

An Assessment of Risk Identification in Large Construction Projects in Iran

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Abstract: One of the most important issue that a project manager must address in construction project management is risk management. Risk management includes identifying risks, assessing risks either quantitatively or qualitatively, choosing the appropriate method for handling risks, and then monitoring and documenting risks. By identifying risks in an early stage of planning and assessing their relative importance, project managers can identify methods used to reduce risks and allocate the best people to mitigate them. Thus, this research focuses on risk identification, as opposed to other processes of risk management. In Iran, "brain-storming sessions" is the most popular method used frequently to identify the risks in projects as deduced from a questionnaire survey from participants in large construction projects. Time and cost management need to be fully integrated with the identification process. Time constraints and project managers with sufficient experience are critical when identifying the level of risk for large and/or complex projects. The most considerable types of risk in construction projects are financial risks, construction risks, and demand or product risks.

Keywords: Risk management, Risk identification, Construction Projects, and Iran

INTRODUCTION

Construction companies and firms in Iran, such as the government, consultants and contractors, normally face different kinds of risks (e.g., environmental, physical, political, social and economic risks) during construction. However, most of them do not predict risks when they are considering bids and tenders. Construction risk is generally perceived as events that influence project objectives, i.e., cost, time and quality. Some of the risks associated with the construction process are fairly predictable or readily identifiable; others may be totally unpredictable (Al-Bahar, 1990). In project management terms, the most serious effects of risk can be summarised as follows:

1. Failure to keep within the cost estimate.
2. Failure to achieve the required completion date.
3. Failure to achieve the required quality and operational requirements.

In recent years, intensive research and development have focused on project risk management. Project risk management is widely recognised as one of the most critical procedures and capability areas in the field of project management (Artto, 1999). Voetsch, Cioffi and Anbari (2004) find a statistically significant relationship between management support for risk management processes and a reported project success. However, shortcomings and improvement opportunities in this field have been identified. Some of the shortcomings are related to the ever increasing complexity of projects. Subcontracting is expanding because many

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companies are focusing solely on their core businesses, which results in more complex construction projects and greater numbers of project participants.

As a developing country, Iran has not focused on risk management. This study aims to better understand the risk identification process and other risk processes. Risk identification is the first process in risk management. Therefore, this study focuses on risk identification because it is important to know how the players in the construction industry handle risk identification. Without having any perspective on or approach for risk identification, construction participants cannot make appropriate decisions in other risk management processes.

This study evaluates risk identification by better understanding the processes and guidelines related to the risks in large and infrastructure construction projects, so that project risk management can be more effective. It has already been recognised that a clear understanding of the risks born by each participant leads to better risk allocation. The objective of this study is to find means of identifying risk management and other processes that can be utilised and to make new suggestions on the use of these risk management methods. It is of particular interest to find the means to manage risks that are the most effectively managed with the co-operation of several project participants.

LITERATURE REVIEW

Risk management is the systematic process of identifying, analysing and responding to project risk. It includes maximising the probability and consequences of positive events and minimising the probability and consequences of adverse events to meet the project objectives (PMI, 2000). According to Al Bahar and Crandall (1990), risk identification is defined as the process of systematically and continuously identifying, categorising and assessing the initial significance of risks associated with a construction project.

Risk Identification

Risk identification is an iterative process that involves the project team, stakeholders and other managers affected by or who affect the project, and finally outside individuals who can comment on the completeness of the risk identification based on their similar experiences (Wysocki, 2004).

Risk Identification: Level 1 characteristics

1. There is no defined and documented process for identifying risks.
2. Project team members occasionally suggest potential risks to the project manager.
3. Project teams initiate risk discussions on an as-needed and when-needed basis.

Risk Identification: Level 2 characteristics

1. There is a defined and documented process for risk identification.
2. The project team examines the WBS, cost, schedule and other relevant aspects of the project plan to identify the operative risks.
3. Risk identification includes input from clients and stakeholders.
4. Risk discussion includes cost, schedule and scope.
5. The project team may rely on industry lessons to identify risks.

Risk Identification: Level 3 characteristics

1. There is a documented standardised risk identification process in place that is used by all projects.
2. There is a historical database of risks that project teams can use as a template.
3. Interproject risks are identified.

Risk Identification: Level 4 characteristics

1. The risk identification process is fully integrated into other corporate processes and procedures.
2. Lessons learned and best practices are captured and made available to other projects.

Risk Identification: Level 5 characteristics

1. A program is in place for the continuous collection and analysis of risk identification process performance data and used to improve the process.
2. Lessons learned and best practices are used to improve the risk identification process.

By identifying risks at an early stage of planning a construction project or a tender and assessing their relative importance, the project management can be adapted to reduce the risks and allocate them to the parties best able to control them or absorb them should they occur. Studies should be carried out early in the life of a project, well before decisions are made to proceed with the project (Thompson and Perry, 1992).

Methods for Risk Identification in Construction Projects

Four techniques are commonly used to identify risks in construction projects (Smith, Merna and Jobling 2006; Kendrick, 2009):

1. Industrial checklists are typically prepared by a documentation specialist for various project and product documents. Checklists often key into potential failure points in past projects and thus are very useful in identifying risks. Interviewing project personnel from each discipline and

staff within the organisation who have experience of similar projects ensures that corporate knowledge and personal experience are utilised in the process of identifying risks. This technique allows project personnel to identify the risks that they can see in the project and gives them a feeling of involvement in the process and ownership of the identified risks, which should then lead to a greater acceptance of any measures implemented to reduce the risks.

2. Interviews with key project participants or analysis of historical data for similar projects and examining similar current or previous projects, risk assessments, lessons learned or project evaluations are other means of obtaining feedback about risks.
3. Examining historic data from previous similar projects utilises corporate knowledge. However, an organisation may not have carried out a similar project, or the data from a previous similar project may not have been recorded; thus, this technique can only be successful in a limited number of cases. Database systems that actively manage and report the progress of projects may be a useful source of information. However, such systems are often limited in terms of the useable or relevant data that are stored.
4. Brainstorming with the project team may be valuable for projects involving new or unusual risks, innovative management arrangements or to develop initial checklists. This technique may be a useful element of risk management workshops.

Brainstorming sessions involve getting the key project stakeholders together to identify and prioritise the risks in the project. This technique enables the stakeholders to hear what the other members of the project team see as risks and to use these ideas to inspire them in identifying additional project risks. It is important to choose the people who comprise the brainstorming group carefully because the right mix of project personnel with appropriate experience and seniority is needed to ensure a successful session.

Source of Risk Identification Activity

A risk management plan provides important input for identifying risks, but because most companies start the process of handling risk with the Work Breakdown Structure (WBS) and the task list, the identification of risk usually starts in earnest in the review and final production of the generic WBS. It is here that the project manager reviews every task for its potential for failure. Identifying risk involves a lot of discussion with team members and stakeholders. For instance, if a technical task in the WBS, such as achieving a given mean-time-between-failures in a product component, is identified initially because of the challenges of completing it, then it is the subject of much discussion and contingency planning early in the project (Kendrick, 2009).

Work Breakdown Structure

The WBS is the basic risk identification activity because it embodies all the work of the project, or should. The WBS should have four levels, to provide enough details to identify project risks.

The WBS is a deliverable-oriented hierarchical decomposition of the work to be executed by the project team that accomplishes the project objectives and creates the required deliverables. The WBS organises and defines the total scope of the project and subdivides the project work into smaller, more manageable pieces of work, with each descending level of the WBS representing an increasingly detailed definition of the project work. The planned work contained within the lowest-level WBS components, which are called work packages, can be scheduled, cost estimated, monitored, and controlled (PMI, 2004).

Product description

The product description is embodied in a configuration management document or in a document, drawing, or specification that defines the product from a performance and component perspective. The description is generated in the design phase when the deliverable has been fully defined.

Schedule and cost estimates

The schedule and project budget (part of the schedule in a MS Project) are good sources to confirm risks, but first, the project manager must prepare a risk matrix as described earlier. The risk matrix identifies the task, the task risk description and the impact (e.g., schedule and cost).

Resource plan

While there is typically no formal resource plan, the general need for personnel, equipment, capital, space and technology is known. Ideally, this resource plan is in one place, for example, in a MS Project or in a planning document. If the resources needed for the project are not clear at this point in the design process, it is not critical. What is needed is a clear idea of the "bottleneck" resources—those resource issues that could represent a barrier to completing the project. These bottleneck resources might be a critical software engineer who is already spread too thinly on current projects, a piece of testing equipment that is critical to meeting quality control thresholds, or a work space or station that is being shared with other projects.

The theory of constraints must be applied to the resource plan. The theory states that the focus of attention in planning and control should not be the whole project and all its tasks, but rather the one or two major resource constraints. The project manager protects against the risks inherent in these resources by identifying time and cost issues from the original estimates and withholding them for allocation when they are needed.

Assumption and constraint lists

An assumption list is a convenient way of indicating the controlling assumptions, e.g., the assumption that a sole source contract with a foreign supplier for a key product component lasts through the project life cycle. In practice, these assumptions are well known by the project team and stakeholders, but it is important to document them and revisit them in project review sessions and to treat them as risks with contingency plans.

Approach to Risk Management

According to Smith, Merna and Jobling (1999), there are two basic approaches to risk management in projects:

- An informal approach
- A formal approach

The type of approach adopted influences the procedures and processes that will be used to manage risk in construction projects.

Formal approach

The formal approach consists of a set of procedures established by an organisation for use in the risk management process. These procedures are structured and give guidelines to be followed, so that they can be used by any member of the organisation. This structure ensures the uniformity of the approach to various problems. This formalisation of the risk management procedures ensures that the process is more objective than the informal approach. Most authors recognise objectivity as an essential feature of risk management.

Formalised procedures for risk management in projects are designed to suit the needs of the particular organisation; thus, there is no single methodology. However, there are frameworks for formalised risk management. Procedures do not detail the methods that should be used but allow the user to choose appropriate techniques. The quality of a formal process of risk management generally depends on management awareness, motivation of project personnel, a methodical approach, the information available (often linked to the project phase), the assumptions and limitations upon which the risk analysis is based, the qualifications and knowledge within the project, and the experience and personality of the risk analyst leading the process. Similarly, there are many well-known assessment pitfalls, including management bias, which occurs when an uncertain variable is viewed as a goal rather than as an uncertainty, and expert bias, which occurs when experts are expected to be certain instead of allowing them some uncertainty. This bias may lead to an underestimation of uncertainty.

Informal approach

One of the most widely used techniques in the informal approach to risk management is the provision of contingency funds. There are two main types of contingency funds: lump sum contingencies and percentage contingencies. A

lump sum contingency is a sum of money put aside in the project budget that is to be used if extra money is required during the project. A percentage contingency is similar to a lump sum contingency; however, instead of being a fixed sum money, it is a percentage of the total project cost according to the project budget.

Contingency funds can be used as a risk management technique because the amount of money allocated to a contingency fund should be representative of the cost of the risks thought likely to occur in a particular project. A contingency fund is not financially representative of all the possible risks in a project because it is unlikely that all the possible risks would be realised. Thus, while a contingency fund is available, it is not to be spent unless it is needed.

Other informal procedures for the management of risk involve talking to experts or people with experience in similar projects and gaining their views as to the possible risks in a project and then reviewing the project given the identified possible risks.

The situation and environment are subject to change and may grow more demanding; thus, all participants become more conscious of the risks they are carrying. Therefore, implementing risk management is approached with either formal or informal methods to ensure the project objectives are achieved.

Finally, identifying risks is not a science: it is an art. It does not require a sophisticated, mathematical exercise, although some measurement may be useful to dimension the risk. Given a project description including project goals, work breakdown, schedule, and resource assignments, potential risks can be identified and categorised using various tools such as risk assessment, brainstorming, peer review, and document review (Barkley, 2004). Risk is always present and must be dealt with accordingly. Risk management can be sophisticated and complicated, but the starting point should always be a simple assessment of the problem and possible solutions.

The risk management process can be defined as a logically consistent framework used to develop the process of finding and understanding alternative risks, assessing their risk and uncertainties, identifying the resources needed and choosing appropriate courses of action to address these risk factors and achieve the desired results. The construction industry is subject to more risk and uncertainty than many other industries. Therefore, the need for risk management is higher. The managerial techniques used to identify, analyse and respond to risk have been applied in the industry using either an informal approach or formal approach.

METHODOLOGY

To achieve the objectives of this research, questionnaires were deemed to be the most effective tool for gathering information. These questions helped identify any projects that should definitely not be undertaken by the parties and those which, although risky, should be examined further after a more rigorous examination of the potential sources of risk. The questionnaire was designed based on the knowledge of Iranian players (government, consultant, or contractor) in large or infrastructure construction projects; the questions were meant to identify their method of risk identification and possible effects of those risks.

This study was carried out based on a literature review and a questionnaire survey. The data were collected through questionnaires, which were distributed through postal and electronic mailing to selected groups of 43 respondents (mainly people who work for construction companies/ firms who enjoy a leading role in planning and construction management, e.g., project managers, general managers, civil engineers, site managers, site engineers, supervisors) from government, construction and consulting companies and firms in the defined area of study. Subsequently, data collection from the questionnaire survey was analysed using statistical methods, and the results of the non-parametric test were presented.

ANALYSIS AND DISCUSSION

As shown in Table 1, there were three methods related to risk identification in construction projects ranked on the basis of relative importance from the perspective of government employees, contractors and consultants. The results show that brain-storming sessions were the most significant method that contributed to identifying the risks of a project. Brain-storming sessions and analysis of historical data for similar projects were found to be the most preferred methods of risk identification in the Iranian construction industry. However, it was suggested by the respondents that these practices led to informal risk identification.

Table 1. Non-parametric Test on Three Methods for Risk Identification

Methods for Risk Identification	Mean Rank	Rank
Brain-storming sessions	2.25	1
Analysis of historical data for similar projects	2.09	2
Use of industrial check-lists	1.66	3

The preferable method of identifying risk is the use of methods that make each project team member focus on risks specific to the project. The process must be carefully managed to remove individual and group subjectivities. The identification process is concerned with risk sources, not risk effects, and different methodologies are suggested.

In Table 2, the results of the relative importance of risk identification processes are shown based on their mean value (the average indexes). The mean for some processes indicates that time management and cost management have affected the process of identifying the risk.

Any identifying project risk management process must be tailored to the particular circumstances of the project. The risk identification process is fully integrated with cost and time management processes. The size of a project certainly influences the standard and formal risk identification process. Applying all processes of risk identification for other projects is encouraged.

Table 2. Non-parametric Test on Risk Identification Process

Risk Identification Process	Mean	Rank
Is the risk identification process fully integrated with cost management and time management processes and the project office?	4.0184	1
Is the process considered standard for large, highly visible projects?	3.3620	2
Is the process encouraged for all projects?	3.2515	3
Does documentation exist on all processes and standards for identifying risk events?	2.7607	4
Does the process include efficient avenues for teams to identify risks (checklists, automated forms, etc.)?	2.6933	5
Does the organisation have a documented repeatable process for identifying project risks which is fully implemented?	2.6012	6
Are all processes in place, documented and being used?	2.1902	7

Rating Scale: (Agreement)

1 = Strongly disagree; 2 = Disagree; 3 = Less agree; 4 = Agree; 5 = Strongly agree

The main objective of this section is to assess the level of knowledge and awareness, including the perception of construction industry players, of identifying the level of project risk in general. Questions were ranked based on the level of importance (the average indexes) to identify the specifications of project risk, as shown in Table 3.

To identify riskier projects, in addition to doing the projects in the developing countries, there are some other factors that can be categorised based on importance. It is necessary to take into account the project complexity and size, extreme time constraints, sufficiently experienced parties and novel methods of risk identification, among other factors, to identify the level of project risk.

During a construction project, risks can result from many circumstances. Based on the data analysed earlier, a total of eleven sources of risk in construction projects were compared, as shown in Table 4. Financial, construction and demand and product risks are the greatest risks in construction projects.

There are some sources of risk associated with engineering projects that have been identified. These sources of risks, the risk drivers, could be used as a checklist. However, the key sources of project risks are essentially the same.

The risks associated with Iranian construction projects included financial risks (project funding problems), construction risks and demand and product risks. These generic risks influenced the achievement of construction project objectives in Iran. Financial risk involves the relationship between an individual (or an organisation) and an asset or expectation of income that may be lost or damaged. A common concern with any investment is that the initial capital invested may be lost. This risk is therefore often referred to as capital risk. Construction risk can also be related to the loss associated with three primary constraints: time, cost and quality.

Table 3. Non-parametric Test to Identify the Level of Project Risk

Identifying the Level of Project Risk	Mean Rank	Rank
Is the project large and/or extremely complex?	3.92	1
Is there an extreme time constraint?	3.71	2
Are the parties involved sufficiently experienced?	3.61	3
Is the project sensitive to regulatory changes?	3.48	4
Does the project require novel methods?	3.3	5
Does the project require new technology or the development of existing technology?	2.98	6

Rating Scale: (Importance)

1 = No importance; 2 = Low importance; 3 = Medium Importance; 4 = High Importance; 5 = Critically Important

Table 4. Non-parametric Test on the Checklist of Construction Risk Drivers

Type of Risks	Mean Rank	Rank
Financial risks	7.92	1
Construction risks	7.33	2
Demand/ product risks	6.77	3
Political risks	6.4	4
Environmental risks	6.24	5
Technological risks	6.05	6
Geographical risks	5.86	7
Geotechnical risks	5.61	8
Communications risks	5.48	9
Legal risks	4.63	10
Social risks	3.73	11

Rating Scale: (Importance)

1 = No importance; 2 = Low importance; 3 = Medium Importance; 4 = High Importance; 5 = Critically Important

In Table 5, the relative frequency of the role of project team members based on mean rank value are depicted. The mean illustrates that the respondents agreed upon having informal behaviours of risk management when the risks occur. Team members did not predict the risk, or the probability of it occurring, in the planning phase, and they await risk in the construction phase of the project.

The role of project team members shows that they dealt with risk in projects when they encountered it. All processes of risk identifications and other processes in place were documented and being used. At the same time, they did not formally use the scope statement, the WBS or the project milestone. Therefore, it can be concluded that among team members, there are no formal methods or approaches for risk identification and other steps of risk management.

Table 5. Non-parametric Test on the Role of Project Team Members

The Role of Project Team Members	Mean Rank	Rank
Are all processes in place, documented and being used?	4.94	1
Are project team discussions on risk sporadic and informal?	4.39	2
Do project managers informally use scope statement, WBS and project milestones to help identify project risks?	4.29	3
Do risk discussions typically take place when the risk is already a current problem versus a future possibility?	3.89	4
Does the project team examine the procurement management plan and staff management plan to help identify risks?	3.76	5
Do project team members rarely suggest potential risks to the management or stakeholders	3.46	6
Does the organisation have a documented process for identifying project risks?	3.28	7

Rating Scale: (Frequency)

1 = Very uncommon; 2 = Uncommon; 3 = Neutral; 4 = Common; 5 = Very common

As shown in Table 6, the respondents agreed that they had a method for identifying priorities and practices from which they learned lessons based on their rankings for improving the identification of risk in construction projects.

Table 6. Non-parametric Test on Improving Risk Identification

Improvement the Identification of Risk	Mean	Rank
Does the risk identification process include a method to identify a priority for the project?	4.1288	1
Are best practices and lessons learned being used to improve risk identification?	3.4785	2
Is there a process in place for the continuous improvement of the qualitative risk management process?	3.3804	3
Is there an improvement process in place to continuously improve risk identification to completely identify all risks as early as possible?	2.5521	4

Rating Scale: (Agreement)

1 = Strongly disagree; 2 = Disagree; 3 = Less agree; 4 = Agree; 5 = Strongly agree

To improve risk identification, there must be a method for identifying the priorities for the project. Then, lessons and experiences can be used to identify risks. There are some activities that lead to continuous improvement of qualitative risk management. Similar criteria must be taken into account to improve risk identification. The aim of this research is not to convince readers that a specific, rigid approach to project risk management should be adopted but rather to present a general methodology that can be adapted to the project and circumstances and to find ways to develop different project risk management identification tasks for various environments, projects, firms and companies.

CONCLUSION

The research results were obtained through questionnaire surveys conducted in Iran. The specifications for identifying project risk that have been particularised for construction projects have been presented from diverse points of view (from government, consultants and contractors) and construction companies and firms that may be helping the process of dealing with the project in the planning and construction phases. The process can also be adapted to identify the level of risk for a particular project.

The brain-storming sessions and analysis of historical data for similar projects were found to be the most preferred methods of risk identification in the Iranian construction industry. The risks associated with Iranian construction projects included financial risks (project funding problem), construction risks and demand/product risks. These risks commonly prevent the completion of construction project objectives in Iran. In contrast with other countries, Iranian construction projects generally have been practiced with an informal approach for risk management. A minority of the firms in Iran have a formal approach in risk management; small and new firms are more likely to use a formal approach.

Formal risk management identification and its relevant methods are infrequently used by the construction industry due to the absence of knowledge and proficiency. In most situations, government employees, consultants and contractors wait until issues arise during construction phases. Team members often document and apply the process in place and their discussions are informal and sporadic.

In addition, many factors referred to in the research can be applied to other construction projects. In many construction projects in Iran, no systematic approach exists for risk identification; however, the participants can deal with the risk when it happens based on their experience and skills. The formal risk management identification and its relevant methods are infrequently used by the construction industry due to the absence of knowledge and proficiency.

REFERENCES

- Al-Bahar, J.F. and Crandall, K.C. (1990). Systematic risk management approach for construction project. *Journal of Construction Engineering and Management*, 116(3): 533–546.
- Arto, K.A. (1999). *Development of World-Class Practices in Project Companies*. In *The Future of Project Management*, Project Management Institute Research Series. Newtown Square, PA: Project Management Institute (PMI), 127–137.
- Kendrick, T. (2009). *Identifying and Managing Project Risk: Essential Tools for Failure-Proofing Your Project*. 2nd Edition. New York: AMACOM Div. American Management Association.
- Project Management Institute. (2004). *A Guide to the Project Management Body of Knowledge*. Newtown Square, Pennsylvania: PMI.
- . (2000). *A Guide to the Project Management Body of Knowledge*. Newtown Square, Pennsylvania: PMI.

- Smith, N.J., Merna, T. and Jobling, P. (2006). *Managing Risk in Construction Projects*. 2nd Edition. Oxford: Wiley-Blackwell.
- . (1999). *Managing Risk in Construction Projects*. Oxford: Wiley-Blackwell.
- Thompson, P. and Perry, J.G. (1992). *Engineering Construction Risks: A Guide to Project Risk Analysis and Assessment Implications for Project Clients and Project Managers*. London: Thomas Telford.
- Voetsch, R.J., Cioffi, D.F. and Anbari, F.T. (2004). Project risk management practices and their association with reported project success. In K. Wikstrom and K. Artto (eds.). *Proceedings: IRNOP VI Project Research Conference*. Turku, Finland, 27 August.
- Wysocki, R.K. (2004). *Project Management Process Improvement*. Norwood: Artech House.