

An evaluation of the impact of risk cost on risk allocation in public private partnership projects

Khalid Almarri, Saleh Alzahrani, and Halim Boussabaine British University, Dubai,
United Arab Emirates

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Abstract

Purpose: A unique aspect of PPP is the opportunity for the transfer of risk ownership to the private sector. This research aims to investigate how risk cost influences risk allocation

Design/methodology/approach: A questionnaire survey was used to collect data. The questionnaire, included nine sub-categories of risks. To quantify the influence of risk cost on risk allocation, a dependency risk matrix is employed. Heat maps techniques were used to visualize the results of the survey.

Findings: The findings showed which risks within the endogenous or exogenous groups are to be allocated to the public sector, the private sector, or to be shared. The finding from this research provides a baseline for the PPP stakeholders in developing guidelines for estimating the value of risk costs in the risks register as well as serving as a mechanism for risk allocation

Research limitations/implications: The context of the study may limit the generalisability of the results.

Practical implications: The study provides practical guidance to PPP stakeholders on risk allocation appetite.

Originality/value: This study extends the processes and methods by which PPP project's risk is allocated to created better value for all the stakeholders.

Keywords: Risk cost, risk allocation, PPP, endogenous risks, exogenous risks

Paper type: Research article

Introduction

Public private partnerships (PPPs) are widely recognised for providing a better value for money (VFM), when compared to the traditional methods (Bing et al., 2005). This improved VFM is due to the fact that PPPs place the risk on the parties, who are willing to undertake them (Boussabaine 2013; Demirag, Khadaroo, Stapleton, & Stevenson, 2012). Hovy (2015) argues that optimal risk allocation is a primary driver of PPP projects as it returns better VFM. He further described, “Risk transfer to the private sector comes at a price, and transferring risks that the public agency is better able to manage is likely to erode VFM”. Hovy (2015) describes that it can be challenging though to properly manage PPP projects. Bing et al. (2005) have discussed that risk allocation among the public and private sector presents some unique challenges. Some researchers argue that risk in a PPP project should always go to the party, which is the most capable of reducing and managing it (Wehrung et al., 1988; Al-Bahar and Crandall, cited in Wang and Chou, 2003). Bing et al. (2005) also argue that it is necessary to transfer the risk to the right party. As a PPP project is often complex, it can be difficult to ascertain risk costing at the start of the project. Boussabaine (2013) pointed out that the major problems with uncertainties in risk pricing analysis are the ability of the analyst to map out all uncertainties and initiating events into the quantities of direct and indirect costs. Furthermore, highlighted Villalba-Romero and Liyanage (2016):

“The party who lends or provides the money in the beginning usually requires a return as a compensation for the risk assumed and also expect the funds to eventually be repaid”

This suggests that risk allocation in a PPP project depends on this complex analysis and should follow the costs and consequences of particular risk conditions. Sastoque et al. (2015) describe that it is a common practice in the financial sector to allocate the risk, according to the expected returns in a venture. Therefore,

The purpose of this research is to illustrate how the cost of risk can influence risk allocation in PPP projects. Thus this research aims to identify the relationship between risk pricing level and optimum risk allocation.

It is believed in PPP projects that as significant risk is transferred to the private sector, the public sector is able to achieve better value for money out of these projects. Currently, there is a lack of evidence that supports this claim. The certainty in construction price (completion time and budget) is often used as a primary measure, for describing a successful risk transfer to the private sector in PPP projects. Some evidence points to the fact that a premium is often paid in many projects to improve the certainty of the overall costs of the project. This is based on the fact that the private sector costs a project according to the risk involved in its undertaking. However, this transfer may not always result in producing better value for money. It can be argued that a private contractor charges a significant fee, in order to cover the risk that they are bearing. Most studies on the topic of risk allocation in PPPs focus on the stakeholders’ ability to manage the risks. In our view, this course of research only provides a particular understanding of the value for money which is created through risk allocation. We find that previous work has failed to explore the connection between the appetite for risk allocation and the actual risk cost levels. There is a significant gap present in the existing literature, which creates a need for performing this research for better understanding the PPP procurement model. Hovy (2015) further states that research is required in order to suggest principles that can be used to improve risk allocation and increase the value for money obtained in various PPP projects. As there are no principles which are currently available for risk allocation based on the level of risk price, this research aims to develop a heat map conceptual model to

help public and private sector to deal effectively with risk allocation based on the value of risk being allocated. This study is set to examine the influence of risk cost on risk allocation appetite in the context of PPP projects in KSA. The infrastructure projects form the cornerstone of the Saudi government ambitious development plans. The majority of procurement contracts in KSA are based EPC contract modalities (Husein, 2014). However, to reduce the state expenditure the KSA government had resulted to seek public-private partnerships to build major projects and public services. The KSA government is aiming formalise contractual structure to position residual risk with the private sector (MCIT, 2016). Thus, our key contribution is a theoretical understanding of the conditions and risk cost level under which risk allocation might be undertaken in PPP projects.

The next section of this research paper describes the theoretical background on risk allocation. The research methodology section follows the theoretical background and describes the details of the primary research activity of data collection and analysis. The last section describes the results and discusses their practical applications.

Theoretical background

It is observed in the last decade that a greater risk is transferred to the private sector in most PPP projects (Sastouque et al., 2015). The management of risk is a primary element in PPPs. These projects, in fact, are designed to transfer greater risk to the private sector, in order to reduce the risk endured by public funds. It also follows the ability of both parties to manage the involved risks (Bing, Akintoye, Edwards, & Hardcastle, 2005). The private party usually receives a premium in order to bear the brunt of the project risk. This means that all the parties need to collaborate with each other and reach a compromise when performing risk management (Demirag et al., 2012). The risk allocation should always be based on a realistic assessment that needs to be performed in order to find the capacities of both parties, and should never follow the interest of a single sector (Shaoul, Stafford, & Stapleton, 2006).

The private partners are usually burdened with a number of responsibilities and risks in most PPP project contracts. This is designed in order to allow the public sector to allocate the risk costs to the private sector in PPP projects. Another point is that this practice of risk transfer reduces the cost of the project, as the private partner is supposed to be more cautious when their money is on the line, but this point is not supported by empirical evidence. It is also suggested that market competition is often absent in these projects, which ultimately results in the private parties charging a higher risk premium. Another practice is that the main private sector company often transfers the risk to third party companies, such as the construction and operation risks to the lower tier of contractors. Murphy (2008) discusses that it is a common practice in PPP projects to observe that the private party takes on the responsibility of all the risks of the project for a period of as long as thirty years. Quiggin (2005) argues that it may not be the best risk allocation to simply transfer the risk completely to the private sector in all the projects, as a standardised practice. Therefore, the purpose of this study is to describe the idea that risk in a PPP project should be based on its actual costs. Risk needs to be treated as a commodity that should be transferred on its individual merits (Boussabaine, 2013). The important point in this regard is that individual risks need to be identified and properly categorised before allocating them in a PPP contract. This will allow stakeholders to perform better costing and define who should own the risk. There are a number of sources that discuss the classification of the risk into different groups that are relevant and often present in a number of projects (Ke et al., 2010; Bing et al., 2005; Shen, Platten, & Deng,

2006; Yuan, Deng, & Li, 2008; Ng & Loosemore, 2007; DTPV, 2001). Martha E. Gross (2010) reported on the development of three tools for assisting decision making processes in PPP procurements. The tools were designed to estimate the viability of toll road projects. The author didn't report on how risk price is treated in the proposed tools. Global Infrastructure (2016) developed standardised risk allocation matrices for several types of infrastructure projects. The report mainly addressed risks from the point of legislation, allocation, and mitigation. The risk allocation method used in the report is like those that can be found in PPP frameworks. Jin and Zhang (2011) claim to develop an artificial neural network (ANN) model for risks allocation based on transaction cost economics. Transactions costs include a wide range of cost items. The authors did not specify in their work if these transaction costs are related to cost of the risks or other PPP contractual costs. However, the authors indicated that they used qualitative measurement of the proportion of a given type of risk transferred to a private partner as a proxy for transaction costs.

The categorisation of PPP risk was identified from academic literature (Zhang, 2000; Bing et al. (2005). Bing et al. (2005) suggested in their study a meta level categorisation method based on the three levels of PPP project risk factors. The three levels consist of macro level risks, meso level risks and micro level risks. This technique has also been utilised by other authors, such as Grimsey & Lewis (2002), Hodge & Greve (2007), and Karim & Alkaf (2011). Bing et al. (2005) state that the macro level includes exogenously produced risks, i.e those external to the project. The authors went to stress that the meso stage of PPP risk comprises endogenously sourced risks. Given the large amount of publication on PPP risks, the selection of papers was based on their relevancy to risk calcification. For the purposes of this research, they will be categorized into two main groups, namely, exogenous risks and endogenous risks. The list presented in Table 1 and Table 2, and discussed in the following sections

Exogenous risks are those that arise from outside the project (Danielsson & Shin, 2010). In this research, exogenous risks are broken down into five sub-categories: political, legal, economic, natural, and market risks. The political risks result from legal changes and obstructive government policies (Ke, Wang, Chan, et al. 2010). Millones (2010) suggested that political risks may arise and endanger a project as a result of an inadequate agreement, imprecise laws, or incorrect actions from organizations. Legal risks may stem from issues outside the rule of law, for example, from flaws in bankruptcy protection, or where a local government may take over a project in extraordinary circumstances. Eversheds (2011) explain that a legal system in some countries is based not only on law itself, but also on a mixture of local custom, principles of natural law, and rule of equity. Economic risks are those related to macroeconomic conditions such as volatility in interest rate and inflation rate, foreign exchange and convertibility, and a weak financial market. Zeng et al. (2008) point to mistakes in predicting demand, reduction in demand, competition, variation of loan interest rate, inflation, and currency risks as the most serious financial threats to the revenues of a PPP project. A force majeure event is one that is totally out of the control of either party and may occur for a continuous or specified period. Owing to its extremely significant consequences, neither party can be responsible for all or a major part of their duties anymore under the signed contract. Market risk is the possibility for an investor to experience losses due to factors that affect the overall performance of the financial markets. Market risk concerns change in broad economic conditions that affect a whole market. The exogenous risks tested in this study are shown in table 1.

Insert Table 1 Here

Endogenous risk refers to the risk from shocks that are generated and amplified within the system (Danielsson & Shin, 2010). This category can be divided into five sub-categories: project selection risks, project finance risks, construction risks, relationship risks and operation risks. Project selection risks include public opposition to projects risk, uncompetitive tender risk, level of demand for the project risk, land acquisition, and competition risk (Li, et al, 2017). Zhang (2005) emphasises that financial capability of a concessionaire is crucial to the development of PPP projects because the financing of these projects is heavily reliant on investors and lenders when they are under construction. Construction risks might take the form of delays in construction and/or an increase of cost, over time. Construction risk might manifest itself as construction flaws which result in inadequate and ineffective service delivery. Karim and Alkaf (2011) state that relationship risk is mainly concerned with organization, coordination, responsibilities, and commitment. Operating risk is a risk that the private sector is not able to fully or partly deliver its contacted services within the agreed costs. Operating risk also referred to as performance risk, comprises three interconnected aspects: management, cost, and technology.

The endogenous risks investigated in this study are shown in table 2.

Insert Table 2 Here

Methodology

A literature review was conducted as described previously to categorise and classify risks. The questionnaire format of the risk check list was checked and validated by academics who had expertise in PPP. The experts accepted the classification risk and the matrix for scoring risk allocation based on risk cost. A questionnaire survey was used to collect data. The questionnaire included nine sub-categories of risks. The questionnaire was sent to experts working in PPP projects in KSA. The participants were selected randomly from the list of local authorities, contractors and consultants based on their participation and knowledge of PPP practices in KSA. The target respondents of the survey were client (public sector), consultant and contractor representatives of PPP projects, including directors, estimators, project managers and contract managers. The respondents were selected from both public (55%) and private sectors (45%). This was necessary to have a balanced view on risk allocation based on the cost of risk. Seventy one percent of the respondents has more than 10 years of experience. Out of the 250 respondents, a total of 68 respondents completed the questionnaire. Hence, response rate was 27% , which is within the acceptable range of 20% to 30% as identified by Couper (2000).

Heat maps techniques were used to visualize the results of the survey. The cluster heat maps are well established methods in the natural sciences. In particular, the method is used extensively in biological sciences to visualise the interrelationship between entities in the form of n-dimensional histograms. Heat mapping methods are a way of showing the clustering of a particular phenomenon with view to extract significant relationships. Density heat maps based on two-dimensional tables of numbers is one of the most widely used techniques. For example, patterns or entities that have high frequency can emerge (Weinstein 2008). Weinstein (2008) articulated the robustness of the heat map methods for representing data. Weinstein views are supported by Gehlenborg and Wong (2012). Li et al (2017) used density maps base on frequency counting to track and capture the spatial distribution of workers on construction sites. Buscail (2012) used heat maps to represent and visualise “the spatial variations of hazard, vulnerability and risk indices”.

The authors used the scale (very low, low, moderate, high and very high) to measure the health risks. Following Rose's (2013) PMI PMBOK guide, Australian Government (2011), Weinstein (2008), Li, et al (2017), Buscail (2012), Gehlenborg and Wong (2012), we used the density heat maps based on the frequency from the correlation clusters that deemed particular appropriate to represent the histograms of the relationship between the level of risk cost and risk allocation appropriateness.

Insert Table 3 Here

To quantify the influence of risk cost on risk allocation, a dependency risk matrix is employed. Similar matrices are used by Rose's (2013) PMI PMBOK guide, and Australian Government (2011). The range 1 to 15 is adopted in this study. Rating from 1 to 5 means allocation to public sector based on level of risks price from very low to very high respectively. Rating from 6-10 is allocated to private sector. Finally rating from 11-15 is to be shared between both sectors. The risk cost scale is based on a five point's scale; very low, low, medium, high and very high. This scale used arbitrary to assist in the development of frequencies which are used to develop risk allocation heat maps. Table 3 shows the matrix used to score risk allocation. The X axis of the table represents the party which is able to bear the risk cost. The Y axis of the table represents the level of the risk cost. The respondents were asked to rate the influence of risk cost on the allocation if risks., for example, if the risk cost of a particular event is high who would be most suitable to bear and manage such risk.

The data was collected in a matrix format so the risk impact events are directly assessed by the respondents. For every cell in the matrix, an average weighted response for each risk event is computed. The values of these weighted averages are then used to develop risk allocation heat maps.

The analysis and interpretation of our constructed heatmaps are based on the intensity of values within each array in Table 3. Each of the arrays in the table are represented by the frequencies based on the respondent perception on risk allocation. Those arrays that are highest in their frequency value, relative to other cells in the table, will be assigned a colour. The outcome of the processes will show us a list of risk allocation possibilities based on the intensity of frequency values as demonstrated in figure 1. The results of this exercise are presented and analysed in the following sub-sections

Results

The findings from the heat mapping are summarised in Figure 1. PPP projects are complex as they are affected by multi interactions between risk factors that could create additional risks ultimately leading to cost overrun. This study found that most of risk factors are usually allocated to the private sector. Most of exogenous risk factors are shared between the public sector and the private sector although the private sectors is allocated the larger share of these factors. Regarding the endogenous risk category, the private sector is found to be the best party to manage most risk factors in this category. Overall, 28 risk factors are allocated to the private sector, 22 risk factors are shared by both parties. Only 14 risk factors out of 65 risk factors are usually allocated to the public sector.

Insert Figure 1 Here

Allocation of Exogenous Risk Events Based on Risk Cost

Ten political risk events were included in this study. The result shows that the majority of the respondents suggested that if the political risk event cost is very low, low and medium, the risk should be allocated to the public sector. Respondents have allocated “Inability of Concessionaire” to the private sector when the likelihood the risk event is low or very low. The respondents generally suggested that if “Poor public decision making process” risk is medium then it is most likely allocated to the public sector. Some thought it is better to allocate it to the private sector. However, all respondents agree if Poor public decision making process risk cost is low then it should be allocated to the public sector. It is noted that these results are not in line with previous studies. Most of the literature including the European bank PPP guide (2012) suggest that *“in general, the private sector is better placed to assume commercial risks while the public sector is better placed to assume legal and political risks”*. This might be attributed to the fact that in Saudi Arabia the economy is mostly controlled by the government. Probably this is the norm in other countries when public projects underperform, the government steps in to provide the necessary support.

Legal risk events are the consequences of possible legislation change, imperfect law and supervision systems and change in tax regulation. It seems that there is a wide range of opinions on how political risk cost influences risk allocation in Saudi Arabia. For “Change in tax regulation, Corruption and lack of respect for law, and Import / Export restrictions”, respondents agree that if risk cost range from high to low then the risk should be shared. Although for Change in tax regulation many respondents thought this risk should better be managed by the private sector. If the cost of Legislation change is low then its allocation, respondents showed no clear preference for risk allocation. However, if this risk cost level was medium, it should be shared by private and public sectors. There appear to be a disagreement between respondents regarding the allocation of RP15- Rate of return restrictions risk event. RP12-Corruption and lack of respect for law, and RP16-Industrial regulatory change have been rated as medium level of risk price, which is the highest in this sub-category, also it is one of the highest overall risk factors considered in this survey. One cannot generalise from these results.

PPP projects are known to be susceptible to economic risk events. An overall observation of the heat map shows a consensus among the respondents that this risk should be allocated to the private sector if their cost is low or medium. The “RP20-Poor financial market” risk is allocated to the private sector if the cost is low. The findings from this section are in line with the current PPP guidelines, which stipulate that commercial risks should be allocated to the private sector.

Natural risk events are mainly considered to be related to acts of God, such as natural disasters. There appears to be a consensus among practitioners that if the cost of a risk event is high to low, then the consequences of this risk should be shared between project partners. In fact, this is the general principle in all existing PPP frameworks. However, some respondents think that if the risk cost for Force majeure is medium to low then the public sector should bear the risk. Moreover, a group of respondents suggest that if the risk cost for event RP24- Geotechnical condition - is medium to very low then the private sector should bear this risk consequences of this event.

Typical market project risks normally arise when the payment for the services that need to be provided by the project is dependent on the level of usage. However, the construction stage of PPP projects could be also subjected to market conditions through unforeseen price variations of construction material, equipment, etc. Practitioners in

Saudi Arabia suggest that the risk cost of RP25- Tariff change and RP26- Market demand risk events have to be shared by both public and private sections when the risk cost is low to very low. However, some procuring authorities prefer the market demand risk to be allocated to the private sector. It is interesting to notice that the respondents thought the cost of these two events is low. This is probably due to the fact that the majority of services in Saudi Arabia are provided by the government and demand for the public services is growing exponentially due to the rapid growth of population and economy. The respondents assessed “RP27-Fluctuation of material cost” risk event cost to be medium to low and suggested that it should be shared by public and private sectors.

Allocation of Endogenous Risk Events Based on Risk Cost

The project selection risk events deal with issues such as delays in land acquisition, planning approval, site availability, etc. the results showed that the first preference is to allocate Public opposition to projects, Level of demand for the project and Competition risk to the public sector when risk cost is low. However, if the risk cost is low, the respondents preferred to allocate the Uncompetitive tender risk to the private sector. The respondents preferred to allocate Public opposition to projects, Uncompetitive tender and Land acquisition to the public sector, whereas Level of demand for the project and Competition risk are preferably allocated to the private sector and shared respectively. The respondents preferred that Public opposition to projects, Uncompetitive tender and Land acquisition to be shared between private and public sectors when the risk cost is low. Contrary to these findings, in most existing PPP frameworks and guidelines project selection risk events are mainly managed by the public sector. No matter what the level of the risk cost, the transfer of these risks is being rarely used as strategy for managing the project selection risks. This might be due to the fact that it is generally impractical to achieve value for money from transferring these risks to the private sector.

Project financial risk events deal with issues such as availability of finance, financial attraction of project to investors, high finance cost that may influence the development budget of projects. It seems that the preference when the risk cost ranges from high to low is to allocate to the risk to the private sector. It is also noticeable that the respondents prefer RP42-Lack of government guarantees to be allocated to the public sector when the risk cost is low to very low.

Construction risk events are related to design, construction and commissioning of the project. It is well recognised that the design and construction phase of the PPP projects is the riskiest stage. Thus, it is possible that if certain aspects of each of these three processes are not implemented correctly might lead to adverse cost escalation and time delays. There seems to be a general agreement among the respondents that no matter what the risk cost is the construction risk events should be allocated to the private sector. However, it appears that the respondents prefer if the RP54- contractual risk is shared between the public and the private sectors. One can only presume that in Saudi Arabia the government is heavily involved in contractual arrangements and approval, hence the desire of the respondents that this risk should be shared. One can also assume that if all of these risks are allocated to the private sector this will increase the risk cost and ultimately the outturn unit cost of PPP projects.

Relationship risk events are related to stakeholder relations as formed in the project procurement process of PPP projects. This type of risk is unavoidable due to the nature of PPP projects and their complex contractual arrangements and coordination. The result indicates that the first preference of PPP practitioners in Saudi Arabia is to share the

relationship risk between the public and private sectors if the risk cost range was between very low to medium. However, the respondents thought that if the risk cost for event RP65- Cultural differences between main stakeholders is low then this risk should be allocated to the private sector. The results show that if the risk cost is between medium and very low then the preference for relationship risk allocation is either shared (e.g. RP57- Different working method between partners) or allocated to the private (e.g. RP58- Inadequate experience in PPP). The result indicated that preference of respondents appears to swing towards the private sector to bear the relationship risk when the risk cost is low.

Discussion

Numerous surveys have been carried out to investigate risk allocation in PPP projects. The majority, if not all, of these investigations were aimed at finding who is able to manage the risk events effectively. (Ke, Wang, Chan, et al., 2010) support the theory that the risk likelihood is reduced when the risk event managed and control by the party in a great position to control the event consequences. But, there is no total agreement between researches on how risk events are allocated. This might be attributed to the fact each study is carried out in different countries which are subject to unique procurement laws and regulations (J. Wang & Yuan, 2011). But in general, there is a consensus on the principles of risk allocation. Overall commercial risks are allocated to the private sector and public sectors assume most of the risks that are related to the bureaucratic aspects of the project. Risks that are too difficult to be managed by only one party are normally best shared between public and private sector. The risk allocation in this research differs from the previous studies in the sense that the respondents were asked to allocate the risk based on the level of the risk cost.

Risks allocated to the public sector

Table 4 shows that majority of respondents has allocated most of political risk events to the public. Only one risk factor from legal sub-category RP15-Rate of return restrictions is allocated solely to the public sector. Also in project finance, sub-category risk event RP42-Lack of government guarantees is only one risk factor that was allocated to the public sector when the risk cost is deemed to be very low or low. This research supports DTPV (2001) view that RP1- Change in law should be allocated to the public sector. Whereas other researchers (Lam et al., 2007; Bing Li, A. Akintoye, et al., 2005; DTPV, 2001; Wang et al., 2000) found that this risk factor should be shared between public and private sectors. Lam et al. (2007) and DTPV (2001) stated that RP2- Delay in project approvals and permits, should be allocated to the private sector, while Ng and Loosemore (2007) see that this risk factor should be allocated to both parties. This research from the level of risk cost prospective see this risk event should be allocated to the public sector.

Insert Table 4 Here

This research support previous research done by (Bing Li, A. Akintoye, et al. (2005) that stated RP8-Strong political opposition /hostility suggested to be allocated to the public sector.

Lam et al. (2007) and (Bing Li, A. Akintoye, et al., 2005) propose from a management point of view that RP5-Unstable government should be allocated to the public sector, similarly respondents in this study indicated that, from the point of view of risk cost, this risk factor should be allocated to the public sector. Regarding the risk event RP31- Land

acquisition, to be allocated to the public sector when risk cost medium or high, this research finding is similar to the finding by (Lam et al., 2007) and (Bing Li, A. Akintoye, et al., 2005). However, others (Ng & Loosemore, 2007) and (DTPV, 2001) stated that this risk factor should be allocated to the private sector.

Risks allocated to the private sector

The majority respondents allocated all economic risks, majority of project finance and construction risks to the private sector.

Insert Table 5 Here

Only one risk factor from political sub-category RP10- Inability of concessionaire is allocated solely to the private sector when the risk price is deemed very low or low. Also in the market risk sub-category the risk event RP27- Fluctuation of material cost by public/private is the only risk factor that allocated to the private sector according to risk cost scenarios. Ng and Loosemore (2007) and Wang et al. (2000) noted that RP17- Interest rate volatility, should be share between public sector and private sector. Nonetheless, the finding from this work supports Bing Li, A. Akintoye, et al. (2005) finding that this risk factor is best managed by the private sector. Similarly, Ng and Loosemore (2007) and Wang et al. (2000) stated that RP18- Inflation rate volatility is best to be controlled by public and private sectors, whereas this research finding supports the view that it should be allocated to the private sector (Li et al., 2005). Likewise, RP33- Availability of finance risk event is preferred to be allocated to the private sector when risk price is very low, low or medium. This is similar to findings on risk allocation based on management of point of view (Bing Li, A. Akintoye, et al., 2005) and (DTPV, 2001). This research supports the view of (Bing Li, A. Akintoye, et al., 2005) that RP52- Late design change, should be allocated to the private sector, although other researchers such as (Ng & Loosemore, 2007) and (DTPV, 2001) prefer that this risk factor should be allocated to the public sector.

This research finds that RP46-Material availability, and RP47- labour availability risk event should be allocated to the private sector when the risk cost is low, medium or high. This is similar to other findings from (Lam et al., 2007; Bing Li, A. Akintoye, et al., 2005) (Wang et al., 2000). This research is in concordance with previous research (Wang et al., 2000), (Bing Li, A. Akintoye, et al., 2005), and (DTPV, 2001) that RP53- Construction technology risk event is better to be allocated to the private sector when the risk cost is very low, low or medium. Also, this study confirms that RP35- High finance cost, should be retained by the private sector as previous studies stated (Bing Li, A. Akintoye, et al., 2005; Wang et al., 2000).

Risks shared

As illustrated in table 6 the majority of the respondents thought that relationship risks should be shared between public and private sectors.

Insert Table 6 Here

A majority of legal risks and majority of market risks are assessed to be managed by both sectors. Only one risk factor from project selection risks sub-category RP32- Competition and RP54- Contractual risks are preferred to be shared between both parties when risk price is very low or low, and low or medium respectively. Lam et al. (2007) stated that RP24- Geotechnical condition should be allocated to the public sector, while Ng and

Loosemore (2007) and Bing Li, A. Akintoye, et al. (2005) found that this risk factor should be allocated to the private sector. However, based on risk cost impact, the respondents in this study thought that this risk factor is to be shared. This research supports Wang et al. (2000) view that RP54- Contractual risk should be managed by public and private sectors. This is contrariwise to the Lam et al. (2007) view that contractual risk should be allocated to the public sector. It is very interesting to note that researcher such as (Ng & Loosemore, 2007; DTPV, 2001; Wang et al., 2000) see that RP25-Tariff change should be managed by private sector, while this research found that this risk should be managed by both public and private sector. This research corresponded with the findings by (Ng & Loosemore, 2007; DTPV, 2001; Wang et al., 2000) that RP21- Force majeure should be allocated to both sectors. There exists conflicting view on the weather risk events. According to Wang et al. (2000) this risk event should be borne by the public sector, whereas Lam et al., 2007 argued it should be shared between public and private sectors. But, Li et al. (2005) stated that this risk factor should be allocated to the private sector. This study disagrees with the later view, and reaffirms that when the risk cost is low or medium then these event consequences should be shared.

Conclusions

Risk allocation has a significant impact on VFM creation. If risks are not allocated according to the expected return, value may not be realised to the public sector. Although, there are a significant amount of literature in this area, but most of the literature did not focus on the impact of risk cost on risk allocation. In this research, the main focus is on the impact of risk cost on risk allocation. The paper presented the results of a study that investigated the opinion of KSA professionals on risk allocation preferences based on the level of risk cost. The risks were identified from the literature and classified into exogenous and endogenous.

In summary, it appears that risk retention by the public sector is preferred for RP3- Poor public decision making process and RP31- Land acquisition when the risk cost is medium. But when the risk cost is low to very low it seems that it is preferred to allocate “*Change in law; Delay in project approvals and permits; Government intervention; Government reliability; Inconsistencies in government policies; Rate of return restrictions; Level of demand for the project; Lack of government guarantees; Unstable government; Strong political opposition /hostility; Expropriation/nationalization of assets; and Public opposition to projects*” to the public sector. Most of the risks to private sector when the risk cost is very low to medium. Similarly, the respondents prefer to share the risk between the private and public sectors if the risk cost is low to medium. What is interesting is that only few risk events have been assumed to have a high to very high risk costs.

The finding from this research provides a baseline for the PPP stakeholders in developing guidelines for estimating the value of risk costs in the risks register as well as serving as a mechanism for risk allocation. The public sector may benefit from using the prosed methodology in formulating the business case to finance the projects via the PPP route. Also, the proposed generic framework provides applicability opportunities for the private sector and funding bodies to assess risk impacts and risk costs before the bidding process. This will allow them to optimise their bids and put in place mitigating strategies. Although, the PPP project procurement environment was the source of information, whilst commonalities across similar building and infrastructure projects exists, this will provide applicability opportunities for this research in other procurement routes as well.

To do so further work is required to develop casual links between risk cost and optimum allocation of risks.

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Table 1: Summary of exogenous risks category

Exogenous risks category	Sources
1. Political Risks Sub-category RP1 Change in law RP2 Delay in project approvals and permits RP3 Poor public decision making process RP4 Government intervention RP5 Unstable government RP6 Government reliability RP7 Inconsistencies in government policies RP8 Strong political opposition /hostility RP9 Expropriation/nationalization of assets RP10 Inability of concessionaire	S. Q. Wang, R. L. K. Tiong et al. (2000) Koppenjan and Enserink (2009) Moran (1998) Millones (2010) Ke et al. (2010)
2. Legal risks sub-category RP 11 Change in tax regulation RP 12 Corruption and lack of respect for law RP 13 Legislation change RP 14 Import / Export restrictions RP 15 Rate of return restrictions RP 16 Industrial regulatory change	DTPV, 2001 Iossa et al. (2007) Ke et al. (2010) Akintoye et al. (2003)
3. Economic risks sub-category RP 17 Interest rate volatility RP 18 Inflation rate volatility RP 19 Foreign exchange and convertibility RP 20 Poor financial market	Gupta and Sravat, (1998) Thomas et al. (2003) Zeng et al. (2008) Karim and Alkaf (2011)
4. Natural Risks RP 21 Force majeure RP 22 Environment RP 23 Weather RP 24 Geotechnical condition	Treasury (2007) DTPV (2001) UNESCAP (2008) Ruster (1997)
5. Market Risks RP 25 Tariff change RP 26 Market demand RP 27 Fluctuation of material cost by public/private	Akintoye et al. (2003) Klijn, E. H., & Teisman, G. R. (2003). Fernandez et al. (2011)

Table 2: Summary of endogenous risks category

Endogenous risks category	Sources
1. Project selection risks sub-category RP 28 Public opposition to projects RP 29 Uncompetitive tender RP 30 Level of demand for the project RP 31 Land acquisition RP 32 Competition risk	Bing et al. (2005) Li et al (2017) Karim and Alkaf (2011)
2. Project finance risks sub-category RP 33 Availability of finance RP 34 Inaccurate estimates RP 35 High finance cost RP 36 High bidding costs RP 37 Delay in payment of annuity RP 38 Financial attraction of project to investors RP 39 Lack of creditworthiness RP 40 Delay in financial closure RP 41 Inability to service debt RP 42 Lack of government guarantees RP 43 Financer unwilling to take high risk	Wang et al. (2000) Moran (1999) Salama (2008) X. Zhang (2005) Lam and Chow (1999) DTPV (2001)
3. Construction risks sub-category RP 45 Construction cost overrun RP 46 Material availability RP 47 labour availability RP 48 Poor quality of workmanship RP 49 Default of sub-contractors or suppliers RP 50 Design & construction complexity RP 51 Design deficiency RP 52 Late design change RP 53 Construction technology risk RP 54 Contractual risk RP 55 Contractor failure RP 56 Quality risk	DTPV (2001) The EU Commission, (2003) Karim and Alkaf (2011) Bing et al. (2005) Li et al (2017)
4. Relationship risks sub-category RP 57 Different working method between partners RP 58 Inadequate experience in PPP RP 59 Lack of commitment from public/private sector RP 60 Organisation and coordination risk RP 61 Inadequate distribution of responsibility and risk RP 62 Inadequate negotiation period prior to initiation RP 63 Conflict between project's participants RP 64 Workers strike RP 65 Cultural differences between main stakeholders	Jepsen and Eskerod, (2009) Yescombe (2007) Manowong and Ogunlana (2010) Aaltonen et al. (2008) Karim and Alkaf (2011)
5. Operation risks sub-category RP 66 Operation cost overrun RP 67 Operational revenues below expectation RP 68 Low operating productivity RP 69 Maintenance costs higher than expected RP 70 Maintenance more frequent than expected RP 71 Residual value (after concession period) RP 72 Operation financial risk RP 73 Operator default RP 74 Quality of operation RP 75 Project / Operation change RP 76 Supporting facilities risk RP 77 Operation technology risk RP 78 Waste of material	DTPV (2001) Bing et al. (2005) Iossa et al. (2007) Grimsey and Lewis (2002)

Table 3: Risk matrix for level of risk price and risk allocation

Risk Price	VH	5	10	15
	H	4	9	14
	N	3	8	13
	L	2	7	12
	VL	1	6	11
		Public	Private	Share
Risk Allocation				

Table 4: Allocation of risk factors to public sector

Risk Factors		Risk sub-category	Risk price level
RP1	Change in law	Political	VL / L
RP2	Delay in project approvals and permits	Political	L / M
RP3	Poor public decision making process	Political	L / M
RP4	Government intervention	Political	VL / L / M
RP5	Unstable government	Political	VL / L
RP6	Government reliability	Political	VL / L
RP7	Inconsistencies in government policies	Political	L / M
RP8	Strong political opposition /hostility	Political	VL / L
RP9	Expropriation/nationalization of assets	Political	VL / L
RP15	Rate of return restrictions	Legal	VL / L / M
RP28	Public opposition to projects	Project Selection	VL / L
RP30	Level of demand for the project	Project Selection	VL / L
RP31	Land acquisition	Project Selection	M / H
RP42	Lack of government guarantees	Project Finance	VL / L

Table 5: Allocation of risk factors to private sector

Risk Factors		Risk sub-category	Risk price level
RP10	Inability of concessionaire	Political	VL / L
RP17	Interest rate volatility	Economic	VL / L
RP18	Inflation rate volatility	Economic	L / M
RP19	Foreign exchange and convertibility	Economic	L / M
RP20	Poor financial market	Economic	VL / L
RP27	Fluctuation of material cost by public/private	Market	L / M
RP29	Uncompetitive tender	Project Selection	L
RP33	Availability of finance	Project Finance	VL / L / M
RP34	Inaccurate estimates	Project Finance	M / H
RP35	High finance cost	Project Finance	L / M / H
RP36	High bidding costs	Project Finance	L / M / H
RP37	Delay in payment of annuity	Project Finance	VL / L
RP38	Financial attraction of project to investors	Project Finance	VL / L
RP39	Lack of creditworthiness	Project Finance	VL / L / M
RP40	Delay in financial closure	Project Finance	VL / L / M
RP41	Inability to service debt	Project Finance	VL / L / M
RP43	Financer unwilling to take high risk	Project Finance	VL / L / M
RP45	Construction time delay	Construction	VL / L / M
RP46	Material availability	Construction	VL/L/M/H
RP47	labour availability	Construction	L / M / H
RP48	Poor quality of workmanship	Construction	L / M / H
RP49	Default of sub-contractors or suppliers	Construction	VL / L / M
RP50	Design & construction complexity	Construction	VL / L / M
RP51	Design deficiency	Construction	VL / L / M
RP52	Late design change	Construction	L / M / H
RP53	Construction technology risk	Construction	VL / L / M
RP55	Contractor failure	Construction	L
RP56	Quality risk	Construction	VL / L

Table 6: Allocation of risk factors to be shared between both sectors

Risk Factor		Risk sub-category	Risk price level
RP11	Change in tax regulation	Legal	L / M
RP12	Corruption and lack of respect for law	Legal	L / H
RP13	Legislation change	Legal	L / M
RP14	Import / Export restrictions	Legal	VL / L / M
RP16	Industrial regulatory change	Legal	L / M
RP21	Force majeure	Natural	L / M
RP22	Environment	Natural	VL / L / M
RP23	Weather	Natural	L / M
RP24	Geotechnical condition	Natural	M / H / VH
RP25	Tariff change	Market	VL / L / M
RP26	Market demand	Market	L / M
RP32	Competition risk	Project Selection	VL / L
RP54	Contractual risk	Construction	L / M
RP57	Different working method between partners	Relationship	L / M
RP58	Inadequate experience in PPP	Relationship	L / M
RP59	Lack of commitment from public/private sector	Relationship	VL / L / M
RP60	Organisation and coordination risk	Relationship	L / M
RP61	Inadequate distribution of responsibility and risk	Relationship	L / M
RP62	Inadequate negotiation period prior to initiation	Relationship	L / M
RP63	Conflict between project's participants	Relationship	L / M
RP64	Workers strike	Relationship	VL / L
RP65	Cultural differences between main stakeholders	Relationship	VL / L

Very High			<u>RP24;</u>
High	RP13;	RP13; RP34; <u>RP12; RP35; RP36; RP46;</u> <u>RP47; RP48; RP52</u>	RP24; RP12; <u>RP1</u>
Medium	RP3; RP31; <i>RP2; RP4; RP7; RP31;</i> <i>RP37;</i>	RP15; RP34; RP47; RP48; RP52; RP18; RP24; RP27; RP33; RP35; RP36; RP43; RP45; RP46; RP49; RP50; RP51; RP53; RP54; <u>RP3; RP9; RP17; RP39;</u> <u>RP40; RP41; RP63</u>	RP12; RP16; RP24; RP54; RP57; RP61; RP63; RP11; RP14; RP21; RP22; RP23; RP56; RP57; RP59; RP62; <u>RP2; RP13; RP18;</u> <u>RP25; RP26; RP31;</u> <u>RP50; RP55; RP58;</u> <u>RP60</u>
Low	RP1; RP2; RP4; RP6; RP7; RP15; RP30; RP42; RP3; RP5; RP8; RP9; RP28; RP29; RP37; <u>RP10; RP21; RP40;</u> <u>RP41</u>	RP10; RP17; RP18; RP19; RP27; RP29; RP33; RP35; RP36; RP37; RP38; RP39; RP40; RP41; RP43; RP45; RP46; RP49; RP50; RP51; RP53; RP55; RP56; RP16; RP20; RP26; RP47; RP48; RP52; RP54; RP60; RP63; <u>RP4; RP6; RP7; RP8; RP11;</u> <u>RP20; RP25; RP32; RP34;</u> <u>RP57; RP59; RP61; RP62;</u> <u>RP64; RP65</u>	RP11; RP12; RP13; RP14; RP21; RP22; RP23; RP25; RP26; RP32; RP57; RP58; RP59; RP60; RP62; RP63; RP17; RP18; RP19; RP26; RP27; RP38; RP55; RP58; RP61; RP64; <u>RP15; RP16; RP19;</u> <u>RP28; RP33; RP42;</u> <u>RP43; RP45; RP54;</u> <u>RP56; RP65</u>
Very Low	RP5; RP8; RP9; RP28; RP1; RP4; RP6; RP42; <u>RP30</u>	RP20; RP65; RP10; RP15; RP17; RP26; RP30; RP33; RP39; RP40; RP41; RP43; RP45; RP50; RP56; <u>RP18; RP23; RP24; RP27;</u> <u>RP37; RP38; RP42; RP46;</u> RP49; RP51; RP53; RP64	RP64; RP25; RP32; RP65; <u>RP5; RP14; RP22;</u> <u>RP29; RP59</u>
	Public Sector	Private Sector	Share

Legend: **BOLD**= 1ST Preference/ Normal font= 2nd preference/ Underlined= 3rd preference

Figure 1: Risk Matrix (level of risk price and risk allocation)