Identifying and Evaluation of Risk Types in New Product Development Projects and Project Risk Management

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Abstract: Success in business comes down to two broad management skills, often termed as 'doing the right thing' (choosing the right projects) and 'doing things right' (good project management). All decisions about which projects an organization should choose are taken without certain knowledge of what the future will hold and how successful the project will be. Whilst decisions are taken in conditions of uncertainty, we can attempt to predict the factors that can impact on a project. Once we can identify these factors and their possible impacts we can call them risks and attempt to analyze and respond to them. Risks can be both positive, such as embedded opportunities, perhaps to do more business with a new client or customer in future. Risk is an uncertain event or condition that, if it occurs, has a positive or a negative effect on at least one project objective. The main aim of this paper is to consider the Risk Types that organizations may face when taking on projects of New Product Development Projects. A project is usually defined as such for project management purposes because it has a unique identity and a finite life and is thus distinguishable from other continuing operations.
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1. Introduction

Risks in an organization can span the gamut of natural disasters, security breaches, failings of human resource, third-part vendors, financial turmoil, unstable business environments and project failures. Risk is an uncertain event or condition that, if it occurs, has a positive or a negative effect on at least one project objective, such as time, cost, scope, or quality (where the project time objective is to deliver in accordance with the agreed-upon schedule; where the project cost objective is to deliver within the agreed-upon cost) (Project Management Institute, 2004).

Risk is often defined as undesired project outcomes, exposure to uncertainty (Raz et al., 2002; Smith and Merritt, 2002; Keizer et al. 2005). Risk management is a structured approach for the identification, assessment, and prioritization of risks followed by planning of resources to minimize, monitor, and control the probability and impact of undesirable events (Smith and Merritt, 2002). Padayachee (2002) describes risk as any variable in the project that causes project failure. However, there is a common agreement between researchers, that risk has a probability attribute which is called in some definitions "likelihood", "probability of occurrence" and "frequency of occurrence". A second attribute typically related to a risk is what is called the "impact", "severity", "con-sequence" (Carbone & Tippett, 2004). Risk management becomes an integral part of project management and plays such an important role that its application goes beyond the traditional scope which normally centers on the construction phase (Del Caño and Cruz, 2002).

In project management, there is no consistent definition for risk (Perminova et al., 2008). In the project management body of knowledge (Project Management Institute, 2004), risk is considered as ''an uncertain event or condition that, if it occurs, has a positive (opportunity) or negative (threat) impact on project objectives.'' However, many practitioners and researchers in project management still consider risk to be more related to adverse effects on project performance (Williams, 1995; Smith and Merritt, 2002). From this perspective, project risk management seems to be about identifying and managing threats to the project. The main purpose of project risk management is to identify, evaluate, and control the risks for project success. The measurement of project success is difficult because it may be changed by project phase, and many stakeholders have different criteria to evaluate project success. However, the project success criteria are generally measured by time overrun, cost overrun, and technical performance (Baccarini & Archer, 2001). Managing risks is one of the most important tasks for the construction industry as it affects project outcomes. Today's project managers believe that a conventional approach to project management is not sufficient, as it does not enable the project management team to establish an adequate relationship among all phases of the project, to forecast project achievement for building

confidence of the project team, to make decisions objectively with the help of an available database, to provide adequate information for effective project management and to establish close co-operation among project team (Dey, 2001).

2. Agile Project Management

In his paper, Agile Project Management How to Succeed in the Face of Changing Project Requirements, Chin (2004) claims that projects can be successfully completed in changing environments if project managers move from a focus on planning to a focus on execution which accommodates the changes as they occur: This is not to say that the areas of project definition and planning will be ignored, just that their focus will shift to supporting decisions during project execution rather than making them all up front. Chin makes a distinction between internal and external uncertainties. The internal uncertainties involve things that can be controlled by the project manager, including scope, time and cost. The external uncertainties refer to factors outside the control of the project manager, such as the industry's business environment, the competition and business strategy decisions.

According to Chin, internal uncertainty depends on the type of project. Internal uncertainty is low for operational projects and high for technology development projects. Unlike internal uncertainty, which is more a function of company maturity, external uncertainty is largely a function of industry maturity. While mature industries have weeded out much of the competition and erected barriers to entry for newcomers, emerging industries have many small companies vying for position, causing a lot of rapid change. As more uncertainty is introduced to these previously mature and stable industries, the classic project management methods are stretched. At some point you start looking for new ways of running projects in an agile manner. Chin defines an agile project management environment as a combination of uncertainty, unique expertise and speed. He illustrates this by contrasting agile and classical approaches to managing projects. The bottom line contrast is that, in the agile environment, projects are the business, while in the classical environment, the triple constraint of scope, resources and schedule, is the prime concern. In an agile strategy, the project manager takes an outward-facing perspective to facilitate the integration of the project and the business. Focus is on delivering business results rather than staying within preset boundaries, as the original project boundaries will quickly diverge from the business reality in an uncertain environment. Chin then explores how the agile strategy is applied to project team development.

When defining roles and responsibilities in an agile environment, boundaries should be used to guide team members rather than erecting barriers to restrict their freedom to act. Team members are encouraged to cross boundaries while not being intrusive. The team is urged to identify and create synergies among related and seemingly unrelated parts of the project.

3. New Product Development Projects

New product development (NPD), also known as innovation projects, start with an idea for a new product or service, which may come from a customer who perceives a need not currently served by the products available in the market, or from an established research and development (R&D) department. Indeed an NPD project can be seen as part of a programme of R&D, taking the idea and translating it into a marketable product. So when does a project stop being R&D and start becoming NPD? Well, there are many R&D projects that are really pure research, which may never materialize as new products, for example scientific projects in pharmaceuticals, perhaps due to lack of success in early trials (functionality) or lack of funding (if not seen as viable in terms of pricing and profit potential). NPD projects are closer to market than that, at what is referred to as the 'commercialization' stage, and must have a sound business case put forward to show viable sales and margins. Many new products are not much more than old ones updated or enhanced in some way, though some involve completely new concepts. There is therefore variability in the level of novelty then that will impact on project risk (Harris, 2009).

The customers may be the general public for everyday consumables, or narrow market segments for specialized products, or sophisticated buyers in organizations that may wield considerable power in the marketplace. Knowing who your customers are and understanding what appeals to them is critical to the success of NPD projects. Product development is by its nature very industry specific, so the nature of the product, delivery process and marketing will vary between industries. There may still be general issues or features of NPD that are widespread (Harris, 2009).

4. Project Risk Concept

4.1. Operational Risks

Operational risks are threats with a potential impact on project objectives resulting from actions that are controlled by the project manager. Operational risks originate from uncertainties in estimates of time, resources and costs, previously referred to as volatility, and ambiguity as a consequence of missing pieces of information. Typically, identification and handling of operational risks is a major dilemma in

planning and controlling the project execution process. Examples of operational risks are:
• Availability of resources.
• Efficiency.
• Timeliness.
• Operability.
• HSSE.

Availability of resources is necessary to complete project work. The following resources need to be considered:
• Drawings and specifications.
• Materials.
• Engineering work force.
• Construction work force.
• Budget (authorization to spend money).

As materials are supplied by vendors and engineering and construction work is carried out by contractors, risks related to the availability of resources will extend to include an assessment of supplier capabilities and capacity. Efficiency relates to work procedures including supporting activities such as in and out-bound logistics, scaffolding and supervision.

Timeliness refers to risks related to late arrival of drawings and materials, to meeting given milestones for issuing of purchase orders and award of contracts and to delivery of constructed modules and the completion of project work. Operability refers to the project deliverable (plant); will it work as specified? As a final answer cannot be given prior to production start-up, the focus in the project execution phase is reduced to quality assurance and quality control.

Health, Safety, Security and Environment (HSSE) refers to risks to the project work force, the facility and to relevant project environments.

Operational risks are limited to the impact of conditions that are likely to occur during project execution, i.e. uncertainty related to situations that are expected to happen (volatility). Events of a more extreme nature may occur but are not considered in project cost estimates and schedules. Rather, extremes are explicitly mentioned as a prerequisite for the planning process. Some possible extreme situations may be identified and some may occur during project execution (black swans). Threats related to extreme situations are considered in contextual risk analysis.

The level of project operational risks is related to how aggressive the project objectives and execution strategies are set by corporate management and agreed to by project management. Compared to the traditional model, which implies a linear risk reduction strategy, risk navigation allows for corporate management to set or agree to a greater project risk level than planned for in standard project procedures. This is a risk level that the project management must acknowledge they are able to manage.

4.2. Strategic Risks

Strategic risks are threats with a potential impact on project business objectives resulting from decisions made by corporate management. Decisions made by the project owner organization are typically related to: The project lifecycle.

• Maturity at project sanction.
• The project execution strategy.
• Changes to project objectives.
• Acceptance of project business risk exposure.

The project life cycle is related to risks as the number of sequential phases and corresponding decision gates is highly relevant for the project risk exposure. The conventional phase-gated concept is an illustration of one approach to manage project risks through a successive reduction of risks until the risk level is considered acceptable. Decisions at the gates are made by corporate decision boards.

4.3 Contextual Risks

Contextual risks are threats with a potential impact on business and project objectives imposed by circumstances outside the project and beyond the control of project and corporate management. Such threats may be caused by man or by nature (extremes) and often originate from:
• Project location.
• Business practices.
• Factor market conditions.
• Culture.
• Geopolitics.

5. Identification Risk factors

Risk refers to all events, occurrences and actions that may prevent you or your organization from realizing its ambitions, plans and goals.RM refers to strategies, methods and supporting tools to identify, and control risk to an acceptable level (Bruckner et al., 2001). Project risk management, one of the main subjects of project management (Raz & Michael, 2001), is the planning, organization, monitoring and control of all aspects of a project and it consists of risk identification, risk qualification, risk response development, and risk response control (Saynisch, 2005).

Furthermore, RM is concerned with making judgments about how risk events are to be treated, valued, compared and combined (Roy, 2004). The propose of RM is to develop a detailed analysis of the organization and project domains to develop a complete set of risk factors and to ensure they are appropriately organized to reflect all the stakeholders

and the various risk perspectives that are required (Roy, 2004).

Based on the previous literatures, we focus on ten Risk factors. The factors used in relevant literatures are listed in Table 1.

Table 1. Risk factors.

factors	Reference
Inadequate selection	Verville & Halingten (2003), Chen (2001), Buonanno et al. (2005), Reuther& Chattopadhyay (2004), Dillard & Yuthas (2006), Botta-Genoulaz et al. (2005), Wei et al.(2005)
Low top management involvement	Boonstra (2005), Voordijk & Stegwee (2005), Botta-Genoulaz (2005), Al-Mashari et al. (2003), Huang et al. (2004), Ehie & Madsen (2005)
Low key user involvement	Berchet & Habchi (2005), Nah (2001), Ghosh (2002), Botta-Genoulaz (2005), Huang et al. (2004), Maguire (2002)
Poor project team skills	Al-Mashari (2000), Marsh (2000), Nah (2001), Holland & Light (1999), Somers & Nelson (2003), Baccarini et al. (2004)
Bad managerial conduct	Motwani et al. (2005), Al-Mashari (2000), Krumbholz & Maiden (2000) , Maguire (2002) , Huang et al. (2004), Somers & Nelson (2003)
Poor leadership	Botta-Genoulaz (2005), Baccarini et al. (2004), Al-Mashari et al. (2003), Boersma & Kingma (2005), Krumbholz & Maiden (2000), Umble et al. (2003)
Inadequate change management	Umble et al. (2003), Al-Mashari (2000), Al-Mashari et al. (2003), Boersma & Kingma (2005), Baccarini et al. (2004)
Ineffective project management techniques	Parr & Shanks (2000), Al-Mashari (2000), Motwani et al. (2005), Al-Mashari et al. (2003)
Inadequate training and instruction	Al-Mashari et al. (2003), Ehie & Madsen (2005), Botta-Genoulaz (2005), Berchet & Habchi (2005)
Ineffective consulting services	Motwani et al. (2005), Ehie & Madsen (2005), Soffer (2005), Baccarini et al. (2004), Somers & Nelson (2003),

6. Project Risk Analysis

6.1. The Project Risk Challenge

The purpose of the project risk analysis process is to establish a fundamental and comprehensive understanding of the total project risk picture. The first step in project risk analysis, the point of departure, is a true understanding of the project challenge itself. An extensive description of project risks should address:

- Size
- Complexity
- New technologies
- New business practices
- Unfamiliar construction methods
- Remoteness of location
- Geopolitical context
- Ambitiousness of business target
- Sensitivity to corporate reputation.

6.2. Risk Factors

As a guide for how to assess the risk exposure of a given project, risk navigation provides an overview of risk factors to be considered. A distinction is made between risks related to state variables and to decision variables. State variables to be considered are:

- Volatility (day to day variations in relevant market prices and productivity).
- Extremes (weather, earthquakes).
- Accidents (construction damages, deaths and injuries, environmental damages).
- Unrests (labor force, impact caused by regulatory authorities and special interest groups).
- Bankruptcies (of suppliers).

In decision analysis, state variables are treated as random variables. Decision variables to be considered are:

• Decisions made or to be made by project management.
• Decisions made or to be made by corporate management.
• Decisions made or to be made by external parties.
• Degree of communication.
• Level of understanding.

The risk factor in construction business is very high. Construction objects are unique and built only once. Life cycle of construction objects is full of various risks. Risks come from many sources: temporary project team that is comprised of employees from different enterprises, construction site and etc. Moreover, the size and complexity of construction objects are increasing, which adds to the risks (Tserng et.al, 2009).

Risk management is an operational process comprising definition of sources of uncertainty (risk identification), estimation of the consequences of uncertain events/conditions (risk analysis), generation of response strategies in the light of expected outcomes and, finally, based on the feedback received on actual outcomes and risks, carrying out identification, analysis and response generation steps repetitively throughout the life cycle of an object to ensure that the project objectives are met (Tserng et.al, 2009).

Construction development, technology and management conditions are different. Environment may change the conditions in the country. Furthermore, specific buildings, projects, and firms face markedly different level of risks. The variables that have been identified to contribute to the level of risks can be categorized into the followings groups: country, industry, project, and enterprise specific risks. Risk groups are presented in the Fig. 1.

Fig. 1. Risk allocation structure by level in construction projects

7. Conclusion

The main aim of this paper was to consider the Risk Types that organizations may face when taking on projects of New Product Development Projects. A project is usually defined as such for project management purposes because it has a unique identity and a finite life and is thus distinguishable from other continuing operations. Risk Management Planning is the systematic process of deciding how to approach, plan, and execute risk management activities throughout the life of a project. It is intended to maximize the beneficial outcome of the opportunities and minimize or eliminate the consequences of adverse risk events. Risk identification involves determining which risks might affect the project and documenting their characteristics. It may be a simple risk assessment organized by the project team. Qualitative risk analysis assesses the impact and likelihood of the identified risks and develops prioritized lists of these risks for further analysis or direct mitigation. The team assesses each identified risk for its probability of occurrence and its impact on project objectives. Project teams may elicit assistance from subject matter experts or functional units to assess the risks in their respective fields. Quantitative risk analysis is a way of numerically estimating the probability that a project will meet its cost and time objectives. Quantitative

analysis is based on a simultaneous evaluation of the impacts of all identified and quantified risks.

Risk response strategy is the process of developing options and determining actions to enhance opportunities and reduce threats to the project's objectives. It identifies and assigns parties to take responsibility for each risk response. This process ensures that each risk requiring a response has an *"owner"*. The Project Manager and the project team identify which strategy is best for each risk, and then selects specific actions to implement that strategy.

Risk Monitoring and Control tracks identified risks, monitors residual risks, and identifies new risks—ensuring the execution of risk plans, and evaluating their effectiveness in reducing risk. Risk Monitoring and Control is an ongoing process for the life of the project.

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