

DEVELOPING A FINANCIAL RISK MATURITY MODEL FOR PUBLIC-PRIVATE PARTNERSHIP PROJECTS

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Globally, the management of financial risk is a topic that has gained much attention in the construction management research community in recent years. Existing studies rank financial risks among the top three risk factors that leads to the failure of a PPP project. Available literature on Public Private Partnership (PPP) projects also acknowledges the need for specific and suitable maturity models to tackle this problem of financial risks. However, there are limited (almost non-existent) studies on specific maturity models on financial risks of PPP projects. In this paper, we developed, tested and validated a financial risk maturity model (FRMM) to enhance the management of financial losses of PPP projects. The FRMM uses a list of statements extracted from financial risk management literature on PPP projects. The statements in the designed model were tested and validated with data from surveys and interviews of experts and practitioners in the PPP market in Australia, China and Ghana. According to the findings backed by experts and literature, FRMM improves the financial success of PPPs. Project managers could use the FRMM as a guide to control financial losses of the project, and the results support further research.

Keywords: finance; risk management; maturity model; PPP projects

INTRODUCTION

The participation of the private sector in the development and management of public infrastructure projects has tremendously increased in the 21st century (Cui *et al.*, 2018, Väilä, 2020). This involvement by the private sector in the public space has led to a term coined in the built environment as Public-Private Partnership (PPP). PPP has no agreed and recognised definition so different researchers, countries, project managers and international organisations explained the concept differently depending on where it is applied and its associated benefits or challenges (Aldrete *et al.*, 2012). World Bank (2021) estimates that more than 14, 000 PPP projects (both ongoing and completed) have been developed at an investment value of \$1.7 trillion around the world. The PPP model has been helpful in the construction of new school buildings, airports, energy plants, light rails, mega road networks, health centres, renovation of dilapidated public facilities, and rendering of essential services (Deng *et al.*, 2016, Rossi and Civitillo, 2014).

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However, PPP projects like all other construction projects encounter unforeseen and unavoidable risks which threatens the success of the projects (Gupta and Verma, 2020). Among all the potential risks, one of the topmost identified by researchers in the construction industry is the financial risks (Akomea-Frimpong *et al.*, 2020, Aladağ and Işık, 2017). Financial risks are explained as the potential financial losses which limit the expected revenue from the project, increases the cost overrun of the project and the risks of inability to repay a contracted debt capital in the project's lifecycle (Xenidis and Angelides, 2005). Studies have strongly related the poor management of financial risks to struggling (or total failure) of PPP projects (Kumar *et al.*, 2018, Lam and Chow, 1999). This claim is supported by huge financial losses incurred (or complete failure of the project) with usage of the PPP model in projects such as Sydney's Cross City Tunnel in Australia, Jakarta Outer Ring Road in Indonesia and Kuala Lumpur Light-rail Transit in Malaysia. Despite this evidence, practical financial risk management models are either avoided (non-existent) or poorly implemented on PPP projects especially in developing economies to avert this problem. Another problem is that mostly, the management of financial risks is lumped up with all risks on PPP projects making it difficult to single it out and deal with it holistically.

To solve these problems and ensure continuous improvement upon the current financial control measures on PPP projects, there must be a specific risk maturity model to tackle financial risks of the projects (Akomea-Frimpong *et al.*, 2020, Jin and Zhang, 2011). The concept of developing risk maturity models to control project risks is not new. Existing studies such as Wibowo and Taufik (2017), Hoseini *et al.*, (2019), Hillson (1997) and Chapman (2019) have presented a close relationship between the usage of risk maturity models and the overall success of construction projects. These studies concentrated on the whole risk management of construction projects with a generic risk maturity model not specifically financial risks of PPP projects. Moreover, a theory-built and validated financial risk maturity model on PPP projects is missing in the literature. Against these backdrops and as part of bigger research project, the objective of this article is to: 1) theoretically construct a financial risk maturity model (FRMM) on PPP projects and 2) test and validate FRMM of PPP projects using practitioners and experts from Ghana, China and Australia.

The contributions of this research are mainly twofold. To contribute to the ongoing discussions among researchers in the PPP market to design practical models to address financial risks and improve financial success of PPP projects. Practically, practitioners will be guided to develop a holistic financial risk models taking from a multidimensional approach.

METHODOLOGY

As shown in Fig 1, the research began with a comprehensive systematic review of existing literature on financial risk management, risk maturity models and Public-Private Partnerships. The literature was searched and retrieved from academic database such Google Scholar, Web of Science and Scopus. Qualitatively, the retrieved literature and documents were subjected to content analysis leading to the extraction of relevant variables and statements for this article (Hwang *et al.*, 2013, Kavishe and Chileshe, 2019). Next, the theoretical model of FRMM was developed from the statements and theories obtained from the literature to address the first objective backed by risk maturity theories from the field of finance, economics and construction management. It is followed by empirical test and validation of the model

and the rationale for the application of the model to practical PPP projects. The test and validation the theoretical model began with the design of survey questionnaires on the outcome of the literature review which forms the basis of the FRMM theoretical model. The survey questionnaire was divided into two main sections. Section 1 of the survey asked questions about the country, profession, and experience of participants. Section 2 captured the financial risk maturity practices of PPP projects structured as: identify and plan financial risk (28 variables), analysis and allocate financial risks (24 variables), and control measures on financial risks (32 variables). The variables in the survey were measured on a Likert scale (Saunders *et al.*, 2007) ranging from 1 to 5-point. The interpretation of the Likert scale is: (1) remotely not critical; (2) not critical; (3) neutral; (4) critical; (5) extremely critical. A pilot test was conducted with eighteen (18) experts with international experiences on PPP projects and risk management to ensure the suitability of the variables included in the survey. Consensually, the experts agreed and approved the criticality of all the variables with no additional recommendations.

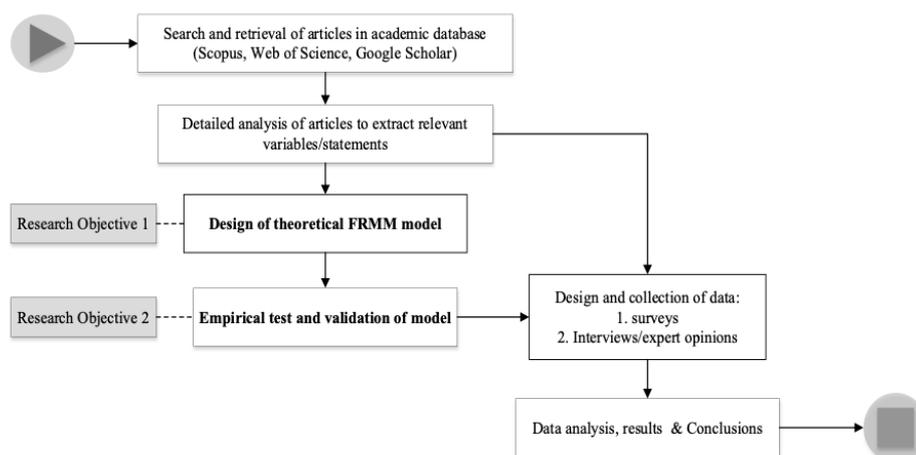


Fig 1: Research method flowchart (Authors, 2021)

The distribution of the survey started with the *search of participants*. We targeted 100 participants with vast experiences in PPP projects in each of the three countries we selected for this study. The countries used in this study are Australia, China and Ghana. These three countries represent the three main phases of development of the global PPP market: developed (Australia), mildly or moderately developed (China) and developing (Ghana) (Jin, 2010, Osei-Kyei *et al.*, 2019). Physically, we could not distribute a paper-based surveys to the participants due to the COVID-19 restrictions, so we utilised the online Qualtrics software with the aid of e-mails. E-mails were retrieved from institutional websites and social media platforms of Facebook and LinkedIn. Also, participants were asked to recommend experts and colleagues who are vastly knowledgeable in project risks and project management to be part of the study. This exercise led to additional participants for the distribution of the survey. A list of the e-mail addresses of all the potential participants were compiled and a survey link from the Qualtrics software was shared with all the participants via the e-mails. We received 184 responses against our target of 300 responses. We took 12 responses out due to incomplete filling of the survey with a remaining 172 responses. In Table 1, the number of responses we obtained from Australia is only 19 percent of the total responses even though it is a developed PPP market. China reported 34 percent of the responses and the largest responses came from Ghana, 47 percent. As an emerging market, Ghana is currently using PPP to overcome its large infrastructural deficit

(Ahenkan, 2019). Also, Table 1 shows that 40 percent of the participants having a vast knowledge on project risk while 60 percent were project management practitioners (architects, quantity surveyors, consultants, and project managers). Furthermore, Table 1 displays the experiences participants in the survey have on financial risks of PPP projects. It was recorded that 44 percent of the participants have knowledge or experienced financial risks on PPP projects for 6 to 10 years; 16 percent for 5 or less years; 30 percent for 11 to 15 years and 10 percent for 15 or more years.

Table 1: Profile of participants in the survey

Variable	Category	Frequency (n=172)	Percent (%)
Country	Australia (developed market)	32	19
	China (middle developed market)	59	34
	Ghana (developing market)	81	47
Profession (job title)	Project risk expert	69	40
	Project management practitioner	103	60
Work experience on PPP projects	5 or less	28	16
	6 to 10	76	44
	11 to 15	51	30
	15 or beyond	17	10

We tested the data obtained from the survey with a factor analysis (FA). The FA was used to assess the criticality of the variables and extract the most relevant statements to arrive at a conclusion. Also, the FA was run to test the relationships between the variables to reduce correlated statements which serve the same purpose (Umar *et al.*, 2019, Wang *et al.*, 2020). Ideally, the FA is used when conditions such as internal consistency, reliability and normality distribution are met, and we run and tested these conditions before the results from the FA were included in this article. The foremost test was internal consistency and reliability with a Cronbach's Alpha. A coefficient of 0.792 was attained for the reliability which is supported by Field (2013), who mentioned that a Cronbach Alpha's score beyond 0.7 is acceptable as reliable. Next, the normality distribution of the data was ascertained by Shapiro-Wilk Test. The test generated p-values less than 0.05 proving the data is not skewed but normally spread (McNeish, 2017). A Kruskal-Wallis Test was run to assess the differences in the responses given by the participants. It was revealed that there were no significant variations in the responses at p-values of greater than 0.05 from the three countries used in this study. The outcome of these tests paved for the FA to be run and interpreted shown in Table 2. Furthermore, we tested the sampling adequacy of the survey data with Kaiser-Meyer-Olkin (KMO) Test and got a result of 0.882 higher than the standard threshold of 0.6 (Hair, 2009). The results support the suitability of the data for the FA analysis. The varimax rotation was used to extract and confirm the three principal processes in the FRMM model. Varimax simplifies the main components of data compared to other rotational techniques such as promax, equamax and quartimax (Umar *et al.*, 2019). The results showed a greater eigenvalue more than 1.0 with 73.15 percent variances in the data.

Lastly, the results from the survey were validated through interviews which were conducted with the participants who answered the survey. Similar studies such as Ahmadabadi and Heravi (2019), Jin and Zhang (2011) and Xu *et al.*, (2010) used interviews to validate theoretical models on PPP projects This request was included in

the concluding part of the Qualtrics survey where interested participants were asked to leave their names and e-mails. An interview guide was designed based on the results from the analysis of the survey. Subsequently, the interview process was initiated with 28 participants whose contacts (or e-mail address) were collected and compiled from the Qualtrics platform. The interview questions, the results from survey data together with consent forms (to obtain the participants' agreement to record the interviews) were sent out two weeks prior to the scheduled date of the interview via e-mail. In addition, an online Zoom link was sent to all the participants. The actual interview session took place within 1 hour for each participant. Interview questions were centred around the clarity, criticality and usefulness of the FRMM as well the willingness to apply the model to their PPP projects. The information gathered during the interview process were recorded, transcribed, and analysed.

RESULTS AND DISCUSSION

Model Development

The bedrock of our financial risk maturity model (FRMM) is the risk maturity models, capability theories, enterprise risk theories and project risk theories (Hartono *et al.*, 2014, Hoseini *et al.*, 2019, Jankensgård, 2019). The key aim of this FRMM is to improve upon the processes of an organisation towards attaining the lowest project costs and improve upon the overall financial returns of the project considering all areas of endeavour and the lifecycle of the PPP project (Qureshi *et al.*, 2009). Scholars have suggested different levels of maturity levels being it four or five or six levels (Chapman, 2019, Yeo and Ren, 2009). However, we have formulated four levels of FRMM with three attributes/processes of managing financial risks of PPP projects. In Fig 2, the FRMM is a top-down maturity model theorised on two conditions. First, the improvement in pertinent matters on financial risk at the organisational level such as commitment of top management, knowledge management, culture, stakeholder management, training, defined policies, and actionable strategies. To meet this condition, the first level of the FRMM is akin to naivety of the Hillson (1997) study where the top managers are either unaware of the prevailing financial risks pertaining to the project or they are aware but have not formulated practical programs to deal with the identified risks and unexpected occurrences. At this point, top managers drive the existing processes of the project including financial risks repetitively (Wibowo and Taufik, 2017). Additionally, top managers do little or grossly neglect to learn from the past with undefined plans to deal with the similar financial losses to the project. At level 2, the top managers (or the organisation) recognise the financial risks of the project but the structures to tackle the problem is not formalised due to limited knowledge of individuals and poor stakeholder management. The attempts of the organisation to formalise the financial risks processes spearheaded by a small number of nominated individuals with little personal knowledge of the financial risks deprive the process of gaining its full benefits (Hoseini *et al.*, 2019). Continuous training to improve the competencies of individuals with allocation of appropriate resources will yield greater positive effects. At level 3, the organisation builds a comprehensive and robust processes on financial risks into the organisational culture. Formerly, the unattended and generic processes on financial risks are formalised and widely implemented in the organisation. It becomes an integral part of the organisation's culture (Qureshi *et al.*, 2009). It is understood and accepted to cutting down financial losses but not in all circumstances. Level 4 represents a well-defined and proactive risk-aware policies and strategies of the organisation. All aspects of the organisation and financial transactions is actively

infused with information and actionable strategies on financial risks of the project (Chapman, 2019). Continuously, this is used to gain competitive edge, take advantage of opportunities and improve upon the financial success of PPP projects.

The second condition underlying our FRMM model is the activities ensuring the application of the policies and strategies on financial risks of PPP projects. Categorically, it is grouped into three processes: plan and identify; analysis and allocation; and control measures on financial risks on PPP projects. Financial risks are identified from relevant documents and broad stakeholder consultation which are grouped into project-specific and externally induced financial risks (Akomea-Frimpong *et al.*, 2020). The project-specific financial risks include constructions costs, costs of labour, cost of materials, cost overruns among others. While the externally induced financial risks include high interest charges, taxation risk, forex/currency risk, and inflation risk (Kagne and Vyas, 2020, Xenidis and Angelides, 2005). At the analysis and allocation of the financial risk stage, financial risks should be examined thoroughly by considering the probability of occurrence or frequency of the risk with the right financial risk assessment techniques. Fair allocation of the financial risks must be allotted to key principal partners of the project. Lastly, the control measures must be implemented to reduce (or eliminate) the losses associated with the financial risks. The model works well when applied to control financial risks on mega projects such as roads, affordable housing, railway, and underground tunnels built through the PPP arrangements.

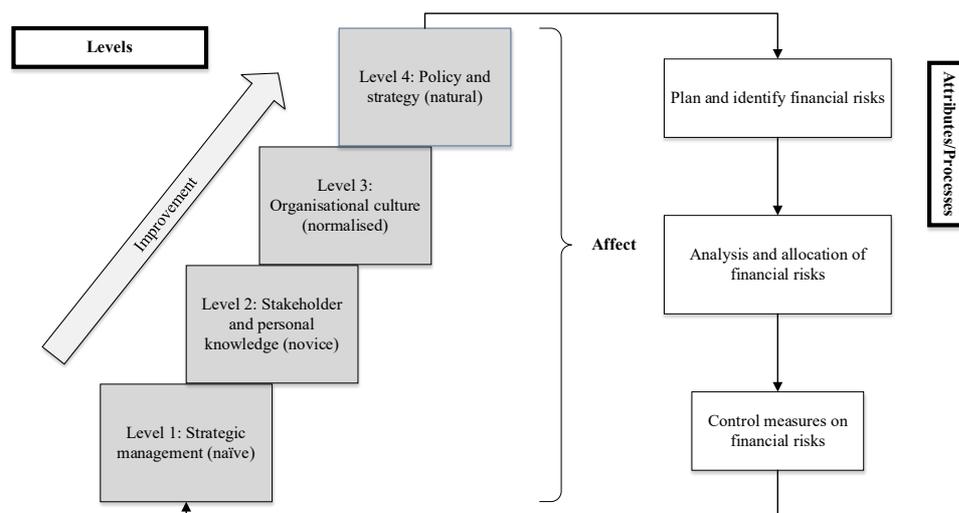


Fig 2: FRMM model (Authors, 2021)

Empirical Tests and Validation of Model

The first step in validating the FRMM model was to test the statements (variables) empirically using exploratory factor analysis to extract relevant statements at each level in Fig 2. The results are shown in Table 2 with details of the statements underlying the model. As mentioned in the research methodology section, the 28 participants in the interview process were given enough time to read the results from the survey (Table 2) and do further research into the topic.

In Fig 2, the significance level is 5 percent, MS= Mean Scores, WS=Wilk-Shapiro test (p-value), KW=Kruskal-Wallis (p-value), and L1-L4 is the Level 1 to 4 of FRMM. Participants who took part in the interview suggested we remove some of the statements from the results of the factor analysis. We took some out but turned down

some of the requests. We argued that some statements are irrelevant to their settings but useful in other jurisdictions and projects. Subsequently, they agreed to this proposition. Also, there was a modification of a number of statements to suit the practical settings of PPP projects.

Table 2: Criticality and relevance of the principal component variables in the FRMM model

Variables/statements	Criticality			Relevance			
	MS	WS	KW	L1	L2	L3	L4
Plan and identify financial risks							
Review reports from World Bank, IMF and auditing firms on similar PPP projects	4.4	0.00**	0.274			X	
Initiate broad consultations with local authorities and experts to ascertain the financial risks	4	0.00**	0.723		X		
Seek top management commitment on financial risk management	3.9	0.00**	0.569	X			
A threshold level of exposure on financial risks of the project is set	3.9	0.00**	0.641			X	
Published research articles is systematically reviewed to identify dominant financial risks	3.9	0.00**	0.021				X
Thoroughly review contractual agreements to establish the financial risks on the PPP project	3.8	0.00**	0.321		X		
Analysis and allocation of financial risks							
Find the root causes of all the financial risks relating to the project	4.7	0.00**	0.351		X		
Consequences of the financial risks are ascertained and analysed	4.5	0.00*	0.436			X	
Fairly allocate the financial risks based on expert judgements	3.9	0.00*	0.723				X
Use appropriate financial techniques such as NPV to assess and share the financial risks	3.8	0.00*	0.004		X		
Control measures on financial risks							
A Minimum Revenue Guarantee (MRG) is established to lessen the financial losses of the investors	4.9	0.00*	0.402				X
Real option analysis is employed to hedge against financial risks	4.7	0.00*	0.469		X		
Government support through subsidies on construction materials	4.4	0.00*	0.008			X	
Establish fixed loan interest rate to avoid paying extra interest charges	4.3	0.00*	0.154				X
Reassessment and renegotiation of financial agreements	4.1	0.00*	0.542				X
Participative budgets involving key partners of the project	3.9	0.00*	0.732		X		
Extend concession period to recoup investments	3.8	0.00*	0.615				X

Additionally, they pointed out the misstatements and errors in the statements and proposed new statements for the level of improvement in the organisation and the processes on managing financial risks. Statements related to Level 1 and Level 4 received many suggestions for continuous improvement. We observed from these suggestions that project management firms have different approaches of tackling financial risks related to PPPs. A participant recounted: ‘I realised that my current organisation’s financial risk maturity model differs from where I used to work as an assistant project manager 5 years ago where we implemented a simplistic two-level

approach to tackle financial risks'. Besides the modifications suggested by the participants, new statements were added to the final model. The participants confirmed the support the FRMM model will provide to project managers to improve the control measures on financial risks of PPP projects taking a holistic approach at both organisation and project levels. A participant recounted that "this FRMM covers relevant issues on financial risks of PPP projects, and it comes handy to assist measures to ensure continuous improvement of processes to score high financial success on a PPP project". Similarly, a participant mentioned the receptivity and flexibility of the model to further discussions and improvements. Participants scored the relevance of the FRMM at more than 80 percent and accepted to use it as a guide to ensure to reduce financial losses.

CONCLUSIONS

In this article, a theoretical model was developed, tested and validated on managing financial risks of PPP projects. The results of our research showcase the paucity of research on this topic in the construction literature, and the authors efforts to bridge this gap in academia and practice. The study used mixed data analysis techniques to address two questions formulated in the opening sections of the article. With regard to the financial risk maturity levels, four levels to ensure continuous improvement from top-level managers to the overall policy and strategy on financial risks of PPP projects were established. The underlying attributes or processes to ensure this happen include plan and identify, analyse, and allocate, and monitor and control financial risks. Relevant statements related to FRMM model was tested with exploratory factor analysis which led to the extraction of significant variables from the survey data. Experts (participants) were given the opportunity to comment and validate the applicability and suitability of the model to PPP projects they have significantly led. The result of this study gives a basis for further investigations and discussions on financial risk management in academia. It could also serve as a guide to project managers to develop models to manage financial risks relating to PPP projects since the participants were selected from countries which bear similarities with other countries classified by World Bank in terms of development and income status (Fantom and Serajuddin, 2016). However, this research is hugely constrained to the opinions of few PPP experts. Thus, an expanded scope of covering many countries with different conditions and large sample size will propel the acceptance of the FRMM model for PPP projects. Further studies must expand the sample size and ensure cross sectional application of the model to real projects.

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