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An Empirical Review of Models for Evaluation of Computer Hardware and Software Vendors

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Abstract: ***The acquisition and use of computer hardware, software and ICT consultancy services requires that the procuring entity chooses a vendor who not only understands the system specifications but also can be trusted to deliver the required quantity of the product on time and of the required quality. Choosing the best vendor that meets the set tangible and intangible evaluation criteria requires the procuring entity to use an efficient and effective model that evaluates the complex multi criteria and multivendor issue. This study sought to examine and assess the model(s) adopted in evaluating and selecting the vendors of computer hardware and software in Moi University. The findings showed that 80% (8) of the respondents interviewed have used weighted point method in evaluating suppliers of computer hardware and software. However, none of the respondents have used cost ratio and total cost of ownership methods in the evaluation and selection of the vendors. Further, 100% (10) of the respondents interviewed indicated that they have never used Analytical Hierarchy Process Model, Data Envelopment Analysis and Artificial Neural Network yet they support multi-criteria decision analysis. It is recommended that an intelligent web based multi criteria system be developed and implemented. This will aid in optimizing the evaluation and selection of computing system vendors. In addition, the multi criteria decision making models should be incorporated in the University's ICT Policy to govern the procurement of computer hardware and software.***

Keywords: AHP, ANN, Computer hardware and software, DEA, Intelligent, Web-based, Multi criteria, procuring entity, vendor evaluation

1. Introduction

Computer hardware and software are composed of tangible and intangible subsystems. Organizations can acquire such systems either through in-house development or by outsourcing from a pool of competing vendors in the market. However, choice of the vendor that meets the required evaluation criteria should be guided by use of appropriate, efficient and effective model that optimizes the complex multi criteria, multi-person and multivendor problem.

According to[1] vendors always form a central part of an organizational's management policy. Moreover, the evaluation and selection of vendors of computer hardware and software is a multi-person, multi-vendor, multi-stakeholder and multi-criteria issue [2].Therefore, this requires that the model(s) used in choosing and ranking the vendors of computer hardware, software and consultancy services should always take into account the multi-nature of the evaluation and selection process.

Such a model should not just make the complex evaluation process simpler but enable the selection of the best vendor in a transparent manner leading to the satisfaction of not only the procuring entity but also the vendors. The satisfaction of the unqualified vendors would ensure that the bidding process is not entangled in numerous court litigation processes and or appeals at the Public Procurement and Oversight Authority. This not only saves time and money but also ensures optimal use of computer hardware and software which a prone to obsolescence due to the dynamic nature of computing technology.

This study investigated the model(s) used by Moi University procurement unit in evaluating and selecting of vendors of computer hardware and software with a view to recommending the adoption of the optimal evaluation and selection model and for incorporation into the University's ICT Policy.

2. Aim

The study aimed to examine and assess the models used to evaluate and select vendors of computer hardware and software at Moi University.

3. A Review of Vendor Selection Models and Methods

3.1 Vendor Selection Models

A review of the literature showed that the three common types of vendor evaluation models and each of the model is composed of two or more methods, namely the total cost model, the mathematical programming model, and the linear weighing model.

3.1.1 The Total Cost Model

This model considers all costs associated with selection of a vendor. It includes the cost ratio method and the total cost of ownership (TCO) method. According to [3]), the cost ratio method considers cost ratios for products quality, delivery, customer service and price. This method measures the cost of each criterion as a percentage of total purchase for the vendor. The higher rating scored by the vendor is due to the lower ratio of costs to value. The method can show the actual cost of doing business and thus determine the financial performance of an organization. Due to its flexibility, it can be adopted by any organization. However the cost ratio method is complex and therefore would operate well in an environment that has a very good cost accounting system, otherwise it would be expensive to implement [3].

TCO is a methodology and philosophy that considers both the price of purchase as well as other purchase-related costs. The methodology provides information that would contribute to cost saving during procurement of services and goods. It improves the purchaser's understanding of vendor performance and cost structure and provides excellent data for negotiation and improvement [4].

However, the methodology may not assist in a situation where some costs are hidden making it not effective for evaluating and selecting first time vendors. The shortcoming of this approach is that, it is very difficult to estimate hidden costs thus this method is hard to use with first time vendor evaluation and selection. Additionally, cost based vendor evaluation methods do not provide for continuous improvement to vendors [4].

3.1.2 Mathematical Programming Model

This model enables the selection of several vendors while optimizing objective function in relation to vendor and procuring entity's constraints. It consists of two methods: the artificial neural network (ANN) and data envelopment analysis (DEA). Neural network consists of two functions. The first function measures and evaluates vendor performance and stores the information in a database to provide data sources (inputs) to the neural network. The second function uses the neural network to select vendors. Hence, ANN is cost effective and saves time of system development. [5] noted that artificial intelligence (AI) based models play important roles in the domain of vendor selection. AI based on computer aided systems can be "trained" by a purchasing expert. Subsequently, non-experts facing similar but new multi-criteria vendor evaluation and selection can consult the system. AI methods are mainly preferred is that they do not require formulization of the decision making process and can cope better with complexity and uncertainty than traditional methods since they are designed to be more like human judgment functioning [5].

Data envelopment analysis (DEA) assesses the comparative efficiencies of decision making units where the presence of multiple inputs and outputs makes comparison difficult [4].

3.1.3 The Linear Weighting Model

This model measures vendors' performance by rating their performance according to various criteria and producing a single score. Categorical method, the weighted-point method and analytical hierarchy process model (AHP) are the three linear weighting models.

The categorical method separates the vendors' performance into different categories such as quality, cost, on-time delivery. The procuring entities express their preferences about vendors' performance on these criteria. Performance attributes for all competing vendors are classified as satisfactory, unsatisfactory or neutral thus making the method very simple, easy to use and implement with least cost. However, it requires very experienced buyers with good memory and individual verdict. The attributes have equal importance and therefore it rarely leads to vendor performance improvement [6].

According to [7], the weighted- point method is one of the most basic of all vendor analysis methods. It considers criteria that are weighted by the buyer. The weight for each criterion is then multiplied by the performance score that is assigned by the buyer. These are finally totaled to give the final rating for each vendor. The vendor with the highest score is presented as the best performer. However, [3] observed the method is more costly than categorical method but tends to be more objective. It is popular due to its simplicity, flexibility, effectiveness and ease of implementation. Its major shortcoming is that it is not easy to effectively to incorporate qualitative evaluation criteria.

On the other hand, Analytical Hierarchy Process (AHP) is a general theory of measurement [8]. It enables a decision maker to structure complex problems in the form of a hierarchy which has at least three levels: the goal, the criteria, and the alternatives. In the case of selection of vendors of computer hardware and software, the goal is to evaluate and rank vendors; the criteria can be, price, quality, financial base, delivery .The alternatives are the different vendors bidding to supply a given computing system.

The method avoids the main drawback of the traditional linear weighting models, which assign weights and scores arbitrarily and can also make a trade-off between the quantitative and qualitative criteria [3]. Generally, the strengths of the method include its ability to: structure complex decision problems through hierarchies that allow gaining insights into decision making process; handle both tangible and intangible attributes; monitor consistency of the decision maker's judgments; provide a systentic score for each supplier [9]. [10], noted that "rather than prescribing a "correct" decision, the AHP helps the decision makers find the one that best suits their needs."

However, the drawbacks of AHP [9] are: the need for consensus in aggregating individual judgments for pair wise comparison matrices; the definition of the hierarchy strongly depends on the practical problem; its use is not straightforward for practitioners; and that the reliability of the outcome depends not only on the quality of the data, but also on knowledge and judgments of decision makers. In addition, AHP cannot effectively take into account risk and uncertainty in assessing the supplier's potential performance because AHP presumes that the relative importance of attributes affecting the supplier's performance is known with certainty [11].

4. Methodology

This study examined and assessed the models used to evaluate and select vendors of computer hardware and software at Moi University. A Descriptive case study strategy was adopted. Purposive sampling technique adopted to select 10 respondents from the procurement and ICT sections of the University to participate in the study owing to their experiential knowledge in the process of vendor evaluation [12]. A structured questionnaire was used to elicit for primary data for the study while secondary data was obtained through a review procurement documents and academic journals. The results were analyzed using Microsoft excel 2007. Bar graphs were used to summarize

and present results on the applicability of the various models in the process of evaluation of vendors of computer hardware and software.

5. Analysis and Discussion of Results

This section presents the analyses and the discussion of the empirical study.

5.1 Models used in Evaluation and Selection of Vendors of Computer hardware, software

Figures 1, 1.1, 1.2 and 1.3 indicate the response on the application/non-application of various models and respective sub models used in evaluation of vendors.

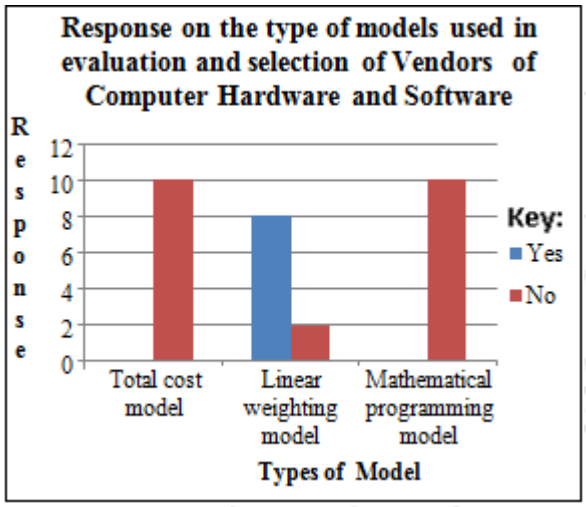

Figure 1: Response on the type of models used in evaluation and selection of Vendors of computer hardware and software

The findings (Figure 1) show that none of the respondents have used total cost model, eight have used linear weighting model and none have used mathematical programming model in the evaluation and selection of vendors of computer hardware and software.

5.1.1 Total Cost Methods

The study sought to establish whether the respondents have used the two total cost weighting methods during the evaluation vendors of computer hardware and software (Figure 1.2).

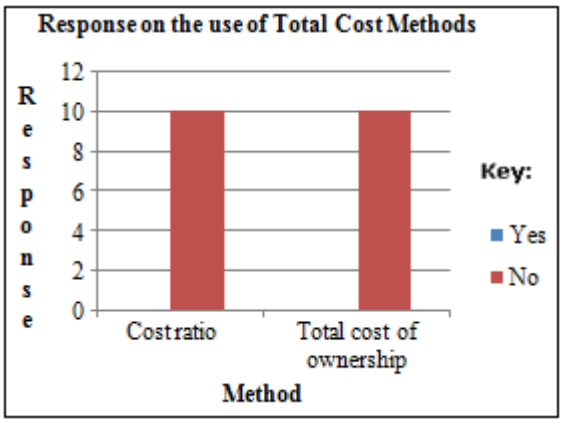

Figure 1.1: Response on the use of Total Cost Methods

The findings showed that none of the respondents have used the cost ratio method or the total cost of ownership method in the evaluation of vendors of computer hardware and software (Figure 1.1). This could be attributed to the fact that these methods give priority to the cost criteria yet vendor evaluation and selection is a multi-criteria decision issue. This is in tandem with [4] observation that cost based vendor evaluation methods do not provide for continuous improvement to vendors.

5.1.2 Linear Weighting Methods

The study sought to establish whether the respondents have used the three linear weighting methods during the evaluation vendors of computer hardware and software (Figure 1.2).

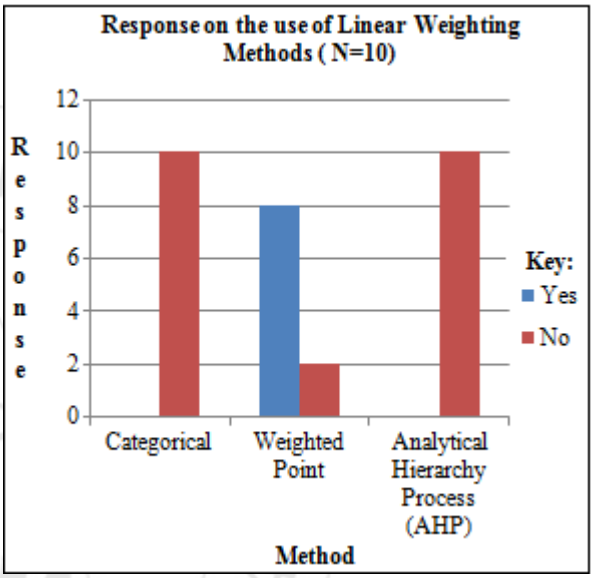

Figure 1.2: Response on the use of Linear Weighting Methods

All respondents had not used either categorical method or AHP model in the evaluation and selection of vendors of computer hardware and software. Eight respondents had applied weighted point method in the evaluation and selection process (Figure 1.2).

5.1. 3 Mathematical Programming Methods

The study sought to establish from the respondents whether they have used two of the mathematical programming methods (DEA and ANN) during the evaluation vendors of computer hardware and software (Figure 1.3).

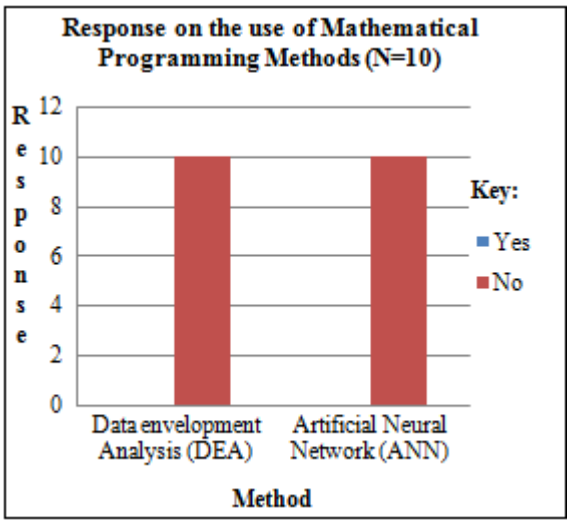

Figure 1.3: Response on the use of Mathematical Programming Methods

The responses showed that none of the respondents has ever used either of the two mathematical programming methods is evaluating and selecting vendors of computer hardware and software (Figure 1.3). This was because neither of the two mathematical methods had been adopted by the procurement section. This is despite the fact that, for example, ANN has the ability solve problems without requiring the presence of an expert given that they can infer patterns inherent in data used in evaluating vendors of computer hardware and software

6. Summary of Findings

None of the respondents have used total cost model, 80 % have used linear weighting model and none (0%) has used mathematical programming model in the evaluation and selection of vendors of computer hardware and software (Figure 1). The total cost model can be carried out using either cost ratio or total cost of ownership methods/sub-models. None of the respondents have used either of methods (Figure 1.1) in the evaluation of vendors of computer hardware and software.

The two types of linear weighting models assessed were categorical, analytical hierarchy process and weighted point methods. Figure 1.2 showed that none of the respondents (0%) have used categorical method and analytical hierarchy process model in
the evaluation and selection of Vendors of computer hardware and software. 80% of the respondents had used weighted point method in the evaluation and selection process. Documentary reviews showed that the weighted point method is the most frequently used method and as noted by [3], it is more objective compared to categorical and is popular due to its simplicity, flexibility, effectiveness and ease of implementation.

The two mathematical programming methods assessed were DEA and ANN. From findings (Figure 1.3), it was established none of the respondents (0%) had used DEA or ANN in the evaluation and selection of vendors of computer hardware and software.

7. Conclusion and Recommendations

It was established that total cost based vendor evaluation methods do not provide for continuous improvement of vendors. The fact that the weighted point method is the most frequently used method implies that the selection of vendors of computer hardware and software suffers the challenges of the method as reported by [3]. To address the challenges it is recommended that model and methods that takes into account both qualitative and quantitative criteria should be adopted.

However, AHP has never been used in the evaluation and selection of vendors of computer hardware and software at Moi University despite the fact that it can perform pair wise comparison of both qualitative and quantitative criteria (information) in a structured, hierarchical manner and give the relative priority weights of each. In addition, none of the two mathematical programming methods (DEA or ANN or both) have ever been used by the procurement unit and the directorate of ICT in the evaluation of vendors of computer hardware and software.

Hence, it is further recommended that an intelligent web based multi criteria system that allows for judgment of both qualitative and quantitative criteria be developed and implemented to aid in the optimization of the evaluation and selection of computing system vendors. In addition, the multi criteria decision making approaches should be incorporated in the Moi University's ICT Policy to govern the procurement of computer hardware and software.

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