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STACE framework: an alternative to Quality Cost Based Model for the selection of ERP systems for public sector

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***Abstract*—Evaluation and selection of Enterprise Resource Planning (ERP) systems for public sector organisations in developing countries is a problem because ERP vendor selection is basically a multi-criteria problem but most organisation use the weighted sum method. Furthermore, it is a problem is developing countries because ERP implementation require colossal sum of money and therefore financed by donor or funding agencies. These donors or funding agencies impose procurement rules that are difficult to follow and that do not necessary yield the best results. For example, the World Bank proposes the use of Quality-Cost Based Selection (QCBS) method for selection. This paper presents the application of Social Technical Approach to to Commercial Off the Shelf (COTS) Software Evaluation (STACE) framework as an alternative to evaluation and selection of ERP software and vendors for public sector organisations. The paper provides the results and lessons learnt in applying QCBS and STACE framework in selecting ERP software and vendor for a public sector organisation in a developing country.**

Index terms - Quality-Cost Based Selection (QCBS), Evaluation and selection of Enterprise Resource Planning (ERP) software and vendors; Social Technical Approach to to Commercial Off the Shelf (COTS) Software Evaluation (STACE) framework.

I. INTRODUCTION

In most large organizations vendor selection process is done empirically and in a transparent manner. However, vendor selection is a problem because though vendor selection is basically a multi-criteria problem, multicriteria techniques are not used frequently to solve the problem. Instead the problem is converted to a single-objective problem by treating all but one objective as constraints and the resulting problem is solved to obtain an optimal solution. There are two problems with this approach: first the criteria, which are considered as constraints, are weighted equally, which rarely happens in practice, and second, they have significant problems in considering qualitative factors (Wadhwa and Ravindran, 2007).

In procurement of Enterprise Resource Planning (ERP) software, the challenge is not just the selection of the vendor but also the ERP solution to be implemented. The challenge is to find the match between the implementer and the solution to be implemented. Corcoran and McLean (1998) argue that selection of vendors is not an easy because it requires the purchaser to assess a supplier's ability to deliver consultancy, which is an intangible product. Furthermore, the consultancy cannot be realistically tested prior to purchase and the level of associated complexity becomes obvious because of the buyer's limited experience with purchasing such a service. The main problem in purchasing consultancy services appears to relate to the purchaser's difficulty in judging what is being offered (Lunsford and Fussell, 1993). Besides these problems, the multi-faceted nature of the consultancy services and the potential impact of the consultancy services on the reputation of the organization also contribute to making the purchase of the consultancy services to be riskier (Lunsford and Fussell, 1993).

Vendor selection decisions are further complicated by the fact that some vendors may have different performances in regard to the different criteria. For example, the vendor who has the best quality performance may not have the best delivery performance (Weber, Current and Desai, 1998). Vendor selection decisions are complicated by the fact that various criteria must be considered in the decision-making process. The criteria used may vary across different product categories and purchase situations (Shen and Yu, 2010). There may not be a generalized consensus on how to identify suitable criteria because these decisions are highly firm-and situation-specific (Hsu, Wang and Tzeng, 2012).

The problem of vendor selection of ERP systems for public sector organisation in developing countries is further complicated and problematic because funding agencies impose procurement rules that may be difficult to understand. For example, the World Bank requires that borrowers and their implementing agencies use the World Bank procurement guidelines (World Bank, 2011a). Depending upon the various situations, different methods of selection of consultants have been suggested by the World Bank (Word Bank, 2011b): Quality and Cost-Based Selection (QCBS); Quality-Based Selection (QBS); Selection under a Fixed Budget (SFB); Least Cost Selection (LCS); Selection-Based on the Consultants' Qualifications (CQS); Single-Source Selection (SSS).

To combat these complexities, it has been suggested that purchasers and suppliers need to be aware of two aspects (Leipold, Klemow, Holloway, and Vaidya, 2004). First, they need to be aware of the issues

purchasers are concerned about when assessing a consultant. Second, both purchasers and suppliers need to be aware of their style of interaction and its impact on purchase decision. The World Bank recommends QCBS as the preferred policy method as it is uses a competitive process among shortlisted firms that takes into account the quality of the proposal and the cost of the services in the selection of the successful firm (World Bank, 2011b) (Leipold, Klemow, Holloway, and Vaidya, 2004). However, these approaches still do not address the problem of multi-criteria nature of vendor and ERP software selection. Furthermore, although the World Bank have developed detailed guidelines for selection of large complex software systems they are still problems and borrowers have to hire foreign consultants to assist them in selection at very expensive rates. The major problem is that these guidelines are complex and there are no software tools to assist in storing and synthesizing the evaluation results. It is these shortcoming that motivate the research presented in this paper. The paper demonstrates the use of STACE framework as an alternative to QCBS for the selection of ERP systems for public sector in developing countries.

II. Quality and Cost Based Selection (QCBS) for the Selection of ERP Systems

QCBS uses a competitive process among short-listed firms that takes into account the quality of the proposal and the cost of the services in the selection of the successful firm (World Bank, 2011b). Cost as a factor of selection is used judiciously. The relative weight given to the quality and cost is determined for each case depending on the nature of the assignment. QCBS is one of the selection method in the international competitive bidding process. The objective of International Competitive Bidding (ICB) is to provide all eligible prospective bidders with timely and adequate notification of specific procurement requirements and an equal opportunity to bid for the required goods and works.

QCBS provides for the two stage bidding process and are fully documented else where (World Bank, 2011a). In the case of turnkey contracts or contracts for large complex facilities or works of a special nature or complex information and communication technology, it may be undesirable or impractical to prepare complete technical specifications in advance. In such a case, a two stage bidding procedure may be used, under which first unpriced technical proposals on the basis of a conceptual design or performance specifications are invited, subject to technical as well as commercial clarifications and adjustments, to be followed by amended bidding documents and the submission of final technical proposals and priced bids in the second stage.

Invitations to prequalify or to bid are advertised as Specific Procurement Notices in at least one newspaper of national circulation in the Borrower's country (or in the official gazette, or in an electronic portal with free access). Such invitations are also be published in UNDB online and in dgMarket (World Bank, 2011a). Notification are given in sufficient time to enable prospective bidders to obtain prequalification or bidding documents and prepare and submit their responses. Prequalification is usually necessary for large or complex works, or in any other circumstances in which the high costs of preparing detailed bids could discourage competition, such as custom designed equipment, industrial plant, specialized services, some complex information and technology and contracts to be let under turnkey, design and build, or management contracting. This also ensures that invitations to bid are extended only to those who have adequate capabilities and resources. Prequalification is based entirely upon the capability and resources of prospective bidders to perform the particular contract satisfactorily, taking into account their (a) experience and past performance on similar contracts, (b) capabilities with respect to personnel, equipment, and construction or manufacturing facilities, and (c) financial position.

The bidding documents furnishes all information necessary for a prospective bidder to prepare a bid for the goods and works to be provided. While the detail and complexity of these documents may vary with the size and nature of the proposed bid package and contract, they generally include: invitation to bid; instructions to bidders; form of bid; form of contract; conditions of contract, both general and special; specifications and drawings; relevant technical data (including of geological and environmental nature); list of goods or bill of quantities; delivery time or schedule of completion; and necessary appendices, such as formats for various securities. The basis for bid evaluation and selection of the lowest evaluated bid is outlined in the instructions to bidders and/or the specifications in form of formula to applied between quality and cost.

During the examination of bids, the Borrower ascertains whether the bids (a) meet the eligibility requirements specified the Procurement Guidelines such as completeness of bids, (b) have been properly signed,
(c) are accompanied by the required securities or required declaration signed as specified in the Guidelines, (d) are substantially responsive to the bidding documents, and
(e) are otherwise generally in order. If a bid is not substantially responsive, that is, it contains material deviations from or reservations to the terms, conditions, and specifications in the bidding documents, it is not be considered further. The bidder shall not be permitted to correct or withdraw material deviations or reservations once bids have been opened.

After examination of bids, the Borrowers then evaluates and compares the Bids. The purpose of bid evaluation is to determine the cost to the Borrower of each bid in a manner that permits a comparison on the basis of their evaluated cost. The bid with the lowest evaluated cost (that is both quality and cost), but not necessarily the lowest submitted price, is selected for award. The bid price read out at the bid opening shall be adjusted to correct any arithmetical errors. The evaluation and comparison of bids is based on CIP (place of destination) prices for the supply of imported goods and EXW prices, plus cost of inland transportation and

insurance to the place of destination, for goods manufactured within the Borrower's country, together with prices for any required installation, training, commissioning, and other similar services.

III. STACE FRAMEWORK

The STACE framework was developed to facilitate a simple, quick and easy to use social-technical approach to Commercial Off the Shelf (COTS) software selection process. STACE framework is an alternative method for ERP software selection because most ERPs are commercial off the shelf software. STACE framework is fully documented elsewhere (Kunda, 2003)(Brooks and Kunda, 2006). STACE is based on a number of important principles and these are:

Support for a *systematic approach* to COTS evaluation and selection. Most organisations select their COTS components in an ad-hoc manner. There is need for example to reuse lessons learnt from previous evaluation cases by maintaining a database of evaluation results.

Support for *evaluation of both COTS products and the underlying technology*. Most COTS evaluation frameworks emphasise either on COTS products evaluation or technology evaluation. This method proposes keystone evaluation strategy in which the underlying technology is selected before selecting the COTS products.

Use of *social-technical techniques* to improve the COTS software selection process. The STACE recommends the use of a social-technical evaluation criteria and customer participation in the COTS selection process. A social-technical development method is a method to develop a system that consists of the human subsystem and a technical subsystem in an integrated way.

Use of *multi-criteria decision-making techniques* to consolidate evaluation attribute data. The STACE proposes the use of Analytic Hierarchy Process (AHP) .

The STACE method (see Figure 1) comprises four interrelated processes: 1) requirements elicitation; 2) social-technical criteria definition; 3) alternatives identification; and 4) evaluation or assessment.

In the requirements elicitation process, the high-level customer and systems requirements are discovered through consultation with stakeholders, from system documents, domain knowledge and market studies. The STACE framework recommends that the high-level requirements be partitioned according to the types of packages expected to be available in the relevant problem domains. Then, the team adjusts the requirements to maximize package use and creates an architecture that will promote the use of acquired packages. This is a paradigm shift from custom development. To avoid a bias risk, they must be careful not to redefine requirements so specifically that only one particular product is suitable.

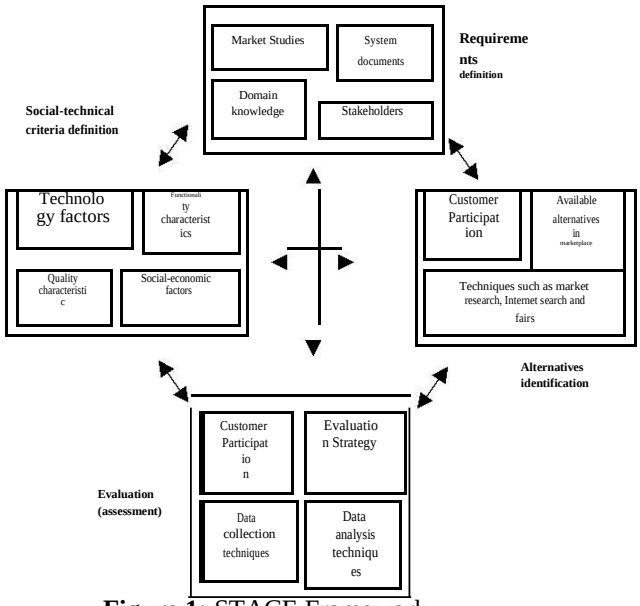


Figure 1: STACE Framework

In the social-technical criteria definition process essentially the high-level requirements from the requirements elicitation are decomposed into a hierarchical criteria set and each branch in this hierarchy ends in an evaluation attribute. The evaluation criteria are parameters against which the COTS product is evaluated and upon which selection decisions are made. The outcome of this process is a social technical evaluation criteria categorized in technology factors; functionality characteristics; product quality characteristics; and socio-economic factors. Socio-economic factors are non-technical factors that should be included in the evaluation such as costs, organisational issues, vendor performance and reliability. Organisational issues include people and process problems that must be overcome before successfully implementing the COTS based system, such as management support and internal organisational politics, staff skills and attitudes. Vendor performance and reliability includes vendor infrastructure and stability, period of vendor business, vendor reputation, references, customer base and track record.

The objective of the alternatives identification process is to identify COTS components that meet the high level customer requirements so that they can be considered for a more rigorous evaluation. This phase begins with identifying the domains relevant to the problem and understanding the types of packages available in those domains. The next step is to obtain information about the COTS products or obtain information about vendor or both. This information may be based on information submitted by the vendor as part of the pre- qualification process. Evaluators screen the candidates by conducting a preliminary (paper) evaluation to arrive at a manageable number of candidates.

The evaluation involves review of vendor documentation provided through the bidding process and product testing for quality and functionality. It includes

evaluating COTS performance, interfaces and ease of integration, comparing short-term and long-term licensing costs against integration costs. The reasons for selecting each component and the reasons for rejecting others should be recorded. STACE recommends the use of the Analytic Hierarchy Process (AHP) to consolidate evaluation data in order to select the "best" components among alternatives. The AHP technique is based on pair-wise comparison between alternatives. The result of this pair-wise comparison is converted to a normalised ranking by calculating the eigenvector from the comparison matrix's largest eigenvalue. There are tools available to support the AHP techniques such as PriEsT: an interactive decision support tool to estimate priorities from pairwise comparison judgments (Siraj, Mikhailov and Keane, 2013).

IV. CASE STUDY ORGANISATION

The case study involved the selection of a vendor and ERP software for the tender for the Supply, Installation and implementation of the ERP system for public sector organisation. The tender involved the supply, installation, commissioning and implementation (through training and provision of preventive and remedial maintenance) of a computerised, Integrated Financial Management Information System (IFMIS) based on a turnkey approach. IFMIS is aimed at improving the acquisition, allocation, utilisation and conservation of public financial resources through the use of automated, integrated, effective, efficient and economic information systems. The IFMIS package comprised of an ERP software, servers, Local Area Networks (LANs), supportive software including operating systems, databases and communication accessories, Metropolitan Area Network (MAN), Wide Area Network (WAN). The set up would be based on open system technologies. The assignment would be implemented in three phases. Phase I is the pilot implementation phase and Phase II is the roll out phase and Phase III would cover the interface phase.

V. APPLYING QCBS FOR THE SELECTION OF ERP SYSTEMS FOR PUBLIC SECTOR

QCBS was applied in the selection of provider (bidder) for the IFMIS solution that is the ERP software, required hardware and vendor to implement the ERP. QCBS comprised of the following steps a) preliminary examination; b) technical detailed evaluation; c) financial evaluation; d) combined bid evaluation.

A. Preliminary examination

The preliminary examination was aimed at assessing the completeness of bids and bid security and other bid document requirements as identified in the Instructions to Bidders. The completeness of the bids assessed whether the bid form was properly signed, bid was coming from a pre-qualified bidder and bid was valid for 120 days, and availability of manufacturer authorization if the bidder is not the manufacturer of the hardware and software. The completeness of bid security assessed whether the submitted bid security was not less than 2% of the bid price or an equivalent amount in a freely convertible currency and whether the bid security was a bank guarantee/ certified cheque and was valid for the period 120 days plus 28 days. All the three bidders were compliant.

B. Technical detailed evaluation

The aim of the technical detailed evaluation was to assess responses to the IFMIS hardware/ infrastructure requirements, supplier performance, and functional specification. The technical score for each bid was calculated as a weighted sum of the total points awarded to the bidders' responses to the proposed features.

The formula below was applied for evaluating technical scores:

$T_{DE} = 0.3\ T_{HI} + 0.3\ T_{SP} + 0.4\ T_{FS}$ where,

T_{DE} = The Detailed Evaluation Technical score

T_{HI} = The Technical score for Hardware/Infrastructure Requirements

T_{SP} = The Technical score for Supplier Performance

T_{FS} = The Technical score for the Functional Specification

Step 1. IFMIS hardware/infrastructure requirements. The objective of this step was to evaluate the hardware requirements, LAN, MAN and WAN requirements, and Business Continuity and software requirements. Each of these requirements comprised detailed requirements, for example hardware requirements comprised of powered equipment requirements, configuration and upgrade requirements, server characteristic requirements, database and application servers, hardware specifications, workstation specification, laptop specification, printer specification, UPS specification, hardware/software documentation. Bidders response which meets a "Mandatory" requirement was given a score 2, poorly meets requirement was given a score 1, otherwise 0. Bidders response which meets a "Desirable but optional" requirement was given a score 1, otherwise 0. The scores from each member of the evaluating team regarding the IFMIS hardware/infrastructure requirements was recorded and an average score was calculated.

Step 2. IFMIS supplier performance. The objective of this step was to evaluate the supplier performance and support requirements. The supplier performance was divided into the following categories: System Support, System Testing, Maintenance and Warranties, Quality Assurance, Capacity Building, Training Support, Change Management, Project Management, Proposed staff qualification and experience. Bidders response which meets a "Mandatory" requirement was given a score 2, poorly meets

requirement was given a score 1, otherwise 0. Bidders response which meets a "Desirable but optional" requirement was given a score 1, otherwise 0. The scores from each member of the evaluating team regarding the IFMIS supplier performance was recorded and an average score was calculated (see appendix 1).

Step 3. IFMIS functional specification. The objective of this step was to evaluate the IFMIS application software. The application evaluation was divided into the following categories: General System Requirements, consolidation and General Ledger, budgeting, accounts payable, accounts receivable, cash book, purchasing and inventory control, asset management, fleet management, debt management, security and auditing. Bidders response was based on whether a software feature is Standard Functionality and was given a score of 10, whether a feature is Modified and was given a score of 2, whether a feature is Third Party and was given a score of 1, and if the feature is Not Available then score 0. The scores from each member of the evaluating team regarding the IFMIS functional specification was recorded and an average score was calculated (see appendix 1).

Step 4. Calculate the technical score. The objective of this step was to calculate the total technical score based detailed evaluation technical score formula. Table 1 presents the summary evaluation of the technical score. For example, Bidder 1 calculation are as follows:

T_{HI} (The Technical score for Hardware/Infrastructure Requirements) = 87.0

T_{SP} (The Technical score for Supplier Performance) = 88.4

T_{FS} (The Technical score for the Functional Specification) = 89.1

T_{DE} (The Detailed Evaluation Technical score) = $0.3\ T_{HI} + 0.3\ T_{SP} + 0.4\ T_{FS}$

T_{DE} (The Detailed Evaluation Technical score) = $0.3*87 + 0.3*88.4 + 0.4*89.1 = 88.3$

Table 1 presents the summary evaluation of the technical score

	Criteria	Max (%)	Bid 1 (%)	Bid 2 (%)	Bid 3 (%)
1	Hardware/Infrastructure Requirements	30%	87.0	83.6	61.7
2	Supplier Performance	30%	88.4	78.3	58.6
3	Functional Specification	40%	89.1	86.9	80.0
	Total Percentage	100%	88.3	83.3	68.1

C. Financial evaluation

In the QCBS the financial evaluation was based on the information provided by the bidder contained in the information forms with regard to price schedule forms. The Recurrent Costs (R) for Bid Price for all the phases was reduced to net present value and determined using the following formula:

$$R = N + M \frac{R_x}{\sum_{x=1}^{} (1 + I)^x}$$

where

N = number of years of the Warranty Period (3 years)

M = number of years of the Post-Warranty Services Period (2 years)

x = an index number 1, 2, 3, ... N + M representing each year of the combined Warranty Service and Post-Warranty Service Periods.

R_x = total Recurrent Costs for year "x," as recorded in the Recurrent Cost Form.

I = discount rate to be used for the Net Present Value calculation (10%).

D. Combined Evaluation

In QCBS the final score takes into account the technical and financial evaluation scores using the combined evaluation criteria below:

Where

S = Bid Score
C = Evaluated Bid Price
C_{low} = The lowest of all Evaluated Bid Prices
T = The total Technical Points awarded to the bid
T_{high} = The highest Technical Points awarded to any responsive bid
X = Weight for the bid Price

The weight of the Bid Price ("X" in the Evaluation Bid formula) = 40%

The weight of the Bid Technical Score (1-X) in the Evaluated Bid formula = 60%

Table 2 presents the combined technical and financial score

COMBINED TECHNICAL AND FINANCIAL SCORE			
Evaluation Description	Bidder 1	Bidder 2	Bidder 3
Weighted Financial Score (40%)	27.80	40.00	29.97
Technical Score	88.30	83.30	68.10
Weighted Technical Score (60%)	60.00	56.60	46.27
Combined bid evaluation (%)	87.80	96.60	76.24
Weighted Financial score=(lowest bid price/bid price)* 40			
Weighted Technical score=(technical score/highest technical score) * 60			
Combined bid evaluation=weighted technical score+weighted financial score			

According to QCBS Bidder 2 provided the Lowest Evaluated Bid.

VI. Applying STACE Framework for the Selection of ERP Systems for Public Sector

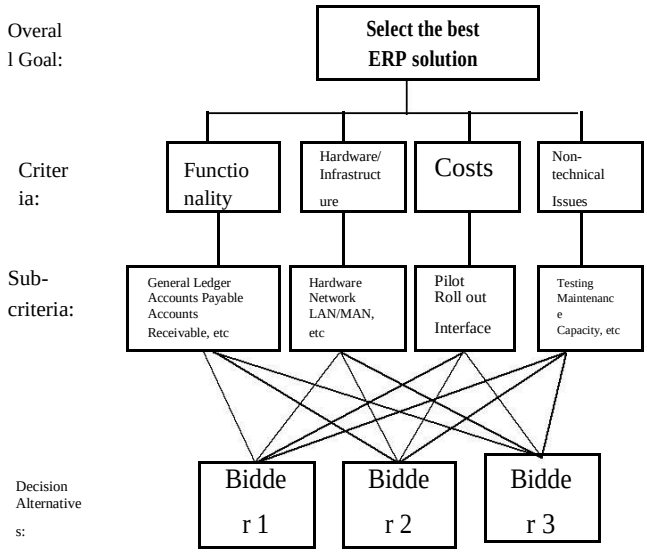
STACE framework was applied in the selection of provider (bidder) for the IFMIS solution that is the ERP software, required hardware and vendor to implement the ERP.. The STACE framework comprised of the following steps a) requirements definition, b) alternatives identification; c) social -technical criteria definition; d) evaluation and selection.

A. Requirements definition

The purpose of the requirements definition phase was to produce a clear, complete, consistent, and testable specification of the IFMIS requirements. The IFMIS requirements were elicited from system documents, domain knowledge such as implementation of IFMIS in other countries, and interviews with stakeholders. The outcome of this process was the functional specification document that was part of the bidding document.

B. Alternative identification

The objective of this process was to identify IFMIS service providers from the marketplace that met the high level customer requirements so that they can be considered for a more rigorous evaluation. The pre-qualification process was used. The identified vendors were screened to reduce them to *Bidder 1, Bidder 2 and Bidder 3.* The basis of screening was completeness of bids and bid security and other bid document requirements as identified in the Instructions to Bidders. The completeness of the bids assessed whether the bid form was properly signed, bid was coming from a pre-qualified bidder and bid was valid for 120 days, and availability of manufacturer authorization if the bidder is not the manufacturer of the hardware and software. The completeness of bid security assessed whether the submitted bid security was not less than 2% of the bid price or an equivalent amount in a freely convertible currency and whether the bid security was a bank guarantee/ certified cheque and was valid for the period 120 days plus 28 days.



C. Social-technical criteria definition

The purpose of the social-technical criteria definition was to derive attributes or parameters against which the IFMIS provider is evaluated and upon which selection decisions are made. According to the STACE method the social-technical criteria include: 1) technology factors, 2) functionality characteristics, 3) product quality characteristics, and 4) social-economic factors. The technology criteria was not used in the hierarchy priority because of keystone approach strategy was adopted whereby all the software to be selected must be compatible with the keystone in this case study Microsoft Windows Operating System. The social-economic factors were divided into non-technical issues and cost issues because of the importance attached to the cost issues compared to other attributes. The final social-technical criteria are provided in table 3. Non-technical issues are those factors that bring in the social dimension in the evaluation criteria. These are similar to vendor performance requirements identified in the QCBS except for customer capability requirements that was added. The customer capability requirements included customer experience with product/technology, customer expectations, internal organisational politics, and customer/organisation policies or preferences.

Table 3: Social-technical criteria for IFMIS provider selection

IFMIS FUNCTIONALITY (FUNCTIONAL SPECIFICATION)	HARDWARE/INFRASTRUCTURE REQUIREMENTS
General System Requirements	Hardware Requirements
Consolidation Module	General Network Requirements
	LAN/MAN Requirements

General Ledger and Reporting	Wide Area Network (WAN) Requirements
Payments/Accounts Payable	Network Management
Receipting and Accounts Receivable	Business Continuity Requirements
Cash Management	System Software Requirements
Purchasing and Commitment	
Accounting	NON-TECHNICAL ISSUES
Inventory and Stock Control	System Support (including local support)
Budgeting and Release of Funds	System Testing
Asset Management	Maintenance and Warranties
Fleet Management	Quality Assurance
Project Accounting	Capacity Building
Debt Management (Financial Instruments)	Training Support
Audit	Change Management
	Project Management
COST ISSUES	Proposed staff qualification and experience
Pilot implementation	Customer capability
Rollout implementation	
Interface phase	

D. Evaluation and selection

Step 1: Using AHP to determine the relative importance of the criteria. Using pairwise comparisons, the relative importance of one criterion over another was computed. A total number of six pairwise comparisons were made to calculate the AHP's eigen vector values and these are shown in table 3. The result in Table 3 shows that the IFMIS functionality attributes is the most preferred criterion and cost issues is the least preferred criterion. Pairwise comparisons were also computed for the sub criteria to determine the relative importance of the sub criteria relative to the criteria.

Table 4: Relative importance of criteria

	IFMIS Functionality	Hardware/ Infrastructure	Non-technical	Costs issues	Relative Importance
IFMIS Functionality	1	2	2	1/2	0.263
Hardware/Infrastructure	1/2	1	2	1/3	0.141
Non-technical	1/2	1	1	1/3	0.141
Costs issues	2	3	3	1	0.455
Total					1.0000

Step 2. Evaluation and priority ranking for IFMIS functional specification. The objective of this step was to evaluate and priority rank the IFMIS application software. Pairwise comparisons were made to determine the preference between each alternative bidder over another for the following categories: General System Requirements, consolidation and General Ledger, budgeting, accounts payable, accounts receivable, cash book, purchasing and inventory control, asset management, fleet management, debt management, security and auditing. Using AHP and a software tool the priority ranking were then synthesised and results are presented in table 3.

Table 5: Priority ranking of IFMIS bidders

Criteria	Priority Ranking	Bid 1	Bid 2	Bid 3
Functional Specification		0.352	0.342	0.306
General System Requirements	0.08	0.348	0.303	0.348
Consolidation Module	0.05	0.349	0.329	0.323
General Ledger and Reporting	0.15	0.337	0.333	0.33
Payments/Accounts Payable	0.07	0.356	0.363	0.281
Receipting and Accounts Receivable	0.07	0.33	0.34	0.33
Cash Management	0.08	0.338	0.348	0.313
Purchasing and Commitment Accounting	0.08	0.346	0.342	0.313
Inventory and Stock Control	0.05	0.349	0.341	0.31
Budgeting and Release of Funds	0.13	0.341	0.339	0.321
Asset Management	0.05	0.336	0.329	0.336
Fleet Management	0.03	0.347	0.347	0.307
Project Accounting	0.03	0.342	0.317	0.341
Debt Management (Financial Instruments)	0.02	0.333	0.333	0.333
Audit	0.10	0.44	0.39	0.171

Step 3. Evaluation and priority ranking for IFMIS hardware/infrastructure requirements. The objective of this step was to evaluate and priority rank the hardware requirements, LAN, MAN and WAN requirements, and Business Continuity and software requirements. Pairwise comparisons were made to determine the preference between each alternative bidder over another for each of these requirements. Using AHP and the software tool the priority ranking were then synthesised.

Step 4. Evaluation and priority ranking for IFMIS non technical issues. The objective of this step was to evaluate and priority rank the non technical issues. Pairwise comparisons were made to determine the preference between each alternative bidder over another for the following categories: System Support, System Testing, Maintenance and Warranties, Quality Assurance, Capacity Building, Training Support, Change Management, Project Management, Proposed staff qualification and experience, Customer Capability. Using AHP and the software tool the priority ranking were then synthesised.

Step 5. Evaluation and priority ranking for IFMIS cost. The objective of this step was to evaluate and priority rank the IFMIS costs. The Recurrent Costs (R) for Bid Price for all the phases was reduced to net present value. Pairwise comparisons were made to determine the preference between each alternative bidder over another for pilot, rollout and interface implementation. Using AHP and the software tool the priority ranking were then synthesised.

Step 6: Using AHP to synthesise the evaluation results and select the product. The priority ranking were then synthesised with the help of PriEsT, a software tool that supports AHP process (Siraj, Mikhailov and Keane, 2013) and the results shown in table 4. It can be noted from this table that although Bidder 1 scored highly regarding the ERP functionality it did not emerge as the winning bidder because according to the case study organisation functionality issues had low priority compared to cost issues.

Table 6: Priority ranking of IFMIS bidders

Criteria	Priority Ranking	Bid 1	Bid 2	Bid 3
Functional Specification	0.263	0.352	0.342	0.306
Hardware/Infrastructure Requirements	0.141	0.378	0.334	0.289
Non-technical issues	0.141	0.349	0.326	0.326
Costs issues	0.455	0.346	0.393	0.260
Overall Ranking		0.353	0.362	0.286

According to STACE methodology Bidder 2 provided the best Bid with score of 0.362. In this study, the results from STACE methodology is the same as the results from QCBS.

VII. Lessons Learnt

The major lesson learnt from case study is that ERP software and vendor selection is a multi-criteria problem and STACE is an alternative to the World Bank's Quality Cost-Based method. Table 7 below presents the summary of the Lessons learnt

Table 7: Summary of Lesson Learnt

Issues	Lesson Learnt
Costs issues	Lesson 1. Cost issues are more important than other factors in the selection of ERP software and vendors. It was noted in this case study that because the budget for the IFMIS project was fixed by the funding agencies, the cost or delivery conditions were more important than other factors. This agrees with findings by other researchers that although managers frequently declare quality to be the most significant criterion, many organisations select their vendors on cost or delivery conditions (Lee, Lee and Jeong, 2003; Sucky, 2007)
IFMIS functionality	Lesson 2. Provision of better non standard functionality can be an important factor to differentiate between ERP vendors. It was observed in this case study that although bidders submitted the same ERP software, yet they were ranked differently in terms of functionality because the public sector funding/ budgeting module was not a standard functionality of the ERP software and one vendor provided a better functionality for this module. Therefore, the public sector funding/ budgeting module became the differentiating factor in the ranking of bidders in terms of ERP functionality.
Non-technical	Lesson 3. Use of non-technical issues in the ERP software and vendor selection is important because it has impact on the successful implementation of the ERP. The most important non-technical issues for ERP software and vendor selection identified in this case study was system support (including local support), maintenance and warranties, quality assurance, capacity building, training support, change management, project management, proposed staff qualification and experience, customer or user capability. This is in agreement with Poon and Yu (2010) as well as Zerbini and Borghini (2014) that non-technical issues such as prior ERP knowledge by acquisition teams and know-how transfer capacity dimensions proved significant when considering supplier performance at the qualification and quotation levels.
Combining or Synthesizing results	Lesson 4. Use of multi-criteria techniques such as Analytic hierarchy process (AHP) as recommended by STACE framework proved to useful for evaluating qualitative data such as vendor performance. AHP is a good approach that can be used in a multifactor decision-making environment, especially when subjective and/or qualitative considerations have to be incorporated. AHP provides a structured approach for determining the scores and weights for the different criteria used in decision making and provides consistency checking (Wadhwa and Ravindran, 2007; Ghodsypour and O'Brien, 1998; Kahraman, Cebeci and Ulukan, 2003)

Evaluation criteria	Lesson 5. Use of detailed and clear evaluation criteria is very important for successful selection of ERP vendor and software. STACE framework proposes the use of detailed social-technical criteria and this proved useful in the project and make the evaluation process clearer and easier to implement. This agrees with literature that emphasizes preparation of a comprehensive list of evaluation criteria for ERP whether it is done formally or informally (Poon and Yu, 2010)
Transparency	Lesson 6. Publish ERP evaluation results to enable bidder understand why they were selected or not selected as provides for transparency in the evaluation and selection process. Publication of evaluation results will help bidders improve their submission and understand why other bidders are preferred. STACE framework being a systematic evaluation method advocates for publication of evaluation results and therefore more transparent than other methods.
Software tools	Lesson 7. Use a software tool to simplify process and for storage of evaluation results. In this case study PriEsT (Siraj, Mikhailov and Keane, 2013), a software tool that supports AHP process was used. The software provides for consistency checking and able store the evaluation result. Storage of evaluation results is important for transparency as other stakeholders can be able review the evaluation process.

VIII. Conclusion and Further Work

The results of this study indicates that STACE framework can be successful used for evaluation and selection of ERP software and vendor. STACE framework recommends the use of multi-criteria techniques such as AHP to synthesize the evaluation results. It was demonstrated that the buyer can use hierarchical approach to calculate the optimal ERP software and vendor selection alternative for different estimated demand scenarios. Therefore, the hierarchical approach can provide valuable decision support for the dynamic strategic vendor selection problem. The outcome of this study suggest that STACE framework can be used as alternative to Quality Cost Based Selection model for the selection of ERP systems for public sector in developing countries. The use of software tool such as PriEsT (Siraj, Mikhailov and Keane, 2013) can simplify the selection process as well as record the evaluation results that can provide the transparency that international funding agencies demand.

Further work will involve application of the STACE framework World Bank selection methods namely: Quality-Based Selection (QBS); Selection under a Fixed Budget (SFB); Least Cost Selection (LCS); Selection-Based on the Consultants' Qualifications (CQS); Single-Source Selection (SSS). In addition, a software tool that specifically apply to STACE framework will developed.

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