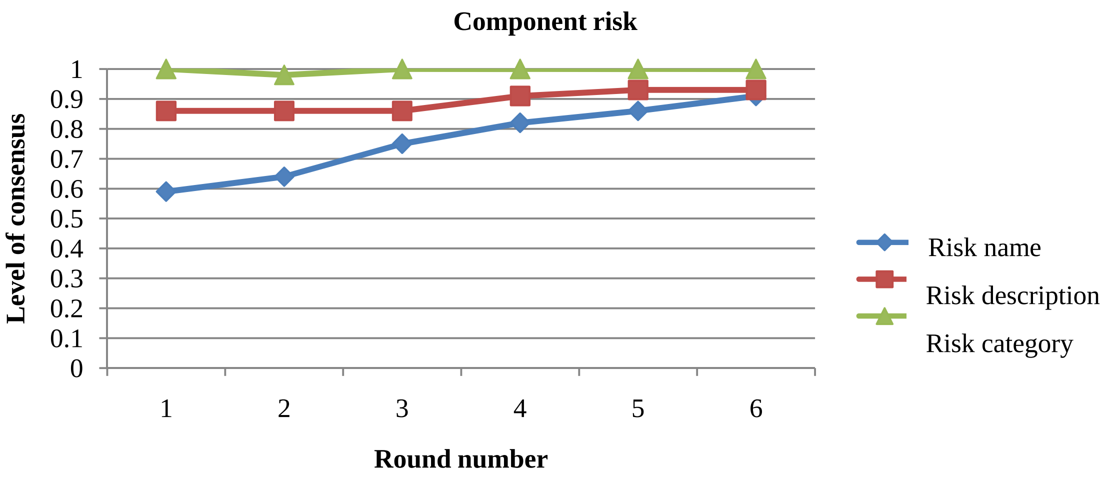

Figure 2 Level of Expert Consensus (within the Scope of the Name, Description and Categorization) in the Component Risk Group

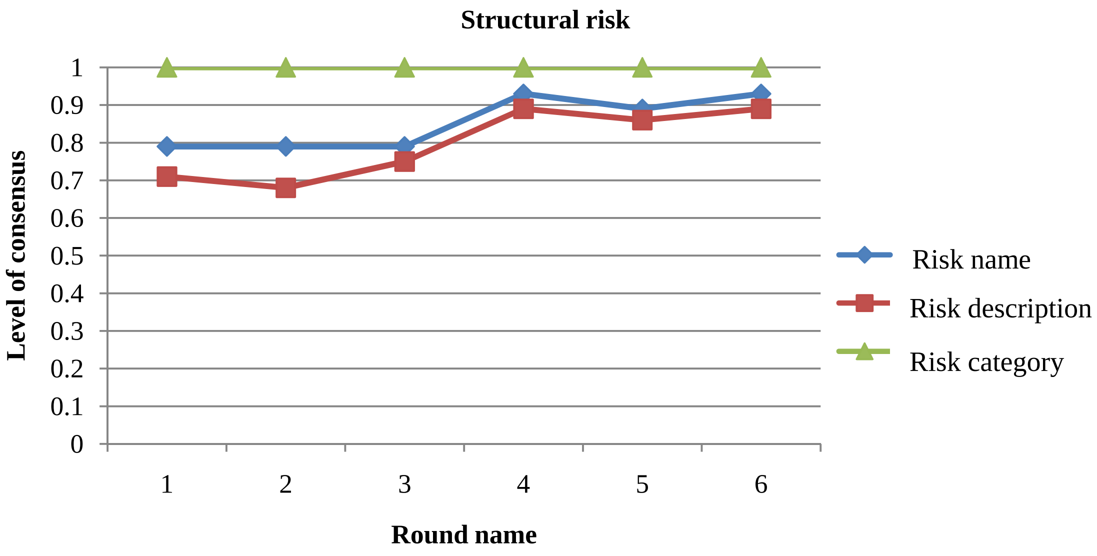

Figure 3 Level of Expert Consensus (within the Scope of the Name, Description and Categorization) in the Structural Risk Group

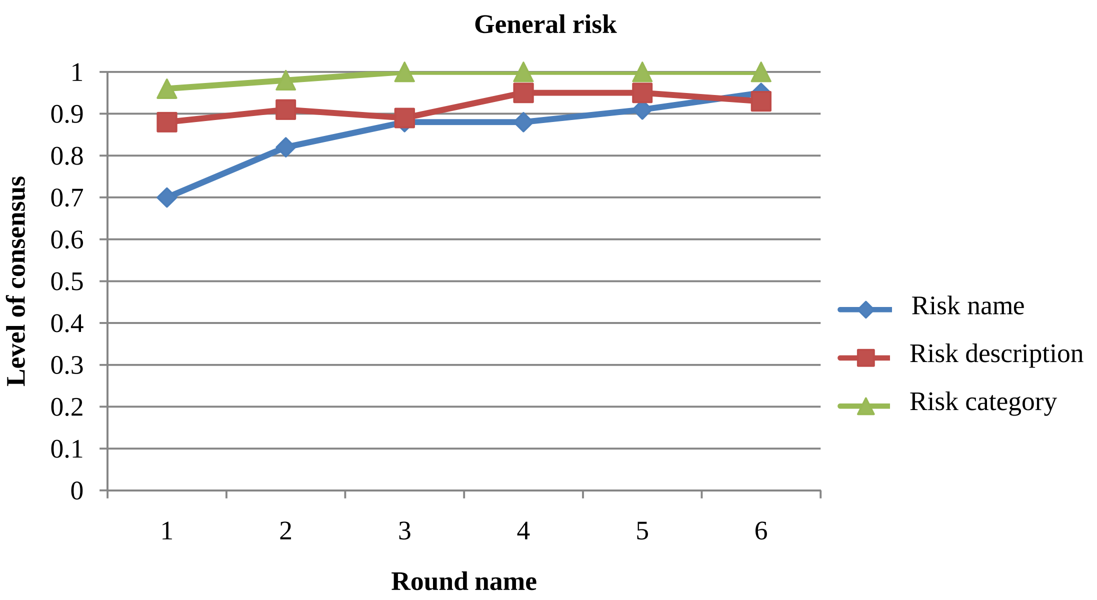

Figure 4 Level of Expert Consensus (within the Scope of the Name, Description and Categorization) in the General Risk Group

In the course of the following evaluation rounds, the experts achieved consensus, as indicated by the increasing value of the coefficient describing the level of expert consensus. The greatest number of differences in expert assessments occurred with the wording of the risk names and descriptions. Nevertheless, the experts reached the desired consensus in each evaluation round. Table 3 shows this tendency, illustrating expert consensus within the scope of the wording of the name, description and categories of particular risks. On the left of the table are the coefficients of convergence of expert evaluations from the previous evaluation round (determined with use of the previously described methodology). The right hand side of the table shows whether the desired expert consensus (understood as consensus of all experts) was achieved within the framework of the tested variables. If the desired consensus was reached in the course of the evaluation with the Delphi method, then that result was described with the word "Yes". In addition, the number of the round in which such a desired consensus was reached is recorded in brackets. The data show that expert consensus was reached for the majority of project portfolio risks within the scope of name (over 70%), description (over 70%), and categorization (100%).

Table 3 Level of Expert Consensus in the View of Particular Risks

	Name	Description	Category		Name	Description	Category
Component risk				**Component risk**			
Risk 1.1	0.25	1.00	1.00	**Risk 1.1**	No	Yes (1)	Yes (1)
Risk 1.2	1.00	0.75	1.00	**Risk 1.2**	Yes (3)	No	Yes (1)
Risk 1.3	0.75	1.00	1.00	**Risk 1.3**	No	Yes (1)	Yes (1)
Risk 1.4	1.00	1.00	1.00	**Risk 1.4**	Yes (3)	Yes (1)	Yes (1)
Risk 1.5	1.00	1.00	1.00	**Risk 1.5**	Yes (6)	Yes (1)	Yes (1)
Risk 1.6	1.00	0.75	1.00	**Risk 1.6**	Yes (6)	No	Yes (1)
Risk 1.7	1.00	1.00	1.00	**Risk 1.7**	Yes (1)	Yes (1)	Yes (1)
Risk 1.8	1.00	1.00	1.00	**Risk 1.8**	Yes (1)	Yes (5)	Yes (3)
Risk 1.9	1.00	0.75	1.00	**Risk 1.9**	Yes (5)	No	Yes (1)
Risk 1.10	1.00	1.00	1.00	**Risk 1.10**	Yes (1)	Yes (1)	Yes (1)
Risk 1.11	1.00	1.00	1.00	**Risk 1.11**	Yes (4)	Yes (1)	Yes (1)
Structural risk				**Structural risk**			
Risk 2.1	1.00	1.00	1.00	**Risk 2.1**	Yes (4)	Yes (4)	Yes (1)
Risk 2.2	0.75	1.00	1.00	**Risk 2.2**	No	Yes (1)	Yes (1)
Risk 2.3	0.75	0.75	1.00	**Risk 2.3**	No	No	Yes (1)
Risk 2.4	1.00	0.75	1.00	**Risk 2.4**	Yes (1)	No	Yes (1)
Risk 2.5	1.00	1.00	1.00	**Risk 2.5**	Yes (1)	Yes (4)	Yes (1)
Risk 2.6	1.00	1.00	1.00	**Risk 2.6**	Yes (1)	Yes (1)	Yes (1)
Risk 2.7	1.00	0.75	1.00	**Risk 2.7**	Yes (3)	No	Yes (1)
General risk				**General risk**			
Risk 3.1	1.00	1.00	1.00	**Risk 3.1**	Yes (1)	Yes (2)	Yes (1)
Risk 3.2	1.00	1.00	1.00	**Risk 3.2**	Yes (1)	Yes (4)	Yes (1)
Risk 3.3	0.75	0.50	1.00	**Risk 3.3**	No	No	Yes (1)
Risk 3.4	0.75	1.00	1.00	**Risk 3.4**	No	Yes (1)	Yes (1)
Risk 3.5	0.75	1.00	1.00	**Risk 3.5**	No	Yes (1)	Yes (2)
Risk 3.6	1.00	1.00	1.00	**Risk 3.6**	Yes (3)	Yes (1)	Yes (3)
Risk 3.7	1.00	1.00	1.00	**Risk 3.7**	Yes (1)	Yes (1)	Yes (1)
Risk 3.8	1.00	1.00	1.00	**Risk 3.8**	Yes (5)	Yes (1)	Yes (1)
Risk 3.9	1.00	1.00	1.00	**Risk 3.9**	Yes (4)	Yes (1)	Yes (1)
Risk 3.10	1.00	1.00	1.00	**Risk 3.10**	Yes (2)	Yes (2)	Yes (1)
Risk 3.11	1.00	1.00	1.00	**Risk 3.11**	Yes (2)	Yes (2)	Yes (1)
Risk 3.12	1.00	1.00	1.00	**Risk 3.12**	Yes (3)	Yes (2)	Yes (1)
Risk 3.13	1.00	0.50	1.00	**Risk 3.13**	Yes (4)	No	Yes (1)
Risk 3.14	1.00	1.00	1.00	**Risk 3.14**	Yes (1)	Yes (1)	Yes (1)

For several risks, no complete expert consensus was reached within the framework of the Delphi method in the issues of name or description. For the majority, expert consensus was reached at a high level of convergence (0.75; 3:1). In such cases, the team chose the recommendation proposed by the majority (i.e., 3) of experts. In the event of two risks (description of risk: 3.3 and 3.13), the experts achieved medium convergence (0.50; 2:2) within the scope of the description of those risks. In those cases, after an analysis of the experts' comments, the team was in favour of one of the two recommendations. Only in one case (risk name: 1.1) were three different recommendations of experts observed, with two experts proposing the same recommendation. All risks where the experts did not reach consensus constitute the subject of special attention of the research team during the following research stages. Table 4 gives the summary of the conducted study, including the collective coefficients of expert consensus for the entire evaluation conducted with the Delphi method.

Table 4 Aggregated Level of Expert Consensus for the Project Portfolio Risk

	Name	Description	Category
	Number of risks for which complete consensus was reached (round – mean value)		
Component risk	9/11 (3.33)	7/11 (1.50)	11/11 (1.18)
Structural risk	5/7 (2.00)	5/7 (2.50)	7/7 (1.00)
General risk	11/14 (2.45)	12/14 (1.58)	14/14 (1.21)

In the components category, for approx. 82% of risks, complete consensus was reached with regard to the name. Complete expert consensus in the issue of names of risks from the components group was reached between the third and the fourth evaluation round on average. In the same category, for 73% of risks, complete expert consensus was reached with regard to the proposed risk description. That consensus was reached between the first and the second evaluation round on average. In the structural risk category, complete expert consensus was reached for 71% of all risks, with regard to the variable constituted by the proposed name and description of the risk. Complete consensus was reached in the second round for risk name and between the second and the third round for risk description on average. In the general risk category, complete expert consensus was reached for 79% of all risks, with regard to the proposed name and for 86% of risks with regard to the proposed risk description. For the proposed risk classification in particular categories, complete consensus was reached for that parameter for 100% of risks. In particular categories, convergence of expert evaluations was achieved usually between the first and the second round of the evaluation.

4. Summary and Conclusions

The aim of the study was to verify the hypothesis that "there is a possibility of identifying risks appearing in multi-project management". Its positive verification enables one to define a list of project portfolio risks, which is essential for further work involving the acquisition of empirical data and modelling of those risks. As was indicated in the introduction to this study, the literature on the subject mentions only those risk-creating areas in project portfolio management, and it was unknown whether the portfolio risk could be separated at a moderately unified level of detail.

To sum up, it should be stated that the high convergence of expert opinions analyzed in the perspective of particular evaluation rounds, identified risks and categories for such variables as proposed name and description of each risk and proposed classification of the risks allows for the positive verification of the research hypothesis made in the introduction. On the basis of the available studies, it was found possible to separate, specify, name, describe and categorize risks, and then to assess them by the experts sensitive to the terminology. The whole study achieved the objective selection of a list of project portfolio risks organized into categories, including risk names and descriptions. Such a list constitutes a contribution to the further research into the probability of the occurrence of particular risks and their impact on portfolio goals. Moreover, this type of list may form suitable material for researchers involved with risk management issues and enterprises that wish to manage the risks of many simultaneously implemented projects.

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