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Moderating role of organisational learning and firm size on risk management maturity in construction firms

Authors:
Chen Wang[1]
Ali M. Alashwal[2]
Arash Asef[2]
Hamzah Abdul-Rahman[3]
Lincoln C. Wood[4]

Affiliations:
[1]College of Civil Engineering, Huaqiao University, China

[2]Faculty of Built Environment, University of Malaya, Malaysia

[3]Faculty of Engineering, Vision College, Malaysia

[4]Department of Business and Management, University of Otago, New Zealand

Corresponding author:
Chen Wang,
derekisleon@gmail.com

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Background: It is not known whether organisational practice of learning and risk management maturity (RMM) varies based on firm size. Literature in the construction field lacks empirical studies on intervening influence of firm size on RMM.

Objectives: This study aims to determine the significant factors influencing RMM by considering four dimensions of organisational learning (OL): information acquisition, knowledge dissemination, shared interpretation and organisational memory.

Method: We tested the theoretical model in construction companies in Kuala Lumpur and Selangor states, Malaysia. There were 1000 questionnaires dispatched by mail and email to managers in the targeted firms. The component-based approach, also known as the partial least square (PLS) method, was used for data analysis.

Results: Hierarchical regression analysis affirmed the influence of ten variables of OL on RMM while controlling the influence of firm size. Regardless of the firm size, the identified factors of OL can play an important role in enhancing the ability of construction organisations to attain better risk management practice.

Conclusion: Construction firms seeking higher RMM should consider OL practices. The identified ten factors of OL are considered the vehicle to move the organisations to a new level of maturity. Particularly, firms should focus on two aspects of OL: information acquisition and shared interpretation. It can be deduced, therefore, that the more a firm acquires and interprets information related to project risk, the higher level of RMM the firm can achieve. In addition, effective learning through information gathering and interpretation could have a positive impact on risk management practices.

Introduction

A large number of project-based organisations in developing countries are implementing project management principles to enhance projects delivery (Lyles 2014; Peltier, Zahay & Lehmann 2013). However, these organisations often lack continuous improvement (Abdul-Rahman et al. 2008), which is a key factor for long-term survival and success (Oliva 2016). Construction projects, among others, are inherently subject to certain risks and uncertainties (Hadikusumo & Rowlinson 2004), which may endanger their delivery and success (Machado et al. 2017). The extended and fragmented phases of construction projects call for continuous risk management throughout the project life cycle (Kerzner 2003). Efficient risk management is therefore essential to minimise losses and enhance profitability (Akintoye & MacLeod 1997).

Achieving efficiency for different processes and practices of organisations requires the adoption of project management maturity models (Brusoni & Rosenkranz 2014). Risk management maturity (RMM), as one of the project management maturity models, can play a dual role in defining risk management capability and enhancing project performance through cost and benefits improvement (Pollard et al. 2004). Learning and continuous improvements have been regarded as the best indicators of project management maturity (Cooke-Davies 2002; Kerzner 2000). Organisational learning (OL) was recognised as a key element in project-based organisations to achieve efficiency and continuous development through better maturity and capability (Nwankpa & Roumani 2014; Strutt et al. 2006). In fact, an organisation's ability to learn was recognised as a key factor in the process of developing different RMM models (Ashcroft et al. 2005; Del Cano & De la Cruz 2002; Hillson 1997; Sharp et al. 2002; Strutt et al. 2006). Thus, there is a widespread belief

that learning is the key element of organisations to achieve the highest level of RMM (Callahan & Soileau 2017; Wibowo & Taufik 2017). However, it is difficult to find a proof in support of this belief in the context of the construction industry. Furthermore, it is unclear how learning can lead to higher levels of RMM (Lathrop & Ezell 2017; Oliva 2016). Therefore, the first objective of this study is to determine aspects of OL that positively influence the level of RMM.

Learning takes place more in larger organisations (Shipton et al. 2005). This may influence an organisation's attempt to achieve higher levels of maturity in risk management process. It is not known whether organisational practice of learning and RMM varies based on firm size. Literature in the construction field lacks empirical studies on intervening influence of firm size on RMM. Thus, the second objective of this article is to determine whether aspects of OL to achieve maturity differ in big and small firms.

Theoretical base for risk management maturity models

One of the first models of RMM adopted learning at the highest level of maturity. Hillson (1997) developed a four-level RMM model (naive, novice, normalised and natural). In the first level, an organisation lacks awareness of the need for risk management. In the novice level, the organisation begins to experiment with some individuals in risk management, but without a structured approach to manage the risk. In the third level, normalised, a structured approach of risk management is applied in most projects and becomes part of the business practice. The highest level, natural, involves awareness culture of risk in all aspects of the business with an emphasis on opportunity management. In this level, learning from experience is an integral part for updating and continuous development of risk management process. Del Cano and De la Cruz (2002) integrated project management process with Hillson's model and indicated learning as the highest level of maturity of the risk management development process. They emphasised learning as a way for increasing the body of corporate knowledge, updating various risks involved in projects and maintaining risk management process.

Sharp et al. (2002) identified five levels of maturity in evaluating health and safety installations in projects. In their model, organisations could be categorised into learner, repeated, defined, managed or adaptive. The learner organisation practises risk management on an *ad hoc* basis. The repeated organisation repeats what has been done before without defining what it does, or adapts from a previous experience to a new situation. The defined organisation can define what it does and how it goes about it. In the managed organisation, what has been done is controlled according to the feedback from a procedural review (Wibowo & Taufik 2017). Lastly, the adaptive organisation is capable of learning and adapting, using best practices and past experiences to correct any problems while improving the methods of operation (Machado et al. 2017).

Strutt et al. (2006) adopted the capability maturity model to develop a new model called design safety capability maturity model (DCMM). The model describes five levels of maturity based on OL. In the Initial (*ad hoc*) level, learning mode is reactive where the organisation has limited experience and safety processes are not standardised and uncontrolled. In the repeatable level, where learning is prescriptive, an organisation can repeat what it does, and processes are standardised but lack real influence on product safety. In the third level, defined, learning is measured in open loop and the processes of safety are defined and there is some influence on the product. In managed level, learning is a single loop, where the processes are quantitative and influence product safety. In the last level, optimised, learning is in the form of double-loop, where the organisation uses the best practice and optimises the processes of product safety. Similarly, Ashcroft et al. (2005) described five types of organisations with respect to safety culture: pathological, reactive, calculative, proactive and generative. This overview indicated that learning is a significant aspect for organisations to achieve the desired level of RMM. The next section will discuss more about the relationship between learning and RMM.

Influence of learning on risk management maturity

Although a traditional project model is clearly useful for laying out the patterns of relationships surrounding a project, it does not provide the temporally embedded accounts that enable us to understand how OL takes place (Lathrop & Ezell 2017). The process-thinking perspective offers a means to solve this problem. Koskinen (2012) analysed how different processes interact dynamically to benefit project-based companies' OL and found that OL is a dynamic concept that emphasises the continually changing nature of a project-based company and sense-making and negotiation of meaning are ongoing processes in project-based companies. Two years later, Jugdev and Wishart (2014) used grounded theory methodology to develop an emergent theory of mutual caring. The main concern was habituation to ineffective lessons learnt sharing practices. Habituation is resolved through mutual caring, a socially and psychologically adaptive process. Mutual caring involves comfortable conversations, engaging or sharing, and developing self-confidence, resulting in an enhanced wisdom pool. Jugdev and Wishart (2014) extended the emphasis on tangible knowledge-sharing mechanisms. Mutual caring could lead to better outcomes, such as more accessible and usable knowledge, a project management wisdom pool and criteria for improved dyadic relationships to enhance project learning. Organisational learning takes place when a unit acquires knowledge that is potentially useful for improving or maintaining performance (DiBella, Nevis & Gould 1996; Hoof 2014; Huber 1991). The purpose of OL is to propel a firm's ability to adapt to evolving market conditions, to provide customer value and to improve organisational performance and capabilities (Santos-Vijande et al. 2012). Thiry (2002) affirmed that an organisation can thrive in a complex and rapidly changing environment if learning and performance processes have been addressed appropriately. Learning and

performance, as Thiry emphasised, aim essentially to reduce uncertainty and ambiguity through sense-making, ideation, evaluation, planning, execution and control. These processes, in fact, represent the fundamentals of risk analysis and management (Callahan & Soileau 2017).

From a capability perspective, OL is defined as a dynamic process of creation, acquisition and integration of knowledge aimed at developing the resources and capabilities that allow the organisation to achieve a better performance (López, Peón & Ordás 2006). This definition links the output of the learning process with capabilities and performance development and infers that organisations can benefit directly from learning to attain a higher level of maturity. Studies on the relationship between learning and the maturity of organisations have indicated a reciprocal influence (Tamayo-Torres et al. 2014). In addition, Liu and Low (2009) affirmed the role of OL in enhancing the risk management ability of organisations when entering a foreign market. Moreover, Dikmen et al. (2008) emphasised the importance of developing a knowledge-driven risk management process and a corporate risk memory to store risk information and lessons learnt. Furthermore, Pollard et al. (2004) expected that OL can support the implementation and development of risk management framework. The ability of organisations to access necessary information and to engage experienced individuals in double-loop learning is needed to develop the risk management framework (Ashcroft et al. 2005). Focusing on maturity as an outcome, we presume that OL is a predictor variable that influences the level of RMM. This study attempts to provide in-depth understanding of the influence of learning aspects and RMM. Figure 1 shows a theoretical model of the relationship between OL and RMM. This model will be tested in construction firms context and significant variables of OL influencing RMM will be identified.

Research design and data collection

We adopted two measurement instruments to measure OL and RMM. The first measurement instrument was originally developed by Santos-Vijande et al. (2012). Organisational learning is measured as four constructs including information acquisition (IA), knowledge dissemination (KD), shared interpretation (SI) and organisational memory (OM). Information acquisition from internal or external sources helps to identify key tendencies, solve specific problems or compare the performance of the company with others. Project-based organisations can acquire knowledge from their projects or other projects (inter-project learning) to identify and manage risks in new projects (Dikmen et al. 2008; Schindler & Eppler 2003). Knowledge accumulation is a prerequisite for KD, which takes place through meetings, cross-training and informal interaction (Santos-Vijande et al. 2012). Shared interpretation or shared meaning aims to achieve a consensus on the meaning of the information and its implications (Day 1994). Lastly, OM (in the form of an individual's memory, social network or computerised information) represents all the knowledge that is gathered by organisations.

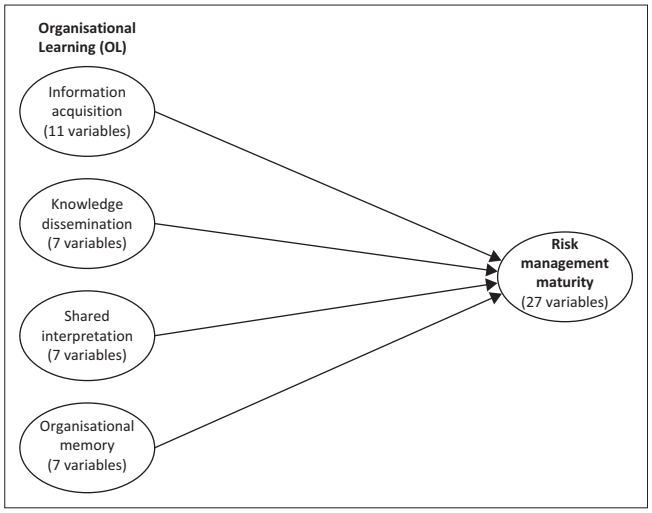

FIGURE 1: Relationship between organisational learning components and risk management maturity.

The second instrument is the organisational project management maturity model (OPM3) to measure the level of RMM. The OPM3 model was developed by the Project Management Institute (PMI) to assist organisations in understanding and evaluating their current levels of project management maturity. This model was recognised as one of the most notable maturity models in project management and construction management (Cooke-Davies 2004; Willis & Rankin 2012). The model incorporates different aspects of project management including risk management at project, programme and portfolio levels (PMI 2008). A section of the OPM3 model is dedicated to the assessment of risk management, which is useful to measure RMM through self-assessment questions. These questions comprise five main processes of risk management: risk planning, risk identification, qualitative and quantitative risk analysis, risk response, and risk monitoring and control. The first two questions are asked if an organisation considers risk during the project selection process and if the project team is encouraged to calculate the risk. The remaining questions determine whether an organisation establishes and uses standard and documented processes for each of the five processes of risk management. Box 1 shows the measurement items of OL and RMM. All these questions were incorporated into a questionnaire survey and measured using a five-point Likert scale.

We tested the theoretical model in construction companies in Kuala Lumpur and Selangor states, Malaysia. Most construction companies in Malaysia registered on the Construction Industry Development Board (CIDB) are located in these two regions (CIDB 2012). Table 1 presents the information of total active construction companies under seven groups of companies, ranging from G1 to G7. Based on the CIDB's definition, categories G1–G6 represent small- to medium-sized companies, while the last category, G7, represents large companies. A random sample of companies from all categories was derived to conduct this study.

Box 1: List of indicators (measurement items) in the questionnaire.

Label	Items of risk management maturity
S2.1	How often does your organisation consider risk during project selection?
S2.2	How often does your organisation create a work environment that encourages project teams to take calculated risks when appropriate?
S2.3	How often does your organisation establish and use standard documented processes in risk management planning?
S2.4	How often does your organisation establish and use standard documented processes in risk identification?
S2.5	How often does your organisation establish and use standard documented processes in qualitative risk analysis?
S2.6	How often does your organisation establish and use standard documented processes in quantitative risk analysis?
S2.7	How often does your organisation establish and use standard documented processes in risk response planning?
S2.8	How often does your organisation establish and use standard documented processes in risk monitoring and control?
S2.9	How often does your organisation use risk management techniques to take measurements and assess the impact of risk during project execution?
S2.10	How often does your organisation establish and use measurements in projects for risk management planning?
S2.11	How often does your organisation establish and use measurements in projects for risk identification?
S2.12	How often does your organisation establish and use measurements in projects for qualitative risk analysis?
S2.13	How often does your organisation establish and use measurements in projects for quantitative risk analysis?
S2.14	How often does your organisation establish and use measurements in projects for risk response planning?
S2.15	How often does your organisation establish and use measurements in projects for risk monitoring and control?
S2.16	How often does your organisation establish and execute controls in projects to manage the stability of risk management planning?
S2.17	How often does your organisation establish and execute controls in projects to manage the stability of risk identification?
S2.18	How often does your organisation establish and execute controls in projects to manage the stability of qualitative risk analysis?
S2.19	How often does your organisation establish and execute controls in projects to manage the stability of quantitative risk analysis?
S2.20	How often does your organisation establish and execute controls in projects to manage the stability of risk response planning?
S2.21	How often does your organisation establish and execute controls in projects to manage the stability of risk monitoring and control?
S2.22	How often does your organisation identify risk management planning?
S2.23	How often does your organisation identify risk identification?
S2.24	How often does your organisation identify qualitative risk analysis?
S2.25	How often does your organisation identify quantitative risk analysis?
S2.26	How often does your organisation identify risk response planning?
S2.27	How often does your organisation identify risk monitoring and control?
Label	**Constructs and items of organisational learning**
Information acquisition	
S3.1	The employees are informed of how the firm was created and what is its philosophy of work.
S3.2	The organisation collects and uses the information generated during organisational changes.
S3.3	Employees' interaction and participation to gather information about possible changes are encouraged.
S3.4	The organisation constantly evaluates the need to adapt to the business environment.
S3.5	The members of the organisation use informal means to know about the most recent events regarding the market or the environment.
S3.6	As a result of the knowledge acquired in the course of time, the employees are more efficient in exercising their responsibilities.
S3.7	The organisation collects information about what competitors do through different means.
S3.8	When the specific knowledge required is not present, the organisation looks for it and acquires from outside the organisation.
S3.9	The organisation periodically checks whether its strategy is aligned with the business environment.
S3.10	Problems are approached proactively, that is, learning from other entities to be able to respond to these problems before they arise.
S3.11	The organisation uses formal and reiterative procedures to evaluate the results and compare them with those of the competition.
Knowledge dissemination	
S3.12	The organisation has a meeting schedule among departments to integrate the existing information.
S3.13	There has devoted time for discussions about the organisation's future needs.
S3.14	The organisation uses databases and organised files to support employees' work.
S3.15	The company's general objectives are communicated throughout the organisation.
S3.16	The organisation is interested in providing employees with an overall view of the company's operations, even with personnel turnover.
S3.17	There are people responsible for collecting the proposals made by the staff and for distributing them internally.
S3.18	Vital information is transmitted quickly to all employees.
Shared interpretation	
S3.19	Employees systematically examine and update their opinion about the business environment.
S3.20	Employees try to develop an interpretation as uniform as possible of relevant information.
S3.21	Employees have at their disposal a wide variety of communication tools (telephone, email, fax, intranet, etc.).
S3.22	There is a present effort to generate concise reports intended to avoid excess information that may limit the capacity to interpret it adequately.
S3.23	Before a decision is taken, the different alternatives are thoroughly analysed.
S3.24	Relevant information is periodically reviewed in case it is obsolete or may lead to error.
S3.25	The organisation does not oppose changes in the way of doing things.
Organisational memory	
S3.26	The organisation has its own expert personnel in the most essential aspects of the organisational operations.
S3.27	Personnel turnover does not risk the organisation's capacity to create new knowledge and solve problems.
S3.28	The organisation carries out training programmes (e.g. workshops, seminars, etc.) for the members of the organisation.
S3.29	Awareness of who has the specific abilities and the experience to intervene when an opportunity or problem arises is present in the organisation.
S3.30	When the organisation faces a new opportunity or problem, key employees can be conveniently contacted.
S3.31	People in the organisation, when an opportunity or problem arises, are actively committed to looking for possible solutions.
S3.32	There is an atmosphere of trust and collaboration among the personnel of the company to cooperate when opportunities or problems arise.

There were 1000 questionnaires dispatched by mail and email to managers in the targeted firms. Those employees with more than 3 years of experience in the construction sector were expected to have more knowledge about the firms' visions, strategies and general operations. The total number of valid questionnaires, after eliminating incomplete forms and outliers, was 134, which represented a 13.4% response rate. The valid responses comprised 88 questionnaires from large-sized companies and 48 questionnaires from small- and medium-sized companies. The component-based approach, also known as the partial least square (PLS) method, was applied for data analysis. The PLS method is a variance-based causal modelling approach developed in the 1960s (Fornell & Bookstein 1982). Partial least square presents iterative procedures using least square estimation or single- and multiple-component models for canonical correlation. It could avoid some restrictive assumptions underlying the maximum likelihood estimation which is more oriented towards predictive applications (Jöreskog & Wold 1982). For estimation, PLS uses least square estimation and attempts to maximise the variance explained by constructs and parameter estimates by minimising each residual variance separately for improved prediction of corresponding constructs (Chin & Newstead 1999). Partial least square is not constrained by the normality assumption and does not require a large sample size. It also allows the use of non-interval scaled data (Chin 2010). It estimates constructs as linear combinations of observed variables using weight relations, thus avoiding indeterminacy and providing an exact definition of constructs score (Fornell & Bookstein 1982). According to Chin (2010), PLS is a comprehensive modelling technique because it consists of many techniques such as canonical correlation analysis, redundancy analysis, multiple regression, Multivariate Analysis of Variance (MANOVA) and factor analysis. Partial least square is more suited to explain the relationships among multiple predicted and predictor constructs. The PLS approach was deemed appropriate for the data analysis in this study mainly because it can handle a complex model and it requires neither a large sample size nor rigorous restrictions on data distribution.

TABLE 1: Active construction companies in Kuala Lumpur and Selangor states.

Variables	G1	G2	G3	G4	G5	G6	G7
Selangor	3950	990	1521	498	704	263	951
Kuala Lumpur	1506	585	1404	391	847	352	1290
Total	5456	1575	2925	889	1551	615	2241
Total small and medium firms	13 011	-	-	-	-	-	-
Total big firms	2241	-	-	-	-	-	-

Source: Construction Statistics Quarterly Bulletin – CIDB 2012
G, Grade.

Result of data analysis

The influence of OL factors on RMM was analysed using regression analysis. Before conducting the regression analysis, an analysis of variance test among small, medium and large companies was conducted. The results shown in Table 2 indicate that there is no difference between practices of OL among firms of various sizes. However, there is a difference in the maturity of risk management among firms. Besides, the correlation test, shown in Table 3, indicates the

TABLE 2: Analysis of variance results among small, medium and large companies.

Variables	Sum of squares	*df*	Mean square	*F*	Sig.
RMM	3.067	2	1.533	3.979	0.021
OL	3.593	2	1.797	15.525	0.000
IA	3.677	2	1.838	10.725	0.000
KD	2.286	2	1.143	6.039	0.003
SI	5.140	2	2.570	10.595	0.000
OM	3.771	2	1.885	9.076	0.000

RMM, risk management maturity; OL, organisation learning; IA, information acquisition; KD, knowledge dissemination; SI, shared interpretation; OM, organisational memory; *df*, Degree of freedom; *F*, F Statistic; Sig., Significance value.

TABLE 3: Result of correlation among firm size, risk management maturity, organisation learning and organisation learning dimensions.

Variables		Firm size	RMM	OL	IA	KD	SI	OM
Firm size	Pearson correlation	1	-0.050	-0.234**	-0.224*	-0.142	-0.127	-0.229**
	Sig. (2-tailed)		0.570	0.007	0.010	0.108	0.151	0.009
	N	130	130	130	130	130	130	130
RMM	Pearson correlation	-0.050	1	0.727**	0.589**	0.505**	0.685**	0.512**
	Sig. (2-tailed)	0.570		0.000	0.000	0.000	0.000	0.000
	N	130	134	134	134	134	134	134
OL	Pearson correlation	-0.234**	0.727**	1	0.807**	0.761**	0.777**	0.807**
	Sig. (2-tailed)	0.007	0.000		0.000	0.000	0.000	0.000
	N	130	134	134	134	134	134	134
IA	Pearson correlation	-0.224*	0.589**	0.807**	1	0.471**	0.392**	0.546**
	Sig. (2-tailed)	0.010	0.000	0.000		0.000	0.000	0.000
	N	130	134	134	134	134	134	134
KD	Pearson correlation	-0.142	0.505**	0.761**	0.471**	1	0.584**	0.444**
	Sig. (2-tailed)	0.108	0.000	0.000	0.000		0.000	0.000
	N	130	134	134	134	134	134	134
SI	Pearson correlation	-0.127	0.685**	0.777**	0.392**	0.584**	1	0.562**
	Sig. (2-tailed)	0.151	0.000	0.000	0.000	0.000		0.000
	N	130	134	134	134	134	134	134
OM	Pearson correlation	-0.229**	0.512**	0.807**	0.546**	0.444**	0.562**	1
	Sig. (2-tailed)	0.009	0.000	0.000	0.000	0.000	0.000	
	N	130	134	134	134	134	134	134

RMM, risk management maturity; OL, organisation learning; IA, information acquisition; KD, knowledge dissemination; SI, shared interpretation; OM, organisational memory.
*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

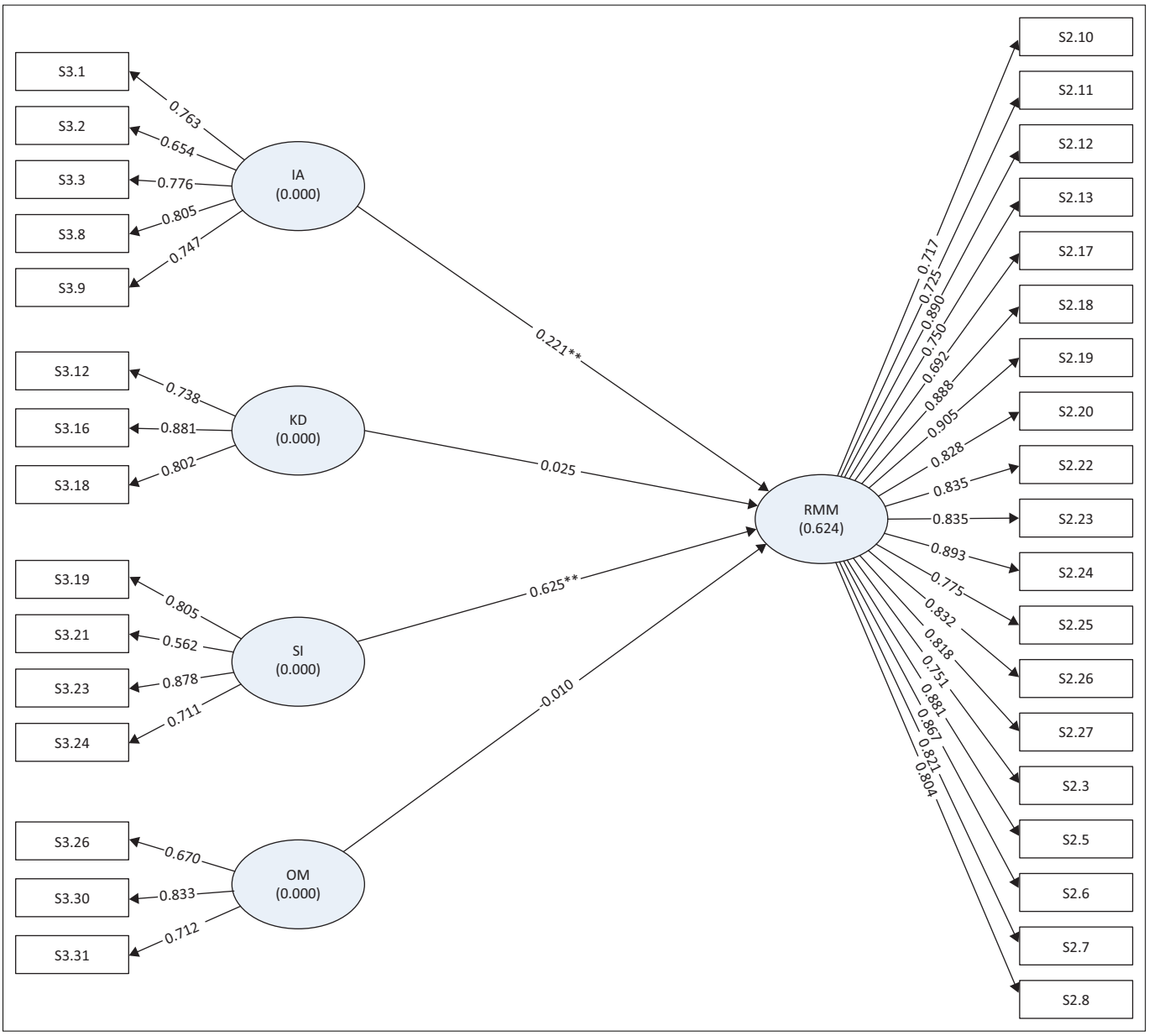

FIGURE 2: Influence of organisational learning components on risk management maturity. Values between parentheses indicate R^2. The symbol '**' indicates a significant level at $p < 0.01$. The full list of indicators' names is presented in Box 1.

potential influence of OL on RMM. Nevertheless, it seems that there is no strong and significant influence of firm size on RMM.

The full model was analysed for both samples (small and medium firms and large firms) to determine the relationship between OL and RMM. The analysis of the full model using the 'SmartPLS 2.0' Software enabled the assessment of both outer and inner models. The outer or measurement model involves the relationship between the manifest variables and latent constructs such as SI and its measurement items. The inner or structural model involves relationships among all constructs. The full model is shown in Figure 2.

To determine the variables of OL influencing RMM, the hierarchical regression analysis (stepwise method) was conducted to control any influence of firm size in the regression model. As indicated previously, this study targeted three types of construction firms: small, medium and large firms. The result of the best model of variables influencing RMM is shown in Table 4. Firm size appears not to have a significant influence in the regression model. Out of several variables of OL, 10 variables have a significant influence on RMM (Table 5). It can be observed that most of these variables belong to two dimensions of OL: SI and IA. This does not mean that KD and OM have no influence at all on RMM. Rather, some variables of these two dimensions can contribute to the RMM level. The contribution of the identified variables of OL represents about 73% of variance in RMM. This is a high level considering that only OL as one concept has been considered in the model. The role of OL therefore cannot be ignored to achieve the desired level of maturity in managing risk that construction companies may face.

TABLE 4: Model summary results.

Model	R^2	Adjusted R^2	Std. error of the estimate	Change statistics					Durbin–Watson
				R^2 change	F change	$df1$	$df2$	Sig. F change	
1[a]	0.007	-0.001	0.63110	0.007	0.905	1	127	0.343	
2[b] (best model)	0.757	0.734	0.32510	0.016	7.564	1	117	0.007	2.301

[a],Predictors: (Constant), firm size; [b], Predictors: (Constant), S1.7, S3.23, S3.7, S3.11, S3.21, S3.29, S3.20, S3.17, S3.1, S3.30, S3.2; R^2, coefficient of determination; $df1$, Degree of freedom for Model 1; $df2$, Degree of freedom for Model 2; Sig. F change, Significance value for the change of F statistics.

TABLE 5: Coefficients of organisational learning variables influencing risk management maturity.

Number	Model	Unstandardised coefficients		Standardised coefficients	Sig.	95.0% confidence interval for B		Collinearity statistics	
		B	Std. error	Beta		Lower bound	Upper bound	Tolerance	VIF
1	(Constant)	3.604	0.235		0.000	3.139	4.069		
	Firm size	-0.084	0.088	-0.084	0.343	-0.258	0.091	1.000	1.000
2	(Constant)	-0.245	0.331		0.461	-0.901	0.412		
	Firm size	0.056	0.050	0.056	0.264	-0.043	0.154	0.838	1.193
	S3.23	0.222	0.044	0.430	0.000	0.136	0.308	0.292	3.424
	S3.7	0.098	0.051	0.123	0.055	-0.002	0.198	0.511	1.955
	S3.11	0.208	0.044	0.323	0.000	0.121	0.296	0.444	2.254
	S3.21	0.174	0.051	0.258	0.001	0.072	0.275	0.358	2.793
	S3.29	0.143	0.038	0.196	0.000	0.068	0.218	0.773	1.293
	S3.20	0.182	0.049	0.195	0.000	0.086	0.278	0.768	1.302
	S3.17	-0.192	0.043	-0.344	0.000	-0.276	-0.107	0.356	2.808
	S3.1	0.176	0.051	0.226	0.001	0.075	0.277	0.486	2.058
	S3.30	-0.166	0.049	-0.330	0.001	-0.263	-0.069	0.220	4.551
	S3.2	0.133	0.048	0.177	0.007	0.037	0.229	0.501	1.998

VIF, variance inflation factor.

S3.23: Analysing different alternatives before making decisions (SI); S3.7: collecting information regarding competitors (IA); S3.11: using formal procedures to evaluate results and compare them with those of competitors (IA); S3.21: availability of variety of communication tools (telephone, email, fax, intranet, etc.) (SI); S3.29: awareness of who has specific abilities and experience when an opportunity or problem arises (OM); S3.20: interpretation of relevant information (SI); S3.17: collecting proposals and distributing them internally (KD); S3.1: top management informs employees how the firm was created and what is its philosophy of work; S3.30: key employees can be conveniently contacted to discuss new opportunity or problem (OM); S3.2: collecting and using information generated during organisational changes (IA).

Discussion of findings

The influence of OL accounted for quite a high variance in RMM (73%). This result reinforces the importance of OL in achieving RMM in construction firms. This study affirmed the influence of ten variables of OL on RMM. Most of these variables belong to two groups of dimensions of OL: IA and SI. The variables of IA dimension include collecting information of competitors, using formal procedures to evaluate results and compare them with those of the competitors, informing employees of how the firm was created and what is its philosophy of work, and collecting and using information during organisational change. These variables contain two aspects of IA, which are external information collection and internal information collection. It seems that internal and external information are both required to achieve the desired level of maturity. Other variables are grouped under the SI dimension and include analysing different alternatives before making a decision, availability of a variety of communication tools and interpretation of relevant information. Two other significant variables grouped under OM are awareness of individuals in the company who have specific capability and experience to be used when needed and those can be conveniently contacted to discuss new opportunity or problem. Only one variable under KD was found significant, that is, collecting proposals and distributing them internally. These findings are in line with the results of Ashcroft et al. (2005) that organisations' ability to access necessary information and to engage experienced and top management individuals in double-loop learning is needed to develop the risk management framework. Besides, Santos-Vijande et al. (2012) supported that IA as one of the four constructs of OL helps to identify key tendencies, solve specific problems or compare the performance of the company with that of others.

Conclusion

To conclude, construction firms seeking higher RMM should consider OL practices. The identified ten factors of OL are considered the vehicle to move the organisations to a new level of maturity. Particularly, firms should focus on two aspects of OL: IA and SI. It can be deduced therefore that the more a firm acquires and interprets information related to project risk, the higher level of RMM the firm can achieve. Furthermore, effective learning through information gathering and interpretation could have a positive impact on risk management practices. The higher the level of RMM, the better it can have a positive impact on the delivery of more successful projects.

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Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

C.W. and A.M.A. were responsible for project design and administration. A.A. was responsible for data collection. H.A.-R. made conceptual contributions. L.C.W. conducted the analysis.

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