CRITICAL BARRIERS IN IMPLEMENTING RISK ASSESSMENT AND MANAGEMENT PRACTICES (RAMP) IN THE IRANIAN CONSTRUCTION SECTOR

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Abstract
Late completions, frequent stoppages of work and cost overruns are common issues in developing countries. Effective risk management (RM) can be utilised to address common construction issues, however, the uptake of RM within the Iranian construction industry, like many developing nations is limited. This study explored why RM was not utilised through a questionnaire survey of 90 professionals in the Iranian construction industry. The findings show that professionals in the industry perceive the three greatest barriers to be: (1) a lack of experience among practitioners; (2) unavailability of risk management consultants, and (3) a lack of knowledge and necessary skills. In comparison, professionals surveyed believed that the least commonly occurring barriers were: “tight scheduling of projects”, and “costs associated with risk management implementation”.

No significant differences were found between the perceptions of the three sub-groups: Contractors, Consultants and Client (private and public), regarding the barriers to risk management. The study contributes to the field by providing insights into what causes the low-level of implementation of Risk Assessment and Management Practices (RAMP) in Iran. It is anticipated that this type of study will result in raising the level of awareness of practices to improve risk management in developing countries. The study advocates a number of solutions for dealing with the identified barriers. These solutions can be implemented or used as guidelines for construction companies and policy makers in other developing countries confronting similar problems.

Keywords: Risk assessment, Risk management, Barriers, Developing countries, Construction industry, Iran

Introduction
Construction projects are inherently risky (Zhao et al., 2013). That is, construction projects operate in an increasingly dynamic and pluralistic society. This is compounded by complex relationships with owners, designers, contractors, subcontractors, suppliers; government authorities, the public and stakeholders (Hwang et al., 2014). Effective implementation of RAMP is indispensable to the success of construction projects (Banatienė et al., 2011); and successful management of risks in projects, facilitates the achievement of the projects objectives (Zou et al., 2006). Yet, the uptake of risk management practices among construction organisations in Iran still remains very low (Ghahramanzadeh, 2013). Promoting RAMP by conducting further research into the Iranian construction industry has been regarded as relevant and necessary by previous researchers (Ghadak Zadeh, 2010; Tavakkoli-Moghaddam et al., 2011). Despite there being some studies on risk management within Iranian construction, the majority of studies have focused on developing quantitative methods for identifying risks. For example Mojtaba et al (2010) and Karimi Azari et al (2011). These studies fail to consider why the Iranian construction industry has been a poor adopter of RAMP in projects (Chileshe and Kikwasi, 2014). There is a need to explore the barriers to risk management implementation within the construction industry of Iran. This study aims to fill this knowledge gap; firstly, by identifying the barriers to RAMP implementation in a developing country and secondly by putting forward remedial solutions to overcome the identified barriers.

This Iranian based study will also reinforce previous researcher’s analysis of barriers to the implementation of RAMP in developing countries and their suggested solutions to remove these barriers. Barriers to implementing risk and related management practices in developing countries generally is an overlooked area of study (Chileshe and Kikwasi, 2013, 2014; Perera et al., 2014). As a result, there are several ways this study will contribute to the existing body of the knowledge. Firstly, it will add to the understanding of inhibitors to construction risk in developing countries. Secondly, the findings will provide insights for policy makers in the construction industry of developing countries, to
direct them towards the underlying reasons for the barriers to risk management in projects, and suggest possible measures that could be employed in overcoming these barriers.

What makes this study unique is that it investigates the RAMP using Iran as an example of a developing country and it provides a comparison for barriers identified for developing countries from other studies.

Literature review

The following section provides a context for this Iranian focused study, by providing information on the significance of the construction industry and its projects to developing countries including Iran. This section will identify the barriers to RAMP within the broader context of developing countries; and will extend the analysis using Iran as a case study. As such, the literature review is structured into the following three areas: (1) Construction projects in developing countries; (2) Barriers to RAMP in developing countries; and (3) Barriers to RAMP in Iran.

Construction projects in developing countries

For Iran as it is for many developing countries, the construction industry is a major contributor to the Gross Domestic Product (GDP) and is a pillar of the national economy (Ghoddousi et al., 2014). The construction industry in Iran has been growing at an alarming rate. This is largely due to an increase in national and international investment to the extent that it is now the largest in the Middle East region (Ifpinfo, 2014). Despite this growth, construction projects in developing countries are fraught with low productivity and frequent work stoppages (Ghoddousi et al., 2014). This low productivity has been exacerbated by low retention of employees (Arashpour et al., 2012) and construction practitioners lacking the prerequisite skills (Tabassi and Bakar, 2009). Furthermore, as a developing country, Iranian construction projects are prone to a wide range of uncertainties (Ebrahimnejad et al., 2010) and market volatilities (Fereidouni, 2011). Studies such as Jahangiri et al. (2011) has identified Iran’s location as being among the top disaster-prone countries in the world and, therefore, disaster management is considered to be one of the most important issues in this country. Construction projects in developing countries often have to contend with government instability, lagging political and institutional reforms and inefficient and inequitable educational systems to train the large transient worker population (IMF, 2014).

These issues further highlight the need for effective risk management practices. Nevertheless, as previously researched “as a developing country, Iran has not focused on risk management” (Tadayon et al. 2012, p. 58). RAMP is not regarded as an essential element of delivering projects within the construction industry of developing countries (Tadayon et al., 2012). Implementing RM in developing countries becomes more necessary as developing countries are prone to political risks which cause great uncertainty for construction projects (Deng et al., 2014; Perera et al., 2014).

Evidence attests that developing countries show a lack of interest in risk management implementation to mitigate ongoing issues in the construction industry (Silva et al., 2013). Application of RAMP in developing countries has remained in its infancy stages (Chileshe and Kikwasi, 2014). As early as 1997 Rao Tummaia et al. (1997) suggested that low levels of RAMP implementation was caused by barriers or difficulties facing construction companies such as: lack of information, human/organisational resistance, a lack of understanding of RAMP, lack of knowledge and cost constraints.

Barriers to RAMP in developing countries

For brevity, the selected studies on main barriers to RAMP application as identified in literature and previously reported in Chileshe and Kikwasi (2014) are illustrated in Table 1.
knowledge regarding RAMP in Sri Lanka was later acknowledged by Perera et al. (2014) as a barrier to effective implementation of RAMP. By the same token, Liu et al. (2011) found that Chinese construction companies lacked the expertise and knowledge required for practical implementation of RAMP, as RAMP has only had a short period of exposure in China.

Within Ghana, Chileshe and Yirenkyi-Fianko (2012) identified the major barriers to RAMP implementation was a lack of information, awareness and experience, ineffective coordination between parties involved, unavailability of specialist risk management consultants and tight scheduling of construction projects. Using the same survey instrument as employed by Chileshe and Yirenkyi-Fianko (2012) in Ghana, an empirical survey study was conducted by Chileshe and Kikwasi (2014) within the context of the Tanzanian construction industry. The findings of that study identified the following seven barriers to RAMP implementation, in ranking order:

1. awareness of risk management processes
2. lack of experience
3. lack of information
4. lack of coordination between parties involved
5. availability of specialist risk management consultants
6. implementation costs, and
7. time constraints.

It should be noted that, while the identified studies of Chileshe and Yirenkyi-Fianko (2012) used the terminology of RAMP, this is the same as RM. The two terminologies are used interchangeably and are the same as applied within the Iranian study.

Acknowledging the impact of lack of knowledge for implementing RAMP, Rao Tummala et al. (1997) suggested that resources necessary for implementing RAMP could not be justified as the uncertainties and the potential benefits of implementing RAMP in construction projects was unknown. A review of literature establishes that research on risk management has been extensive. However, few studies focused on detecting the barriers to RAMP implementation. Apart from a limited selection of studies (i.e. Chileshe and Kikwasi, 2013, 2014), we do not have research focusing on identifying the barriers to implementation of RAMP within the construction context in developing countries. Hence, in view of the salience of RAMP for construction projects in developing countries, the primary objective of the present study (ascertaining the barriers to RAMP implementation and devising corresponding solutions) is further reinforced.

Barriers to RAMP in Iran

Given the scarcity of studies on barriers to risk management within the Iranian construction projects, some selected studies with synergies to risk management were also included in the review of the literature. These mainly included studies in the areas of disaster management, business process re-engineering and knowledge management. Table 2 presents a summary of the selected risk management and comparative studies.

<table>
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<th>Research methods</th>
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<td>This research is based on the data collected via a survey questionnaire. A survey was chosen as exploring variables which are similar across construction projects in a certain context (e.g. a country) justifies deploying a quantitative approach such as a survey questionnaire (Amaratunga et al., 2002).</td>
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Questionnaire design and measurement instrument
The basis of the questionnaire for this study was adapted from a validated instrument i.e. the questionnaire deployed by Chileshe and Kikwasi (2014) within the Tanzanian context. According to Carless and De Paola (2000) adapting and customising available instruments for the specific environment targeted by a research study is acceptable. Thus, to customise the data collection tool for Iran, (in the absence of standard or a validated barriers RAMP questionnaire the approach suggested by Sharifirad’s (2011) protocol was taken. Sharifirad’s (2011) procedure required the translation and review of the questionnaire. The Chileshe and Kikwasi (2014) questionnaire required translation (from English into Persian and vice versa) and review of the items contained therein. This involved forward translation, assessment, backward translation and assessment.

As part of the identified four-step procedure, the basic instrument was presented to four Iranian project managers each with more than 12 years of experience on construction projects. The questionnaire was approved by the project managers, with their suggestion that technical terms (e.g. risk management terminology) should be fully clarified. Thus, central definitions were added to the questionnaire to make objectives clear for potential respondents. The rationale in submitting the questionnaire to the Iranian project managers is further supported by Forza (2002) stating that ‘industry experts’ should be involved in the pre-testing of a questionnaire. The final questionnaire retained the same number of items (seven) as the Chileshe and Kikwasi (2014) but slightly different, with a number of changes made. The first barrier (BR1) and third barrier (BR3) in the Chileshe and Kikwasi (2014) questionnaire were “Awareness of risk management instrument”, and “Lack of information”, these were deleted from the Iranian RM sub instrument and replaced with the following barrier: “Lack of knowledge and necessary skills”.

The final questionnaire consisted of the following two sections:

- Section 1 asks about the demographic attributes of respondents; and

- Section 2 is concerned with the views of the respondents on the levels of importance of the barriers to RM. Respondents were asked to rate using a five-point Likert scale, ranging from ‘1’ as the least important (or strongly disagree) to ‘5’ as the most important (or strongly agree) with regards to the barriers to RM implementation.

Survey administration

According to Roudsari and Ghodsi (2005) and Ghoddousi et al. (2014), Tehran as the capital and most populated city of the country represents a pool for construction company headquarters. As a result, it brings together the country’s construction practitioners. Construction practitioners in Tehran were targeted as the respondents of the survey.

The lists of certified companies were selected from the data bank of licensed construction companies in line with the method utilised by Ghoddousi et al. (2015) for targeting construction companies in Iran. These were merged and sorted based on alphabetic order. Afterwards, a random selection among the outcome was done by using a non-replacement random selection technique as deployed by Ghoddousi and Hosseini (2012).

The average response rate of 20% was observed in previous studies in Iran (e.g. Ghoddousi et al., 2015). Thus, to obtain a minimum of 100 completed questionnaires for the sake of conducting complicated statistical analysis such as structural equation modelling (SEM), a total of 494 invitations were sent by post to the list of companies. Respondents were invited to distribute the questionnaire among their employees in construction projects. Follow up calls were conducted and resulted in receiving 90 completed questionnaires. The process of preparing the list, data collection and entering data took seven months and was completed at the end of May 2013.

Instrument (measurement) validity and reliability
As recommended by Forza (2002), the internal consistency of the survey was tested using reliability analysis. The Cronbach alpha was found to be 0.714 for the RM barriers sub instrument, which was greater than 0.7, thus indicating an acceptable reliability.

**Analysis of results**

A number of data analysis techniques were employed in this study in line with previous studies investigating the barriers to RM (Liu et al., 2011; Chileshe and Kikwasi, 2013) as described next.

**Multivariate analysis of variance (MANOVA)**

In order to test whether different groups of the stakeholders differed in their perception about the barriers to RM, a MANOVA test was undertaken. This was used to consider the different attributes of respondents on their perceptions regarding barriers to RAMP. In developing countries such as Iran, clients and companies form the basic units of the construction industry as described by Moavenzadeh (1978). Likewise, according to the main source of information for licensing construction companies in Iran (see [http://www.sajat.in/](http://www.sajat.in/)) licenses are issued in two main categories. These are comprised of contractors and consultants, who, along with clients form the necessary elements for delivering a construction project (Moavenzadeh, 1978).

Respondents were divided into three groups according to their role in the construction industry (Group 1 = Clients; Group 2 = Consultants; and Group 3 = Contractors). This enabled researchers to compare the viewpoints of primary entities active within the Iranian construction industry. A range of respondents is important because a respondent with a different role may express a different viewpoint on aspects associated with RM than a respondent in a different role (Perera et al., 2014). The inclusion of three groups (Contractors, Consultants and Client) is highly desirable as previous studies in the area of RM mostly relied on one group of project participants. According to Tang et al. (2007), project risks cannot be controlled by one party. By the same token, the perception of barriers to RAMP needed to rely on a wide range of project participants.

**Spearman rank correlation coefficient**

Equation 1 i.e. Spearman rank correlation coefficient ($r_s$) that was used for the bid / no bid factors by Cheung et al. (2012) was deployed in the present study.

$$r_s = 1 - \frac{6\sum d^2}{N(N^2-1)}$$

*Equation 1*

Where:

- $d$ = difference in rank of the two groups for the same barrier to RM; and
- $N$ = total number of responses concerning that barrier to RM, (7 in this case).

**Partial least square structural equation modelling (PLS-SEM)**

According to Hair et al. (2014), in research studies which for there are no established theory to explain the associations between the concepts, application of PLS-SEM becomes relevant. Unlike CB-SEM, PLS-SEM is robust to small sample sizes and presents accurate results when normality requirements of data are not met (Ringle et al., 2012). PLS-SEM is well-capable of interrogation of data to explore and reveal associations among a number of constructs (Hair et al., 2012). Given the relatively small sample size and novelty of the concepts in the present study, PLS-SEM was considered as a rigorous statistical method for analysing the data. SmartPLS v.3.2.1 recommended by Hair et al. (2014) was used to run the SEM-PLS analysis.
Characteristics of sample

The characteristics of the respondents and their organisations are summarised in Tables 3 and 4 respectively.

Individual characteristics

Examination of Table 3 shows that the majority (33.0%) of the respondents were supervisors, followed by design engineers (21.6%) and project managers (14.8%) or site managers. It was interpreted that the respondents had gained first-hand experience in delivering construction projects and were knowledgeable about management strategies in their companies.

Length of service in construction industry

The results revealed that the respondent’s period of experience (employment) in the Iranian construction industry was evenly spread across the spectrum: Less than 5 years, 5 – 10 years, 11 – 15 years, and more than 15 years (Table 3). The respondents presented a sample covering all levels of experience within the Iranian construction industry. This sample therefore provides a wide range of views commonly prevalent within the Iranian construction industry given the diversity in length of services in the construction industry (see Table 3) and variability of roles in the sample.

<Insert Table 3 here>

The majority of Respondents (68.5%) had more than 5 years of experience in the Iranian construction industry. This is highly significant given that the frequently used risk assessment techniques were highly dependent on intuition, judgement and experience (Lyons and Skitmore, 2004). As such it could be inferred that the level of experienced Iranian practitioners would contribute towards mitigating some of the barriers associated with implementing RM.

Organisational characteristics

The profile of respondents in terms of their role is illustrated in Table 4.

<Insert Table 4 here>

As can be seen from Table 4, there is a fairly equal distribution among three key players in projects. Such equal distribution has been observed in other studies conducted in the Iranian construction industry as well (Pournader et al., 2015).

Results and discussion

Identified barriers to implementing RAMP

The overall ratings of the barriers to implementing RAMP with respect to sample as well as group-wise are shown in Table 5.

<Insert Table 5 here>

Ranking differentiation for barriers having the same mean was achieved through the coefficient of variation (C.V). Using the CV obtained by dividing the mean score with the standard deviation has been adopted by previous researchers (Chileshe and Kikwasi, 2014; Ghoddousi et al., 2014). Hence, CV has been used as an acceptable basis for meaningful comparisons to evaluate level of consensus of respondents on different items in construction research (Ghoddousi et al., 2014). It shows the extent of variability in relation to the mean of the population.

Multivariate analysis of variance (MANOVA)

To ensure clear interpretation of responses, an analysis of the respondents profile was compared to their perception of barriers. Utilising a Multivariate Analysis of Variance (MANOVA) is widely-acceptable...
within the literature as proposed by Ghoddousi et al. (2014). That is, deploying several univariate tests for each item increases the potential for Type I error as stated by Cronk (2012). By deploying MANOVA, causes of error are contained; enabling statistical analyses to take place at the same time (Abbott, 2011). According to Cronk (2012), the most common multivariate test is Wilks’ Lambda. Thus, a one-way MANOVA for examining the potential discrepancies among perceptions of respondents regarding seven items identified as barriers to RAMP implementation was calculated as illustrated in Table 6.

The results of one-way MANOVA as illustrated in Table 6 showed no significant effect different categories associated with profile of respondents on scores of perceptions of respondents regarding barriers to implementation of RM. That is, results indicated that there is no difference between perceived barriers to RM among Iranian construction practitioners in terms of their role in projects (Lambda (14, 152) = .799, p = .218 > 0.05). The same results were observed for respondents in different professional backgrounds (Lambda (28, 264.62) = .584, p = .054 > .05) and with different levels of experiences (Lambda (21, 213.038) = .806, p = .729 > 0.05). This was reflective of the consensus among Iranian construction practitioners regarding the barriers to RAMP implementation in the construction industry. This is a logical result as major barriers identified in the study were associated with the lack of knowledge, experience and unavailability of skilled personnel for RAMP. This also reinforces the assertions by Ghoddousi et al. (2015), that there is consensus among all the practitioners regarding the unavailability of skilled personnel in different levels and lack of training for practitioners in the industry. In essence, predicaments stemmed from the lack of knowledge are identified as a source of major issues rampant within the construction industry for developing countries as argued by Ofori and Toor (2012). This justifies why multivariance analysis of variance (MANOVA) did not show any significant discrepancy among different respondents.

Overall ranking of barriers to RAMP

This subsection examines the contractors, clients, and consultants’ perception of the barriers in implementing RM. Table 5 summarises the results of the analysis of the barriers based on the overall sample and the group wise ratings of the respondents (contractors, clients, and consultants).

While the barriers were not grouped into specific categories as factor analysis was not undertaken. The ranking and severity of these barriers indicated the grouping of them into the following three areas: (i) lack of formal risk management systems, (ii) lack of agreement and support among parties; and (iii) project constraints of time and cost inhibiting the use of resources for RAMP. To draw upon the findings, and to utilise the literature effectively, the barriers to RAMP will be discussed in the three above-mentioned groups rather than individually.

Lack of formal risk management systems

As illustrated in Table 5, based on the overall sample size, the highest ranked barriers impeding the implementation of RM within the Iranian construction context are:

- the lack of knowledge and necessary skills (mean = 4.307)
- the ‘unavailability of risk management consultants’ (mean = 4.161), and
- the level of experience among practitioners (mean = 4.182) within the Iranian construction industry.

Examination of Table 5 shows that the clients ranked ‘lack of knowledge and necessary skills’ as the first, whereas contractors ranked ‘unavailability or risk management consultants’, and interestingly, the consultant’s ranked ‘lack of support from clients and project stakeholders’. This finding demonstrates that both clients and consultants attribute the major barriers to RM as a result of the inaction of each other (i.e. availability and cooperation). This corroborates the observations made by Kululanga (2012) regarding the serious impacts of adversarial relationships, the blame game prevalent and lack of joint efforts in the construction industry in developing countries.
The findings are also consistent with literature on barriers to RM (e.g., Wang et al., 2004; Choudhry and Iqbal, 2013). Choudhry and Iqbal (2013, p. 47) collectively labelled the grouping of these three barriers as ‘lack of formal risk management systems’. It should however be noted that some previous studies provide contradicting views on the need for formalised RM processes. For example, Khan and Burnes (2007) argued that effective RM does not need to be a highly formalised and structured process; but instead it should be based on good common sense. This study opted for the inclusion of ‘lack of formal risk management systems’ as a barrier, due to complex nature associated with estimating the probability and impact of risk, as well as the support by the majority of studies in favour of formalised RM system (e.g., Tah and Carr, 2001). Similarly, within the context of international projects and developing countries such as China, Wang et al. (2004) emphasised the ‘formal’ nature by defining RM as a formal and orderly process of systematically identifying, analysing, and responding to risks throughout the life-cycle of a project to obtain the optimum degree of risk elimination, mitigation and / or control.

This study has collectively categorised these barriers as a ‘lack of formal risk management systems’ based on the assumptions of the Pakistan study by Choudhry and Iqbal (2013, p. 47). The higher ranking achieved by these barriers is hardly surprising as they are all associated with either lack of ‘experience’ or ‘knowledge’. As observed by Kazaz and Ulubeyli (2007) and Ofori and Toor (2012), the two most prominent features of the economics of developing countries are low levels of education, training, and skill among the work force; and insufficient infrastructure. Iran is a developing country facing similar issues as identified by (Tabassi and Bakar, 2009) and acknowledged by Ghaddoursi et al. (2015).

These findings also reiterate the observations made by Tadayon et al. (2012) and Bowers and Khorakian (2014) indicating that RM is rarely implemented in the Iranian construction industry due to the absence of knowledge and proficiency. In agreement with this observation, J. Wang and Yuan (2011) and Chileshe and Kikwasi (2014), contended that awareness of risk management practices and methods of implementation is a critical success factor for implementing RM. The implication of this finding is that, as observed by Choudhry and Iqbal (2013), without a formal risk management system in construction companies, implementing RM becomes dependent on expertise and knowledge of employees or external experts. As shown in Table 5 and the higher ranking of these barriers, the Iranian construction sectors’ lack of knowledge and necessary skills (mean = 4.307) is further exacerbated by an unavailability of consultants (mean score = 4.161) and professional consultants to guide companies in implementing RM.

Lack of skills and unavailability of skills are rooted in another issue adversely affecting the construction industry in developing countries as explained in length by Kululanga (2012). The latter is a serious issue for Iran in light the international sanctions and ever-increasing isolation of the country from developed economies and foreign investments as pointed out by Perthes (2010). The lack of links between academic university studies and the major practical problems facing industry is a significant deficiency for developing countries Kululanga (2012).

Lack of agreement among parties and stakeholders regarding RM implementation

The barrier, ‘lack of agreement among the parties and stakeholders of projects regarding RM implementation’, was ranked the fourth overall among the respondents (mean = 3.909). This suggests that this is another hurdle in RM implementation within the Iranian construction industry. This finding is similar to the observations among the developing countries such as for the Ghanaian construction industry provided by Chileshe and Yirenkyi-Fianko (2012), and in Tanzania (Chileshe and Kikwasi, 2014).

The lack of agreement has been exacerbated by the lack of support for implementing risk management from clients and project stakeholders. This mirrors the barriers identified by Chileshe and Kikwasi (2014) for the Tanzanian construction industry. Likewise, a ‘lack of joint risk management’ was identified by Tang et al. (2007) and Choudhry and Iqbal (2013) as one of the major barriers to RM for construction projects in China and Pakistan. This is understandable in view of the common issues in developing countries i.e. lack of ‘joint industry activities’ and ‘effective coordination’ among the main units of the construction industry as pointed out by Kululanga (2012). This could be a major barrier to implementation of RM, because lack of champions and managerial support in one party might hinder implementation of RM and result in diminishing the interest for RM in other parties involving the same
project as indicated by Silva et al. (2013). According to Zhao et al. (2014), the commitment, support, and leadership of the board and senior management are critical for implementing RM in projects.

Project constraints of time and cost inhibiting the use of resources for RAMP

According to Kutsch and Hall (2009, p. 78) ‘the most dominant reason for the non-application of project risk management appeared to be the problem of cost justification’. However, construction practitioners in Iran regarded time and cost for implementing RAMP as the 6th (mean = 3.43; C.V= 0.330) and the 7th (mean = 3.273; C.V= 0.333) barriers hindering the implementation of RAMP in Iranian construction projects. This finding is also consistent with a number of selected studies within developing countries such as Chileshe and Kikwasi (2013) in Tanzania which ranked the two RAMP barriers in the same 6th and 7th position.

According to Kululanga (2012) majority of companies in developing countries are small, lack strategic vision and capacity for growth. In essence, construction companies in developing countries usually suffer from lack of resources to deliver the projects (Perera et al., 2014). This is an issue in Iran where irregular payments compound the problem as construction companies’ struggle to cover the expenses and survive in the volatile market (Ghoddousi and Hosseini, 2012). As such, cost concerns are a barrier to RAMP in a developing country such as Iran as shown in Table 5. On the other hand, as identified by Ghoddousi et al. (2015) the pressure from the government (major client in the construction industry) contractors put on-time completion of the project as their first priority. Thus tight scheduling becomes one of the hurdles of RAMP as illustrated in Table 5.

As discussed above, the main barriers to RAMP were oriented by the lack of knowledge, skills and availability of skilled operators, which were encapsulated in “Lack of formal risk management systems”. Two other categories i.e. “Lack of agreement and support among parties and “Project constraints of time and cost” were of lower importance as perceived by the respondents. On the other hand, as implied by Chileshe and Kikwasi (2014) and Choudhry and labal (2013); lack of interest in RAMP could be attributed to lack of knowledge as well as lack of resources (time/cost). Besides, due to lack of knowledge and skills organisations are not interested in allocating resources and time to implement new methods for delivering projects as indicated by the seminal study by Slaughter (2000). Such assumptions are presented in form of the PLS-SEM model in Figure 1.

As illustrated in Figure 1, each category of barriers is considered as a construct. These are concepts that are not directly measured and are usually shown using ovals in SEM models. Constructs are reflected in their indicators, which are variables that contain raw data and are directly measured (rectangles in SEM models as described in Table 5). Single-headed arrows show the associations among constructs and indicators. Analysing associations using PLS-SEM models enables researchers to identify key target constructs and discover the ones acting as the drivers of others (Hair et al., 2014). The PLS algorithm was deployed to calculate outer loadings between the elements of the model. The algorithm converged with 8 iterations. The number of iterations below 30 implies sufficient variability of the constructs in the model. The significance of associations should be assessed through running a bootstrapping test (Hair et al., 2014). The outcome of running the bootstrapping is illustrated in Table 7.

As illustrated in Figure 1, for “Lack of agreement and support among parties”, R-square equalled 0.3, thus 30% of the variance in the category is explained by the elements associated with it while 70% comes from elements not included in the model.
Advocated solutions and guideline for RAMP Implementation

The solutions below are suggested in literature on RM in other developing countries. While these solutions are not verified by experts within the Iranian study; they are underpinned by a similar study albeit on knowledge management (KM) and within Iranian project-based organisations (PBO) by Akhavan et al. (2014). The justification for the selection of this study is based on the similarities and linkages between KM and RM (Tah and Carr, 2001), as well as the context (country) under examination, namely Iran. This is further corroborated in view of the outcome of the PLS-SEM as described above. That is, the category stemmed from lack of skills and knowledge was the driver for other categories and barriers identified in the present study.

- **Professional bodies led RM training programs** - The Iranian study by Tabassi and Bakar (2009) identified low levels of education among the major problems facing the Iranian construction workers. The proposed remedial solution for our existing RM study is the encouragement of relevant professional associations for contractors, architectures and professional bodies to introduce training programs associated with implementation of RM for their members. The similar approach of proposing ‘education and training’ has been suggested as a condition for overcoming barriers in KM implementation among Iranian project-based organisations (Akhavan et al., 2014). The above suggestion is further supported by the RM study undertaken within the Pakistan context by Choudhry and Iqbal (2013) and is further reinforced and supported by Tabassi and Bakar (2009) which proposed government to legislate new rules and regulations to labour, and provide training facilities.

- **Best practice from successful RM implementation case studies** - Getting ‘wins on the board’ by documenting, publishing and communicating with contractors, consultants and clients successful cases where RM has successfully been introduced into projects and positive outcomes achieved (Chileshe and Kikwasi, 2013).

- **Risk management knowledge as prerequisites for licensing authorities** - Providing training for construction practitioners through formal channels (Tabassi et al., 2012). Authorities in charge of issuing licences for contractor and consultant companies should require a minimum level of risk management knowledge among the managers of the company as a prerequisite for receiving licenses. This would lift the basic skill level of the managers of the company.

- **Risk management prerequisites for tendering procedures** - Requiring Risk management documents to be submitted as part of tendering procedures for awarding contracts by relevant authorities as suggested by Goh and Abdul-Rahman (2013) and Perera et al. (2014).

- **Joint ventures with foreign contractors** - Enhancing collaboration with foreign contractors is a vehicle for acquiring necessary skills and essential skills for construction practitioners in developing countries as opined by Chileshe and Kikwasi (2014). Infrastructure projects in the oil and gas fields in Iran have usually deployed collaboration from international companies for delivering projects (Ebrahimnejad et al., 2010). Such projects could be treated as available training fields for local contractors for acquiring the knowledge and the expertise necessary for implementing RM in projects.

- **Integration of RM knowledge areas within training programs for licensed engineers** - Formally include the required knowledge of RM among the compulsory training programs and areas of study designed for licensed engineers. According to Arashpour et al. (2012) the Iranian construction industry is traditionally at the mercy of engineers. Thus, strength of the construction industry in terms of implementing RM becomes reliant on limited knowledge and abilities of engineers on management sciences including risk management (Ghahramanzadeh, 2013).

- **Enhanced organisational RM knowledge through training programs** - Increasing the level of knowledge in organisations (Choudhry and Iqbal, 2013). This could be pursued, particularly in government organisations, by inclusion of RM training subjects among the compulsory training programs of employees in organisations acting as the clients in the Iranian construction industry.
Facilitation of joint risk management frameworks by independent experts - Joint risk management frameworks should be developed and implemented for projects to guide clients and other stakeholders. The commissioning of experts outside by the government could facilitate this process and preparing the necessary material as recommended by Ikediashi et al. (2014).

Development of standards and codes - Standards and codes for joint risk management should be developed and their implementation should become compulsory in construction projects as suggested by Choudhry and Iqbal (2013).

Improved tendering procedures - Clients do not support RM implementation if they are not held accountable for risk occurrence and the consequences on projects (Kutsch and Hall, 2009). According to current regulations in Iran, contractors suffer from majority of risks in construction projects (Ghahramanzadeh, 2013). Hence, all parties should be regarded as ‘risk owners’ and held accountable according to contractual requirements of construction projects.

Resources necessary for implementing RAMP - As can be seen from Table 5, based on the overall sample, the least ranked two barriers relate to the ‘time’ and ‘cost’ aspects of completing a project. Interestingly, the group differentiation (contractors, clients and consultants) had ranked these barriers as the least ranked (Table 5). These have been categorised or grouped under the heading ‘Resources necessary for implementing RAMP’ as this last grouping is due to the project constraints of time and cost inhibiting the use of resources for RAMP.

Enhanced culture through formalisation of RM procedures - This refers to enhancing the culture in the Iranian construction industry by formalising the risk management procedure in construction projects Kutsch and Hall (2009, p. 78); Thaheem and De Marco (2014). This could be achieved by putting in a compulsory framework for implementing risk management in construction projects by relevant authorities as pointed out by Tadayon et al. (2012) and Perera et al. (2014).

Bridging the research gap between academia and industry - According to Cagliano et al. (2015), knowledge about RM is becoming a matter of paramount importance to effectively deal with the complexity of projects. To enhance this knowledge creation the gap between academia and the construction industry in Iran needs to be bridged. From the academic perspective, this objective should be pursued through research comparing the time and costs of implementing RAMP against the consequences of risks occurrences in construction projects as suggested by (Kutsch and Hall, 2009).

Streamlined approach to RM and lessons learned - Reducing the cost and time necessary for implementing RM, preparing standardised documented databases for risks, applicable templates and lessons learned within the construction industry by a professional association and relevant authorities might be an effective solution as suggested by Tadayon et al. (2012). Similarly, Ahmed et al. (2007) providing support for ‘lessons learnt’ by recommending the measures for project RAMP endeavours to project management practices through existing knowledge with lessons learnt.

Enforcement of effective financial discipline - Improving the financial security of construction companies so that they focus less on immediate issues and consider the overall project and take long term perspective. The construction industry in developing countries, including Iran, usually suffers from crippling effects of late and irregular payments to contractors and consultants, which result in shortage of resources for implementing RAMP in projects (Ghahramanzadeh, 2013). A better financial framework could enhance the financial security of contractors and consultants and lower this barrier.

Correlation analysis

To identify if there are relationships and interactions among identified RM barriers, Pearson correlation coefficient is used as recommended by Cronk (2012). The results are summarised in Table 8.
For brevity only the most significant correlations are commented upon. Examination of Table 8 shows that 8 (38%) out of 21 correlations were significant at the p < 0.01 and 3 (14.3%) at the p < 0.05 levels. From the analysis, a strong and positive correlation was found (r(86) = 0.685, p < 0.01) between ‘lack of knowledge and necessary skills’ and ‘lack of experience among practitioners’. This indicates that participants who identified the lack of knowledge and necessary skills tended to also consider lack of experience among practitioners as important.

Spearmen rank coefficient

Using the approach under by Tang et al. (2007), to test whether there was consensus among the various three groups (clients, contractors and consultants) on the rankings of the criticality (importance) of barriers to RM, the Spearmen rank correlation coefficient (Equation 1) \( r_s \) was computed. The results are reported in Table 9.

Examination of Table 9 shows that the highest degree of agreement (correlation) is (82.1% with mean scores) between the contractors and clients implying a reasonable consistent view of barriers to risk management implementation. The lowest degree of agreement appears between contractors and consultants (about 67.9%). Why there is this disparity between the three groups is open to conjecture but may be due to each group having a different perspective and thereby recognising different risk factors. This would require further study.

Conclusion

The purpose of this paper is to explore and identify the critical barriers to risk management implementation within the Iranian construction sector. Based on the perception of the major Iranian construction practitioners, the study found that there was limited knowledge of and awareness of the implementation of risk management in construction projects.

The research clearly indicated that a shift towards effective implementation of RAMP in developing countries will only occur if policy makers and researchers participate in a joint effort for enhancing knowledge, supplying the industry with required resources and providing the regulatory framework for facilitating permeation of a risk culture.

The study presents evidence that viewpoints of all key players in the Iranian construction industry are consistent in their ranking of the barriers to implementation of RAMP. It can be concluded that such agreement on detecting barriers could be indicative of the available potential for overcoming problems due to the consensus among key players in the construction industry in dealing with barriers.

Limitations and Future Areas for Research

There is a conspicuous absence of investigations into barriers to implementing RAMP in developing countries; thus, the present study is a significant contribution to the field. However findings should be considered in light of a number of limitations. These include the sample size of the study which is relatively small. This opens the door for broader studies drawing upon larger sample sizes from different developing countries; and would provide more depth to the analysis. However it could be suggested that not all developing countries demonstrate the same barriers to RAMP, it would be interesting if future studies looked at such factors as the proportion of itinerant workers utilised by the construction industry, the pervasive culture and other indicators of diversity.

Another limitation, the present study provides limited discussion and suggestions of possible methods to reduce the barriers for developing countries. Industrial relations and regulatory frameworks might be different in different developing countries. Hence, new avenues for further research are opened by replicating the study in other developing countries using more comprehensive methods such as mixed methods. Remedial solutions drawing upon empirical studies from the construction industry for each developing country would also be a fertile area for further research.
References


Dept., CA 2014, Islamic Republic of Iran: 2014 Article IV Consultation-Staff Report; Press Release; and Statement by the Executive Director for the Islamic Republic of Iran, IMF 14/93.


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Captions

**Table 1:** Selected studies on barriers to RAMP application in developed and developing countries

**Table 2:** Summary of selected RM and comparative studies in Iran

**Table 3:** Profile of study sample (professional background and experience)

**Table 4:** Profile of study sample (role in projects)

**Table 5:** Overall sample and group-wise (Clients, Consultants and Contractors) rating of barriers

**Table 6:** Wilks’ Lambda results (MANOVA Tests)

**Table 7:** Significance of associations between the constructs

**Table 8:** Pearson correlations

**Table 9:** Spearman rank coefficient

**Figure 1:** Associations between categories of barriers (please see Table 5 for details of elements of the model)
Table 1: Selected studies on barriers to RAMP application in developed and developing countries

<table>
<thead>
<tr>
<th>Researchers/ Context</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mok et al. (1997) – Survey of 52 building services engineers responsible for cost estimation in the Building Services Branch (BSB) in Hong Kong.</td>
<td>Barriers to RAMP expressed in terms of ‘inherent problems’ and ‘implementation problems encountered’. Identified the following five inherent problems encountered during implementation of risk management processes (RMP): difficulty in obtaining input estimates and assessment of their probabilities; time involvement; difficulty in understanding and interpreting outcomes of RMP; managers cannot agree on quantification of uncertainty / subjective probability. The following five were the ‘implementation problems encountered’ in ranking order: (i) human / organizational resistance to change; (ii) managers’ understanding of risk management process techniques; (iii) lack of computing resources and assistance; (iv) lack of middle management support; and (v) lack of top management support.</td>
</tr>
<tr>
<td>Kim and Bajaj (2000) - Interviews of 13 Korean managers of general construction firms.</td>
<td>Three reasons limiting the usage of risk management techniques: a lack of familiarity with techniques; most clients and / or owners wanted to see tangible calculations and unambiguous evidence of risk; and lack of expertise with techniques</td>
</tr>
<tr>
<td>Lynos and Skitmore (2004) - General survey of 17 contractors, 11 consultants, 10 clients and 6 developers in</td>
<td>Identified nine barriers inhibiting the implementation of risk management: lack of time; lack of familiarity with the techniques; lack of dedicated resources; lack of</td>
</tr>
</tbody>
</table>
Queensland (Australia) construction engineering organisations  

Liu et al. (2007) - General survey of contractors’ attitudes in China

Researchers / Context  

Findings

Tang et al. (2007) - General survey of 115 stakeholders comprising 19 clients, 30 contractors, 21 designers, 20 superintendents, 10 management organizations, 8 planning organisations and 7 others in China

Eleven barriers to risk management: lack of joint management mechanisms by parties; shortage of knowledge /techniques on risk management; different recognition of risk control strategies; ineffective implementation of risk control strategies; ineffective monitoring; lack of formal risk control strategies; ineffective monitoring; lack of formal risk management systems; no incentive for better risk management; lack of risk consciousness; inappropriate risk allocation; lack of historical data for risk trend analysis; inappropriate risk allocation; and insufficient ongoing project information

Wang et al. (2009) - Interviewees of government agencies, and organizations and Australian firms in China.

Identified the following three major risks: (i) IP protection; (ii) complex networks of policies; and (iii) decrees and regulations, and fragmentation or conflicting among them imposed by the state, industry and local government.


Examined the following two possible barriers to risk management: (i) individual biases; and (ii) cultural norms. The following three cognitive biases that may impede risk assessment: (i) confirmation bias; (ii) overconfidence / optimism; and (iii) framing, were analysed and explored whether ‘corporate culture’ and ‘the environment at entrepreneurial or risk-aggressive firms’ posed a barrier to effective risk-management practices.

Kikwasi (2011) - Interviews of 55 consultants, architects and quantity surveyors in Tanzania.

Identified three challenges inadequate risk management knowledge; not being a priority in clients requirements; lack of holistic approach to risk management; and reluctance of consultants to spearhead risk management process

Chileshe and Yirenyi-Fianko (2012) - General survey of 34 contractors, 46 consultants and 23 clients (public and private) in construction projects in Ghana.

Identified seven main barriers to risk assessment and management practices: awareness; lack of experience; lack of coordination between parties involved; lack of information; availability of specialist risk management consultants; time constraints; and lack of knowledge and expertise

Researchers / Context  

Findings

Carter and Chinyio (2012) – A questionnaire survey of 113 construction professionals (project managers, clients, quantity surveyors and contract experts)

Identified the following barriers: making a late start, using inexperienced personnel; attitude towards risk; not robust enough; incompetency of risk managers;
Paape and Spekle (2012) – Surveyed respondents (chief financial officers, controllers and risk managers) from 825 organisations with annual revenues of more EUR 10 million, and more than 30 employees in the Netherlands.

Hwang, Zhao and Toh (2013) - A questionnaire survey of 15 consultants and 19 contractors in Singapore based on data collected from 668 projects.


Paape and Spekle (2012) – Identified the following five broad group of factors as antecedents to the extent of ERM implementation: (1) the regulatory influences; (2) internal influences; (3) ownership; (4) auditor influence; and (5) firm and industry-related characteristics.

Hwang, Zhao and Toh (2013) - Identified ten probable barriers to RM implementation in small project: competition among small and medium contractors (SMC); complexity of analytical tools; lack of potential benefits; lack of budget; lack of government legislation; lack of knowledge; lack of manpower; lack of time; low profit margin; and not economical.

Chileshe and Kikwasi (2014a) - Based on the overall mean sample scores, identified the following ten CSFs for implementation of RAMP, in ranking order: (1) awareness of risk management; (2) teamwork and cooperation; (3) management style; (4) effective use of methods and tools; (5) goals and strategic objectives of the organisation; (6) availability of specialist risk management consultant; (7) consideration of external and internal environment; (8) cooperative culture; (9) customer requirement; and (10) positive human.
establish a knowledge management program in Iran Aerospace Industries Organization (AIO). A case study methodology was applied in the area of knowledge management.

(2) leadership and commitment of CEO; (3) appropriate organizational infrastructure; (4) pilot, benchmarking and KM systems; (5) job enrichment and security; (6) culture, change management and strategy; (7) collaborative and flexible organization; and (8) training and learning.

**Fallahi (2008)**

Analyses the extent to which such opportunities were capitalized upon and proposes strategies and recommendations for future risk preparedness planning in Bam, Iran. A case study methodology was applied in the area of disaster and risk management.

The earthquake provided an opportunity for further development and growth of the city’s unique and internationally known date production through more publicity, renovation of the old irrigation systems, and expansion of its related industries.

**Tarokh et al. (2008)**

This paper aims at studying the success and failure of BPR projects executed throughout Iran. The methodology included the statistical analysis of efficiency indexes mean value and project effectiveness whereas the scope was in business process re-engineering and business failure.

BPR projects executed in Iran have failed to reach predefined acceptable success.

<table>
<thead>
<tr>
<th>Researchers1</th>
<th>Aim, methodology and context / scope</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parsizadeh and Ghafory-Ashtiany (2010)</td>
<td>This paper seeks to provide a brief summary on the comprehensive earthquake education program for increasing the public awareness and preparedness for earthquake through an integrated educational program using all types of media, especially in the schools and amongst children. Employed a literature review and the scope was in risk management (RM) and disaster management (DM).</td>
<td>Established that there is still a long way to go to achieve a fully prepared and seismically safe community and for this stronger cooperation and participation of the whole of society are necessary for enhancing public safety.</td>
</tr>
<tr>
<td>Ebrahimnejad et al. (2010)</td>
<td>The main aim was to understand risks in build-operate-transfer (BOT) projects</td>
<td></td>
</tr>
<tr>
<td>Jafari et al. (2011)</td>
<td>This study sought to develop a model for risk management of knowledge loss in a project-based organization in Iran. A case study methodology was applied in the area of knowledge management (KM) and risk management (RM).</td>
<td>The proposed model had the ability to reduce the job positions facing knowledge loss were by 88 percent.</td>
</tr>
<tr>
<td>Jahangiri et al. (2011)</td>
<td>The study was aimed at making a comparative study on the community-based disaster</td>
<td>Participation of the community in various disaster management lifecycles identified as necessary</td>
</tr>
</tbody>
</table>
management (CBDM) in various selected countries in order to design a model for Iran. Used a **descriptive comparative study** methodology in the area of disaster management (DM).

**Todayon et al. (2012)**

The study was focused on research identification, as opposed to other processes of risk management. The methodology employed was via a **questionnaire survey**, and the scope was risk management (RM).

Established that time constraints and project managers with sufficient experience are critical when identifying the level of risk for large and / or complex projects.

<table>
<thead>
<tr>
<th>Researchers</th>
<th>Aim, methodology and context / scope</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alavifar and Motamedi (2014)*</td>
<td>The study was aimed at identifying delayed risks for construction projects from the owners, contractors and consultant’s perspective, evaluated and classified risks. Employed the methodology of data collection through <strong>questionnaire survey</strong>. The scope was in <strong>risk management</strong>.</td>
<td>Classified the levels of problems facing the time delay risks of construction projects into the following three categories: (1) Managerial; (2) Systematic; and (3) Strategic. Different ranking of frequency, severity and importance of the causes of delay by the three groupings (owners, contractors and consultants).</td>
</tr>
<tr>
<td>Bowers and Khorakian (2014)*</td>
<td>The study sought to establish what project risk management should be applied and where in the innovation project. Employed a dual methodology of research <strong>framework</strong> and case study. The scope was in <strong>project risk management and innovation process</strong>.</td>
<td>Established that risk management needs to be applied in differential manner: simple, unobtrusive techniques early in the innovation life cycle with more substantial, quantitative methods being considered for later stages.</td>
</tr>
</tbody>
</table>

**Notes:** 1The studies are arranged in chronological order; *Specific risk management studies; Study based on literature review on RM drawn similar Middle Eastern Countries such as United Arab Emirates (UAE), Saudi Arabia, Turkey, Lebanon, Kuwait, Jordan and other developing countries such as Malaysia, Nigeria and Libya; For the purpose of our current study, the terminology risk management (RM) is used interchangeably with risk assessment and management practices (RAMP)
Table 3: Profile of study sample (professional background and experience)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Number of respondents</th>
<th>%</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional &amp; trades background</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supervisor</td>
<td>29</td>
<td>32.94</td>
<td>32.94</td>
</tr>
<tr>
<td>Design engineers</td>
<td>19</td>
<td>21.60</td>
<td>54.54</td>
</tr>
<tr>
<td>Project manager</td>
<td>13</td>
<td>14.77</td>
<td>69.31</td>
</tr>
<tr>
<td>Site manager</td>
<td>12</td>
<td>13.64</td>
<td>82.95</td>
</tr>
<tr>
<td>Other</td>
<td>15</td>
<td>17.05</td>
<td>100.0</td>
</tr>
<tr>
<td>Experience in the construction industry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 5 years</td>
<td>28</td>
<td>31.1</td>
<td>31.5</td>
</tr>
<tr>
<td>5 – 10 years</td>
<td>27</td>
<td>30.0</td>
<td>61.8</td>
</tr>
<tr>
<td>11 – 15 years</td>
<td>20</td>
<td>22.2</td>
<td>84.3</td>
</tr>
<tr>
<td>More than 15 years</td>
<td>14</td>
<td>15.6</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notes: *The profile of the professional and trades background is based on a sample size of 88 due to some missing data.*
### Table 4: Profile of study sample (role in projects)

<table>
<thead>
<tr>
<th>Role in projects</th>
<th>Number of respondents</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contractor*</td>
<td>32</td>
<td>35.6</td>
<td>35.6</td>
</tr>
<tr>
<td>Consultant</td>
<td>31</td>
<td>34.4</td>
<td>70.0</td>
</tr>
<tr>
<td>Client (private and public)¹</td>
<td>27</td>
<td>30.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*The contractor grouping includes 1 specialist sub-contractors and 1 operator.* According to the formal classification of contractors as currently in place in Iran, construction companies active in government projects are classified into 5 categories. Those in class 1 are allowed to undertake projects with the biggest budgets (Ghoddousi and Hosseini 2012);¹

¹The construction industry of Iran is divided into two main sections: the first is government infrastructure projects and the second is the housing industry (Ifpinfo, 2014).
Table 5: Overall sample and group-wise (Clients, Consultants and Contractors) rating of barriers

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Overall sample (N=88)</th>
<th>Clients (N=27)</th>
<th>Consultants (N= 31)</th>
<th>Contractors (N=32)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MS</td>
<td>Standard deviation</td>
<td>Rank</td>
<td>MS</td>
</tr>
<tr>
<td>Lack of experience among practitioners</td>
<td>4.182</td>
<td>0.7357</td>
<td>2</td>
<td>4.154</td>
</tr>
<tr>
<td>Unavailability of risk management consultants</td>
<td>4.161</td>
<td>0.7905</td>
<td>3</td>
<td>3.885</td>
</tr>
<tr>
<td>Lack of knowledge and necessary skills</td>
<td>4.307</td>
<td>0.9142</td>
<td>1</td>
<td>4.462</td>
</tr>
<tr>
<td>Lack of agreement among the parties and stakeholders of projects regarding RAMP implementation</td>
<td>3.909</td>
<td>0.9177</td>
<td>5</td>
<td>3.615</td>
</tr>
<tr>
<td>Lack of support from clients and project stakeholders</td>
<td>4.091</td>
<td>1.0243</td>
<td>4</td>
<td>3.692</td>
</tr>
<tr>
<td>Tight scheduling of projects</td>
<td>3.430</td>
<td>1.1328</td>
<td>6</td>
<td>3.115</td>
</tr>
<tr>
<td>Costs associated with risk management implementation</td>
<td>3.273</td>
<td>1.0905</td>
<td>7</td>
<td>2.846</td>
</tr>
</tbody>
</table>

Notes: *MS = Mean score of the barrier, where 5 = strongly agree; 4 = Agree; 3 = Neutral; 2 = Disagree; and 1 = strongly disagree.
<table>
<thead>
<tr>
<th>Effects</th>
<th>Value</th>
<th>F</th>
<th>Hypothesis df</th>
<th>Error df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role in projects*</td>
<td>.799</td>
<td>1.292b</td>
<td>14.000</td>
<td>152.000</td>
<td>.218</td>
</tr>
<tr>
<td>Professional and trades** background</td>
<td>.584</td>
<td>1.520</td>
<td>28.000</td>
<td>264.627</td>
<td>.054</td>
</tr>
<tr>
<td>Experience in the construction** industry</td>
<td>.806</td>
<td>.791</td>
<td>21.000</td>
<td>213.038</td>
<td>.729</td>
</tr>
</tbody>
</table>
Notes: *Table 4; **Table 3
**Table 7:** Significance of associations between the constructs

<table>
<thead>
<tr>
<th>Associations</th>
<th>Outer loadings</th>
<th>T statistics</th>
<th>P values*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of formal risk management systems</td>
<td>0.45</td>
<td>5.290</td>
<td>0.000</td>
</tr>
<tr>
<td>Lack of agreement and support among parties</td>
<td>0.32</td>
<td>3.541</td>
<td>0.000</td>
</tr>
<tr>
<td>Projects constraints of time and cost</td>
<td>0.20</td>
<td>1.686</td>
<td>0.092</td>
</tr>
</tbody>
</table>
Table 8: Pearson correlations

<table>
<thead>
<tr>
<th>Barriers to risk management implementation</th>
<th>BR1</th>
<th>BR2</th>
<th>BR3</th>
<th>BR4</th>
<th>BR5</th>
<th>BR6</th>
<th>BR7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of knowledge and necessary skills</td>
<td>Pearson Correlation: 1</td>
<td>.685**</td>
<td>.253*</td>
<td>.206</td>
<td>.167</td>
<td>.042</td>
<td>.129</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.017</td>
<td>.056</td>
<td>.124</td>
<td>.698</td>
<td>.229</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>88</td>
<td>88</td>
<td>88</td>
<td>87</td>
<td>86</td>
<td>88</td>
<td>88</td>
</tr>
<tr>
<td>Lack of experience among practitioners</td>
<td>Pearson Correlation: .685**</td>
<td>1</td>
<td>.416**</td>
<td>.287**</td>
<td>.120</td>
<td>.066</td>
<td>.191</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.000</td>
<td>.000</td>
<td>.007</td>
<td>.270</td>
<td>.539</td>
<td>.074</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>88</td>
<td>88</td>
<td>88</td>
<td>87</td>
<td>86</td>
<td>88</td>
<td>88</td>
</tr>
<tr>
<td>Lack agreement among the parties and stakeholders of projects regarding adoption of risk management</td>
<td>Pearson Correlation: .253*</td>
<td>.416**</td>
<td>1</td>
<td>.451**</td>
<td>.289**</td>
<td>.186</td>
<td>.241*</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.017</td>
<td>.000</td>
<td>.000</td>
<td>.007</td>
<td>.083</td>
<td>.024</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>88</td>
<td>88</td>
<td>88</td>
<td>87</td>
<td>86</td>
<td>88</td>
<td>88</td>
</tr>
<tr>
<td>Unavailability of risk management consultants</td>
<td>Pearson Correlation: .206</td>
<td>.287**</td>
<td>.451**</td>
<td>1</td>
<td>.349**</td>
<td>.319**</td>
<td>.199</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.056</td>
<td>.007</td>
<td>.000</td>
<td>.001</td>
<td>.003</td>
<td>.065</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>87</td>
<td>87</td>
<td>87</td>
<td>87</td>
<td>85</td>
<td>87</td>
<td>87</td>
</tr>
<tr>
<td>Tight scheduling of projects</td>
<td>Pearson Correlation: .167</td>
<td>.120</td>
<td>.289**</td>
<td>.349**</td>
<td>1</td>
<td>.464**</td>
<td>.171</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.124</td>
<td>.270</td>
<td>.007</td>
<td>.001</td>
<td>.000</td>
<td>.115</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>86</td>
<td>86</td>
<td>86</td>
<td>85</td>
<td>86</td>
<td>86</td>
<td>86</td>
</tr>
<tr>
<td>Costs associated with risk management implementation</td>
<td>Pearson Correlation: .042</td>
<td>.066</td>
<td>.186</td>
<td>.319**</td>
<td>.464**</td>
<td>1</td>
<td>.266*</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.698</td>
<td>.539</td>
<td>.083</td>
<td>.000</td>
<td>.000</td>
<td>.012</td>
<td>.000</td>
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<td>87</td>
<td>86</td>
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<tr>
<td>Lack of support from clients and project stakeholders</td>
<td>Pearson Correlation: .129</td>
<td>.191</td>
<td>.241*</td>
<td>.199</td>
<td>.171</td>
<td>.266*</td>
<td>1</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.229</td>
<td>.074</td>
<td>.024</td>
<td>.065</td>
<td>.115</td>
<td>.012</td>
<td>.000</td>
</tr>
<tr>
<td>N</td>
<td>88</td>
<td>88</td>
<td>88</td>
<td>87</td>
<td>86</td>
<td>88</td>
<td>88</td>
</tr>
</tbody>
</table>

Notes: **. Correlation is significant at the 0.01 level (2-tailed); *. Correlation is significant at the 0.05 level (2-tailed).
### Table 9: Spearman rank coefficient

<table>
<thead>
<tr>
<th>Pairing</th>
<th>Mean Scores</th>
<th>Spearman rank correlation coefficient</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
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<td>Contractors - Clients</td>
<td>0.821</td>
<td>0.05</td>
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</tr>
<tr>
<td>Clients - Consultants</td>
<td>0.750</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Contractors - Consultants</td>
<td>0.679</td>
<td>0.05</td>
<td></td>
</tr>
</tbody>
</table>
Figure 1: Associations between categories of barriers (please see Table 5 for details of elements of the model)