

Assessment of Knowledge Areas by Risk Severity Levels:
Road Construction Contractors' View

تقييم مجالات المعرفة حسب مستويات شدة المخاطر: وجهة
نظر مقاولي بناء الطرق



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الملخص

إدارة المخاطر هي جانب بالغ الأهمية في إدارة المشاريع. حيث تساعد في تحديد وتقييم وتخفيف المخاطر التي قد تؤثر على نجاح المشروع. إدارة مخاطر المشروع هي واحدة من المجالات العشرة الموضحة في دليل PMBOK®. تركز هذه الدراسة على تقييم مجالات المعرفة بناءً على مستويات شدة المخاطر وتحديد المجالات التي لها أكبر تأثير على عملية صنع القرار في مشاريع الطرق. تم جمع البيانات باستخدام استبيان مسح لـ 164 خبيراً من شركات المقاولات العاملة في قطاع بناء وصيانة الطرق في خمس دول في الشرق الأوسط: الأردن ومصر والمملكة العربية السعودية وقطر والبحرين. خضعت بيانات المسح للتليل الإحصائي باستخدام مؤشر الأهمية النسبية (RII) لتحديد وتصنيف شدة المجالات. تشير النتائج إلى أن جميع مجالات المعرفة تقع ضمن المستوى العالي من حيث شدة المخاطر. كان نطاق المشروع هو الأكثر تصويتاً، بينما كانت اتصالات المشروع هي الأقل.

ABSTRACT

Risk management is a critical aspect of project management, as it helps to identify, assess, and mitigate risks that could potentially impact the success of a project. Project Risk Management is one of the ten areas outlined in the PMBOK® Guide. This study focuses on assessing Knowledge Areas -based on risk severity levels and identifying which areas have the greatest impact on decision making in road projects. Data was collected using a survey questionnaire for 164 experts from contracting companies working in the road construction and maintenance sector in five countries in the Middle East: Jordan, Egypt, Saudi Arabia, Qatar, and Bahrain. The survey data was subjected to statistical analysis using the Relative Importance Index (RII) to identify and rank the areas' severity. The results indicate that all Knowledge Areas are within the high level in terms of risk severity. The Project Scope was the most voted, while the Project Communications was the least.

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ASSESSMENT OF PROJECT MANAGEMENT KNOWLEDGE AREAS ACCORDING TO RISK SEVERITY LEVELS: HIGHWAY CONSTRUCTION CONTRACTORS' VIEW

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ABSTRACT

Risk management is a critical aspect of project management, as it helps to identify, assess, and mitigate risks that could potentially impact the success of a project. Project Risk Management is one of the ten areas outlined in the PMBOK® Guide. This study focuses on assessing Project Knowledge Areas based on risk severity levels and identifying which of these areas have the greatest impact on decision-making in highway projects. Data was collected using a survey questionnaire for 164 experts from contracting companies working in the highway construction and maintenance sector in five countries in the Middle East: Jordan, Egypt, Saudi Arabia, Qatar, and Bahrain. The survey data was subjected to statistical analysis using the Relative Importance Index (RII) to identify and rank the knowledge-areas' severity. The results indicate that all Knowledge Areas are within the high level in terms of risk severity. The Project Scope was the most voted, while the Project Communications was the least.

Introduction

The issue of project development in some Middle Eastern countries has become increasingly important for institutions, companies, universities, and other organizations. Industrial-technological development, difficulty in obtaining resources, complexity of execution, and lack of financial resources show how much effective management is necessary for achieving desired outcomes. On the other hand, construction projects, especially the projects of highway construction and maintenance, frequently experience delays in their schedules, and this has become a widespread and persistent issue globally (Durdyev and Hosseini 2020; Gurgun et al. 2022). A multitude of researches have sought to study the problem of project delay and identify the primary causes based on several factors such as geography, project type and procurement methods, taking into account the perspectives of various participants involved (Lessing et al. 2017; Oyegoke and Al Kiyumi 2017; Sweis et al. 2008).

However, many companies, including the construction industry, do not have performance measurement systems or, when they do, there are significant shortcomings (Yu et al. 2007; Oladimeji et al. 2025). Organizations have difficulties in determining what to measure and how to measure (Wegelius-Lehtonen 2001) which is reflected negatively in scheduling priorities and identifying areas that require the most monitoring and risk control (Abdelgawad and Fayek 2010). Performance measurement is therefore important in project performance management as it provides information that supports decision-making and helps in controlling management processes and procedures, allowing for monitoring and controlling the initially established strategic objectives and goals (Kagioglou et al. 2001).

Academic research and publication on project management can be traced back to the mid-to-late 20th century. The first edition of the Project Management Institute's "Project Management Body of Knowledge" (PMBOK® Guide) was published, as a whitepaper, in 1987, and the first edition appeared as a book format in 1996, which helped establish project management as a distinct field of study and practice. It's difficult to pinpoint the exact year or reference when the first academic articles on project management were published, but it's likely that they began to appear in academic journals and proceedings in the 1970s and 1980s, following the rise of the field as a profession and the publication of early works such as the PMBOK® Guide. Since then, the study of project management has continued to grow and evolve, with a growing body of literature and research in areas such as project governance, project risk management, project leadership, and project performance evaluation (Derakhshan et al. 2019)

The definition of risk can be very broad because it involves extremely interrelated concepts. One of the definitions used and widely accepted is that risk is the combination of the probability of an event and its consequences (Cretu et al. 2011). In this regard, the severity of a risk factor has fundamental importance in the planning of risk management.

The purpose of this paper is to present the areas with the highest risk severity in order to pinpoint in which areas the greatest risk control should be applied to avoid deviations throughout the highway projects life cycle. Based on the areas of knowledge suggested by the PMBOK® Guide the main issue is to seek an understanding of what these areas are according to their degree of severity in the occurrence of a risk and, thus, enable the concerned organizations to prioritize, plan, and manage risks effectively throughout the project life cycle.

The methodological approach of this article is based on four steps:

- **Step 1** involves defining the problem in this study, which mainly focuses on finding a definition of the knowledge areas with the greatest impact and severity for risk management in a project. From this definition, organizations can monitor and control risks and uncertainties in a more consistent manner and achieve a more effective project management process.
- **Step 2** deals with contextualizing risk management based on project management and the integration of risk within this context. The main focus is to generate a theoretical perspective of risk management linked to highway project performance as a whole during its life cycle.

- **Step 3** involves collecting data — using a questionnaire for a group of highway construction industry experts. The research body is selected based on their area of knowledge, research, performance, and experience. However, the questionnaire is based on identifying the severity level of each knowledge area in the occurrence of a risk factor.
- Finally, in **Step 4**, the results were analyzed to generate considerations and conclusions about the data found.

Risk Management Perspective in Alignment with Project Monitoring and Control

Risk management is a critical aspect of project management, as it helps to identify, assess, and mitigate risks that could potentially impact its success (Raz et al. 2002). Barron and Andrew (2022) defined a project as a unique event with established goals, having a fixed cost, quality, and deadline and with a defined start and end. However, Abd El-Karim et al. (2017) reported that one of the high-impact issues — when it comes to project evaluation — is the expectation of results and monitoring activities to minimize deviations and improve management processes. Moreover, the fact that an ongoing activity already opens the possibility of events or situations that can contribute to either opportunities or threats to the project. In the same context, Raz et al. (2002) indicated that when it comes to project monitoring and control, risk management can play an important role in helping to ensure that the project stays on track and achieves its objectives. Thus, organizations tend to seek greater control of risk to minimize its possible impacts and promote project opportunities.

Highway projects have systems with very particular characteristics regarding infrastructure and sophisticated facilities to better meet the demands and expectations of end clients (Wu et al. 2019). Irfan et al. (2011) mentioned that to meet the expectations of all project stakeholders throughout the entire project life cycle and to ensure the success of the highway construction projects, management requires simultaneous and constant monitoring of several dimensions: cost and budget consumption, scope, physical progress of the contractor, meeting specific agreed-upon deadlines, quality of the final product; the use of production resources and means; and the risks that can compromise any of the project objectives. .

PMBOK® Guide (2017) categorizes “Monitor and Control Project Work” as one of the project integration management processes. According to the guide, the process of monitoring and controlling project work involves the tracking, assessment, and communication of the project's overall progress in achieving the performance objectives outlined in the project management plan. This process offers several advantages, such as enabling stakeholders to have a clear understanding of the current state of the project, mitigating any performance deviation issues, and the future status of the project, including cost and schedule projections.

However, to form a complete perception of the relationship between risk management and project monitoring and control, it is important to first to introduce the operational definitions of these concepts and related terminology. These are (Chapman 2001; Hazır 2015):

- **Project Monitoring and Control:** This refers to the ongoing processes of monitoring, measuring, and controlling various aspects of a project, such as its progress, cost, quality, and performance. Project monitoring and control helps to ensure that the project stays aligned with its objectives and timeline, and enables project managers to take corrective actions as needed to keep the project on track.
- **Risk Management:** This refers to the systematic process of identifying, assessing, and mitigating risks that could potentially impact the success of a project. Risk management involves the proactive identification of potential risks and the development of strategies to mitigate or avoid those risks, so that the project can proceed as planned.

- **Risk Identification:** This is the first step in the risk management process, where potential risks are identified and documented. This can be done through a variety of methods, including brainstorming, stakeholder interviews, and risk management software.
- **Risk Assessment:** Once potential risks have been identified, they are assessed in terms of their likelihood and potential impact on the project. This helps to prioritize risks and determine which risks need to be addressed first.
- **Risk Mitigation:** This is the process of developing and implementing strategies to reduce the likelihood of risks occurring, or to minimize their impact if they do occur. This can involve a variety of strategies, such as risk transfer (e.g. purchasing insurance), risk avoidance (e.g. canceling the project), or risk reduction (e.g. implementing risk-reducing measures)

Based on these concepts and terminology, the relationship between risk management and project monitoring and control can be examined. Essentially, risk management provides a proactive approach to ensuring project success, while project monitoring and control provides a reactive approach to correcting any issues that arise during the project (Montes-Guerra et al. 2014)

Professionals in the field try to describe their projects according to their complexity and management processes, indicating a practical acceptance that conventional tools and techniques alone may not be sufficient (Bahnas et al. 2024). By monitoring the project's progress and performance and identifying and assessing potential risks, project managers can develop strategies to mitigate those risks, which help to minimize the impact of risks and ensure that the project remains aligned with its preset objectives and timeline (Perry 1986; Alotaibi et al. 2025). However, even with careful risk management, there is still a chance that issues will arise during project lifecycle (Shimizu et al. 2014).

Severity of Risk Factors

Over time, many authors have sought definitions not only of the concept of risk but also its breadth of approach. According to Chapman (2001), the goal of risk identification is not limited to merely listing potential risk factors, but also involves determining the significance and importance of each of these factors.

Numerous studies have identified risk factors in construction projects. Ibrahim et al. (2006) identified financial, technical, political, force majeure, and social risks as the key factors that could impact project profitability. El-Sayegh et al. (2021) evaluated the potential hazards associated with sustainable building endeavors in the United Arab Emirates. The researchers categorized thirty different factors into five distinct groups, which included management, technical aspects, the green team, green materials, and organizational/economic considerations. Moreover, Abd Karim et al. (2012) conducted an extensive literature review to identify common risk factors in construction projects. They identified a total of 25 factors which were categorized into five groups: Construction, Politics and Contract Provision, Financial, Design, and Environmental. The authors reported that the group of risk factors related to construction includes issues arising from poor construction techniques, managerial problems, cost increases, and delays in completing the project. Risks related to politics and contract provisions are those that arise due to changes in laws and unsupportive policies of the government. Financial risks are those that arise from insufficient hedging of revenue streams and financing costs. In the design risk category, the risks occur due to technical faults and late amendments.

Thamhain (2013) indicated that project management and control need to understand the areas of highest risk in the project context and develop methods, systems and tools to deal with risks, with an emphasis on control needs and special and unique situations. Edwards and Bowen (2013) stated that when thinking about risk factor, the following four elements must be considered: (1) possible future event and its sources; (2) possible consequences of the event; (3) probability of occurrence and severity; and (4) duration of occurrence and its consequence.

In other words, the process involves predicting the impact and the occurrence of a specific event. In this regard, construction projects require effective risk management since they are inherently complex projects and, with time are increasing in complexity (Pryke and Smyth 2012)

One of the common characteristics related to the project life cycle is the level of uncertainty. At the beginning of the project, the level of uncertainty is high, as necessary planning information has not yet been obtained and the detailed execution of project activities is not yet defined. As the project progresses, the level of uncertainty decreases, as adherence to the scope and overall project planning is established. Given these uncertainties, risk management is of fundamental importance, as it defines how to deal with uncertainties and unexpected events through predictability so that deviations remain within an acceptable range for the project (Atkinson et al. 2006; Li and Madanu 2009)

Project Management Knowledge Areas

Having access to knowledge is the essential resource that holds the most significance when it comes to project management (Gasik 2011). According to a review of literature, the initial papers discussing project knowledge management were written in 1987 (Boddie 1987; Gulliver 1987), and have been a topic of interest for both practitioners and researchers ever since. Numerous articles, as well as books and special editions of professional journals, have been published on the subject of project knowledge management (Lampel et al. 2008). Project knowledge has been gathered in various forms, such as bodies of knowledge (PMI 2017), standards (ISO 2003), methodologies (OGC 2002), and maturity models (PMI 2008)

According to the PMBOK® Guide (2017), a Knowledge Area is a specific area of project management that is characterized by its knowledge requirements, and is described by its component processes, practices, inputs, outputs, tools, and techniques. Even though these knowledge areas are interconnected, they are distinguished as separate entities in the field of project management. Nonetheless, most projects tend to utilize the knowledge areas that have been identified in this guide on a regular basis. This guide outlines ten Knowledge Areas (Figure 1), which are as follows:

- ***Project Integration Management:*** This involves identifying, defining, combining, unifying, and coordinating the different processes and project management activities.
- ***Project Scope Management:*** This encompasses the processes required to ensure that the project includes all necessary work and only necessary work to achieve success.
- ***Project Schedule Management:*** This includes the processes necessary to manage the timely completion of the project.
- ***Project Cost Management:*** This comprises the processes involved in planning, estimating, budgeting, financing, funding, managing, and controlling costs to keep the project within the approved budget.
- ***Project Quality Management:*** This involves the processes that address an organization's quality policy with regards to planning, managing, and controlling project and product quality requirements to meet stakeholders' expectations.
- ***Project Resource Management:*** This covers the processes for identifying, acquiring, and managing the resources needed to successfully complete the project.
- ***Project Communications Management:*** This includes the processes necessary to ensure timely and appropriate planning, collection, creation, distribution, storage, retrieval, management, control, monitoring, and ultimate disposition of project information.
- ***Project Risk Management:*** This comprises the processes of conducting risk management planning, identification, analysis, response planning, response implementation, and monitoring risk on a project.
- ***Project Procurement Management:*** This involves the processes necessary for purchasing or acquiring products, services, or results needed from sources outside of the project team.
- ***Project Stakeholder Management:*** This includes the processes necessary for identifying the people, groups, or organizations that could impact or be impacted by the project, analyzing

stakeholder expectations and their impact on the project, and developing appropriate management strategies for effectively engaging stakeholders in project decisions and execution.

Figure 1: Project Management Knowledge Areas according to the PMBOK® Guide (2017)



The risk area is of vital importance within this context as it is directly linked to the mapping and control of all aspects of project success throughout its life cycle and to the monitoring of uncertainties and possible deviations that can directly impact not only the project but also the organizations involved in the activities (Vivek and Rao 2022). Therefore, the company's awareness regarding risk control processes becomes of great importance for risk management within the organization. In terms of projects, risks usually appear through various interfaces including the project itself, competition, changes in the sector, international considerations, and macroeconomic factors (Shibani et al. 2024).

Organizations should have mechanisms to respond quickly to changes, and be prepared to proactively meet new demands (Hazır 2015). In light of this, for an enterprise to succeed and deal with project deviations, it is necessary to understand the inherited risks and develop strategies to face them. Thus, it is necessary to understand the differences between the risk severity of each area of knowledge and to take into account the phases of the projects in order to try to generate predictions that support the treatment for each risk event in an anticipated manner (Irfan et al. 2011). The likelihood of failure—regardless of when it occurs and independent of stakeholders' intentions—is higher in organizations lacking maturity in risk management than in those that are more developed in this area (Thamhain 2013).

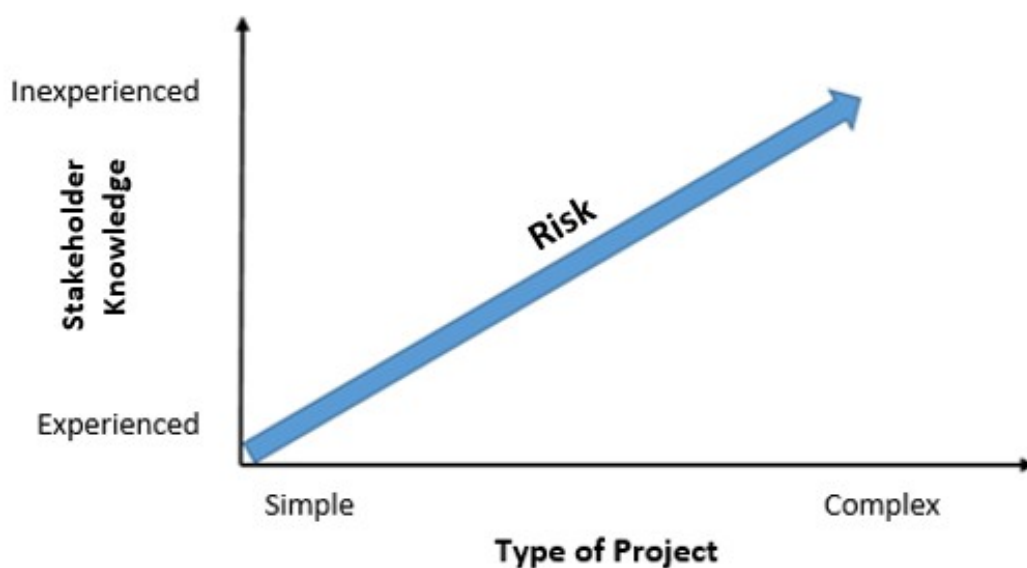
Establishing criteria with systematic processes that can support decision-making is crucial in managing and anticipating risk events (Jokkaw and Tongthong 2017). Risk management becomes necessary in the

context of changes that may occur throughout the initially planned activities. Shimizu et al. (2014) notes that all management techniques can be treated as risk prevention techniques.

With regards to complex projects such as highway construction, an inherent and similar characteristic between them is the fact that they present risks. Thus, when planning a project of this nature, understanding the risks becomes a challenge for all project stakeholders. If a risk event occurs, the impact may increase the cost and time of the project. In this sense, risk management can be considered the main task to be performed within project management (Thamhain 2013).

Moreover, Kerzner (2018) clearly emphasized the relationship between complex projects, the risks involved, and the alignment of knowledge among stakeholders, as shown in Figure 2. The author pointed out that the greater the mismatch between the stakeholder's knowledge, the higher the degree of risk in accordance with complexity. This knowledge is directly linked to the uncertainties of activity development, which in turn generates risks throughout the project life cycle.

Figure 2: Risk according to stakeholder knowledge and type of project (Kerzner 2018)



Research Methodology

As mentioned above, the research aims to present the areas of knowledge with the greatest impact on risk assessment within projects from the point of view of experts. To ensure statistical robustness and generalizability, a structured questionnaire survey was adopted, enabling the collection of quantifiable data from a large sample of industry experts across multiple countries. While expert interviews could provide additional qualitative insights, the chosen approach effectively aligns with the study's objective of identifying knowledge areas with the greatest impact on risk assessment. The data was collected using a survey questionnaire for 164 respondents working in companies registered with the construction contractor's associations in five countries in the Middle East: 44 in Jordan, 32 in Egypt, 63 in Saudi Arabia, 17 in Qatar, and 8 in Bahrain. Within the specialization of highway construction and maintenance. The target respondents were project managers, engineers in leadership positions, heads of implementation and supervision departments, and project operation officers. They were chosen based on their area of knowledge, research, performance, and experience.

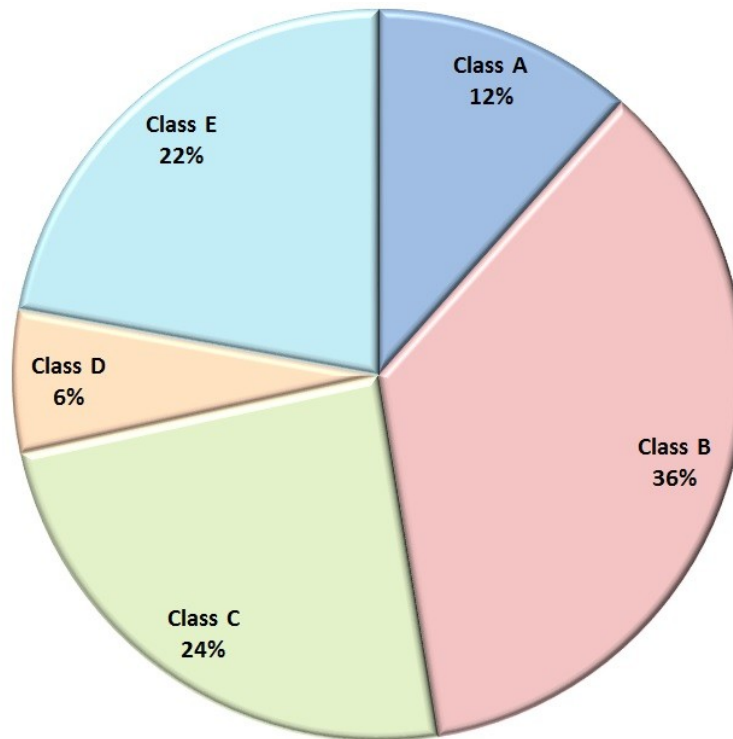
The questionnaire was based on identifying the severity level of each knowledge area in the occurrence of a risk factor. In line with the objective of this research, and since the stakeholders are the targeted participants in the survey, the area dealing with Stakeholder management was excluded, and eight areas of knowledge were considered, namely Integration, Scope, Schedule, Cost, Quality, Resource, Communications, and Procurement. Five-point Likert scale was used as a form of standardization and alignment of possible agreement between respondents. The Likert Scale is a kind of measuring tool used in

psychology that allows respondents to express their degree of agreement with a statement by selecting from a range of options usually consisting of five points (Preedy 2010). The respondents were asked to score the severity of each area of knowledge regarding potential risks, 1 being as very low severity and 5 as being very high severity.

Data Analysis

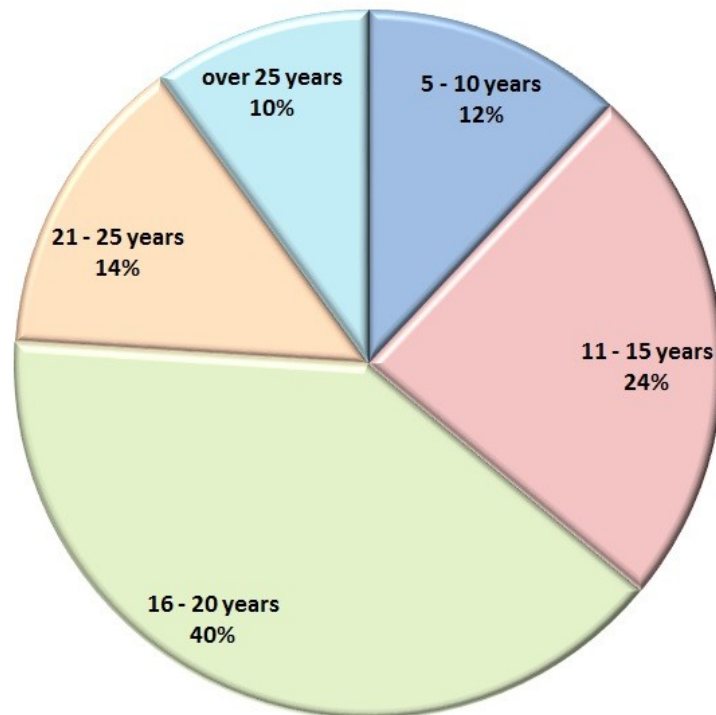
Based on the classification of companies approved by contractor associations in the countries mentioned above, the survey participants were classified into different categories of contractors: Category “A” represents contractors who are allowed to perform large highway construction projects; while, contractors of category “F” are allowed to small road projects. As shown in Figure 3, the percentage of contractors belong to category B is 36% of the total; 24% of the contractors are registered under class E; 22%, 12% and 6% of the contractors were of class C, class A and class D, respectively; and no one from class F participated in the survey.

Figure 3: Rate of respondent based on class of contractor



The experience of respondents in the highway construction industry ranged from five to more than twenty-five years. Figure 4 shows that the majority (40%) of the respondents had working experience of 16 to 20 years in the construction industry; 24% of respondents had 11 to 15 years; 14% had 21 to 25 years; 12% had 5 to 10 years; and 10% had more than 25 years of work experience.

Figure 4: Rate of respondent based on contractor experience



To ensure the accuracy of the data obtained, Cronbach's coefficient alpha (α) was carried out in the beginning of the analysis. The reliability coefficient ranges from 0 to 1: a higher value indicating greater reliability of the criteria's internal consistency in the scale. In this particular case, the Cronbach's Alpha (α) was 0.844 with variables, indicating a high level of internal consistency within the dataset compared to the cut-off value of 0.7 that was approved by previous studies such as Abd Karim et al. (2012), Esbensen et al. (2002), and Ghosh and Jintanapakanont (2004).

The survey data was subjected to statistical analysis using the Relative Importance Index (RII) to identify and rank the areas' severity. The Relative Importance Index analysis is a useful technique for determining the most significant criteria based on the responses of participants, and it is also an effective method for prioritizing indicators evaluated on a Likert-type scale (Rooshdi et al. 2018). The RII is computed using the following expression (Johnson and LeBreton 2004):

$$\text{Relative Important Index (RII)} = \sum a_i \cdot n_i / A \cdot N$$

Where:

a: constant expressing the weight assigned to each response;

n: frequency of each response;

N: total number of responses; and

A: the highest weight (5 point).

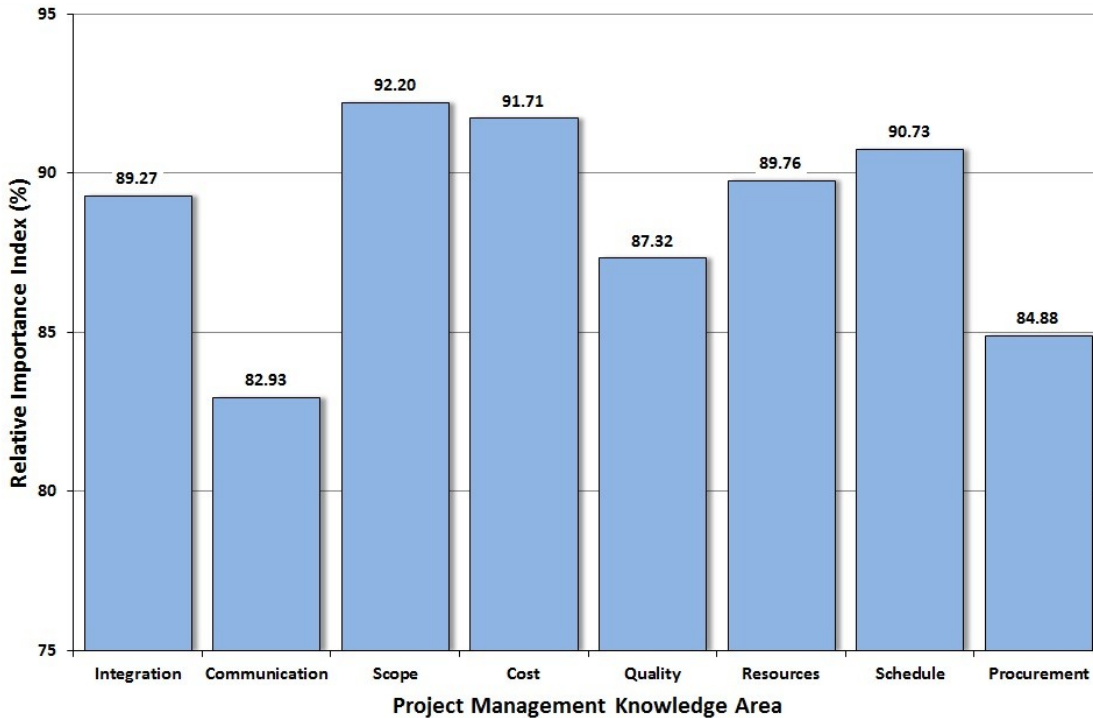
It should be noted that the literature indicates that RII values are usually categorized into several levels of significance. Akadiri (2011) adopted the following five levels in classifying the Relative Importance Index (RII) values: high ($0.8 \leq \text{RII} \leq 1$), high to medium ($0.6 \leq \text{RII} \leq 0.8$), medium ($0.4 \leq \text{RII} \leq 0.6$), medium to low ($0.2 \leq \text{RII} \leq 0.4$) and low ($0 \leq \text{RII} \leq 0.2$). This study will adopt this category of levels.

Table 1 and Figure 5 present the results of the analysis of the collected data. The results indicate that all knowledge area is within the high level in terms of risk severity, as the RII values are greater than 0.8. Scope was the most voted (RII = 92.20), while Communications was the least (RII = 82.93). Moreover, since the prerogative of most projects is to fulfill the project scope within budgeted cost and limited time, it was expected that these three areas of knowledge would have the highest weight in the severity criterion and were very close values: 92.2 for the Scope, 91.71 for cost, and 90.73 for Schedule.

Table 1: Ranking of Project Knowledge Areas.

Rank	Project Management Knowledge Area	RII
1	Scope	92.20
2	Cost	91.71
3	Schedule	90.73
4	Resources	89.76
5	Integration	89.27
6	Quality	87.32
7	Procurement	84.88
8	Communications	82.93

Figure 5: Relative Importance Index of Knowledge Areas.



As for the most voted item, Scope has its severity as a crucial factor in the impact on several projects. In many cases, highway projects go over budgets and delay due to scope problems, either due to a poor definition or due to changes that occur during the project's execution. Thus, having this item as the most voted demonstrates the respondents' perception of the importance of leveling and controlling the scope in the context of the project and that the occurrence of scope deviations has an impact on all other areas of the project. Furthermore, in a scenario of uncertainties, defining the scope of a project becomes complex for the main parties involved in the project, making it a challenge to cohesively align the scope to be delivered.

Another issue to be considered and analyzed is the fact that Communication is not among the most voted, even though it is an area directly linked to the scope of the project. Project scope issues are often caused by a lack of communication both within the project team, as well as with customers and other stakeholders.

Communication having the lowest weight among the other areas reveals a real problem in projects in progress, which is the misalignment of information. In many cases, several problems are generated in projects due to issues that could be resolved in a simple way if there was effective communication. Failed communication generates inconsistent decision making, lack of control over the progress of the project, difficulty managing the project team, and stakeholder dissatisfaction.

Conclusions

With the increase in large projects in some Middle Eastern countries, it was necessary to improve management processes. Keeping in mind the problems of deviations, mainly in cost and time, risk management has become an essential part of project monitoring and control. Establishing and prioritizing which areas have the greatest impact becomes an important tool in this management. The severity of each area, as well as the way each area will be treated throughout the project's life cycle, can be the difference between project success and failure.

In view of this study, organizations can establish criteria and prioritize ways of managing risks both in the identification phase and in the monitoring of these factors during the project. Moreover, focusing on project scope control, as well as time management and cost monitoring plays a fundamental role in achieving success.

On the other hand, the vision of organizations regarding Communication and Procurement still needs to be explored in order to understand what factors made these areas not to be valued within the risk management scenario. Despite being areas that are part of the entire project, they had the lowest degree of severity among the others, thus reflecting a problem in understanding the relevance of these areas within the general context of project management.

Seeking alignment between the areas of greater and lesser degrees of severity, it is possible to build a risk management plan that places the necessary emphasis on actions in the event of a risk and, thus, control the project taking advantage of the opportunities and reducing threats.

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