

Design of decision support system for implementation and monitoring of public private partnerships in the Zambian construction sector

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Abstract

Zambia introduced the Public Private Partnership (PPP) law in 2009 in order to narrow the infrastructure gap in the country. The PPP legislation has had difficulties in that it allows cabinet ministers to make decisions on complex issues affecting the implementation of projects. The government ministry responsible has not provided sufficient guidelines regarding evaluation processes in the way schemes may be executed, operated and monitored. In the period 2009 – 2019, very few projects have been accomplished since the introduction of the law. There have also been problems concerning professionals acquiring additional professionals' skills to aid them evaluate and monitor such complex projects. As PPPs are nascent to the country, financial support systems have not been developed to monitor projects funded using weighted average cost of capital (WACC). Upcoming projects would be successful if capital asset pricing models (CAPM) are utilised to inform decision-makers. Findings suggest that technocrats must be trained in risk related aspects for PPP projects to be implemented successfully. Stringent monitoring assisted by a restructuring of the law would need to be instituted. This will encourage investors and conserve financial resources. The research used focus group interviews of professionals involved when the PPP law was implemented. An industry wide questionnaire was distributed to assess the effectiveness of evaluation methods used in decision-making. Spearman's rho was used to appraise the efficiency of the methods used in monitoring projects. A decision support system is suggested for monitoring application and for effective supervision of PPP schemes.

Keywords: Decision support system, Implementation, Monitoring, Public private partnership, Zambia

1. Introduction

In 2009, the Zambian government enacted the PPP law. However, the process of implementing this law has had challenges regarding the assessment of proposals. PPPs signify greater private sector involvement in the delivery of public services. Private sector participation brings with it risk complexities regarding the nature of funding and availability of expertise. Over 90% of PPPs projects on the African continent are externally funded (Zulu and Muleya, 2009). Usually, finance lenders assume about 70 – 75% of the risk on capital costs required for development of large scale infrastructure projects. Evaluation procedures must be effective to raise the confidence of multilateral lending agencies. Additionally, this also deepens the developer's desire to readily own risk during the project. Three factors which have enabled the stage to be set for PPPs in Africa – the changing economic, social and political environment with its globalisation influence, instituted measures for control of public sector borrowing and the vital role that modern infrastructure plays in economic growth and poverty alleviation which has been largely crippled by inadequate levels of public sector income in emerging economies. However, Zambia has had other challenges of inadequate regulatory frameworks and an under developed public and private sectors - which are necessary requisites for PPPs.

2. The quest and demand for PPPs

The quest for governments to involve the private sector in development of infrastructure is one that is encouraged worldwide. Various methods of development are utilised to enable growth of economies. Among such schemes are privatisation, concessions and public private partnerships (Cui et al, 2018). PPPs are viewed as advantageous as they integrate the public and private sectors in a long term partnership. Two factors have enabled governments to partner with private investors. The first reason is that basic infrastructure is fundamentally capital-intensive while the second is the competitive demands on scarce financial resources (Alfen et al, 2009). The aim is to reduce the demand-supply infrastructure gap as well as fulfill social commitments. Public provision of services in developed countries using PPPs includes projects for education, waste water management, public buildings, health services, power and road sector projects (Akintoye, 2009). The telecommunications sector has also been a recipient of huge investments in terms of physical infrastructure.

Demand for public services has led to a new set of circumstances. The OECD (2008) predicted that the world economy is expected to grow at about 3 percent per annum to the year 2030. Much of this growth will be in developing countries. Governments in developing countries therefore have to undertake such service delivery through decentralised management and stock market mechanisms (Heider et al, 2015; Pongsiri, 2002). Governance becomes a matter of concern. Stoker's (1998) definition of governance shows the necessity of accountability, transparency, fairness, efficiency, participation and decency. On the other hand, Alfen et al (2009) expressed governance as a process of evaluation culminating in decision-making. Governance must have transparency in all supervisory processes. In developing the good project governance (GPG) concept, Abednego and Ogunlana (2006) raised the importance of prudent performance in evaluation procedures for PPPs. They saw that project allocated risk was only achievable through good governance which would lead to better project performance. Eight distinguishing factors would comprise the GPG (Abednego and Ogunlana, 2006):

- that right decisions at the right time are the result of contractual parties' active participation;
- contract fairness ensures that the rule of law is the framework that enforced impartiality in application of procedures between the parties;
- information transparency is available to the parties affected by decisions on the project;
- responsiveness being the ability to carry out decisions within a specific timeframe;
- continuous project control and monitoring in achieving common goals amongst stakeholders;
- equality implies that all parties to the contract are equal;
- effectiveness and efficiency ensures that results produced meet contractual parties needs as well as make best use of available resources; and
- accountability in having to fulfill the twofold objective of user satisfaction and community participation

Abednego and Ogunlana (2006) suggested that a contractor's pre-finance (CPF) has the best risk allocation strategy. This strategy shifted the responsibility of financing the project from the owner to the contractors. This also meant that other cash-flow and liquidity problems subsisting with the owner can be overcome (Boamah, 2017; Belkhir et al, 2017). This is because the loan would be made directly between the financial institutions and the contractors. Developers prefer directly dealing with the financiers than going through third parties (Cedrick and Long, 2017).

3. Decision support systems for PPPs

Decision support systems (DSS) assist developers in the management of risks on projects (Kartashova, 2018). There's been much research done on the allocation of risk and monitoring of the same during the implementation of PPP projects between 1998 and 2018. The following conclusions form the accepted understanding (Davies et al, 2018; Akintoye, 2009):

- the assertion that allocated risk structures vary according to contract types placing risk with the contractual party concerned. For instance, Build-Operate-Transfer (BOT) contracts allocate risk to the private sector as opposed to service and management ones;

- economic factors existing in countries such as exchange rates and interest rates are constantly monitored by investors using the PPP method of development;
- that private firms using PPPs are exposed to various risks as they execute projects in other continents than their own; and
- the contractual party able to handle a particular risk should have the capacity to monitor as well as manage it.

For PPPs to succeed, public and private entities have to evaluate risks. These risks can arise from a variety of areas and must be carefully included in contract conditions. Critical risks affecting the scheme are assessed allowing informed decisions to be made during the projects' implementation. These risks are a combination of the political, legal, economic and the social environment prevailing in the country (Joslin and Konchitchki, 2018). The developer will, therefore, have to have a number of hedging instruments. Extended periods of project implementation require financial instruments that have longer maturity to abate interest risk. Financial distress of the project as well as asymmetric information occasions choice of what equity would be used. The safer choice is to have the public share the risk. Reduced exposure of the commercial risk needs decisions aimed at a PPPs project speedy implementation. Liquidity risk must be evaluated to curb a developer's insolvency. Credit risk of this nature can be mitigated by enacting laws that would enhance sharing of information through banks. Counterparty risk is rated highly as it seeks to assure project lenders of the financial standing of the developer. Country or political risk raise the question of a country's ability to service external debt on time. Political risk presents a negative effect and raises the cost of equity for investors evoking consequences that include expropriation or worse still, cancellation of the project. In terms of implementing a project on time, these risks oversee the effect that interest rates have on loans obtained from multinational companies and are used by proprietors during the development process. Low interest rates are an advantage to investors in accelerating construction activities on projects while higher ones have the opposite effect. With high interest rates, developers slow down on their projects. The literature reviewed noted two research gaps relating to methods used in implementing PPP schemes as well as monitoring systems needed to mitigate risks on projects.

4. Research methodology

A mixed method research methodology was used for the study included structured interviews as well as administration of an industry wide questionnaire. 11 specialists were selected from a list of individuals that had crafted the PPP law. Experience, therefore, was the criteria used for those chosen on the focus group. The emphasis of the interviews was to establish evaluation and monitoring methods. Further, 120 questionnaires were administered to various construction industry professionals. However, out of the 53 questionnaires that were completed, 5 contained errors in the answers given by respondents. These were rejected with the final analysis for the paper based on 47 responses. As risk is perceived to make project assessment uncertain, Spearman's rho was used to assess the accuracy of evaluation and monitoring methods. The interviews and questionnaire distribution were done in Lusaka.

5. Focus group interview information and analysis

Owing to the fact that PPPs were novel in Zambia at the time of the study, a purposive sample of 11 stakeholder interviewees were selected based on their knowledge of the PPP procurement mode. Descriptive analysis was used to interpret the collected qualitative data (Silverman, 2010). Responses on the monitoring methods were further analysed using Spearman's rho. Respondents interviewed in held high and middle management positions in their organisations. All the respondents had a minimum of a bachelor's degree. However, three had post graduate master's degrees. 8 of the respondents had well over 15 years of experience in the construction industry while 3 had only served for 10 years. 72.72% of the respondents had PPP experience while 27.28% had not. However, respondent's PPP experience was limited to responding to requests for proposals and submission of the same to client organisations. Only one chief executive had gone beyond submission in terms of advising clients over

implementation procedures. This was a response of less than 10% (9.09%).

5.1 Financial evaluation tools and analysis

A total number of 6 financial evaluation tools were identified as shown in **Table 1** below. These were:

Table 1: Financial evaluation tools

	Evaluation tool	Responses	% response
1	Financial appraisals	5	45.50%
2	Cash flow analysis	2	18.18%
3	Profit and loss analysis	1	9.08%
4	Development concept	1	9.08%
5	Cost benefit analysis	1	9.08%
6	Life cycle costing	1	9.08%
	Totals	11	100%
	% response	100%	

Financial appraisals were the preferred monitoring tool by financial institutions as noted by eight respondents (giving a response of 80%). This was followed by cash flow analysis that had two (20%) occurrences from respondents. It was observed that projects applied a combination of decision-making tools. Hence a combination of the use of financial appraisals and cash flow analysis was noted twice (for A and B). The other monitoring tools used were profit and loss analysis, development concept, cost/benefit analysis and life cycle costing which had a single response each, as listed above. However, such tools are very basic in examining the financial worthiness of PPP projects. Such tools are vague in assisting proper risk assessment of projects.

5.3 Spearman's rho financial evaluation tools method accuracy

Spearman's rho calculations were used to determine the accuracy of use for project evaluation of five of the financial monitoring tools recommended by the focus group. The five financial monitoring tools were the payback period of the project, internal rate of return, life cycle costing, discounted cash flow and net present value. Typically, these are the tools used for evaluating the financial management of projects. Spearman's rho gives the relative strength of a relationship. The resultant assessment between 0 and 1 indicates no direct construal. However, when the rho value is squared, a proportional reduction in error (PRE) in the tools is conceivable. The given equation for obtaining the desired rho value was (Healey, 2009):

$$r_s = 1 - \frac{6 \sum D^2}{N(N^2-1)} \quad [1]$$

where N is the ranking of the tool and D² is the sum of differences in the ranks of the groups

Table 2: Spearman's rho calculation for financial evaluation tools

Financial evaluation tools	Mean	Field mean ranking	Focus group rating	Focus group ranking	D	D ²
Payback period	4.30	1	5	1.5	-0.5	0.25
Internal rate of return	3.98	2.5	4	3	-0.5	0.25
Life cycle costing	3.98	2.5	3	4.5	-2	4
Discounted cash flow	3.74	4	3	4.5	-0.5	0.25
Net present value	3.62	5	5	1.5	3.5	12.25
					$\sum D^2 = 0$	$\sum D^2 = 17$

Spearman's rho value=0.15

Using the formula shown above [1], a Spearman's rho value of 0.15 was obtained. By squaring 0.15, the value of 0.0225 was obtained meaning the use of the financial evaluation tools with risk assessment imbedded in them, would have a predictable reduction in error of 2.25%. This means using financial evaluation tools would have an accuracy rate of about 97.75%, minimizing errors by 2.25%. Financial tools that are able to analyse a compendium of time-related risk factors such as inflation, political threats and global influences. The challenge of having accurate financial projections is an assurance to both developers as well as recipients of the scheme, guaranteeing timely successful completion.

6. Analysis of the industry questionnaire

An industry-wide questionnaire survey was conducted using the earlier structured questions devised for the focus group interviews. These were expanded to gather as much information. Again, the draft questionnaire was pre-tested so as to improve response clarity as well as the removal of ambiguities.

6.1 Survey composition

It was necessary to investigate factors that warranted good project monitoring before, during and after implementation of a scheme. A key component of this was to ascertain whether the construction industry was ready to accept the PPP mode of development. PPP contracts can be complex and that industry professionals may not be able to handle certain technical difficulties. A sample size of 5% of registered firms with the National Council for Construction was taken leading to the distribution of 120 questionnaires and had 53 responses. Of these, 5 had noticeable errors in the answers given by respondents. The remaining 47 responses were used in the analysis obtaining a response rate of 39.17%. Researches of a similar nature done by Jang (2011) and Awodele (2012), gave responses of 53% and 32%, respectively. Response rates from the various professionals consisted of 12 out of 33 quantity surveyors (25.53%); 11 out of 13 valuation surveyors (84.62%); 9 out of architects (36%); 10 out of 28 civil engineers (21.28%) and 6 out of 21 contracting firms (28.57%). All the respondents were in management positions and were well advanced in their careers. The respondent with the highest years of working construction experience had 14 years while the lowest only had a year. 47 years was the average age of the respondents. In terms of education, all stated to have a minimum of a basic degree

with at least 14 years' experience while five had a post graduate masters' degree. Results from the questionnaires were analysed qualitatively as well as using Spearman's rho.

6.2 Respondent's PPP experience

Respondents were asked to indicate their industrial experience as well as the period they have dealt with PPPs. There was a huge disparity in terms of the year's worked, industrial experience and PPP proficiency. Noted among the respondents was the low PPP experience. Although 66% (representing 31 respondents) indicated that their organisations had done PPPs, actual working experience on these types of contracts was negligible. 34% (i.e. 16 respondents) indicated that they had never participated in PPP projects.

6.3 PPP monitoring methods and discussion

From **Table 4**, only 31 respondents had participated in PPP contracts. These were asked to indicate what monitoring methods had been used on PPP projects. **Table III** gives the respondent's frequencies and means of their preferred monitoring methods that were listed using a Likert scale of 1 to 5; one indicated 'less preferred' while 5 was the 'most preferred'.

Table 3: Preferred monitoring methods

	Type of monitoring method	Frequency	Mean	% Response
1	Budgeting	25	4.45	81
2	Cash flows	21	4.36	68
3	Profit and loss analysis	17	4.32	55
4	Return on investment analysis	14	4.26	45
5	Life cycle costing	11	4.02	34
6	Sensitivity analysis	9	3.77	29

From Table 5, 81% of the respondents indicated that 'budgeting' was the most preferred method for monitoring PPP projects. This was followed by cash flows (68%); profit and loss analysis (55%); return on investments analysis (45%); life cycle costing (34%); and sensitivity analysis (29%). However, such tools are very basic in monitoring the financial worthiness of PPP projects. For instance, most budgets are done for a limited period of time of one to five years. PPP projects on the other hand exceed 25 years. Budgets were preferred by developers because they showed the profitability of project (Ronnie, 2018). Inevitably, this means that methods of monitoring must be focused on the phases of the projects. Responses from the respondents, however, preferred short term methods (1 to 3) than ones that gave a long term perspective (4 to 6).

6.4 Monitoring methods accuracy

Spearman's rho calculations were used to determine the accuracy of use for project monitoring of the six monitoring tools. The obtained values by using formula [1] yielded 0.58 which when squared gave a proportional reduction in error (PRE) of 3.4%. As the computation suggests, these monitoring methods can achieve an accuracy of 96.6%. This verifies use of financial tools with the proviso that project risks are carefully monitored during the negotiation, construction and operation phases.

Table 4: Monitoring methods

Monitoring tools	Mean	Mean ranking	Group rating	Ranking	D	D ²
Budgeting	4.45	1	5	1.5	-0.5	0.25
Cash flows	4.36	2	5	1.5	0.5	0.25
Profit and loss analysis	4.32	3	1	6	-3	9
Return on investment analysis	4.26	4	4	3	1	1
Life cycle costing	4.02	5	2	5	0	0
Sensitivity analysis	3.77	6	3	4	2	4
					$\sum D^2 = 0$	$\sum D^2 = 14.5$

Spearman's rho value = 0.58

Financial monitoring methods have the advantage of constantly ensuring that risks are gauged over the period of the project.

7. Proposed decision support framework for PPP projects

One pertinent issue pointed out in the foregone discussion and analysis of the focus group, questionnaire focused on the lengthy implementation period for PPP projects. There were 17 steps identified in the procedure of Act No. 14 of the PPP law from the proposal of the project to its execution with the process taking a period of one to three years. Cost implications of the procedure were not the ambit of this research project. Decision support, however, must start from before the conceptualisation of the project. The government departments give consent starting with the registration of the concept until the final clearance is given by the Office for Promoting Private Power Investment (OPPPI) in the Ministry of Mines, Energy and Water Development.

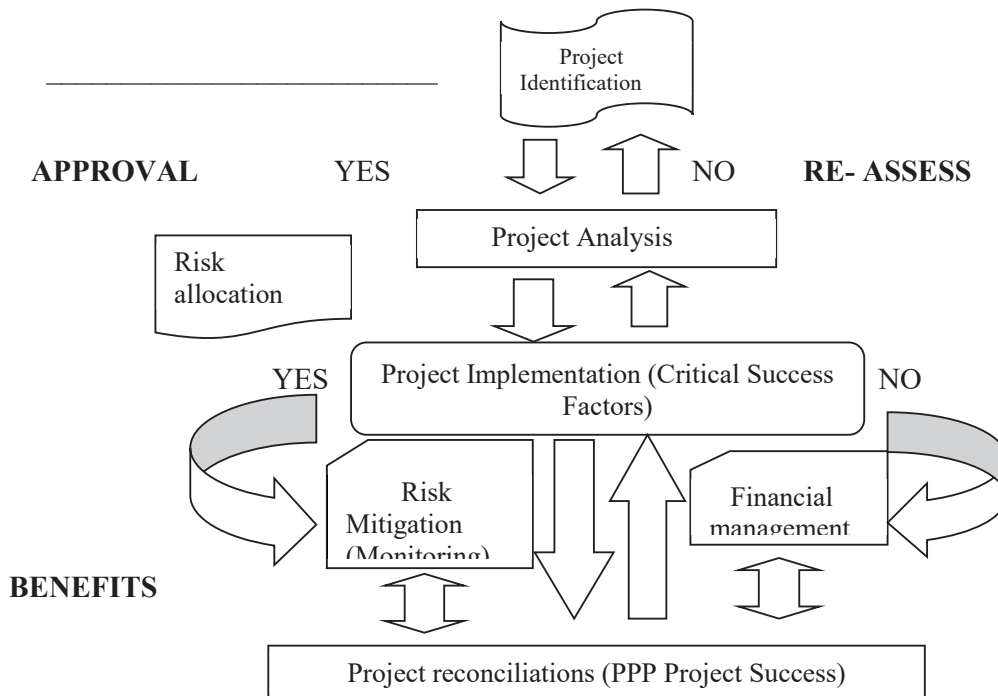


Figure 1: Proposed Decision Support System framework

One pertinent issue pointed out in the foregone discussion and analysis of the focus group, questionnaire focused on the lengthy implementation period for PPP projects. There were 17 steps identified in the procedure of Act No. 14 of the Public- Private Partnership policy (GRZ, 2009) from the proposal of the project to its execution with the process taking a period of one to three years (Mukalula and Muya, 2014). Decision support, however, must start from before the conceptualisation of the project. Government departments give consent starting with the registration of the concept until the final clearance is given by the Office for Promoting Private Power Investment (OPPI) vested in the Ministry of Mines, Energy and Water Development. A major setback in the current procedure is the difficulty of going back on issues covered. This is not surprising as meetings normally take several months apart. Following up on critical issues pondered at the beginning, are left unattended. Due to time, financial structuring issues are overtaken by inflation that make projects attain supplementary budgets.

The proposed decision support system took into consideration the key element of time i.e. from the moment the project is proposed to its implementation. In order to achieve greater value for money (or benefits), allocated risks must constantly be aligned to critical success factors in order for the project to succeed (Cui et al, 2018). For this to happen, stringent project analysis must be done. Project specific risks must be evaluated. If at these critical stages, there would be a mis-alignment of the risks envisaged, then the entire project must be re-assessed. Financial management is an important aspect in re-assessing the project's financial viability amid known and unknown risks (Smith et al, 2014; Heider et al, 2015). Investment is only considered when there would be an adequate return to the investor. Weighted average cost of capital (abbreviated as WACC) is what investors often use to balance their equity and debt which is reflected in analyses concerning the profit and loss analysis as well as return on investment. Essentially, corporate investment is negatively related to the cost of capital. Lower interest rates in developing countries encourages investment. The Zambian banking situation has had high interest rates which have hindered investment in key sectors such as energy and road construction. Companies that vying for investment have a duty to have their risk profiles equated to the WACC so as to cover project threats (Balog et al, 2017). Project threats would then be handled by the best party to handle them in the PPP contract (Joslin and Konchitchki, 2018).

The focus group was again approached to critique the decision support framework for PPP implementation in Zambia. Various suggestions were given that aided changing of some aspects to the framework. Eventually, 8 out of the 11 individuals consulted, were able to verify the workability of the framework shown in Figure I. This gave a 72.73% response in favour of the use of the framework.

8. Conclusions

The following conclusions were drawn from the findings of the study:

- (1) respondents were well able to articulate issues on PPP monitoring in spite of the fact that PPPs have been recently introduced in Zambia;
- (2) respondents preferred a combination of financial tools in monitoring PPP projects such as financial appraisals with cash flow analysis and development concept with profit and loss analysis since these have the capability of assessing the weighted average cost of capital (WACC);
- (3) financial evaluation methods such as profit and loss analysis, cash flow analysis, financial appraisals and were better able to analyse long term risks in projects using the capital asset pricing model (CAPM);
- (4) respondents used financial monitoring tools for PPP projects with the most used being budgeting and the least being sensitivity analysis; and
- (5) financial monitoring tools have a high accuracy rate in monitoring projects.

9. Recommendations

In the southern African region, South Africa is leading in the use of PPPs as a mode for development. Botswana and Namibia have also instituted laws in using PPPs and are still in their infancy. This study have shown the grave challenges for countries convinced that PPPs are a remedy to lack of development. The following recommendations have, therefore, been made with a view that corrective measures would be taken to ensure the successful implementation of projects. These are:

- (1) that construction industry professionals be trained in risk related financial disciplines to assist them in evaluation processes; and
- (2) that short- and long-term monitoring methods be adopted during implementation.

10. Limitations and scope of the research

The following limitations from the findings are worth noting in view of the scope of the research:

- (1) there was biasness in the responses to the questions in the country wide questionnaire. The majority of the responses leaned towards the acceptance of PPPs without substantive justification for that position;
- (2) data on critical success factors was not discussed in the findings; and
- (3) there was perceived misunderstanding of concepts related to monitoring procedures, risk allocation and mitigation among professionals that answered the questionnaire. For instance, quantity surveyors' perceptions were largely driven to ensure that PPP prior quantitative aspects be monitored before the project is embarked on. Architects thought that clients needed to get on with projects irrespective of being financially able. There is need to examine the impact of this array of perceptions before PPPs projects are implemented.

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