A Study of Procurement Selection for Bridge Construction

Akalya Shanmuganathan
State Engineering Corporation of Sri Lanka

Vijitha Disaratna
Department of Building Economics, University of Moratuwa, Sri Lanka

Mathusha Francis
Department of Building Economics, University of Moratuwa, Sri Lanka

Abstract

Construction industry is pivotal part of any countries economy. Hence, the construction procurement selection is paramount important. This affects the successful and satisfactory completion and delivery of projects. In Sri Lanka, bridge construction is a key sector which contributes to the betterment of the construction industry and lends support to the growth of the economy. In addition, wrong selection of construction procurement approach usually leads to project failure, it is therefore very important to select the most suitable procurement system for bridge projects. The aim of this research is to address the selection of suitable construction procurement for bridge construction in Sri Lanka. The attempts were made through identifying and analyzing the factors which are highly influencing in the selection of a procurement system for bridge construction projects.

Through the comprehensive literature review and preliminary survey, twenty six factors were identified as factors influencing the selection of procurement system for bridge construction projects. A Survey research approach was adopted to investigate the research phenomena. The first round questionnaire survey was conducted with a view to identify the most significant factors affecting the selection of procurement system. From the first round of questionnaire survey, eleven factors were identified as most significant factors influencing the selection of procurement system by ranking the factors using Relative Important Index (RII) tool. The research found that accountability and transparency were the top most important factors which influencing the selection of procurement system for bridge construction.

Utility factors of available construction procurement systems for bridge sector against identified most significant factors were identified through the questionnaire survey round two by using RII tool. The importance and interrelationships of identified significant factors and utility factors provide a solid background for development of procurement selection criteria. The research recommended that the measure and pay system is the most appropriate procurement systems to procure the bridge construction projects through the developed utility model.

Keywords: *Bridge Construction Procurement, Procurement Selection Parameters, Procurement System, Utility Factors.*

1.0 INTRODUCTION

The construction industry is considered as the backbone of the economy of many countries. Generally, considerable amount of Gross Domestic Product (GDP) in developing countries is contributed by the construction industry, whereas the contribution of Sri Lanka is around 7% of GDP during last decade (Central Bank Report, 2010). According to De Silva and Rameezdeen (2002), construction industry recognized as an economic regulator, plays a major role in the economy, providing significant contribution to the national economy. The concept of procurement in such an influential industry has been defined in many ways. Cheung, Lam, Leung, and Wan (2001) revealed that the procurement is a key factor contributes to the project success as it determines overall structure of responsibilities and authorities of participants within the construction projects.

Construction projects are unique and each has its own characteristics. Different procurement systems are used for different types of projects and the correct choice may help to avoid conflicts and be the key to the attainment of project specific goals (Rameezdeen, & Rathnasabapathy, 2006). Conception is that the choice of an appropriate procurement system will lead to a successful project outcome; this makes an implicit assumption that the objective of a procurement system is to provide a successful project (Rowlinson &McDermott, 1999). Gamage (2005) stressed that it is much more important to identify factors affecting the procurement selection in advance for the choice of procurement system for particular project, because the conventional view of selection criteria is that it should be based around the concepts of time, cost and quality.

One of the major sectors of construction industry is infrastructure development such as roads and bridges. Infrastructure industry requires to be procured in a systematic way as it involves high cost, risk and complexity (Dharshana, 2010). According to Road Development Authority's (RDA's) statistics, there are 12165km of national roads including 4000m bridges within Sri Lanka (Road Development Authority, 2012). There are number of road rehabilitation projects and simultaneously bridge construction projects are on-going and as well as planned to complete in the near future. As the investment proportion is relatively significant as noted above, procurement in Sri Lankan bridge construction industry critically affects to the country's economy. Thus, procurement selection is critical. Prior to selection of procurement systems, it is an essential work to identify factors affecting the procurement selection. Those procurement selection parameters are very vital in selecting different types of procurement systems for bridge construction sectors. However, the procurement selection for bridge construction has not been still explored by the researchers under Sri Lankan context. Therefore, this research aimed at addressing the selection of suitable construction procurement for bridge construction in Sri Lanka. This will be achieved by identifying significant factors affecting procurement selection and determining the suitability of available procurement systems for bridge construction in Sri Lanka.

2.0 LITERATURE REVIEW

The term "Procurement" can be described simply as the way of getting things done. When moving to construction industry it is described the total process meeting the client's need for a building project (Brandon, 1999). According to Rathnasabapathy and Rameezdeen (2007) the procurement system is a key mean through which the client creates the pre-conditions for the successful achievement of project specific objectives. Hence, procurement is a key factor contributing to project success. It is hard to find a single procurement system which is suitable for all type of clients and all projects. Each project has its own characteristics and requirements. Therefore, different procurement systems are used for different projects (Rameezdeen, & Rathnasabapathy, 2006). If a client makes a wrong choice of procurement method, the penalty may be time and cost overrun and a general dissatisfaction. Therefore, the selection of the most suitable procurement method is critical for both clients and all other project participants. The appropriate selection may help to avoid problems and be the key to the attainment of project specific goals.

2.1 Construction Procurement Systems

Several types of construction procurement systems have been developed due to recent significant changes in the technical and economic conditions prevailing in the construction industry. Masterman (1992), Love, Earl, and Skitmore, 1998 and many authors have attempted to categorize procurement systems in many ways. The following Figure 2.1 shows the construction procurement systems practiced within the construction industry.

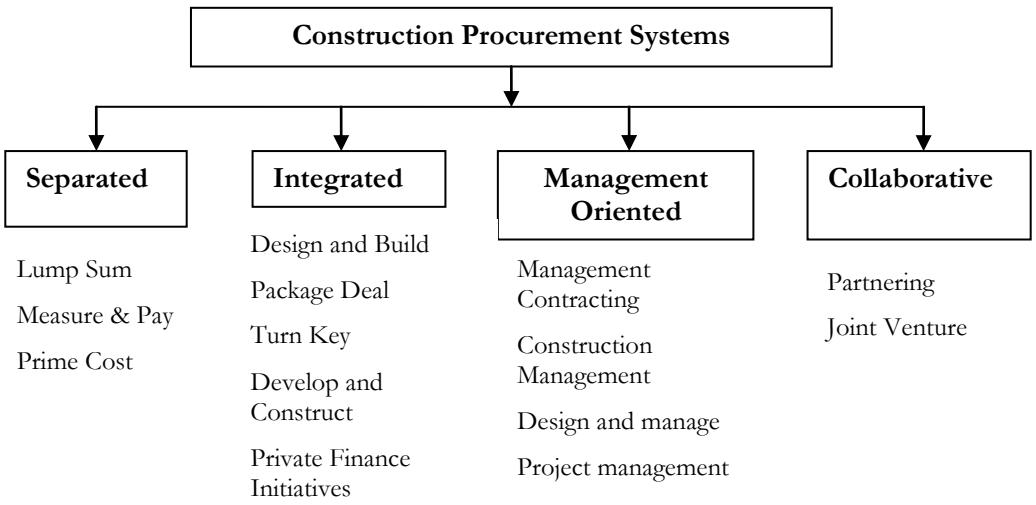

Figure 2.1: Categorization of Construction Procurement Systems *(Source: De Silva & Rameezdeen, 2002)*

2.2. Significance of the Sri Lankan Bridge Construction and Importance of Proper Procurement Selection

According to Hancher (2009), road and bridge sectors are perhaps the most conservative segment of the construction industry. Small improvements in this industry can result significant savings in time and cost, as well as better quality and fewer disputes. Bridge infrastructure plays a key role in the progress and economic growth of a nation, both through the direct effects of a higher mobility for citizens and goods and also via the indirect benefits derived from the process of building infrastructure. The positive economic impact of the bridge construction is that it is creating job opportunities, bringing business to local companies, and is benefiting the local resort community, which ultimately create impact on the entire country.

Roads and bridges infrastructure assets are drivers of economic development and social equity. They also have a significant impact on the natural and man-made environment. Transport system forms the backbone of local, regional, national, and international trade, making most economic activities critically dependent upon this resource. The infrastructure objects are complex engineering facilities and their construction and use require much special scientific knowledge (Dharshana, 2010).

The bridge replacement project will support the future widening of highway and has many features to ease traffic congestion and maritime movement in Roads, for many years to come. The whole island is benefited through the constructions of bridges by reducing travel time, vehicle operating cost and average speed of the vehicles. Further local people are also benefited. Project revenues are expected to be necessary to bridge the gap between total Project costs and available funds, and the toll revenues generated on the project could be sufficient to fill this gap. When considering the transport sector of Sri Lanka, the emphasis is always on roads and bridges. Thus these sectors are the backbone of the transport sector in the country. With 19 million people, Sri Lanka has a road network about 12,165 km of national roads (Classes A and B) including 4000m bridges. This network constitutes a vital component for the movement of people and goods and plays an important role in integrating the country, facilitating economic growth and ultimately reducing poverty (RDA, 2012). Therefore, huge bridge construction projects are to initiate in near future.

Hashim et al. (2006) argued that single procurement method is not suitable for every project since different projects have different characteristics. Thus, selecting an appropriate procurement system for bridge projects must be done in a careful manner than a building project. According to Masterman (1992), it should be done in a realistic, systematic and formalized way. Since bridge constructions have unique characteristics in their nature, factors which are significant in procurement selection for building construction may not significantly affect procurement selection of bridge construction. There may be separate set of significant factors affecting their procurement selection. Hence, identification of procurement selection parameters for bridge constructions is vital to select the most appropriate procurement system.

2.3 Procurement Selection Parameters - Conventional

From the client point of view, there are probably three basic concerns on his mind. These are cost, quality and time. Hence, traditional procurement selection processes result in prioritising the client's basic criteria of Time, Cost, and Quality (Seely, 1997). The basic idea of this is that, the client wanted the highest quality, at a lower cost in minimum time period. However, in most of the times this is not possible to achieve due to the fact that one or more requirements will suffer when trying to achieve one requirement (Bagnall, 1999).

Studies in the complex and competitive construction industry have identified several coherent Procurement Selection Parameters (PSPs). Since PSPs are crucial to procurement selection, accuracy of decisions generated from limited number of PSPs is in doubt. Therefore, only consideration of these three factors which lacks structured procedures based on good information may lead to unsuitable selection which ends with project failures (Luu, Ng, & Chen, 2003). Thus, considerations have to proceed beyond conventional parameters while selecting an appropriate procurement system for a construction project.

2.4 Procurement Selection Parameters - Broader

Construction industry is becoming more enthusiastic about the use of multifarious alternative construction procurement systems and choosing an appropriate method of procurement to satisfy the unique client and project requirements (Luu et al., 2003). There need be a clear basis to select the best procurement system. Researchers therefore argued for the development and application of a more systematic approach for procurement selection and the identification of appropriate PSPs as the first step of the selection process.

According to Ashworth (1996), factors affecting the procurement selection can be categorized under following four main categories.

- Client Requirements
- Client Characteristics } Internal Environmental factors
- Project Characteristics
- External Environmental factors

2.4.1 Client Requirements

Construction projects are almost governed by the client and it is obvious that clients' requirements act as a major factor in the construction procurement selection. Turner (1990) argued that the procurement route that is most appropriate to the clients' requirements and priorities should arise from his or her own objectives and priorities. Therefore, it is an important task to identify the possible client requirements which affect the particular procurement selection prior to make decision on any procurement selection. Procurement selection parameters have been adopted by many researches over the construction industry during last decade. Through evaluation of previous studies conducted in this particular research area, the following client requirements were identified as most discussed factors.

- Speed of construction
- Price certainty
- Quality level
- Risk management
- Price competition
- Responsibility
- Disputes and arbitration
- Accountability and Transparency
- Time Availability and Predictability
- Familiarity

2.4.2 Client Characteristics

Client's characteristics govern their strategy in mobilising the project team and their attitude in dealing with risks (Luu et al., 2003). Further, Luu et al. (2003) highlighted seven client characteristics through their studies and emphasised that those should be taken into the consideration when selecting procurement system.

- Client type (Private/Public)
- Client's experience
- Client's in house technical capability
- Client's in house financial capability
- Client's willingness to take risks
- Client's willingness to be involved
- Client's trust towards other parties

2.4.3 Project Characteristics

Each construction project contains its' own unique characteristics. Therefore, every project is different from one another. Due to these unique characteristics most of the researchers have emphasized that project characteristic should be considered at the procurement selection. Luu et al. (2003) have identified seven project characteristics which include project type, project size, building construction type, project site location, unknown site risk factors, known site factors likely to cause problems and usage of pioneering technology. Alhazmi and McCaffer (2000) identified project type, project cost, time constraints, degree of flexibility, degree of complexity, payment method, design and construction integration and project funding method as the major characteristics that should be taken into account. Following project characteristic can be identified as the widely discussed factors to be considered in selection of the procurement system.

- Project type
- Project size
- Project cost
- Project site Location
- Project funding method
- Site risk factors
- Degree of flexibility
- Degree of complexity
- Time constraints
- Construction method

- Payment method of the project

2.4.4 External Environment Factors

Procurement selection process is an open system which receives information from its environment and returns it as output to the environment. Therefore, it is very important to know what forces from the environment drive the system and how these forces might change during the duration of the project life cycle (Rowlinson & McDermott, 1999). Luu et al. (2003) has identified 13 major external environment factors which affect to the construction procurement selection. Rowlinson and McDermott (1999) found out 10 major external environment factors affecting construction procurement selection. Following factors are the findings of those researches as the external environment factors which affects construction procurement selection.

- Market competitiveness
- Technology feasibility
- Regulatory feasibility
- Weather conditions
- Natural disaster
- Material availability
- Experienced contractor availability
- Industrial actions
- Institutional bodies
- Objection from neighbours
- Political constraints
- Cultural differences
- Finance for the project

3.0 RESEARCH METHODOLOGY

This research was carried out to identify the most significant factors affecting procurement selection and suitable procurement methods for bridge construction in Sri Lanka. Thus, it was essential to think of an appropriate research process, which is competent of identification of procurement selection parameters governing the bridge construction in Sri Lanka. Further, a proper research process can minimize the errors during the research and can reduce the mistakes that can be done by the researcher.

The current study adopted a survey research approach to investigate the research phenomena. Using convenience sampling technique, the samples for the current study were selected from the professionals in employer, consultant and contractor organizations who have implemented or being implementing class A and B bridge construction projects within Sri Lanka. Sample size must be high enough to avoid sampling errors. The sample selected for this study was 34 and the responses obtained were 30. It consists twelve respondents representing employer and another eighteen respondents representing consultant and contractor organizations.

The questionnaire survey was started from a pilot survey which was carried out to ensure the reliability of the survey. Five experts from bridge sector procurement were involved in this task and their feedbacks were used to fine-tune the format of the questionnaire. The questionnaire survey round one was prepared in order to explore the significant procurement selection parameters related to bridge construction projects. Commonly practiced procurement methods in Sri Lanka and the most significant factors influencing in selection of procurement method identified in the questionnaire round one were used to prepare the second questionnaire. Those most significant eleven factors identified out of 26 factors included in questionnaire round one have been considered against four commonly used procurement methods in bridge construction to identify the utility of procurement methods.

Collected data from questionnaires survey had been evaluated systematically to achieve a proper answer to the research question. The research aims to rank the Procurement Selection Parameters (PSPs) governing bridge construction procurement selection relatively to the importance of other available PSPs. Thus, Relative Important Index (RII) was used as the tool for the analysis. Therefore, likert scale was used in questionnaire survey. Reliability was measured by calculating Cronbach's alpha using SPSS software.

4.0 RESEARCH FINDINGS AND DISCUSSION

The data were collected from various construction professionals in two different phases through two sets of different questionnaires. The questionnaire one was developed using procurement selection parameters identified through the literature survey and preliminary survey and Questionnaire two was developed based upon the findings from all of the distributed and completed questionnaires at round one. The questionnaire one comprised twenty six PSPs which

consists ten parameters from client requirements, eight parameters from project characteristics and eight parameters from external environment factors.
The respondents were asked to indicate the significance of those PSP's in the 1-5 likert scale according to their individual view to select procurement method for the particular bridge project which they refer. Gathered data had been analysed using RII tool to obtain the RII values of each parameter. Then parameters were ranked according to the RII value of the each parameter. In order to ensure the reliability of the data used, Cronbach's alpha had been calculated for the data.

The PSPs which are having RII value more than 75% as per the overall perspective were taken as the most significant procurement selection parameters for bridge construction in Sri Lanka. They had been extracted and presented as shown in the Table 4.1. This identification of most significant PSPs was the main aim of this research.

Table 4.1: RII values and rankings of PSPs – Overall Perspective

No.	Procurement Selection Parameter (PSP)	RII	Rank
	Client Requirements		
1	Price Competition	82.67	4
2	Price certainty	72.67	12
3	Quality of work	86.67	2
4	Risk management	80.00	8
5	Responsibility	69.33	15
6	Disputes and arbitration	54.67	24
7	Speed of construction	71.33	13
8	Accountability & transparency	89.33	1
9	Time availability & predictability	82.00	5
10	Familiarity (Client's awareness of procurement system)	79.33	9
	Project Characteristics		
11	Project type	70.00	14
12	Estimated project cost	68.00	16
13	Project funding method	83.33	3
14	Site risk factors	64.00	18
15	Degree of flexibility	80.67	6
16	Degree of complexity	80.67	6
17	Time constraints	79.33	9
18	Payment method of the project	77.33	11
	External Environment Factors		
19	Market competitiveness	51.33	26
20	Technology feasibility	63.33	19
21	Regulatory feasibility	57.33	22
22	Weather condition/ Natural disaster	58.67	21
23	Resource availability	62.67	20
24	Objection from neighbour/Public	55.33	23
25	Political constraints	54.67	24
26	Finance for the project	68.00	16

Overall perspective of the bridge construction industry had been observed by analysing the data from employer (RDA) and other parties' together. Most significant PSPs have been highlighted in the above Table 4.1. Altogether eleven

factors has been identified as the most significant PSPs. Six out of those eleven PSPs represent client requirements while five represent project characteristics and none represents external environment.

4.1 Utility Factors of Most Significant PSPs

Questionnaire two had been developed by considering the above stated most significant procurement selection parameters in order to find the utility of current procurement methods against these PSPs. It is pointless to assess the suitability of procurement methods which are not used in bridge construction projects in Sri Lankan context. Thus, it has been selected only the procurement methods which have been observed through the questionnaire round one. The procurement methods used in questionnaire one have been identified through the literature survey as used for bridge projects in many countries around the world. The questionnaire two has been used to assess the suitability of these procurement methods to Sri Lankan context.

The questionnaire had been distributed among the respondents of questionnaire round one. They were asked to indicate the extent of suitability of each procurement method stated in the questionnaire to meet or support the stated procurement selection parameters in the 1-5 likert scale. Data which were collected through the questionnaire two also had been analysed using the RII tool. The result observed through the analysis is shown in the below Table 4.2. Observed RII values of each PSP against the particular procurement method had been considered as the utility factor values of those PSPs against the particular procurement method.

Table 4.2: Utility factors of most significant PSPs for bridge construction projects in Sri Lankan context.

Procurement Selection Parameter (PSP)		Traditional System - Lump Sum	Traditional System - Measure & Pay	Design & Build	Turnkey
1	Accountability & transparency	76.67	85.33	53.33	64.00
2	Quality of work	70.00	71.33	65.33	74.67
3	Project funding method	80.00	64.67	71.33	67.33
4	Price Competition	78.00	86.00	62.67	60.67
5	Time availability & predictability	51.33	67.33	80.00	61.33
6	Degree of complexity	50.00	61.33	71.33	74.00
7	Degree of flexibility	40.67	84.00	57.33	55.33
8	Risk management	81.33	64.67	74.67	70.00
9	Time constraints	58.67	55.33	80.67	70.67
10	Familiarity(Client's awareness of procurement system)	64.00	87.33	75.33	58.00
11	Payment method of the project	70.00	81.33	72.00	59.33

4.2 Usage of Utility Factors

Above identified utility factors had been obtained considering the overall bridge construction in Sri Lanka. Therefore, they can be successfully used at procurement selection process for bridge construction in Sri Lankan context. When selecting a procurement method for a particular bridge project, first step is to rank the identified most significant eleven PSPs as per priority. Then rank number one may assign weight of eleven. Rank number two may assign weight of ten. Accordingly rank number eleven may assign weight of one. Then the utility value of each PSP against particular procurement method shall be multiplied with weight assigned to the PSP and the weighted utility factor value shall be calculated. Finally weighted utility factor values related to each procurement method shall be added together. The procurement method which possesses the highest weighted utility value is the most suitable procurement method for that particular bridge project according to the priorities and this utility value model. Traditional system using measure and pay was identified as the most appropriate procurement method to procure the bridge construction projects through the developed utility value model as shown in the below Table 4.3.

Table 4.3: Usage of utility value model.

No	Procurement Selection Parameters	Weight	Traditional System - Lump sum		Traditional System - Measure & Pay		Design & Build		Turnkey	
			UF %	WUFV	UF %	WUFV	UF %	WUFV	UF %	WUFV
1	Accountability & transparency	11	76.67	8.43	85.33	9.39	53.33	5.87	64.00	7.04
2	Quality of work	10	70.00	7.00	71.33	7.13	65.33	6.53	74.67	7.47
3	Project funding method	9	80.00	7.20	64.67	5.82	71.33	6.42	67.33	6.06
4	Price Competition	8	78.00	6.24	86.00	6.88	62.67	5.01	60.67	4.85
5	Time availability & predictability	7	51.33	3.59	67.33	4.71	80.00	5.60	61.33	4.29
6	Degree of complexity	6	50.00	3.00	61.33	3.68	71.33	4.28	74.00	4.44
7	Degree of flexibility	5	40.67	2.03	84.00	4.20	57.33	2.87	55.33	2.77
8	Risk management	4	81.33	3.25	64.67	2.59	74.67	2.99	70.00	2.80
9	Time constraints	3	58.67	1.76	55.33	1.66	80.67	2.42	70.67	2.12
10	Familiarity(Client's awareness of procurement system)	2	64.00	1.28	87.33	1.75	75.33	1.51	58.00	1.16
11	Payment method of the project	1	70.00	0.70	81.33	0.81	72.00	0.72	59.33	0.59
				44.49		**48.62**		44.21		43.59

UF Utility Factors
WUFV Weighted Utility Factor Value

According to the Table 4.1: RII values and rankings of PSPs, accountability and transparency is identified as the most critical factor which influencing selection of procurement method for bridge projects in Sri Lanka. In relation to Table 4.3; Utility value model, traditional using measure and pay got the highest WUFV of 9.39 and design and build got the least WUFV of 5.87 for accountability and transparency. This seems that traditional procurement method has high accountability and transparency compared to other methods. This could be because; in Sri Lanka RDA is the major client who is a public authority. Therefore, accountability and transparency have been identified as the mist important PSP and the D&B and Turnkey are poor in terms of satisfying this PSP.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The construction industry is one of the major industries in all the countries. This critically affects to the countries' economy. Thus, construction procurement selection has been one of the major research areas in current practice. The existing literature have pointed out the importance of developing more systematic approach in procurement selection process for any specific project and identification of appropriate Procurement Selection Parameters (PSPs) to formalize the selection process.

Bridge construction is one of the dominant sectors contributing to the construction industry in Sri Lanka. Hence, procurement selection in bridge construction projects critically affects to the country's economy. Identification of Procurement Selection Parameters (PSPs) relating to bridge constructions is the first step to formalize the selection process.

As the first step identification of the influencing factors in procurement selection from the perspectives of clients' requirements, project characteristics and external environment factors was achieved through a comprehensive literature review. Then, quantitative research approach based questionnaire survey has been used for this research in order to identify the most significant PSPs governing bridge construction procurement selection. Collected data from questionnaire survey had been evaluated systematically using Relative Important Index (RII) to achieve proper answer to the research question. PSPs were ranked according to their RII values. According to the results following are the most significant parameters which are affecting the procurement selection for bridge construction in Sri Lankan context.

Table 5.1:Most significant factors affecting procurement selection for bridge construction in Sri Lanka

Procurement Selection Parameter (PSP)	Rank
Accountability and transparency	1
Quality of work	2
Funding method	3
Price competition	4
Time availability and predictability	5
Degree of complexity	6
Degree of Flexibility	6
Risk management	8
Time constraints	9
Familiarity (Client's awareness of procurement system)	10
Payment method of the project	11

Accountability and transparency is the top most significant parameter to be considered at procurement selection for bridge construction projects according to the overall perspective of the bridge construction industry in Sri Lanka.

Further, the results of this analysis indicated that although various procurement methods exist, still traditional measure and pay system is the ruling procurement method in the Sri Lankan bridge construction industry. Without limiting to the above results, this research study extended to find the utility factors of above identified most significant procurement selection parameters against the procurement methods used for bridge construction projects in Sri Lanka through the second round of questionnaire survey. The findings revealed that traditional system using measure and pay method has the highest utility with five PSPs while traditional lump sum method, design and build method and turnkey have highest utility with two PSPs. The procurement method which possesses the highest weighted utility factor value shall be taken as the most suitable procurement method for that particular bridge project according to the priorities and this utility value model.

The research recommends that the Sri Lankan economy would be enhanced through infrastructure development. As a first step, this could be achieved by selecting the most suitable procurement method considering the factors influencing the procurement selection. Further the study suggests that the industry should move towards new procurement trends for bridge construction projects to procure the projects in a systematic way which leads to project success in terms of cost, time, quality, public health and safety.

6.0 REFERENCES

Alhazmi, T., & McCaffer, R. (2000). Project procurement systems selection model. *Journal of Construction Engineering and Management, 126*(3), 176 – 183.

Ashworth, A. (1996). *Contractual procedures in the construction industry* (3rd ed.). England: Wesley Longman Ltd.

Bagnall, B. (1999). *Tenders and contracts for building* (3rd ed.). United Kingdom: Blackwell science Ltd.

Brandon, P. (1999). *Quantity surveying techniques; New direction.* London: Blackwell science Ltd.

Central Bank of Sri Lanka, 2010. Annual report 2010, Colombo: Central Bank of Sri Lanka.

Cheung, U., Lam, T., Leung, M., & Wan, Y. (2001). Analytical hierarchy process based procurement selection method. *Construction Management and Economics, 19*(4), 427 – 437.

De Silva, S., & Rameezdeen, R. (2002). Trends in construction procurement systems in Sri Lanka. *Built-environment-Sri Lanka*, *2*(2), 2-9.

Dharshana, R.R. (2010). *Risk management of bridge construction projects in Sri Lanka* (Unpublished Dissertation, BSc). University of Moratuwa, Sri Lanka.

Gamage, I.S. (2005). *Factors affecting construction procurement selection: Study of clients' requirements and project characteristics* (Unpublished Dissertation, BSc). University of Moratuwa, Sri Lanka.

Hancher, E. D. (2009). *Contracting methods for highway construction*. Carolina: University of Kentucky, Department of Transportation. Retrieved from: http://onlinepubs.trb.org/onlinepubs/millennium/00023.pdf

Hashim, M., Yuet, M. C., Yin, N. C., Hooi, N. S., Heng, S. M., & Yong, T. L. (2006). *Factors influencing the selection of procurement systems by clients*. Johor, Malaysia: Universiti Teknologi Malaysia, Faculty of Built Environment. http://eprints.utm.my/716.

Love, P.E.D., Earl, G., & Skitmore, M. (1998). Selecting a suitable procurement method for building projects. *Construction Management and Economics*, *16*(1), 221-233. doi:10.1080/014461998372501

Luu, D. T., Ng, S. T., & Chen, S. E. (2003). Parameters governing the selection of procurement system-an empirical survey. *Engineering, Construction and Architectural Management*, *10*(3), 209-218. doi:10.1108/09699980310478458

Masterman, J. W. E. (1992). *An introduction to building procurement systems*. London: E & FN Spon.

Rameezdeen, R., & Rathnasabapathy, S. (2006). *Traditional vs alternative procurement systems: Are we ready to face challenges*. (Report No. 7, 59-68). Sri Lanka: University of Moratuwa, Department of Building Economics.

Rathnasabapathy, S., & Rameezdeen, R. (2007). A decision support system for the selection of best procurement system in Sri Lanka. *Built-environment-Sri Lanka*, *7*(2), 43-53.

Road Development Authority. (2012, Febrary). *Annual report*. Retrieved from http://www.rda.gov.lk/source/rda_roads.htm#top

Rowlinson, S., & McDermott, P. (1999). *Procurement systems. A guide to best practice in construction*. London: E & FN Spon.

Seeley, I. H. (1997). *Quantity surveying practice* (2nd ed.). London: Macmillan press Ltd.

Turner, A. (1990). *Building procurement.* UK: McMillan.