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The Use of the Risk Management Procedure in Hi Tech Project Management

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ABSTRACT

To start doing anything a man should have an impulse. The author's motivation to investigate the issue of „Risk Management Procedure in Hi Tech Project Management" derives from the commercial world of managing hi-tech projects. Such an impulse in the entrepreneurial world is called an entrepreneurial intention (B. Bird 1988). The 21st century technology is characterised by development and implementation of sophisticated products, which are subjected to various risks and incredible market competitiveness. The management of conventional and traditional projects has objective difficulties to cover all management components dictated by risks and the competitive market. The paper's aim is to deal with the question of "whether risk factors receive enough attention by management?" and recommend expanding the awareness among all the management and use risk management which will help with improving the ability to cope with the management difficulties.

Based on the author questionnaire results it was found that risk management should be part of project management, which fully meets the PMs' expectations and has been found to meet the hypothesis assumptions.

Keywords: Project Risk Management (PRM), Risk Management (RM), Questionnaire, PM (Project Management).

1. Introduction

In today's competitive business and sophisticated technology environment, business entities are faced with greater uncertainty (risks and opportunities) as they strive to create value. Hi-tech projects are exposed to the complex effects of risks, due to tied contracts, resources and structural features. The paper deals mainly with the subject of hi-tech projects risk management, which currently is handled by the senior management levels, and exposes the needs to explore the awareness of management at all levels of risk management, which may help companies reduce costs and stay competitive. In order to do this, businesses and investment managers have to pay attention to project risk management, both inherent and emerging in their organisations.

The paper is divided into four parts. The first part presents a literature review and hypotheses regarding the follow's subjects: history, risk management process, management awareness, risk management practices in projects. Professionals state that risk management must be conducted the strategic and disaster risk management, standards and process. The hypotheses which will be examined in the study are presented. The second part contains a study of the follow's subjects: the methodology of the study, namely the description of the research sample, the data collection process and information regarding the construction of the questionnaire. The third part contains the results which were collected by the author and on the basis of another questionnaire, the expectation questions based on the hypotheses' assumptions, the limitation of the questionnaire and the gaps between risk management implementation and reality. The final part presents conclusions regarding the influence of intentions on the basis of both the literature review and the research.

2. Literature Review and Hypothesis

The methodology used in this study is based on documents, research and literature review, as well as an analysis of the concepts used in the literature. The author has analysed the literature published between 1978 and 2017 in

books, the International Journal of Project Management, the International Journal of Information Management, Hand Books and international standards.

2.1. History

One of the first definitions of risk is attributed to Bernoulli, who proposed measuring risk with the geometric mean and minimising risk by spreading it across a set of independent events (Bernoulli, 1954). Accordingly, the traditional definition of risk is measured by the two main combined variables: a) frequency of occurrence (probability) of the 'risky' event, i.e., the number of times the risky event is repeated in a predetermined period and b) extent of the consequences (magnitude) that the event generates, i.e., all the results of its occurrence. The first two academic books on risk management were published by the fathers of risk management, Mehr and Hedges (1963) and Williams and Hems (1964). Nothing is simple, given the complexity and magnitude of the risks that companies face. Scholars recognise a macro classification of risks into two main categories (Mowbray et al., 1979). First, pure or static risk is risk that only causes damage without the opportunity of earning from its occurrence. Always negative, it is characteristically unexpected because it is determined by accidental events. Second, speculative or dynamic risk is risk that can cause either damage or earning opportunities. These are the typical commercial risks, consequences, for example, of a new technological implementation that has not generated a profit but is unique. Such risks are normally related to planning and managing different businesses and functions of an enterprise, such as production, products, marketing, project management and sales. Following Chapman and Cooper (1983), risk is the possibility of facing economic and financial losses or physical material damages, as a result of inherent uncertainty associated with the action taken.

The Project Management Body of Knowledge defines risk as an uncertain event or condition which, if it occurs, has an effect on at least one of the following project objectives: scope, schedule, cost and quality (Project Management Institute, 2008: 275). Risk is everywhere and is a potential problem that might happen. Regardless of the outcome, it is a good idea to identify risk, assess its probability of occurrence and estimate its impact (Alhawari et al., 2012).

Regarding the use of risk management in projects, professionals state that risk management must be conducted because all of the project management handbooks say so, and it should be done in the way the standard handbooks recommend it (Project Management Institute, 2008; Office of Government Commerce, 2007; Association for Project Management, 2006; 2004). This concept is found in literature that focuses on risk management (Ropponen and Lyytinen, 1997). Project risk management has the objective to decrease the probability and/or impact of negative events in the project and to increase the probability and impact of positive events (Project Management Institute, 2008: 274). Gemmer (1997) affirms that effective risk management requires functional behaviour of the stakeholders, which means that they may not necessarily comply with the risk management procedure. Dey et al. (2007) affirm that generally stakeholders must be involved in the risk management process, and this is crucial for the project's success or failure.

The promoters of the evaluation approach (Jiang and Klein, 2000; Procaccino et al., 2002) assume that knowledge of risks implies that they can and will be managed, therefore the project will end successfully. Management awareness/approach to project risk management is an approach which answers the question of how to deal with risks in order to prevent project failure. The management approach to risk management has processes based on rational decision making and complies with an engineering view on project management. It focuses on identifying the events and situations specific to projects that can interfere with the original plan and developing measures to keep the current project on track. The contribution of the management approach of risk management to the project's success is direct, as it focuses on the relevant and specific risks of the current project. The promoters of the management approach (Gemmer, 1997; Ropponen and Lyytinen, 1997; Kutsch and Hall, 2005; Dey et al., 2007; Bannerman, 2008) generally recognise risk management as a process consisting of well-defined steps of identification, analysis, response, monitoring and control (Bakker et al., 2010a). According to the contingency approach, risk management is not considered to be a separate management process. Instead, it is embedded in the various processes and procedures of the project (Jun et al., 2011).

2.2. Risk management practices in projects:

Risk management has developed rapidly over the recent decades as an integral part of project management (Del Cano and Cruz, 2002). It includes the processes concerned with risk management planning, identification, analysis, responses, as well as monitoring and

control of a project (Project Management Institute, 2008). Risk management is a discipline, which integrates knowledge from a variety of different business fields, where wide varieties of methodologies treat specific problems (Alhawari, 2012).

Risk management is a very important and integral part of any business, well recognised by the project management institutions (Del Cano and Cruz, 2002). Risk management refers to strategies, methods and supporting tools to identify and control risk to an acceptable level. The risk management objective is to identify all applicable risks in a project. This involves ranking the risks based on their importance, frequency of occurrence, level of impact, and then establishing the actions needed to control the identified risks. Kutsch and Hall (2009) conclude that little research has been done to establish whether project managers involved in IT projects really apply risk management and what reasons lay behind their decisions not to pursue any active management of risk in some cases. The subject literature focuses on what project managers should do, more than on what they did do (reactive attitude instead of proactive attitude). As long as no evidence is produced to explain why project managers fail to apply project risk management, the acceptance of best practices in project risk management standards is insufficient. Risk management is an iterative process and it occurs all through the project life cycle. When risk events occur, using an effective risk management technique will facilitate measuring the project performance in terms of schedule, cost and quality. The risk management practices have a considerable influence on the stakeholders' perception of project success.

Effective risk management requires adherence to a thinking in which risks are treated, not denied and problems are identified and not hidden. Regardless of the approach, a standard method for identifying, assessing and responding to risks should be included in any project as this influences the outcome of the project. Risk management follows a stagegate (Figure 1) process (ISO 31000, 2018). A preparatory step requires defining the risk management plan as being consistent with strategic business objectives and conducting a context analysis. The first stage aims to identify all the risks to which the enterprise project is exposed. The second stage determines the probability and the expected magnitude associated with the occurrence of the damage. A threshold of acceptability must be defined to proceed to the next stage, depending on the risk appetite of top management and on the resources available for risk management. The third stage is the treatment of unacceptable risks, which identifies the most appropriate actions to reduce the risk. Finally, the process is supervised. In the literature, the first two stages (identification, evaluation and analysis) are often called risk assessment. The implementation of a risk management system is a long-term, dynamic and interactive process that must be continuously improved and integrated into the organisation's strategic planning and awareness (Di Serio et al., 2011). Figure 1 presents the general risk management process and the levels of the managers involved in the project.

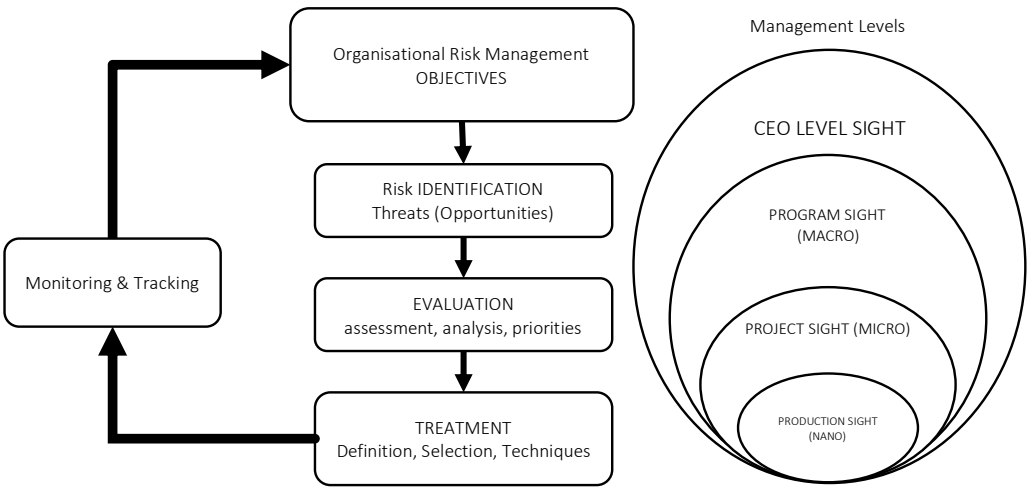

Figure 1: The general risk management process and the levels of the managers involved in the project
Source: the author's own work

2.3. Literature summary

It is therefore of great importance for project management and senior management to take advantage of making appropriate, solid decisions based on risk evaluation on uncertain outcome risks, as – at worse – it would cut-down losses due to a disaster, and – at best, improve profitability in the cases of opportunities. "Uncertainties present both risks and opportunities, with potential to erode or enhance value". The sources of uncertainty with adverse effects / outcomes (the probability of which is defined as risk) are described as being due to the volatility / complexity / heterogeneity of risk, the impact of external events (such as customer preferences, competitor strategies, technology and so on), the response to external events / developments (such as compliance with policies / regulations / standards, development of strategies, and so on) and the behaviour of employees. Project management and the involvement of low-level management are part of the human resources factor. In a technological hi-tech project carried out on the basis of a legal contract, the Statement Of Work (SOW), Specification (SPEC) and Terms and Conditions (T&C) as well as maintenance of supplier-customer relations, senior management is responsible for implementing every contractual commitment (schedules, production costs and profits) (Erik W. Larson and David H. Gobeli, 1988). The process of project risk management is one of several control tools that enable senior management to inspect and meet the contract's obligations. On the basis of this literature review and the questionnaire circulated by the author of the article, the following hypotheses can be formulated:

h1 – Awareness of all management levels is essential for the implementation of the project risk management process.

h2 – All levels of management are essential and should have responsibility, authority and influence over the risk management chain (related to schedules, technology complications and total costs).

h3 – The customer and the shareholder should be involved in the project risk management procedure.

h4 – Risk which is detected at an early stage of the activity is easier to handle.

h5 – Use of identifying and handling risks is a tool for reducing unnecessary expenses.

3. Study

This paper intends to provide an indication to the use of the project risk management procedure as an inherent management activity via the hi-tech project's conventional management. Project risk management is a process entailing ongoing management, which is intended to detect risks, hazards and opportunities while assessing the scope of harm / damage, prioritising their handling as per their magnitude, determining improvement and investment required to obtain improvement and controlling the implementation of such improvement attempts. By raising the management's awareness of using the project risk management procedure, the assumption is that the management's responsibility and commitment at all levels of management will improve the project implementation. The assumption is that by running the author's questionnaire and interviews with senior and low-level project managers (PMs') who are / were leading hi-tech defence and general projects in Israel, will help to analyse the relationship between the theoretical research goals and the defined hypotheses based on the real collected data. The paper uses the results of the questionnaires conducted by the author, summarising the management experience of PMs' with more than a few hundred projects worth several billion dollars. The format of the questionnaire was based on the informational knowledge and experience of the PMs'. The author has 30 years of experience in the management of hi-tech projects.

3.1. Paper Goals

Presenting the data outcome and structure collected with the author's questionnaire; associating the main hypotheses with the qualitative, informative and quantitative results from the questionnaire data. Presenting the gap between the managers' awareness of the project risk management procedure during the project life cycle and the data collected. The paper intends to emphasise and inspire the awareness of each person to use and be involved in the process of risk management of hi-tech projects as well as to join forces and take part in the risk management procedure. In the following paper, the use of literature focuses mainly on project risk management activities at all levels. Project risk management activities are to supplement management practices and investigate the project's structure, organisational environment, external environment, products, processes and procedures. Furthermore, by supplementing the existing knowledge with "lessons learnt", the best business practices can be developed.

3.2. Methodology

The paper emphasises and concentrates on all levels of managers' management awareness of risk management, which should be followed

by the managers' authority and responsibility to manage and the techniques used. The method to be used in conducting the study was chosen with regard to the following options:
Option 1 – Observation in a 'live' hi-tech project in the industry: this means that the project risk management will be monitored in parallel time to the project running schedule, the cash flow and other additional activities are monitored.
Option 2 – Design of a simulated hi-tech projects environment: develop of simulation system (tailor made) which will help to computerize and monitor the risk management procedure as a part of the project management.
Option 3 – Questionnaires concentrate in risk management that will include senior project managers who are/were management leaders in hi-tech defence and general projects in Israel.

3.3. The Decision

In this study, the questionnaire method has been used, with each of the project managers in the hi-tech industry receiving a questionnaire, with the data collected being analysed and presented. Running a questionnaire and interviews with senior and low-level project managers (PMs') who are / were leading hi-tech defence and general projects in Israel, has helped in analysing the relationship between the theoretical study goals and defined hypotheses, based on the real data which was collected.

A similar approach to the paper done by the author's paper based on a questionnaire was published in the past by Raz, Dvir and Senhar (2002). The data presented information about industrial projects executed in Israel over the last 15 years and were collected using structured questionnaires distributed among 182 project managers. These managers were approached during executive project management seminars, academic training programs or via personal contacts. A total of 127 completed questionnaires were returned with a response rate of about 70%. The projects were performed in a variety of industries including, construction, electronics, computers, mechanical, aerospace and chemical, and involved various technologies such as electronics, computing, materials, chemical, biochemical, optical, mechanical, semi-conductors, aeronautical and construction. They were all complet-ed or terminated before the collection of the data. The projects were either financed internally, as new product development efforts, or they were customer-paid projects, for which a contract had been signed before the project's initiation. Projects ranged in budget from $40,000 to $2.5 billion, and in duration from three months to twelve years. The paper's main conclusions were that "it seems that risk management is still in its infancy, and that there is still a long way to go. More awareness, more application, better training, more tools, and additional studies, are needed to further promote the un--derstanding, usage, and usefulness of risk". The author's (unique) questionnaire summarises more than a few billion dollars' worth of projects and hundreds of projects per year of management experi-ence. The projects covered a large variety of branches and manufactured products which were sup-plied to customers (companies and governments) who were located in Israel and other places around the world. The format of the questionnaires was based on the information, knowledge and experience of the PMs'.

3. Results

The questionnaire (composed by the author) applied in this study was first tested in February 2017, beginning with 6 acting PMs' and 2 academics. The parameters that were tested included: the time that it takes to answer, the text's clarity and the logic of the questions (this took about 3 months). After the questionnaire was tested and qualified, the main research was conducted, with the procedure starting in May 2017. The questionnaire data was uploaded on the SPSS application. The questionnaire con--tained 47 questions of quantitative, qualitative and information type. The questionnaire's publication and replies were conducted via traditional mail, electronic mail (Internet) and personal interviews / meetings. The main subjects of the interviews included management and queries with managers about project risk management use and the performance of large--scale projects.

The study focused on several sections and was basically divided into three sections: 1) expec-tations, 2) implementation of the risk management procedure in the projects and 3) information which was used for the questionnaire database in the study. The expectations were defined according to the assumption of the hypothesis.

Implementation Question (the author's questionnaire): "What was the share (%) of the total project's expenses in million dollars dedicated to risk management issues?" The study focused on PMs' management budget which should allow them to run the projects, with part of it spent on oper-ating the risk management procedure; the following implementation question deals with the funding share which was implemented for RM procedure. The study's finding was that 36.4% of the PMs' had 5%

of the share (which shows that only 5% of the budget was invested in implementing the RM pro-cedure).

Expectation Question (the author's questionnaire): "Based on your experience, what should be the ratio of management involvement between risk management and conventional management?" The study's finding was that 89.5% of the PMs' answered that the ratio of management involvement between risk management and conventional management should be 11-25%. It shows that minimum 11% of management involvement should be implemented to RM. Remark: The study basically showed the idea of not enough use of the risk management procedure in projects.

Table 1: Data based on the data collected with the author's questionnaire

1	Number targeted	25
2	Number of respondents	21
3	Response rate	84%
4	In total, the PMs have experience of	≈ 215 years
5	In total, the PMs have managed	≈ 550 Projects
6	Maximum, one project budget value managed	≈ 1,250 M$
7	Total revenue of the managed projects	≈ $18,000 million
8	PMs who managed >15 Projects	≈ 61%

Source: the author's own study.

Expectation Questions (based on the hypothesis assumption). 1. The author's questionnaire: "Is it necessary to use IPT's (In Process Team) in risk management?". The results of the questionnaire showed that hypothesis h3 was accepted by the majority of respondents: 80% Agree, 20% Partly Agree. 2. The author's questionnaire: "Is risk which is detected at an early stage of the activity easier to handle?" The results of the questionnaire showed that hypothesis h4 was accepted by the majority of respondents: 94% Agree. 3. The author's questionnaire: "Should the customers / shareholders be involved in the project risk management procedure?" The results of the questionnaire showed that hypothesis h3 was accepted by the majority of respondents: 37.5% Agree, 37.5% Partly Agree, 25% Do Not Agree. 4. The author's questionnaire: "Should risk management be conducted throughout the entire project duration?" The results of the questionnaire showed that hypothesis h1 was accepted by the majority of respondents: 73% Agree, 21% Partly Agree, 6% Do Not Agree. The rationale of this question is based on the continuity of supporting the customer after project delivery. 5. The author's questionnaire: "Is identifying and handling risks considered as a tool for reducing unnecessary ex-penses?" The results of the questionnaire showed that hypothesis h5 was accepted by the majority of respondents. 6. The author's questionnaire: "Based on your experience, should risk management be part of project management?" (Question based on PMs' opinions). The results of the questionnaire showed that 100% of respondents chose Agree. This was the most significant answer given by the PMs. According to a sample based on survey results that were collected by the INTECH Institute in 2012 in Lithuania, "PMs agreed that risk management has to be part of conventional project manage-ment. The perceivers of risk management are the project participants, and a contractor is any entity which has the power to influence project decision-making directly. Related to experience, only 11% of the respondents affirmed that they have experience in risk management. Most of them are project managers and have more than 15 years' experience; this proves the relationship between risk percep-tion and the experience of respondents. Some 34% of the respondents affirmed that they have no prac-tical experience in risk management, while 55% of the respondents affirmed that they do not have enough practical experience in risk management. 97% of the respondents answered that risks must be managed in the early stages of the construction project". 7. The author's questionnaire (information): "What was your daily responsibility as a manager?" The results of the questionnaire showed that hy-pothesis h5 was accepted by the majority of respondents. 8. The author's questionnaire (implementa-tion): "What were the major subjects of concern in the projects you managed?". The results of the questionnaire showed that hypothesis h2 was accepted by the majority of respondents. 9. The author's questionnaire (implementation): "How many levels of management (on average) were managing the projects?". The results of the questionnaire showed that hypothesis h2 was accepted by the majority of respondents. The results show the numbers of management levels.

Limitations: The author's questionnaire was conducted in the state of Israel and answered by Israeli PMs. Most of the project activities were operated in the defence and commercial branches. The Gaps: The results of the questionnaire showed that the actual implementation and what was really im-plemented in risk project management does not meet the PMs' expectations.

4. Summary and Conclusions

The paper results are based on the data gathered in questionnaires that were conducted on the site and with active hi-tech project managers who have 215 years of experience and managed 550 projects. With the total revenue of $18 billion. Based on the PMs' opinions and experience, it was found that 100% of the respondents agreed that risk management should be part of project management, and 97% of the respondents answered that risks must be managed in the early stages of the construction project.

The paper reveals the need for risk management awareness in all the management levels of the project during a life cycle of the project's process. The study intends to recommend a follow-up re-search on quantitative and qualitative values and on the importance of project risk management en-gagement, while dividing management into levels, from the production line level through the level of development, storage, procurement and all the other levels being part of the project. To motivate and generate awareness of the importance by senior managers, the project risk management procedure should be used in correlation with the general management procedure.

It was found that the implemented project risk management does not meet the PMs' expecta-tions and the ratio of expectation to implementation is ≥ 0. It seems that risk management is still at infancy and that there is still a long way to go. Based on the paper (the author's questionnaire and the literature review), managers should pay more attention to inherent risks (89.5%) and those emerging in their projects through their management organisation as part of the overall traditional management, emphasise the awareness of using the risk management procedure by all levels of management and mix traditional management.

More awareness, more application, better training, more tools and additional studies are needed to further promote the understanding, usage and usefulness of risk management in hi-tech projects. It is clear from this and other studies that in risk management we need to improve the risk management techniques to various types of projects and develop better and more specific tools to manage risk in different project types. Such specific tools should become part of the common toolbox of every organ-isation and every project manager. We need to tailor and develop different tools for all hi-tech projects that address the specific uncertainty issues and promote better thinking and analysis on project risks. We must also learn to distinguish among project risk management tools for simple versus more com-plex and large projects. Finally, since there are various risk management tools available, further re-search is needed to find what works best and in what circumstances and environments. As more or-ganisations are adopting project risk management as part of their normal business processes, addition-al understanding and deeper learning of risk management will continue being at the fore of the disci-pline of project management. The foundation for building TRM (Total Risk Management) similar to TQM (Total Quality Management) (Stensaasen, 2010) starts at the bottom (the managers) and must be supported by the upper senior management; there are two opposite driven forces which have to be synchronised, focusing the senior project management's attention on the importance of inherently us-ing the project risk management process as part of general management.

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