Risk management in the development of new products: A review and classification of the literature

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Abstract: Many of the problems which presently occur with projects, such as delays, changes in scope, and even cancellations can be due to ineffective management of their risks. Risk management is becoming increasing important for successfully dealing with risks and for the respective corporations. Despite several studies on the subject of risk management in new product development (NPD), many authors point out the need for research on the issue to evolve. In this sense, this article presents a mapping of the present literature on risk management. To do so, a number of pre-selected articles were examined and classified according to the focus and approach of the research and its respective area of application. A dearth of studies on "Risks in NPD" with a theoretical-conceptual approach and studies with an empirical approach were the main findings. In the empirical research, a tendency to use the case study method instead of others was observed. Over 50% of the articles do not touch upon a specific area of application. This can also point out a possible trend toward generalized models for risk management.

Keywords: risk management, product development, risks in NPD.

1. Introduction

In this age of growing competition and globalization, the success of projects has become even more decisive to the business performance of companies. Even so, many projects suffer from delays, changes in scope, errors and are even canceled (SHENAR, 2002). In general, many of these problems can be caused by ineffective project risk management, which has become increasingly important to successfully managing the businesses themselves (CARBONE et al., 2004).

For the area of new product development (NPD) specifically, MIKKELSEN (1990) states that different models for managing NPD risks provide for ruling out ideas for non-viable new products and high-risk ideas, without taking into consideration whether these include, or are accompanied by, significant opportunities for financial gain or technological advance. Large engineering projects are "high-risk games" characterized by often irreversible agreements, structures motivated by compensation, but with a high probability of failure (MILLER et al., 2001).

Furthermore, a large part of decision making about investing in NPD projects is characterized by high levels of uncertainty (HUCHZERMEIER et al., 2001) and, in relation to uncertainty in NPD, there are also many decision-making variable and points of view on every project, the authors conclude that a more holistic vision of risk management in NPD projects has proven to be necessary (PHILIPS, 2002).

In this sense, several studies from a theoretical-conceptual or empirical slant (as defined by FILIPPINI, 1997), on risk management in new product projects are being undertaken. It is in this context that the goal of the present study is to make a contribution to the body of knowledge on managerial risks in NPD projects by means of searching and classifying the available literature based on a number of pre-selected studies. To do so, the concept of mapping the literature is utilized (based on CROOM, 2005).

The article is structured in five sections: section 2 presents the basic concepts and definitions of types of risks and risk management. Section 3 presents the methods adopted in the research as well as the steps taken during the mapping and classification of the literature. Section 4 includes the results of the review and the mapping of the literature and, finally, section 5 offers the conclusions, limitations and recommendations for future work.

2. Risk management in NPD projects: summary of the theoretical framework

Project risks can be defined as undesirable events that can cause delays, excessive expenses and unsatisfactory results for the project, the organization, society, the environment, etc., or even their total failure (SHENHAR et al., 2002). According to the PMBOK (PMI, 2004), a project risk is an event or uncertain condition which, if it occurs, will have

a positive or negative effect on at least one of the project objectives, such as timeframe, cost, scope or quality. A risk can have more than one cause and if it occurs, can have more than one impact on more than one dimension of the project.

Risks can further be identified and grouped into categories, which should reflect a common source of risks to projects (CARVALHO; RABECHINI, 2005). These categories are (PMI, 2004): technical risks, risks in project management, risks from within the organization and outside risks. The technical risks involved stem from the use of unproven or complex technology, unrealistic performance requirements, and changes in the technology used or in the industry norms during the course of the project. The category of management risks to the project is characterized by risks derived from the inadequate allocation of resources, unrealistic estimates and poor quality of the project plan. Organization risks have to do with project goals (cost, timeframe, scope) which might be incoherent, a lack of project prioritization and insufficient or interrupted financing. Finally, outside risks are those caused by changes in the legislation, changes in market trends, labor issues and changes in the priorities of the project sponsor (CARVALHO; RABECHINI, 2005).

Another classification of types of risks can be considered, especially when the focus is on NPD projects (BLAU et al., 2000; HUCHZERMEIER et al., 2001). For these authors, risks in NPD are, above all, those related to product performance expectations, costs and timeframes for development (engineering), meeting market requirements and the prioritization, selection and management of the portfolio of new projects.

The literature identifies some specific studies of managing risks in information technology (JIANG; KLEIN, 1999; KUMAR, 2002; COSTA et al., 2006) and, in some cases, identification of risks in new product development (MIKKELSEN, 1990; BLAU et al., 2000; HUCHZERMEIER et al., 2001). However, a general consolidated view of the presently available literature on managing risks in NPD projects proves to be very useful for a more solid and unified mapping of the subject. Based on the goals of the present study, section 3 present the methods used in its development.

3. Research methods

The general objective of the present study is to contribute to the body of knowledge on managing risks in NPD projects, by means of a review and classification of the available literature using a pre-selected number of studies. In this sense, it can be classified as a theoretical study, according to Filippini (1997), based on a review of the literature, its classification and analysis. Specific objectives are the classification of the scope of the studies, as well as their areas of application.

The method used was to map the literature. According to Croom (cited in Cauchick Miguel, 2005) this is an approach that utilizes the mapping to locate the subject of the research in the context of its antecedent literature and determine its influence on the development of theory about the chosen subject.

The following steps were followed in mapping the literature:

- Defining the parameters for selection of articles;
- Selecting the articles that fit the subject of the study; and
- Classifying the articles according to the focus of the research, approach of the study and area of application (based on the approach proposals by Cauchick Miguel, 2005; Pignanelli et al., 2006).

To accomplish step 1 ("Defining the parameters for selecting the articles"), three parameters were defined in order to research the literature in a systematic manner, as follows:

- Data bases to be searched: Data bases which included international articles were consulted and gathered. The databases utilized were: PROQUEST, SIBI/USP and EMERALDINSIGHT as well as CAPES (a link to various data bases available in Brazil); and
- Journals searched: A total of fifteen periodicals, selected due to their relatively greater impact on the subject of risk management and product development management were previously selected, as listed below:
  - Risk Management Journal;
  - Risk Management & Insurance Review;
  - International Journal of Quality & Reliability Management;
  - Risk Analysis an International Journal;
  - Risk Analysis;
  - International Journal of Product Development;
  - R&D Management;
  - Engineering Management Journal;
  - Computers and Chemical Engineering;
  - The Journal of Systems and Software;
  - Journal of the Operational Research Society;
  - Management Science;
  - Information & Management;
  - International Journal of Project Management; and
  - Professional Safety.
- Key words: in order to select the articles related to the subject in focus from the journals listed in item 2, key words were defined and used in their respective combinations, as follows:
  - Risk Management;
  - Risk Analysis;

- Product Development Decision Making;
- Project Management;
- Risk Management & Product Development;
- Risk Analysis & Product Development;
- Risk Management & Product Development Decision Making;
- Risk Analysis & Product Development Decision Making;
- Risk Management & Project Management; and
- Risk Analysis & Project Management.

Step two ("Selecting the articles that fit the subject of the study") consisted of evaluating the titles and abstracts from the list of previously selected articles. Of the total 542 articles found in step 1, twenty-two were selected for the study, due to their relevance and fit with the theme of risk management in NPD projects.

Step 3 ("Classifying the articles according to the research focus, approach of the study and area of application") was developed by the authors based in previous work (approach methods) by Cauchick Miguel (2005) and Pignanelli et al. (2006). First, each article was analyzed with respect to its research focus (project risks generally, risks in NPD projects and others, as discussed in Section 2 of this article, and then subdivided into technical risks and others). Then, the articles were classified as to their approach, either theoretical-conceptual or empirical, as proposed by FilippinI (1997), classifying the studies on operations management as: case studies, field studies, laboratory experiments, modeling, simulation, surveys, theoretical/conceptual and others (when the research approach is not clear or another approach, such as research-action is used, for example). Moreover, research approach was subdivided into theoretical-conceptual and empirical categories, as proposed by Pignanelli et al. (2006). The theoretical-conceptual category was subdivided into "model proposals" and "adaptation of tools;" the empirical was subdivided into "favorable results" and "unfavorable results" (according to whether the study results were in consonance with the reigning theory or not). Finally, the articles were classified with respect to their areas of application, i.e., in which type of industry the research was conducted.

It is important to mention that the present article does not include a description of the contents of each article analyzed. The types of risk in NPD projects, which are the basis for the classification of the focus of the articles, are listed in Section 2. Section 4 presents the main results and their analysis.

4. Results and analysis

The classification of the articles selected as important, according to the literature mapping method described in Section 3, is presented in Table 1. The articles are classified according to their research focus, project risks (technical and others), risks in NPD (technical or others) or several others, as outlined in Section 2. Then, they were classified as to the research approach which can be theoretical-conceptual or empirical (subdivided in "model proposals" and "adaptation of tools." The empirical category was subdivided into "favorable result" and "unfavorable result". Finally, the articles were then classified with respect to their area of application. The references (author and year of publication of the article) are in the last column of Table 1. An analysis of the results obtained is discussed with the aid of Figure 1 through Figure 4.

Table 1 shows an analysis of the distribution of the 22 articles. Exactly 50% (11 articles) deal with the subject of risk in projects generally, without focusing on the issue of product development. Here a focus on technical risks can be found along with other types of risks, such as meeting deadlines, costs and the wishes of the stakeholders. Six articles (27%) present a focus on risk management specific to NPD, also subdivided into focus on technical risks and others, Finally, five articles (23%) focus on other types of risks, such as risks to workers' health/safety, risks of opportunity, and risks in analyzing production process activities.

Figure 2 shows the distribution of the seventeen articles classified according to their focus on project risks and NPD risks. Of the eleven articles classified with a focus on project risks, almost half (five) can be classified as focusing on technical risks, while six articles deal with other types of risk. Technical risks, as seen in Section 2, refer to the possible failure or unsatisfactory performance of the product and/or service, which is the project goal. Other types of project risks are usually linked to meeting deadlines and cost projections, or to the risk of changes in scope and serving the stakeholders.

Articles about risks in NPD are distributed over technical risks and others, but not in such a uniform way as seen for the articles on risks in projects. Only one article that deals with technical risks in NPD was identified. It deals with the issue of the risk of failure analysis and reliability specifically at the stage of project development. The other articles (five, which were classified as "other risks in NPD") deal with risks of a financial nature, of timeframes, competencies, meeting market requirements and balancing the portfolio.

The majority of the articles classified with respect to "Research Approach" (fourteen articles; 64%) was classified under "theoretical-conceptual, while the rest (eight articles; 26%) were classified as empirical type research.

In Figure 3 a more detailed distribution of the types of research approaches can be seen, in line with the proposal by Filippini (1997). The majority of articles classified in Figure 3 are of the theoretical-conceptual, eight of the fourteen articles are in the subdivision "model proposals" and the rest (six articles) of under "adaptation of tools." A

Table 1. Classification of the literature on risk management.

Focus of the study		Research approach					Area of application	References
		Theoretical conceptual		Empirical				
		Model proposal	Adaptation of tool	Type	Favorable result	Unfavorable result		
Project Risks								
1	Technical		X				Non specific	Puente et al. (2002)
2			X				Non specific	Carbone and Tippett (2004)
3				Case study		X	Various (Aerospace, Hospital, Environmental)	Paté-Cornell (2002)
4			X				Non specific	Sankar and Prabhu (2001)
5				Case study	X		Aerospace	Garrick (1989)
6	Others			Survey	X		Various (Aerospace, Chemical, Construction, etc.)	Shenhar et al. (2002)
7		X		Others (Research-Action)	X		Software	Costa et al. (2006)
8		X					Non specific	Miller and Lessard (2001)
9				Survey	X		Information systems	Jiang and Klein (1999)
10		X					Non specific	David and Raz (2001)
11		X					Information technology	Kumar (2002)
Risks in R&D								
12	Technical			Case study	X		Automobile	Chamberlain and Modarres (2005)
13	Others	X					Non specific	Huchzermeier and Loch (2001)
14			X				Non specific	Blau and Bose (2000)
15				Case study	X		Pharmaceuticals	Blauet al. (2000)
16				Case study	X		Construction	Phillips (2002)
17				Others (Research-Action)		X	Non specific	Mikkelsen (1990)
Various								
18		X					Non specific	Franke et al. (2006)
19			X				Non specific	Kaplan et al. (2001)
20			X				Non specific	Hillson (2001)
21		X					Non specific	Trammell (2004)
22		X		Case study			Non specific	Yu et al. (1999)

model proposal is considered to be any research that analyzes existing theories about a certain subject, identifies possible gaps and proposes a theoretical advance (as established by WHETTEN, 1989). All the articles classified as "proposals for models", when analyzed with respect to the "focus of research" are of the type "other risks" or "various," none are classified as "technical risks".

The classification "adaptation of tools" was proposed to distinguish those articles with a focus on management tools and/or those which analyze risk, from those that really focused on "theory (models) of risk management."

For those articles whose research was classified as "empirical," most (six articles; 25% of the total) are of the case study type. Only two studies were classified as the "survey" type and two in the "others" category, in this case, action research.

With respect to the area of application of the studies, over 50% of the articles have no specific area, that is,

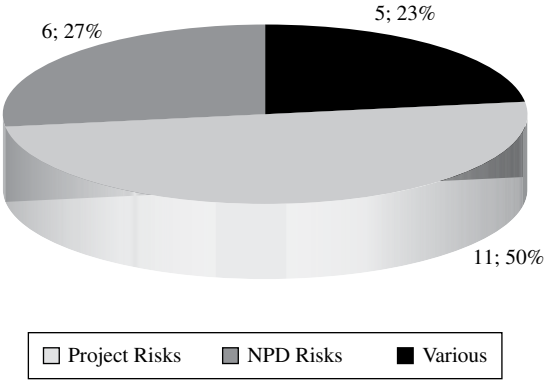

Figure 1. Classification with respect to "research focus".

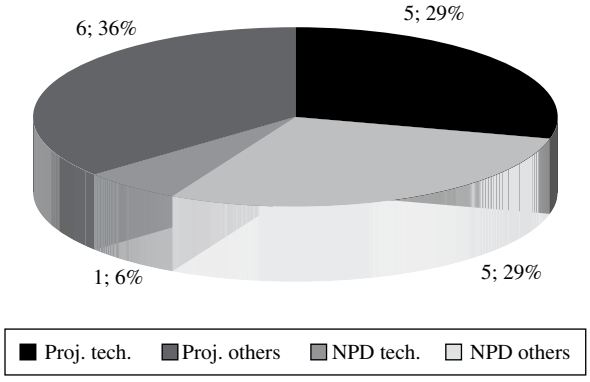

Figure 2. Classification of "research focus" subdivided by type of risk.

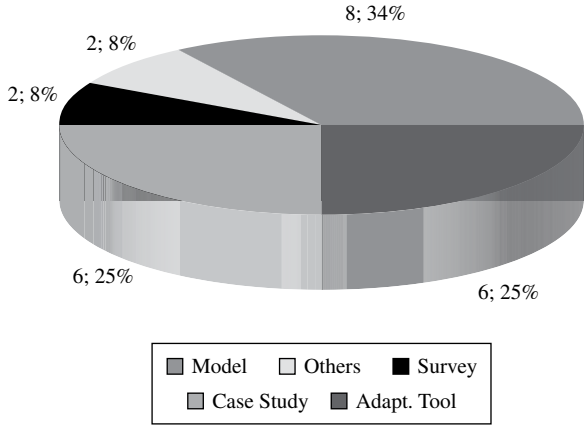

Figure 3. Detailed classification by "research approach".

they aspire to validity independently of their sector of application. As expected, this is especially true for articles with a theoretical-conceptual approach.

For those articles with a defined area of application, three (13%) are related to the area of information technology (IT), two (9%) include several areas (such as: aerospace, hospitals, environment, chemistry and construction). The other show a uniform distribution of only one article for the areas of pharmaceuticals, aerospace, automotive and construction. Those results are shown in Figure 4.

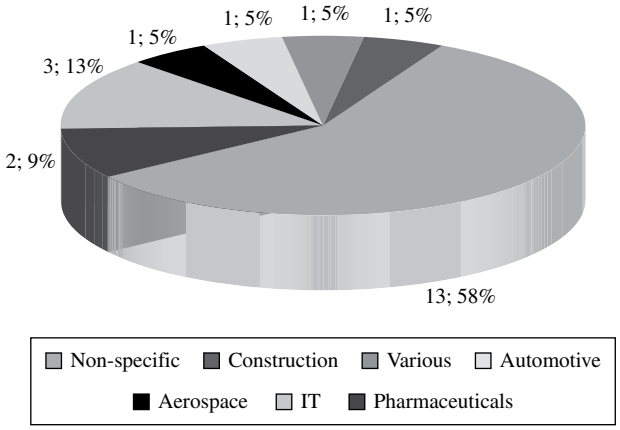

Figure 4. Classification by "area of application".

5. Concluding remarks

First, it is worth stressing that an understanding of the literature and the context in which the study is being carried out, constitute an important step for any research project and, further, by mapping the literature it is possible to identify how the subject has been influenced by existing theory. In this sense, it can be concluded that the present study makes a contribution, if only limited due to the small number of articles identified as relevant to the field of knowledge of risk management for NPD projects. This was done by means of searching and classifying the available literature.

The limitations of the study can be cited as the reduced number of twenty-two articles deemed important, which leads to the need to restrict generalizations from the presently available literature on project risks, even though the number of periodicals researched is significant.

Nonetheless, some conclusions can be extracted from the detailed observations of the study, where a possible dearth of studies with a theoretical-conceptual approach to "Risks in NPD" and of studies with an empirical approach to "various risks" can be noted. In the study of those with an empirical approach, there is a tendency to use the "case study" method in relation to others. Finally, the fact that 50% of the articles do not have a specific area of application also could point out a possible trend to generalist models for risk management. This last finding coincides with the literature, which establishes that methods for project and risk management cannot be standardized for all type of projects, but must be adapted in their scope and methodological uncertainty. These limited concluding points can be worked on in possible future studies to obtain a more solid vision of the theory of risks in NPD projects.

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