

## **Risk Management Maturity Models: A Review and Future Directions for Improvement**

Begum Ongel, Ali Murat Tanyer

*Department of Architecture, Middle East Technical University, Ankara, Turkey  
ongel@metu.edu.tr, tanyer@metu.edu.tr*

Irem Dikmen

*Department of Civil Engineering, Middle East Technical University, Ankara, Turkey  
idikmen@metu.edu.tr*

### **Abstract**

Risk management is now an accepted discipline with its own language, philosophy, techniques, procedures and tools. With the increased awareness on the benefits of having a formal structure to manage risk, many organizations are seeking to introduce risk management into their organizational and project processes or to enhance their existing practices. As Project Management Institute (PMI) claims, although the core elements of project risk management are known and used by many organizations, there are a number of areas that risk management needs to be developed in order to build on the foundation that currently exists; and the ability to measure the effectiveness in managing risk is one of the most important of these areas. A risk management maturity model is an assessment tool designed to measure risk management capability of projects or organizations and provide objectives for improvement. In this study, after a literature survey on the existing risk management maturity models, six of them have been identified as outstanding and reviewed. After describing each model in detail, the models are evaluated in terms of their effectiveness and usability. Built on the evaluations, future directions for the development of an improved risk management maturity model applicable for the construction industry are proposed.

### **Keywords**

Construction risk management, Capability maturity model, Risk management maturity

### **1. Introduction**

According to Flanagan and Norman (1993), construction projects have a large number of risks, contractors cope with it and owners pay for it. As Flanagan and Norman (1993) further continue, risk and uncertainty are more expansive in the construction industry than many other industries. Similarly, Akintoye and MacLeod (1997) state that there is a high degree of risk in construction industry due to the nature of construction business activities, processes, environment and organization. In spite of these, as Flanagan and Norman (1993) claim, managerial techniques used to identify, analyze and respond to risk have been applied in the industry only during the last decade. According to the authors, risk management in construction has perhaps a greater significance at present than any other time since the 1970s, because of the increased integration between financial and real sectors of the economy and major capital commitments in the building industry.

According to PMI (2002), being one of the knowledge areas of project management, risk management is now an accepted discipline within organizations and individual projects, with its own language,

techniques, procedures and tools. There has been a wide recognition of the potential benefits of risk management. Becoming aware of the value to have a proactive formal structural approach to managing risks and uncertainty, many organizations are seeking to introduce risk management into their organizational and project processes.

To ensure good performance in managing a company, a project or a work package, attention to risk is crucial. A guide to the Project Management Body of Knowledge (PMBOK Guide) by PMI (2000) defines project risk management as “the systematic process of identifying, analyzing, and responding to project risk”. Throughout the life of a project, risk management aims to obtain the optimum or acceptable degree of risk elimination or control (Merna and Al-Thani, 2005). According to Flanagan and Norman (1993), risk management should involve common sense, analysis, judgment, intuition, experience, gut feel and willingness to operate a disciplined approach.

As PMI (2002) claims, although the core elements of project risk management are known and used by many organizations, there are a number of areas that risk management needs to develop in order to build on the foundation that currently exists. The ability to measure the effectiveness in managing risk is one of the most important of these. The aim of this study is to report initial findings of an on-going research about assessment of risk management maturity in construction companies. In this paper, the existing risk management maturity models are evaluated in terms of their effectiveness and usability. In the forthcoming stages of this research, a risk management maturity model specific to the construction industry will be developed to assess the risk management maturity level of the Turkish Construction Companies.

## **2. Maturity Models**

According to Crawford (2002), recently, the term “maturity” has started to be used to describe the state of an organization’s effectiveness at performing certain tasks. Today, this maturity concept is being utilized increasingly to map out logical ways to improve an organization’s services. A maturity model is described by Wikipedia web-site (2009), as a structured collection of elements that describe certain aspects of maturity in an organization, and aids in the definition and understanding of an organization’s processes. As it continues in the web-site, a model can be used as a benchmark for comparison and as an aid to understanding, and it may provide; a place to start, the benefit of a community’s prior experiences, a common language and a shared vision, a framework for prioritizing actions and a way to define what improvement means for an organization. According to Hopkinson (2000), the levels of a maturity model are designed to aid assessment and set objectives. Hopkinson (2000) further continues that to follow a logical and realistic route in order to reach higher standards, an organization should aim at achieving objectives at the next highest level. Ren and Yeo (2004) argue that maturity models have been proposed for many activities like: quality management, software development, supplier relationships, research and development effectiveness, product development, innovation, product design, product development collaboration and product reliability. The Capability Maturity Model (CMM) is the most famous and most widely accepted one of them. As Crawford (2002) claims, the term “maturity” evolved in the software industry. With an extensive, government-funded research into how to evolve and measure an organization’s effectiveness at developing software, resulted in the Software Engineering Institute (SEI)’s CMM. Serving as the foundation for many of the project management maturity models, the CMM aims to provide a structured and objective means for measuring a software organization’s development processes and comparing these measures against optimum practices.

### 3. Risk Management Maturity Models

According to Loosemore *et al.*, (2006), the sophistication of an organization’s understanding of its risk portfolio, its knowledge of how to mitigate those risks and of the extent of its internal business continuity systems needed to cope with and recover from risk events reflect the risk management maturity of an organization. Hillson (1997) states that an organization’s current approach to risk, as well as a definition of the intended destination should be identified to define its goals; specify the process and manage progress. For this purpose, an accepted framework is needed to assess the current level of maturity and capability objectively and assist in defining progress towards increased maturity. As Hopkinson (2000) claims, being an assessment tool, a risk maturity model is designed to measure risk management capability and to provide objectives for improvement.

Several tools have been designed for diagnosing risk management maturity of a project/an organization. To be further examined for this study, six outstanding risk management maturity models were identified. These models are described in detail in the following sub-sections.

#### 3.1 Risk Maturity Model (RMM)

For the organizations wishing to implement a formal approach to risk management or to improve their existing approach, Hillson (1997) constructed a framework against which to benchmark their current risk management practice (Table 1). The Risk Maturity Model (RMM) has four levels of capability maturity, each linked to specific attributes. These are; **Level 1: Naive**, **Level 2: Novice**, **Level 3: Normalised** and **Level 4: Natural**.

This model aims to assist the organizations to assess their current level of risk management capability maturity, identify realistic targets for improvement and produce action plans for developing or enhancing their risk management capability maturity level. It also suggests strategies to move to the next level of maturity. Each RMM level is briefly described in Table 1.

**Table 1: Risk Maturity Model (RMM) Framework by Hillson (1997)**

<b>Definition</b>	<b>Naive</b>	Unaware of the need for management of risk. No structured approach to dealing with uncertainty. Repetitive and reactive management processes. Little or no attempt to learn from past or to prepare for future.
	<b>Novice</b>	Experimenting with risk management through a small number of individuals. No generic structured approach in place. Aware of potential benefits of managing risk, but ineffective implementation, not gaining full benefits.
	<b>Normalised</b>	Management of risk built into routine business processes. Risk management implemented on most or all projects. Formalized generic risk process. Benefits understood at all levels of the organization, although not always consistently achieved.
	<b>Natural</b>	Risk-aware culture, with proactive approach to risk management in all aspects of the business. Active use of risk information to improve business processes and gain competitive advantage. Emphasis on opportunity management (“positive risk”).
<b>Culture</b>	<b>Naive</b>	No risk awareness. Resistant/reluctant to change. Tendency to continue with existing processes.
	<b>Novice</b>	Risk process may be viewed as additional overhead with variable benefits. Risk management only used only on selected projects.
	<b>Normalised</b>	Accepted policy for risk management. Benefits recognized and expected. Prepared to commit resources in order to reap gains.
	<b>Natural</b>	Top-down commitment to risk management, with leadership by example. Proactive risk management encouraged and rewarded.

**Table 1: Risk Maturity Model (RMM) Framework by Hillson (1997) (Continued)**

<b>Process</b>	<b>Naive</b>	No formal processes.
	<b>Novice</b>	No generic formal processes, although some specific formal methods may be in use. Process effectiveness depends heavily on the skills of the in-house risk team and availability of external support.
	<b>Normalised</b>	Generic processes applied to most projects. Formal processes, incorporated into quality system. Active allocation and management of risk budgets at all levels. Limited need for external support.
	<b>Natural</b>	Risk-based business processes. “Total Risk Management” permeating entire business. Regular refreshing and updating of processes. Routine risk metrics with constant feedback for improvement.
<b>Experience</b>	<b>Naive</b>	No understanding of risk principles or language.
	<b>Novice</b>	Limited to individuals who may have had little or no formal training.
	<b>Normalised</b>	In-house core of expertise, formally trained in basic skills. Development of specific processes and tools.
	<b>Natural</b>	All staff risk-aware and using basic skills. Learning from experience as part of the process. Regular external training to enhance skills.
<b>Application</b>	<b>Naive</b>	No structured application, no dedicated resources and risk tools.
	<b>Novice</b>	Inconsistent application. Variable availability of staff. Ad hoc collection of tools and methods.
	<b>Normalised</b>	Routine and consistent application to all projects. Committed resources and integrated set of tools and methods.
	<b>Natural</b>	Second-nature, applied to all activities. Risk-based reporting and decision-making. State-of-the-art tools and methods.

As Hillson (1997) claims, to achieve a more detailed diagnostic tool required for objective and consistent assessment of risk management process maturity, four attribute headings are integrated to the system: Culture, process, experience and application. With this breakout, clear criteria that have been accepted by numerous risk management organizations were attempted to be utilized in the assessment. The barriers faced by organizations when attempting to progress to the next level of maturity are also given and some strategies are suggested for overcoming them.

### 3.2 Project Management Maturity Model (PMMM) by Project Management Solutions, Inc.

According to Crawford (2002), Project Management Solutions, Inc. developed a Project Management Maturity Model (PMMM) to assist organizations in improving their project management processes. The model provides a conceptual framework within which specific project management processes can be optimized. It serves for the determination of the maturity of an organization’s project management processes, for the improvement by mapping out a logical path and to track progress. PM Solutions’ model utilizes the PMBOK Guide’s nine knowledge areas and the CMM’s five levels of maturity. The knowledge areas are; Project Integration Management, Scope Management, Time Management, Cost Management, Quality Management, Project Human Resource Management, Communications Management, Risk Management and Procurement/Vendor Management. Five levels of maturity are; **Level 1:** Initial Process, **Level 2:** Structured Process and Standards, **Level 3:** Organizational Standards and Institutionalized Process, **Level 4:** Managed Process and **Level 5:** Optimizing Process.

Each knowledge area is defined for each level of maturity. Each of the knowledge areas are broken down into their specific components to provide the most complete definition. The model defines 5 components for risk management: Risk identification, risk quantification, risk response development, risk control and risk documentation. For each maturity level, there is a brief general description of the characteristics and also more detailed descriptions are provided for each component at each maturity level.

### 3.3 Risk Management Maturity Model (RMMM)

According to PMI (2002), Risk Management Research and Development Program Collaboration group completed the first version of a Risk Management Maturity Model in April, 2002. This model is an elaboration of the initial work accomplished by Hillson (1997), to enhance the diagnostic elements of RMM and to further aid in identification of the current risk management maturity level at which an organization is operating. As the PMI (2002) claims, it is a simplified maturity model designed to quickly target weaknesses and is applicable to all types of projects and all types of organizations in any industry, government or commercial sector. The labels of the levels has been changed but the basic structure remained the same with the Hillson (1997)'s model. The maturity levels of RMMM are; **Level 1:** Ad-Hoc, **Level 2:** Initial, **Level 3:** Repeatable and **Level 4:** Managed.

Also the four attribute headings have been taken from the Hillson's (1997) model, therefore the headings remained the same as; culture, process, experience and application. When compared with the previous models, there are some elaborations on the descriptions in the content of the framework and on the suggested strategies for moving to the next level.

### 3.4 IACCM Business Risk Management Maturity Model (BRM3)

The IACCM Risk Management group (2003) designed a tool for the organizations to evaluate their level of maturity in the area of business risk management. The tool aims to assist an organization to assess whether its approach to risk management is adequate or not, to compare its approach with best practice or against its competitors and create an accepted benchmark for organizational risk management. Dr. David Hillson participated throughout this project and provided a framework to be utilized in this work. Accordingly, the basic structure of the framework is not so different from RMM and RMMM. 4 levels of organizational business risk management maturity are utilized, which are; **Level 1:** Novice, **Level 2:** Competent, **Level 3:** Proficient and **Level 4:** Expert.

Similar to the previous models, the maturity characteristics are provided by a maturity level – attribute matrix in this model. However, instead of this general framework, a detailed questionnaire is provided as a set of tables, each row containing one characteristic within an attribute. For the culture section there are 10 rows of characteristics. Similarly, it is 8 for the process, 6 for the experience and 7 for the application sections. Each characteristic is scored according to the maturity levels (1, 2, 3 or 4) and at the end, total attribute scores and maturity score of the organization are achieved. The variation between the characteristic and attribute scores reflects the strengths and weaknesses of the organization. Thus, along with serving for the assessment of the maturity level of the organization, the questionnaire can also be used to set realistic targets for improvement and measure progress towards achieving them.

### 3.5 Risk Management Capability Maturity Model for Complex Product Systems Projects (CoPS-RM-CMM)

According to Ren and Yeo (2004), this model has been built upon the risk maturity model proposed by Hillson (1997), HVR Risk Maturity Model by Hopkinson and Lovelock (2004), the RMMM and CMM. It offers a framework for complex product systems projects to benchmark their current approach in risk management against 5 standard levels of maturity. The tool allows for the assessment of their current level, identify realistic targets for improvement and develop action plans for increasing their risk management maturity. The model utilizes the maturity levels of CMM, which are; **Level 1:** Initial, **Level 2:** Repeatable, **Level 3:** Defined, **Level 4:** Managed and **Level 5:** Optimizing.

As claimed by Ren and Yeo (2004), for the improvement of risk management maturity, the organization must develop its capabilities in organizational culture (context), risk management process (process) and risk management knowledge/techniques (content) simultaneously. Accordingly, against its 5 maturity

levels, the tool defines 3 key capability areas; organization culture, risk management process and risk management knowledge/technology.

According to the model structure, the organization culture dimension is about the appropriate risk management culture, open communication, leadership commitment to risk management and collaboration between the stakeholders to dealing with known and emergent risks. Continuous and effective risk identification, risk analysis, risk mitigation and the integration of risk management process with other management processes are included in the process dimension. The knowledge dimension entails the correct understanding of risk management principles, mastering risk management techniques and tools and acquiring risk management competences for project participants. For each maturity level, the model defines major organization culture characteristics, major risk management process characteristics and major knowledge characteristics and a theoretical framework is obtained. The model also includes a questionnaire based on this framework, made up of 75 questions/statements in total, which are assumed to have the same weight. The questionnaire gives key attributes for each of the 3 key capability areas, which are as follows:

For the organization culture;

- Attitude towards risk and uncertainty,
- Stakeholders and
- Leadership and commitment to risk management.

For the risk management process;

- Risk identification,
- Risk analysis,
- Risk mitigation and
- Integration with other processes.

And for the risk management knowledge/technology;

- Management of risk knowledge and
- Experience and competence.

Tentative items of measuring each attribute are listed. A scale of five choices, ranging from “strongly disagree” to “strongly agree”, was used to measure the responses for the case study that the authors performed.

### **3.6 PMI’s Risk Management Maturity Model (RMMM) Adapted to the Construction Industry**

Loosemore *et al.*, (2006) have built their work upon the Risk Management Maturity Model (RMMM) designed by the PMI (2002). While valuable, the RMMM is evaluated by the authors as being quite narrow in its description of what characterizes each level of maturity. According to the authors, it needs refining to suit the peculiarities of different industries such as construction. Utilizing the integration of work by Mitroff and Pearson (1993) and Loosemore (2000), PMI’s work has been adapted and expanded for the construction industry by Loosemore *et al.*, (2006), and a more robust model has been obtained. This new model lists the typical attributes of an organization at each maturity level under the headings of; culture, processes, awareness, skills/experience, image, application, confidence and resources.

Finally, the model utilizes the mentioned headings against 4 levels of maturity, which are; **Level 1:** Ad-Hoc, **Level 2:** Established, **Level 3:** Managed and **Level 4:** Integrated.

## **4. Evaluation and Comparison of the Existing Risk Management Maturity Models**

The described risk management maturity models are further examined in terms of their usability and effectiveness. The evaluations are given in the following sub-sections.

#### **4.1 Evaluation of Risk Maturity Model (RMM)**

Hillson's (1997) Risk Maturity Model is the first notable attempt to develop a framework for a risk maturity model. It serves as a foundation for many of the subsequent maturity models such as RMMM, RMMM Adapted to the Construction Industry, IACCM Business Risk Management Maturity Model and Risk Management Capability Maturity Model for Complex Product Systems. The attribute headings of the model are reasonable and for it to be restricted with 4 levels of capability maturity decreases ambiguity in the assessment of the maturity level of the organization. As expressed by Hillson (1997), 4 standard levels of maturity provide clarity and simplicity.

The culture attribute heading is reasonable since organizational culture may reflect the attitude of the organization towards risk management. Under this heading, the model questions risk awareness, belief in value of risk management and attitude of top management towards risk management. The process attribute heading is essential for the assessment, as it undertakes the operation of risk management throughout the lifetime of a project in an organization. Though playing a vital role, this section of RMM lacks elaboration. It is inadequate to serve for an assessment, as the too general entries do not give any clue about the risk management processes. The experience attribute heading is mainly concerned with skills and capabilities of people responsible for risk management and training of them. However, the issues such as processes and tools are also included. In this respect, it is fuzzy in its content and destination. The application attribute heading, aiming to evaluate the amount of risk that the decision-making process involves, is reasonable and to the point. Usage of resources and tools are also considered under this heading. Although critical for a risk management system, the model does not underscore the integration of risk management with other project management processes.

As also pointed out by Hillson (1997), a more detailed diagnostic tool is required for objective and consistent assessment of risk maturity. Although constructing a strong basis, the framework does not provide a comprehensive approach. Its practicality is restricted with its entries which are too general and superficial. There is no defined evaluation system. The content of the framework needs elaboration and refining, and also needs to be organized into a system for it to become an effective and usable assessment model.

#### **4.2 Evaluation of Project Management Maturity Model (PMMM) by Project Management Solutions, Inc.**

Project Management Maturity Model (PMMM) by Project Management Solutions, Inc. is intended for diagnosing the maturity of the project management processes of an organization. It focuses on the processes of the project so the big picture covering the entire organization is not taken into account. Therefore, its effectiveness is restricted with the process attribute, when the aim is to measure the risk management maturity of an organization. Being effective only on a specific part, the model provides detailed characteristics of the processes at each maturity level. This detailed approach compensates the deficiency that exists in the process section of RMM. In this respect, although not serving to assess an organization's risk management maturity, the model can be considered as effective on the processes. Apart from its focused view, the only point under question with this model is its five levels of maturity. It utilizes the CMM's five levels of maturity, whereas five levels may increase fuzziness in determination of the maturity level of an organization. Similar to Hillson's RMM, the model just lists the descriptions and does not provide a systematic assessment approach. It needs some proper arrangements combined with an appropriate evaluation system to become usable.

#### **4.3 Evaluation of Risk Management Maturity Model (RMMM)**

PMI's (2002) Risk Management Maturity Model (RMMM) is an elaborated version of the Hillson (1997)'s model. It holds the structure of the RMM. As it is pointed out by PMI (2002), the authors had

felt that having more than four levels would increase ambiguity without giving any additional refinement to the model. Therefore, it is an advantage of the model to have 4 levels of maturity. When compared with RMM, it is seen that some parts of the framework are expanded in terms of content. Although the definition section remains the same, some entries have been added to other sections to provide a more detailed approach. But still, the progress cannot be regarded as a major move from the RMM. For the culture attribute heading, entries on upper management involvement have been added to the content. The process section is still superficial, since the processes have not been detailed one by one. Therefore, the practicality of the model is in question. For it to be usable, elaboration is still needed. Although the RMMM can be considered as one step forward from RMM, some of the problematic points still remain the same.

#### **4.4 Evaluation of IACCM Business Risk Management Maturity Model (BRM3)**

IACCM Business Risk Management Maturity Model (BRM3) developed by the IACCM Risk Management Group (2003) provides not only a framework but also a detailed and systematic questionnaire. Each attribute characteristic is given for each level of maturity so no gaps are left in the structure. Thus, each characteristic has a correspondent in each of the maturity levels. The evaluation system is defined and clear which increases the usability of the model.

Using the same attribute headings with RMM and RMMM and 4 levels of maturity which are reasonable, the content is also parallel to the mentioned models. However, unlike the previous models, the model considers the integration of risk management with other processes. But still, in terms of content, there are lacking points. No attempt is undertaken to elaborate the processes one by one. Also, the attributes under process heading are vague. Therefore, the effectiveness of the model cannot be evaluated as successful as its usability.

#### **4.5 Evaluation of Risk Management Capability Maturity Model for Complex Product Systems Projects (CoPS-RM-CMM)**

Risk Management Capability Maturity Model for Complex Product Systems Projects (CoPS-RM-CMM), developed by Ren and Yeo (2004), is built upon previous models like RMMM and CMM. It has a different structuring than the mentioned models that are built upon Hillson's (1997) model. Not only a framework, but also a more detailed outline composed of questions/statements is developed by the authors. The evaluation system is given, but the connection of the theoretical framework with the questionnaire in terms of evaluation is in question. Nevertheless, as the evaluation system is clear, the model can be regarded as systematic. The model utilizes five maturity levels, but as mentioned before, having more than 4 levels is disadvantageous as it makes assessment more complicated.

The model elaborates the process section under the headings of risk identification, risk analysis and risk mitigation. This is a positive approach in terms of the effectiveness of the model. The model also includes the integration of risk management with other processes in its process part as another improvement. The knowledge section is intended to evaluate subjects such as post project evaluation, existence of a risk database, risk management techniques and tools, skills and capabilities of people dealing with risk management and training of them. Although the model can be regarded as effective in terms of content, the comprehensibility of its statements is not enough for it to be considered as usable.

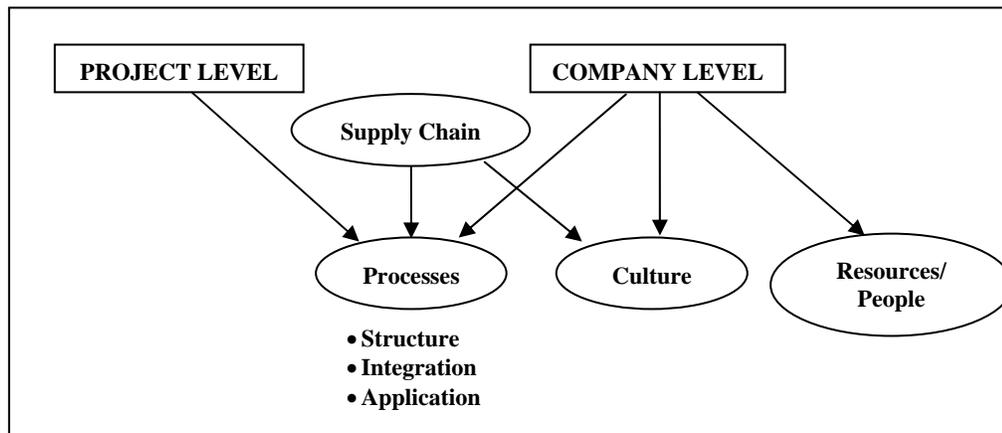
#### **4.6 Evaluation of PMI's Risk Management Maturity Model (RMMM) Adapted to the Construction Industry**

RMMM developed by PMI (2002) is adapted and expanded for the construction industry with the Loosemore *et al.*, (2006)'s model. It maintains the structure with 4 levels of maturity whereas extra attribute headings are integrated to the RMMM framework – awareness, image, confidence and resources.

When compared with RMMM, it is seen that some entries are added to the existing descriptions. Most of them are comprised of details, whereas the notable ones are about the supply chain. Considering the construction industry, the content is expanded with some entries regarding the supply chain in construction. As mentioned, another modification is related with the extra attribute headings. Taking cognizance of the descriptions of the term “organizational culture” in the literature, it was seen that the content of culture heading comprises awareness, so creating an extra heading may be unnecessary. Likewise, confidence and image headings do not add any value to the model and the content of the confidence heading can be involved under the experience heading. To create a resource attribute heading is reasonable in terms of comprehensiveness, since this subject is involved in the application heading in RMM and RMMM. Also for this model, there is no evaluation system. In terms of usability, it can be claimed that the model cannot go beyond RMMM that it is developed upon.

## 5. Suggestions for Improvement

In the light of the inferences from the examination of existing models, some critical points are identified for improvement. It is believed that in order to create an effective organizational risk management maturity model, due importance should be given to the project level and also the company level risk management, as outlined in Figure 1.



**Figure 1: Suggested Framework Structure**

At the project level, the effectiveness of processes should be assessed. First of all, existence of systematic and formal processes should be questioned, by examining the processes (*i.e.* risk identification, risk quantification, risk response development, risk control and risk documentation) one by one. The application of a proactive risk management approach, existence of a risk management plan, usage of risk metrics, post project assessment, capturing of the lessons learned and usage of tools are the other points to be taken into account in this section. For the project level, the integration of risk management with other management processes is another subject that should not be disregarded. The activities on the construction value chain and project life cycle (design, construction, operation, *etc.*) shall be considered. The integration of risk management processes within the supply chain should be assessed. Also, how “risk level” as an important decision criterion is involved in the decision-making processes within the supply chain should be questioned.

At the company level, one subject to be assessed is organizational culture. In this respect, risk awareness, belief in value of risk management, senior management attitude towards or involvement in risk management process, communication with stakeholders appear as critical points for an organization. For this level, another matter of concern is resources, both in terms of material and in terms of people.

Dedicated resources for risk management, skills and capabilities of staff dealing with risk management, existence of risk management training are the aspects to look at in order to obtain information in this domain. The information systems that aid risk management and corporate memory on risk events may also be considered among company resources. Besides, it is argued that both project and corporate value chains should be taken into account as well as company resources devoted to risk management and company culture. Moreover, a rating system that takes into account of interrelations between attributes and fuzzy borders between different categories should be developed rather than using simple multi-attribute rating technique for the assessment of risk management maturity level.

## 6. Conclusion

In this paper, six outstanding risk management maturity models are reviewed in detail. As the next step, the models are evaluated in terms of their usability and effectiveness. The characteristics of the models that come to the fore or overlap are examined together with their strengths and deficiencies. Considering the inferences from the evaluation, some critical points for future work are raised. The necessity to assess project and company level risk management processes considering the supply chain and life cycle of construction projects is mentioned.

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