Benchmarking the Use of Project Risk Management Tools

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Introduction

The management of risk in projects is currently one of the main topics of interest for researchers and practitioners working in the area of project management: a recent survey by Williams (1995) includes 241 references. Risk management is one of the eight main areas of A Guide to the Project Management Body of Knowledge (PMBOK™ Guide), and is included in most training programs for project managers. Within the current view of project management as a life cycle process, project risk management (PRM) is also seen as a process that accompanies the project from its definition through its planning, execution and control phases up to its completion and closure.

Several variations of the PRM process have been proposed. Boehm (1991) suggested a process consisting of two main phases: assessment (which includes identification, analysis and prioritization), and control (which includes risk management planning, risk resolution and risk monitoring).

Fairley (1994) talks about seven steps: (1) Identify risk factors; (2) Assess risk probabilities and effects; (3) Develop strategies to mitigate identified risks; (4) Monitor risk factors; (5) Invoke a contingency plan; (6) Manage the crisis; (7) Recover from the crisis. The Software Engineering Institute (Dorofee et al. (1996)), a leading source of methodologies for managing software development projects, looks at a PRM as consisting of five distinct phases (identification; analysis; response planning; tracking; and control) linked by an ongoing risk communications effort. In the PMBOK™ Guide, the Project Management Institute presents four phases of the PRM process: identification; quantification; response development; and control.

Kliem and Ludin (1997) describe a four-phase process (identification, analysis, control, and reporting) that parallels Deming's four steps for quality management (plan, do, check and act). Chapman and Ward (1997) outline a generic PRM process consisting of nine phases: define the key aspects of the project; focus on a strategic approach to risk management; identify where risks might arise; structure the information about risk assumptions and relationships; assign ownership of risks and responses; estimate the extent of uncertainty; evaluate the relative magnitude of the various risks; plan responses; and manage by monitoring and controlling execution. It is evident from this brief review of representative PRM processes that there is general agreement regarding what is included in the process, with the differences depending on variations in the level of detail and on the assignment of activities to steps and phases.

Of course, any PRM process requires tools for its implementation. The adoption of analysis, planning, control, or management tools involves a certain investment, which in certain cases may be quite significant. This cost represents the effort required, both at a personal and at the organizational level; to understand and to learn how to use the tool, and to acquire the necessary infrastructure (technical expertise, computing aids, data bases, operating procedures, etc.). A question of major relevance to any individual or organization considering the adoption or improvement of a PRM process is: which tools can provide the greatest benefits?

In this paper we present the results of a study carried out in Israel in order to answer that question. The objective was to help project managers focus on those few crucial tools and methods that are recognized as the key contributors to the effectiveness of the PRM process. The study was based on a questionnaire administered to project managers in the software and high-tech sectors in Israel. The methodology of the study and the results are presented next.

Tools Identification and Classification

The first phase of the study consisted of an extensive review of the literature in order to identify the tools, techniques, and practices associated with project risk management. Some of these were quite narrow and technical tools, such as fault tree analysis or cause and effect analysis; others were broader, such as cost-benefit analysis or periodic status reporting; and some were practices of a more general nature, such as prototyping or simulation. In this study we did not distinguish among the various types, and we will refer to all them by the generic term "tools" Overall the literature search yielded a list of over 100 tools, which were classified into six functional groups.

The first five groups corresponded to the five phases of the SEI risk management process: identification, analysis, planning, tracking and control. The main reason for choosing the SEI process framework was that the study focused on project risk management practice in the software and high-tech sectors, and the SEI seemed to be the most appropriate. The sixth group included tools that could not be attributed to a specific phase of the PRM process. These are tools that provide general support by improving quality, improving the management focus and minimizing uncertainties in processes. We called this group the "background" tool group, meaning that these tools work in the background and help create a stable and effective environment supportive of successful project risk management.

Pilot Study

Prior to carrying out the tool usage survey, we carried out a pilot study in a limited sample. The objectives of the pilot were to validate the list of PRM tools obtained from the literature and to finalize the format of the questionnaire. The selection and validation of the pilot group and the results of the pilot survey are described next.

Selection and Validation of the Pilot Group

The pilot study was carried out on a group of five companies. The companies selected are leaders in their respective industries and are considered successful and well managed as it appears from their business performance data. They were three major software development companies, a company engaged in the development and manufacture of communications hardware, and a manufacturer of chemical products.

A variation of the Taxonomy Based Questionnaire (TBQ) developed by the Software Engineering Institute (SEI) was applied to measure the level of project risk in the five organizations and to ascertain that they operated under comparable risk levels. The TBQ, which is described in detail by Carr et al. (1993), is an instrument designed to survey the distribution of risks in software development projects. It consists of a series of questions organized in a three level hierarchy. The top level of the hierarchy consists of three classes as described next:

- Product Engineering—includes all technical aspects of the work need to be done in order to produce the product.
- Development Environment—includes all the methods, tools and processes that are used in order to develop the product.
- Project Constraints—includes the contractual, organizational and operational factors that are "externals" to the project.

Each class is divided into a number of elements. For example, the Product Engineering class consists of the following elements: Requirements, Design, Code and Unit Test, Integration Test, and Engineering Specialties. Each element is divided into a number of attributes. For instance, the Requirements element is divided into the following attributes: Stability, Completeness, Clarity, validity, Feasibility, Precedent, and Scale. Each attribute is covered by a number of binary questions that are designed to ascertain the extent of risk inherent in the respective aspect of the project.

Some minor changes were made in the phrasing of the elements and attributes in order to adapt the TBQ instrument to development projects in general. The TBQ was administered to an experienced project manager from each of the five organizations in the pilot group. The application of the full TBQ instrument is rather lengthy and requires several hours. In order to keep the time requirements to an acceptable amount (about two hours of direct interview for each respondent), the following change was made. Instead of requiring an answer for each of the 194 questions, the respondents were asked to rate directly the level of risk on each attribute, using a 0-5 scale, with higher values signifying higher risk level.

Based on the numerous risk assessments that the SEI carried out, it compiled statistical data regarding the relative weight of each class, element and attribute in the TBQ. The risk level assessments provided by the respondents were weighted according to these statistical weights and normalized to the 0-1 range in order to yield a risk index for each of the five organizations. The results are shown in Exhibit 1. They indicate that in general the five organizations have comparable overall project risk levels, with the values for the software development companies somewhat higher than for the other two. This finding was helpful in allowing us to draw conclusions about the intended population of the survey.

Tool Screening and Validation

Having ascertained that the pilot group is fairly uniform in terms of project risk levels, we proceeded to validate the list of PRM tools obtained from the literature. This step was carried out as follows. A second questionnaire was prepared, listing all the tools. The respondents were asked to rate each tool on a 0-5 scale in the following four dimensions:

- What percent of the relevant organization employees apply the tool?
- What is the extent of use of the tool?
- What is the frequency of use of the tool?
- How much does the tool contribute to project management success?

The questionnaire was administered through individual interviews with the project managers in the participating companies. Analysis of the responses revealed two interesting conclusions.

First, it turned out that the dimensions were highly intercorrelated, meaning that the tools that are perceived to be the greatest contributors to project success are those that are applied in greater detail and more often by a larger fraction of the relevant employees in the organization. Thus, it seems that there is no need to ask four different questions in order to obtain the same answer, and we decided to have in the final a single question, with wording similar to question 4 in the pilot.

Second, it turned out that the tools list needed to be refined. Based on the responses we eliminated from the list duplicated tools, combined related tools, eliminated tools that were not applied in practice and added related tools that were missing from the list, yielding a final list of 38 tools, which appears in Exhibit 2. These are all generic analysis and management tools, and are not specific commercial implementations. For the reader interested in learning more about then, the applicable we included bibliographical references next to each tool description. The tools without references were added to the list based on suggestions from the panel. It is interesting to note that certain tools that are normally associated with risk management, such as decision trees, fault tree analysis and influence diagrams, were reported to be seldom or not at all used and consequently are not included in the final list.

Exhibit 1. Projects Risk Level by Company

Company	Overall risk level
A – Software development	0.53
B – Software development	0.43
C – Software development	0.42
D – Communications hardware	0.37
E – Chemical products	0.33

Project Risk Management Survey

The final version of the questionnaire, which was written in Hebrew, was distributed either personally or through email to a random sample of about 400 project managers from the software and high-tech sectors in Israel during April through June 1998. At the end of the survey period there were 84 usable completed questionnaires. The mean and standard deviation of the responses for each of the 38 tools appear in Exhibit 2. The rightmost column shows the ranking of the tools sorted in descending order of their mean score.

Analysis of Results

Of the ten tools that received the highest mean score, five belong to the Background group, and that all the tools in this group received scores above the overall average of 2.72. The fact that they also have relatively low standard deviation further suggests that there is agreement regarding their contribution to project management success. This finding indicates that risk management is tightly related to other management practices, such as requirements management, subcontractor management, and configuration control, and that the contribution of these types of organization-wide processes to effective project management is well recognized. Also, it appears that simulation and prototyping are development practices that are associated with risk management.

In the Analysis group we find two tools that had the largest standard deviation: Time Frame Assessment (T7) and Graphic Presentation of Data (T10). This finding suggests that there is wide variability in the perceived contribution (and, supposedly, use) of the two tools, meaning that some project managers find them useful while others don't. It could be interesting to investigate the reasons for the difference, however our data did not supply any statistically significant explanation.

Two tools in the Planning group received high average scores with low variability: responsibility Assignment (T11) and Action Item lists (T13). These are relatively simple tools, while the more involved tools in the group were scored lower. A similar finding can be observed in the Tracking group, where the only tool that received a high score was Risk reporting to Senior management (T22). Overall, it appears that are used are those that are simple and easy to apply, and do not require significant technical expertise.

The tools in the Control group are perceived as low contributors, with five out of six receiving below average score. There are two possible explanations for this finding. One is that currently there are no effective tools for risk control, and that the tools offered in the literature are not perceived to be adequate. The other explanation is related to management culture. Project managers might be willing to invest time and effort in the earlier phases of risk management, which are carried out in conjunction with other project planning activities. However, during the execution of the project they becomes busier and are subject to mounting resource and time pressures, and are likely to neglect the risk control phase. Consequently, risk control tools are used sporadically or not at all, and their contribution is rated as low.

Exhibit 2. Descriptive Statistics for the PRM Tools

Group	Tool	Description	Mean	Standard Deviation	Ranking
Identification	T1	Checklists [5]	2.20	0.98	36
	T2	Brainstorming [6, 7]	3.74	0.79	8
	T3	Risk documentation form [4]	2.65	0.94	29
	T4	Periodic risk reporting [4]	2.88	1.12	24
Analysis	T5	Risk probability assessment [1,2,4,5,8]	3.57	1.01	14
	T6	Risk impact assessment [1,2,4,5,8]	3.86	0.68	3
	T7	Risk time frame assessment [4]	2.58	1.25	30
	T8	Risk Classification [3,4,9,10]	2.38	1.17	33
	T9	Ranking of risks [1,2,4,5,8]	3.29	0.91	17
	T10	Graphic presentation of risk information	1.82	1.24	38
Planning	T11	Responsibility assignment[4]	3.99	0.84	2
	T12	Planning for risk mitigation [4,9]	3.61	0.99	12
	T13	Time-limited action-item lists	3.70	0.82	9
	T14	Cost-benefit assessment during risk planning[7,12]	2.69	1.08	26
	T15	Cause and effect analysis for risk planning [6,7,11]	2.33	1.14	34
	T16	Project replanning for risk mitigation [4]	3.17	1.05	21
Tracking	T17	Revision of risk assessments [4]	3.30	0.77	16
	T18	Periodic document reviews [4,5]	3.18	1.01	20
	T19	Periodic risk status reporting [4]	3.20	1.05	19
	T20	Periodic reporting of risk mitigation plans [4]	2.80	0.93	25
	T21	Periodic trend reporting [4]	2.58	1.01	31
	T22	Critical risk reporting to senior management [5]	3.75	0.99	6
Control	T23	Analysis of trends, deviations and exceptions [4]	2.69	0.93	27
	T24	Project replanning [4]	2.94	1.02	23
	T25	Procedure for closing risks [4]	2.20	1.27	37
	T26	Contingency plans for risk mitigation failure [4]	2.43	1.14	32
	T27	Cost-benefit analysis during risk control [7,12]	2.68	1.10	28
	T28	Cause and effect analysis during risk control [6,7,11]	2.27	0.99	35
Background	T29	Prototyping	3.75	1.03	7
	T30	Simulation	4.00	0.85	1
	T31	Benchmarking	3.58	0.87	13
	T32	Requirements management [13]	3.69	0.89	10
	T33	Subcontractor management [13]	3.77	0.96	5
	T34	Configuration control [13]	3.81	0.70	4
	T35	Quality control [13]	3.69	0.76	11
	T36	Quality management [13]	3.39	0.76	15
	T37	Training programs [13]	3.11	0.82	22
	T38	Customer satisfaction surveys	3.27	0.96	18
		Average across all tools	2.72	0.64	

[1] Boehm (1991)	[2] Sisti and Sujoe (1994)	[3] Carr et al. (1993)
[4] Dorofee et al.(1996)	[5] Down et al. (1997)	[6] Lumsdaine (1990)
[7] Xerox Corporation (1992)	[8] Air Force (1988)	[9] Brassard (1989)
[10] Brassard and Ritter (1994)	[11] Scholtes (1988) [12] Arrow (1988)	[13] Paulk et al. (1996)

Concluding Remarks

The objective of this study was to identify the tools that have the greatest potential for contribution to a project risk management process. The results of the survey provide important guidance with respect to this issue. First, any one facing the design of a risk management process should first consider the tools that are most commonly used. These are obtained from the ranking in Exhibit 2. Adoption of these tools brings the organization in line with the current state of the practice in the field.

The approach taken in this study is similar to the benchmarking methodology developed by Camp (1989), Balm (1992) and others: we looked at current practice in the more successful organizations and attempted to identify what it is that they do that others don't. This approach can be extended to other aspects of the risk management process, such as assignment of roles and responsibilities, timing and frequency of risk management activities, and amount of effort applied. It could also be applied to other processes related to project management, and, as the benchmarking proponents advocate, to many aspects of the organization.

Our specific methodology was based on a questionnaire that required a self-assessment of the efficiency of the project management practices in the organization and of the contribution of the risk management process. Although the possibility of respondent bias exists, we feel that by setting threshold values relative to the sample rather than in absolute terms, we overcome most of this difficulty.

Our survey was limited to the software development and high-tech industrial sectors. This was done because we suspected that in these sectors, which are characterized by very short opportunity windows, high uncertainty, and rapid decision-making, the need for simple tools and processes to manage risks ought to be greater than in others areas, such as construction, heavy manufacturing or services. Further, our review of the literature revealed that a substantial part of the tools and methodologies used in PRM were developed for these two specific areas.

Another limitation of this research stems from the unique characteristics of Israeli culture, which places a high value on personal initiative, improvisation and on-the-spot problem-solving, while giving less emphasis to disciplined work processes. It will be interesting to see if there are differences across various industrial sectors and different organizational cultures. Our impression, based on personal contacts with numerous project managers in different countries over the last several years, is that indeed this will be the case.

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