

Improving International Capital Project Risk Analysis and Management

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Introduction

Risk analysis and management is critical to the decision-making process for construction projects, yet few decision tools and guidelines exist to assist both owners and contractors with international capital facility planning and construction. The global market is an increasing factor for businesses and the growth of foreign private investment and demands for capital facilities requires owners to assess a diverse set of political, geographic, economic, environmental, regulatory, and cultural risk factors when contemplating international capital projects. Contractors must consider a similar set of risk factors in determining whether to undertake such projects, and how to price, schedule, and successfully deliver the work if they do. Although an increasing demand for international project risk analysis is apparent, a limited body of research and non-proprietary management tools exists to address these issues. Current efforts to evaluate the portfolio of risks associated with international construction are fragmented and fail to provide similar risk categories and elements for contractors and owners at both the project and senior management level. The lack of the continuity between project parties pursuing the same goal to manage risks is compounded when the frequency and scope of the risk analysis does not carry through from project development to operations.

The Construction Industry Institute (CII)—with additional support from the Center for Construction Industry Studies (CCIS) at the University of Texas at Austin, and the Design-Procurement-Construction Specific Interest Group (D-P-C SIG) of the Project Management Institute (PMI®)—appointed a research committee and began work in April 2001 on a study to improve risk analysis procedures for international construction. Project Team 181 consists of fourteen individuals representing CII member companies with a balance between owner and contractor representatives, PMI

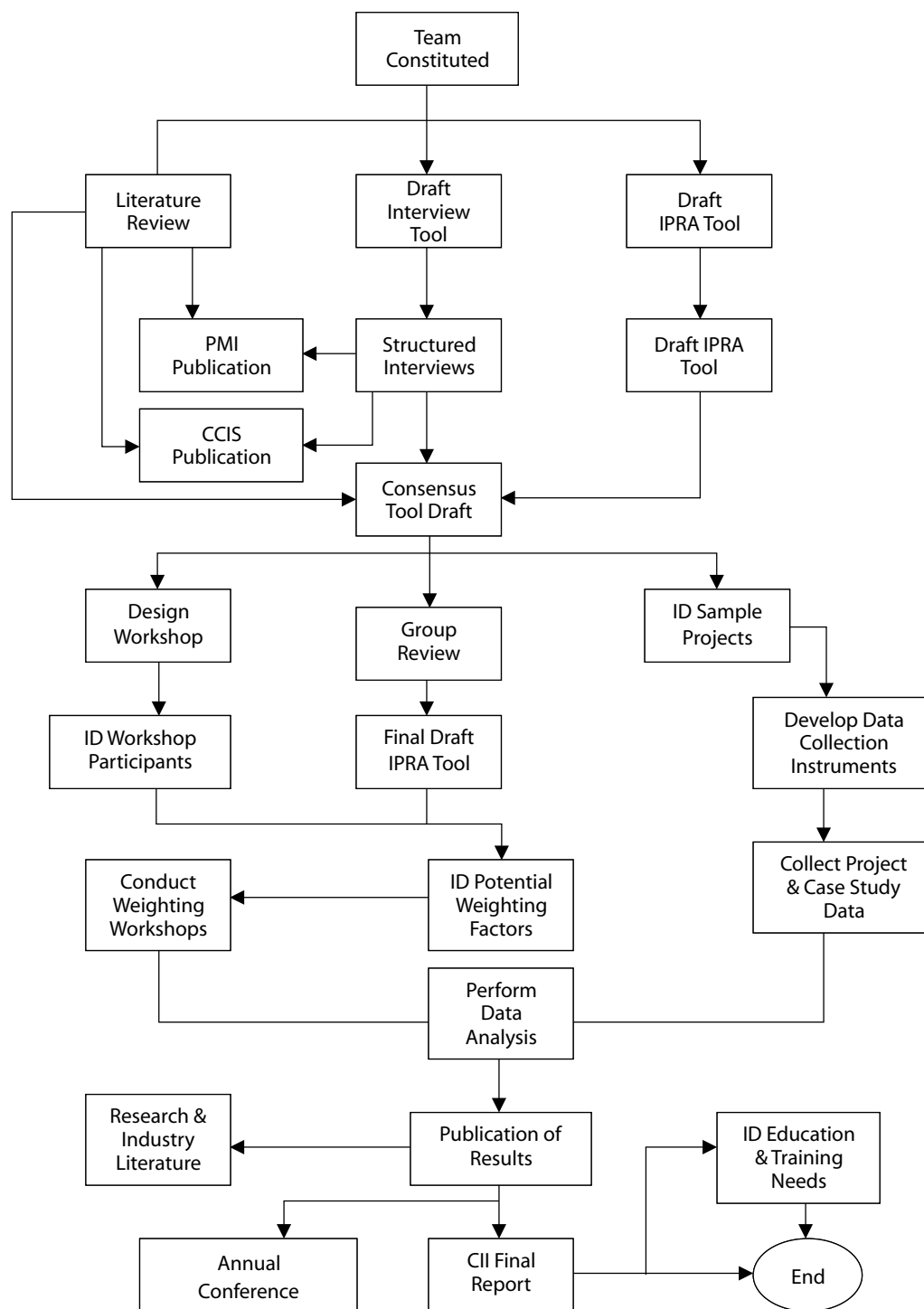
DPC-SIG, and the University of Texas at Austin. The goal of this two-year collaborative research effort is to develop a process, methods, and metrics to increase the success of international capital facilities for owners and contractors, with project success defined as budget and schedule achievement, and meeting technical and operational objectives. Principal beneficiaries of the results will be to the industrial, building, and infrastructure sectors, including both private and public organizations that conduct international operations and activities. The tools and techniques should also be relevant to organizations outside of construction given that many project risk issues and factors are generic and systemic.

This paper will provide a brief overview of the issues driving the purpose and need for this research, status of the work including the study's methodology and procedures, literature, and structured interview results, and an introduction to the proposed instrument to facilitate systematic risk analyses to improve decision-making on international projects for both owners and contractors. The paper concludes with a report of preliminary findings and the resulting path forward.

Scope of Issues

Construction is a combination of economics, engineering management, business, socio-cultural, and legal factors, and working in an international setting often requires a much wider view of the project's context than with domestic projects. International construction defined for this research project is limited to North American companies doing work outside of their home country. This geographic distinction is mostly due to the national origins of companies belonging to CII with twelve of the world's 100 largest transnational corporations and twenty-six of the largest contractors from North America. However, there is reason to believe that what

Exhibit 1. Research Tasks Flow Diagram



is applicable to the CII membership could also be used by other companies operating in an international setting.

Construction is a major worldwide industry accounting for approximately \$3.4 trillion, or almost ten percent of global Gross Domestic Product (ENR 2000; Batchelor 2000; Bon 2001). Proportionally, the majority of international construction activity is conducted by local, regional, or na-

tional entities, yet an increasing percent of industry participants operate on an international level (Bon 2001). Although the United States (US) is the largest construction market—estimated at over \$800 billion—projects completed outside of the domestic market, have long been and will become an even greater part of the capital investment portfolio of US owners and the work performed by American contractors.

Most industry analysts agree that international business opportunities will continue to attract US foreign investment and the international construction market will attract US contractors. Respondents to a survey on the future of international construction markets for the next twenty-five years, agreed that American firms in highly specialized construction services possess a competitive advantage, and are predicted to have the most competitive exports in construction services (Bon 2001).

An increasing global marketplace exists for both owners and construction firms as national boundaries have been opened and conventional market constraints diminished. The growth and activities of multinational corporations has been a major contributor to the creation of an international construction market. Foreign direct investment in 2000 from the US reached high levels of \$139 billion with a significant portion consisting of capital investment. For example, nearly 400 of the Fortune 500 firms have invested in over 2,000 projects in China including the world's leading manufacturers of computers, electronics, telecommunication equipment, pharmaceuticals, petrochemicals, and power-generating equipment (United Nations 2001).

Business theory and literature equate international ventures and projects as opportunities for above average return on investments, usually attributed to the corresponding higher risks. The high-risk, high-reward model is nothing new to construction industry participants, yet only 20 percent of the top 400 contractors undertake international projects (ENR 2001). To undertake successful international projects, it is necessary and critical for firms planning work overseas to have enhanced techniques to adequately evaluate and understand their projects and the associated risks.

However, understanding the risks associated with international capital projects is an important yet difficult task from both practical and research perspectives. Real world international projects are often first or one-time efforts that are difficult to assess and document. As a result, some companies use high minimum acceptable rates of return on international projects to judge their acceptability with the hope that this provides a built-in contingency margin to cover risk. Increased exposure to risk is an inevitable consequence of the economic, technological, and financial complexities of international projects, and the viability of long-term capital investments hinges on how the risks associated with such investments are evaluated and managed. Despite the presence of risk management consultants, computer software, and sophisticated statistical procedures, a demonstrated need exists for suitable risk analysis methods for owners and contractors that can be used throughout the various project stages.

Research Project Inception

Recognizing the difficulty of performing international projects, and as a subtask to CII's overall mission of improving the competitiveness of the construction industry, the Globalization Committee was created to assist CII member

companies to successfully complete projects outside of North America. A major emphasis of the Globalization Committee has been a series of forums open to CII member companies and other invitees that have given participants insight into the engineering, cultural, and governmental challenges in foreign locations for both start-up and continuing operations. To date, regional forums have already been conducted for Asia and Latin America with specific-country events held for China and Brazil.

As a result of the forums, recognition of market trends, and increasing input from member organizations regarding the need for improved data and information to facilitate the operation of member firms in global environments, the Globalization Committee successfully lobbied for the creation of a CII-sponsored research project to improve the capital investment process by advancing risk analysis procedures for international construction. As the Alfred P. Sloan Foundation sponsored research center for the construction industry, CCIS participation with this research effort was promoted by the interdisciplinary scope of the research, and the desire to continue its efforts to evaluate the changing nature of the project execution process and the implication of these changes on the industry. Facing similar international project risk challenges and concerns, PMI's D-P-C SIG joined the research effort at the onset of the project as part of its mission to explore and improve methods of improving construction project management.

Research Methodology

The research project and this paper are built on the hypothesis that international projects going through a systematic risk analysis and management process and associated decision-making steps will perform significantly better than projects that do not. The research methodology to define and test this hypothesis will follow the task flow as shown in Exhibit 1, and summarized as the following:

- Perform an extensive literature review, including information in the CII knowledge structure, in order to develop research hypotheses. Use information gleaned from CII's globalization forums, and industry/academic research.
- Develop and deploy a questionnaire and interview guide for selected CII owner and contractor organizations that will identify and assess specific issues and the approaches to manage the risks incurred on international projects.
- Develop an international projects risk tool conceptually similar to the Project Definition Rating Index (PDRI)¹ in the research team setting. The tool should be targeted towards project management staff but should also include a summary rollup feature for senior management.
- Conduct several case study evaluations with selected owner and contractor organizations to identify specific risk approaches to risk areas such as political, economic, cultural, environmental/regulatory, experience, legal, and technical areas. Incorporate these findings into the overall development effort.
- Conduct a series of workshops for invited personnel to comment on the tool and importance of individual weights.

It is envisioned that these workshops will tap expertise from 25–30 owner and contractor organizations, with representation of between 40–50 individuals.

- Finalize the tool and validate on completed and ongoing projects. It is anticipated that approximately 30 completed projects (after the fact) and 10–20 ongoing efforts will be assessed using the tool and to validate the model and process.
- Develop the required research publications and presentations.
- As necessary, develop, and deploy education material targeting an industry audience.

Synopsis of the Literature Review

The literature review to date has focused on academic research and industry reports and guidance on risk analysis for international capital projects. Given the limited body of knowledge specific to this topic, the review also included an investigation of risk analysis activity by the domestic construction industry, as well as general risk consideration by businesses undertaking ventures overseas.

With little surprise, the literature review has revealed a myriad of risk and risk-related definitions as applied to construction projects, and no standard definitions or procedures exist for risk analysis or its management associated with international construction. In the construction industry, risk is often referred to as the presence of potential or actual treats or opportunities that influence the objectives of a project during construction, commissioning, or at time of use (RAMP 1998). Risk is also defined as the exposure to the chance of occurrences of events adversely or favorably affecting project objectives as a consequence of uncertainty (Al-Bahar 1990). Dias and Ioannou (1995) concluded that there are two types of risk: 1) pure risk when there is the possibility of financial loss but no possibility of financial gain, and 2) speculative risk that involves the possibility of both gains and losses. CII's definitive work on construction risks (CII 1988) uses classical operations research literature to distinguish the concepts of risk, certainty, and uncertainty.

Determination of risk responsibilities and ownership is critical yet can be difficult to determine for international projects. The Fédération Internationale des Ingénieurs Conseils (the International Federation of Consulting Engineers, FIDIC) and the International European Construction Federation (FIEC) publish two well-known and widely-accepted forms of conditions of contract for international construction projects (the Red and Yellow Books) that include provisions on the fair and equitable risk sharing between the owner and the contractor as well as risk responsibilities, liabilities, indemnity, and insurance. A discussion on risk sharing is included in an analysis of the FIDIC Red Book (Bunni 1997) that includes a series of flow diagrams of the risks in construction, and their ensuing responsibilities, liabilities, and how these are dealt with by the Red Book (Conditions of Contract for work of Civil Engineering Construction).

Risk analysis, in a broad sense, is any method—qualitative and/or quantitative—for assessing the impacts of risk on plans and schedules. There are a variety of risk analysis methods that incorporate qualitative and quantitative techniques. A shorter list exists of those that combine both qualitative and quantitative techniques. The goal of any of these methods is to help the decision-maker choose a course of action, given a better understanding of the possible outcomes that could occur. Defining the basic concepts and processes of risk assessment and management for construction projects is a prerequisite to determine such risks for international projects.

The research team has noted the major difference between international and domestic projects in the presence of political risk. Political risk refers to the possibility that political decisions, conditions, or events in a country will affect the business climate in such a way that investors will lose money or not make as much money as they expected when the investment was made (Howell 2000). Analysis of political risks is the effort to determine the causes or sources of risk and to map the relationships between causes. Analysis both relies on and contributes to theory of political risk. Political risk analyses consist of both verbal and statistical methods and can be a major influence on international projects.

The global business environment requires risk management to expand to more than the terms of financial or hazard risk. Business risk management in an international setting differs from domestic factors. For example, multiple jurisdictions complicate decision-making, threats from deploying new technology are greater, and a foreign labor force creates many uncertainties. These factors—and many others—increase the risk of business venture failure, especially in the context of a worldwide economy.

Businesses throughout the world are or have implemented integrated risk management systems that identify, measure, and manage risk across the organization as part of their regular business and strategic planning processes. Often referred to as enterprise risk management, such awareness recognizes that all risks, whether strategic, operational, financial, or political, need to be monitored and managed on an ongoing basis (Debouch 2000; Miccolis and Shah 2000). These benefits include:

- Reducing the cost of capital by managing volatility
- Exploiting hedges and portfolio effects
- Focusing management attention on risks that matter by expressing disparate risks in a common language
- Identifying which risks to exploit for competitive advantage
- Protecting and enhancing shareholder value.

The value of systematic risk management of project activity is not fully recognized by the construction industry. Since no common view of risk exists, owners, investors, designers, and constructors have differing objectives and adverse relationships between the parties is common. Attempts at coordinating risk analysis management between all of the project participants have not been formalized and this is especially

Exhibit 2. Risk Sections and Categories for International Construction

Sections:	Commercial	Country	Facilities	Production & Operations
Categories for Each Section:	Business Plan	Political	Project Scope	People
	Finance/Funding	Cultural	Sourcing and Supply	Legal
		Legal	Design and Engineering	Technical
		Tax/Tariffs	Construction	
			Startup	

true between contractors and owners. The expected value of identifying and managing construction risks are to:

- Allow for early identification of hazards and opportunities
- Identify and manage uncertainty
- Identify and manage for worse-case scenarios
- Communicate risks between project participants
- Establish ownership of risks and risk mitigation actions
- Enhance risk-based decision-making.

Research by Han and Diekmann (2001) on developing a *Go/No-Go decision model* for risk identification involving international construction, groups risk into categories consisting of political, economic, cultural/legal, technical/construction, and other/special. Under each category, more specific risk elements were identified and defined. For example for the category economic risks, the specific elements are: *currency exchange, currency restrictions, inflation, burden of project financing, and tax/tariff discrimination and change.*

CII research (CII 1988) is consistent with the literature (ASCE 1979; CIRA 1994; Kangari 1995; Project Management Institute 2001; Smith 2001) on what is considered the sequential procedures for construction risk identification and management.

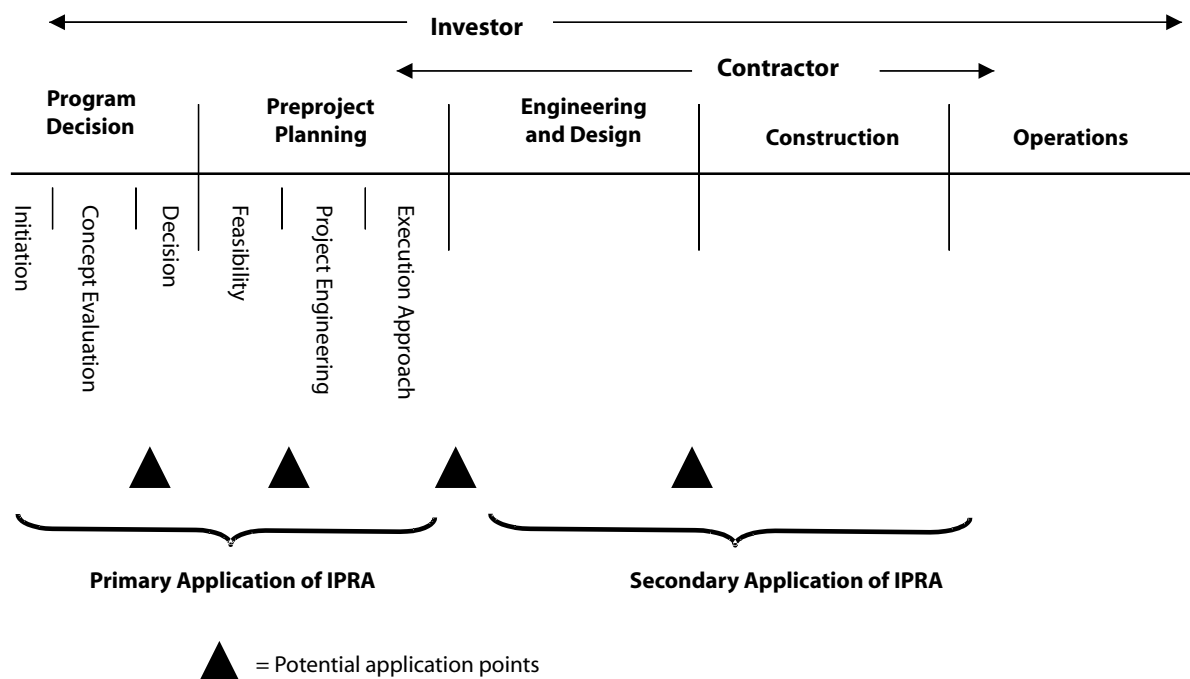
- Identification
- Analysis
- Measuring impact
- Management response.

The literature review has identified an adequate treatment of identifying what are the major risks surrounding construction. However, very little work has been done that addresses both owner and contractor risks, including how to conduct an effective program, and the risk elements that are specific to projects conducted in an international setting.

Synopsis of the Interviews

The committee developed a structured interview instrument with the intent to capture information on why organizations pursued international capital facilities and investments, current risk analysis process and procedures, and the effectiveness and results of current risk analysis and management practices. Interviewees were selected from a broad range of private sector companies and public sector organizations within and connected to international construction. They included representatives of the owner components of the industry, contractors, engineering service firms, lawyers, insurers, and financiers. The limited number of interviews conducted to date does not permit the formulation of conclusions that are representative of all members of the construction industry or the affiliated entities. Seeking industry input was seen by the committee as a technique to identify potential indicators of the issues that need to be examined by interpretation of the interviewees' responses.

Exhibit 3. Potential Application Points of the Tool



To date twenty-four interviews have been conducted with most reporting that they have increased their investment and the number of international projects over the past ten years with the majority occurring in the past five years. Almost all of those interviewed performed some level of risk analysis and mitigation measures when undertaking international projects, and about a third of the companies reported a structured process carried out by a specific unit or group. Only one respondent noted that their current process and practices were completely adequate in identifying the portfolio of risks for international ventures. The majority of respondents identified current risk analysis practices as inadequate or fairly adequate in their ability to identify or weigh the portfolio of risks. Some interviewee described their procedures as either too subjective or too quantitative, and most noted that analysis results could not be used from project to project. About one-third of the respondents reported the use of quantitative methods to assess project risk, with the majority relying on subjective judgment. A majority of owners and contractors reported disconnects between decision-makers and project personnel, often severe enough to impact outcomes.

The interviews conducted to date have highlighted the diversity of risk analysis and management techniques deployed by owners and contractors. Overall, the research team has found that most large contractors and sophisticated owners engage in some type of risk analysis as part of an overall risk management program, although the depth and quality of these efforts vary widely. When risk analysis activities do take place they are often conducted as a one-time effort at the onset of a project. Even if organizations

have an in-house risk analysis/management program there is no standard way of quantifying procedures in place to carry lessons learned forward.

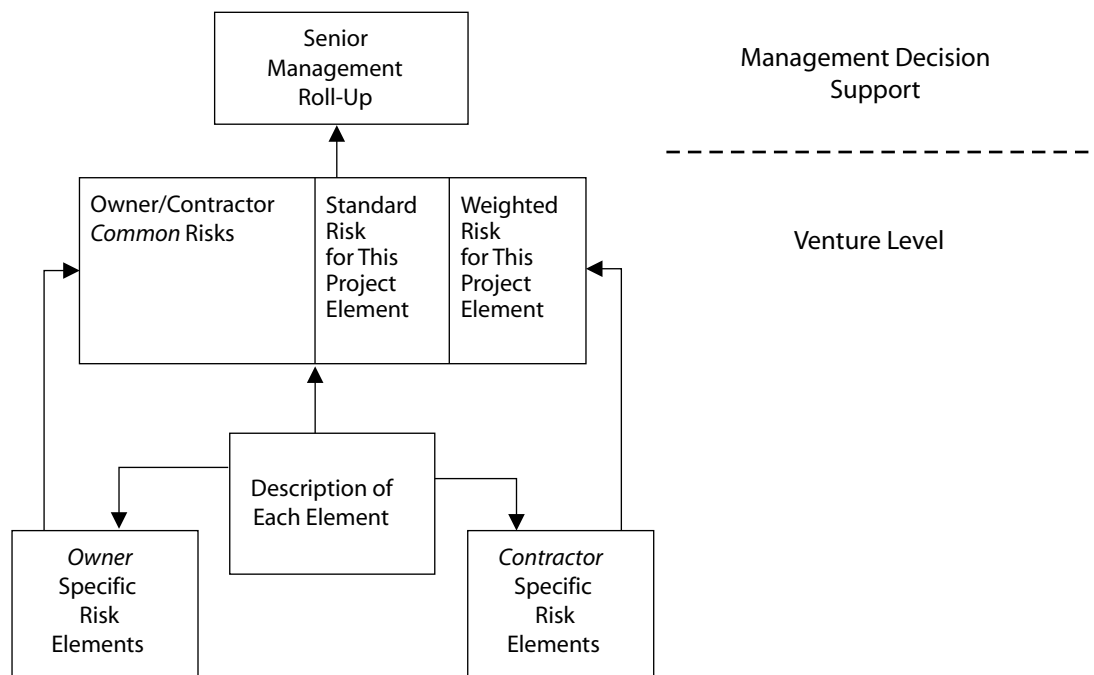
Risk Analysis Tool Development

The basis of the assessment tool originates from the literature review, structured interviews and the collective knowledge and experience of the project team. Giving consideration to a generally accepted risk process as well as the sequential nature of projects was a critical objective of the committee in the development of the risk analysis tool. The project team felt it necessary for the tool to incorporate qualitative and quantitative analysis methodologies that required further investigation into the identification and description of the risks, assessment and analysis of the identified uncertainties, and an understanding of preliminary management actions. The following sections further detail the risk management process, the potential application, and the draft tool.

Risk Identification

Successful project management requires the identification of the factors impacting project scope definition, cost, schedule, contracting strategy, and work execution plan. Identifying the risks associated with international construction projects is a critical and feasible task. Lists of relevant construction risks (Kangari 1995; RAMP 1998; Smith 1999), as well as political risk are available (Ashely and Bonner 1987; Howell 2001). To be most beneficial, risk identification should be initiated early

Exhibit 4. Conceptual Framework and Tool Use



in the project's life cycle, and if possible during the feasibility stage via the project sponsors. Since many project risks may not be apparent from the onset or may evolve over time, risk identification may have to be conducted on a periodic basis for the duration of the project. On large or more complicated projects, systematic approaches such as checklists and structured expert reviews are often used to identify risks.

The risk identification phase consists of identifying all the possible risks that may significantly impact the project's success. These risks may range from high-impact/high-probability, through high-impact/low-probability, low-impact/high-probability to low-impact/low-probability. The high and medium-level risks, including accumulations under any one item of risk, should receive the most attention. Moreover, combinations of risks, which together pose a greater threat than each individually, should not be overlooked.

Risk identification is incomplete if the symptoms of each particular risk are not identified. These symptoms can then be used as triggers for project management to measure when a risk is progressing to a stage when it must be significant and be addressed. There are numerous methods of identifying risk such as, interviews, questionnaires, and in-depth reviews by knowledgeable staff or consultants. Identification techniques can be used on an individual basis or combined with the goal to ensure that all risks are fully identified so they can be adequately assessed and the potential impacts evaluated. Identification and defining common international project risk elements was a task deemed crucial by the committee and resulted in a more comprehensive literature review, and inventory of risks considered to be pervasive on assignments abroad.

Risk Analysis

Through the literature review and structured interview process, the research team has identified that the next phase of the risk management process involves an analysis process consisting of the following:

1. Identification of the risk events using an agreed upon set of descriptions. The risks that should receive the closest attention are those that could have both the greatest impact on the project as well as the most likely probability of occurrence.
2. Estimate probabilities associated with the relevant risk events.
3. Evaluate the severity of specific risk events with the knowledge that individual projects risks are interrelated.
4. Provide a mechanism to assess the severity of each risk element and collectively using the project timeline from inception to the closeout of operations as the framework to categorize risks.
5. Provide a process to capture the lessons learned conducting the outlined analysis.

The conclusions to these process steps will delineate which of the risk elements for international construction projects are applicable for this particular project. Any other significant risks would also be added. The total number of risks to be addressed in the next phase of risk response need to be delineated with expected project costs for implementing the risk response approaches. From a practical, economic standpoint this will reduce the number of risks to be addressed in the next risk response phase.

The basic framework of developing a useful risk analysis tool consisted of brainstorming sessions combined with

items identified in the literature review were combined for the specific risk elements. The research team identified four major sections (commercial, country, facilities, and operations), and the categories within each section are identified in Exhibit 2. It is envisioned that each section, category, and risk element will be broken down in this fashion and the draft “score sheets” can be used to rate the risk severity level for each element. Each section, category, and element will have a team agreed to description that also provides examples to assist with the understanding of each element. For example, the risk element *repudiation* is described as:

Repudiation is when governments refuse to acknowledge or pay a debt or obligation. Issues of concern include:

- History of government of repudiating against the firm, industry, and other organizations from your country
- Availability and cost of repudiation protection via private or government insurance
- Other.

Impact weights would be determined for each element by polling experts in a structured format. Determining the project impact weights is a critical component of the research effort that will come after agreement is reached on the risk elements.

Risk Mitigation

Generally, risk mitigation should be based on the principle that responsibility for managing the risk should be placed on the shoulders of those most capable of addressing the risk. The literature review identified a number of potential responses for a particular risk event:

- Ignore the risk
- Recognize the risk but take no action
- Avoid the risk
- Reduce the risk
- Share the risk
- Transfer the risk
- Retain and absorb the risk
- Use a combination of the above steps.

Appropriate risk mitigation is critical to the success of any risk management process. The span of this research project allows the research team to outline a framework for mitigation, however, detailed mitigation steps and procedures are outside of the committee’s scope.

Application of the Risk Analysis Tool

At what point during the life of a project would the tool be used? Agreement was reached by the committee that the primary value of the tool would be highest during the preproject planning phase, and to be most effective, should be deployed at three separate points of the project timeline: 1) validation of project feasibility, 2) project definition, and 3) decision to proceed. The project team also felt that a secondary use of the tool could occur during project execution. Exhibit 3 shows at what points the committee feels the tool is most applicable during the project development.

A decision-maker summary sheet will be developed as a one-page roll-up for senior management. This tool should

allow those at the executive and project level to first make decisions and then help recheck those decisions as they move forward with project development. The tool should also be applied to owners and contractors, as well serve as a tool to be used by both senior management and project managers as shown in Exhibit 4.

Path Forward and Expected Product

The validation phase of the risk management tool will follow once the committee has conducted a series of workshops for invited personnel to comment on the tool and determine the relative importance of individual risk element weights. It is envisioned that these workshops will tap expertise from 30–35 owner and contractor organizations, with representation of between 60 and 80 individuals.

The approach to handling risk on the project may range from informal to formal and responsibility for risk management can range from simply being that of the project manager to being the task of a specialist or team under the project manager’s direction. The committee expects to pursue this phase of the project beginning September of 2002.

The expected product of this research will be a risk management process map and tool to identify risk factors, along with definitions, and performance measurement methods. It is envisioned that the tool will be “PDRI-like” and used in a team setting or as a checklist. Additional modules may be necessary to focus on specific owner and contractor issues. The ultimate objective is the utilization of the developed process and tools to enable the project team to carefully consider risks, assist decision-making, and if appropriate, a plan to mitigate such risks. Completion of the research project is scheduled for June 2003, with the final results delivered at the 2003 CII Annual Conference.

Preliminary Findings and Path Forward

Based on the work completed to date, the following observations will guide the actions the research team to effectively implement the risk analysis and management tool:

1. Risk analysis and management is most effective when deployed early.
2. Disconnects often exist between decision-makers and project management when identifying, analyzing, and mitigating risks.
3. A properly structured risk identification, analysis, and mitigation process can mitigate the risks associated with international construction projects.
4. A broad perspective is needed when analyzing international projects and their risks.
5. Adequate preproject planning, analysis, and engineering are beneficial and should be coordinated with the risk analysis process.
6. Traditional relationships between owners, investors, and contractors working in international settings make it difficult to assess and manage risks.

7. Projects with certain characteristics (new technology, multiple participants, unstable political situation, and so on) will likely be exposed to increased levels of risk.

8. The risk management process should capture usable data and be kept as simple as possible.

9. Documentation is critical and properly recording the identification, analysis, and risk management determinations and results for each risk element and project allows for lessons to be learned.

The project team will continue to test the research hypothesis by following the project proposal tasks and schedule. The team's immediate focus is the development of the assessment tool to a level that identifies the appropriate international risk categories and elements along with agreed upon definitions. From there the team will conduct several case study evaluations with selected owner and contractor organizations to identify specific risk approaches to risk areas such as political, economic, cultural, environmental/regulatory, experience, legal, and technical areas. A series of workshops will be conducted beginning in September of 2002 for industry experts to comment on the tool and importance of individual risk element weights. Fall 2002 and winter of 2003 is the timeframe expected to finalize the tool and validation on completed and ongoing projects. It is anticipated that approximately twenty completed projects (after the fact) and 10–20 ongoing efforts will be assessed using the tool and to validate the model and process. The team will develop the required publications during 2003, as well as prepare for the research results presentation at the 2003 CII Annual Meeting in Orlando Florida.

Notes

1. PDRI is an acronym for Project Definition Rating Index, which is a widely used CII risk management tool developed to validate the extent of scope development for front end planning of capital projects. Visit <http://www.cii-pdri.org/> for further information.

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