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Decision Support Framework for Insourcing and Outsourcing Building Maintenance Activities in Tertiary Institutions

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Abstract

The making of an appropriate decision on either to insource or outsource maintenance services in a tertiary institution is strategic in nature. Also, the decision-making process is usually complex and often constitutes a difficult task to decision makers. This is because different sourcing option suits different scenarios. The process of developing a decision-support framework for building maintenance insourcing and outsourcing decision-making in tertiary institutions is the aim of this study. Through a cross-sectional survey, data were collected from maintenance staff and building users using two sets of self-administered questionnaires. The results revealed the factors influencing decision to insource or outsource maintenance services in universities and polytechnics in South-West, Nigeria. The study develops a decision-support framework to assist policymakers and maintenance managers on insourcing and outsourcing decisions for building maintenance services in tertiary institutions. It recommends that decision in tertiary institutions should adopt the proposed maintenance sourcing decision-support framework as a tool for driving building maintenance sourcing decisions.

Keywords: Buildings; In-sourcing; Maintenance; Outsourcing; Tertiary institutions

1. Introduction

An integral aspect of the overall management responsibility in any organisation or institution, irrespective of the nature and scope of its core business activities is the maintenance management of buildings and allied infrastructure. Ogunmakinde, Akinola and Siyanbola (2013) posit that it is practically impossible to produce buildings which are maintenance-free. Adenuga, Odusami and

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Faremi (2007) opine that although much can be done at the design stage to reduce the amount of maintenance work to be executed at the operation and maintenance phase of buildings, building elements generally deteriorate. The rate of deterioration is, however, influenced by the nature and characteristics of construction materials, method of construction, age, environmental conditions, usage, method of design, and the existing maintenance management system for the building.

Maintenance management services can be procured through insourcing or outsourcing (Natukunda & Pitt, 2011). Sometimes, a combination of insourcing and outsourcing is employed in a hybrid sourcing arrangement. Wong (2008) explains that insourcing refers to the arrangement of providing services internally using own personnel while outsourcing refers to the strategy of having third party vendors provide services for a fee over a period of time. The decision to insource or outsource can, however, constitute a challenge as it can ultimately affect the quality of maintenance services that are delivered, the overall maintenance cost and speed of delivery (Faremi, Adenuga & John, 2013). There is, therefore, the need for decision makers in tertiary institutions to choose the most appropriate maintenance sourcing option that optimises cost, improve quality of service and efficiency, and meet the demands for greater accountability (Ikediashi, Ogunlana & Bowles, 2012).

In many institutions, decision makers follow a rule of chance approach in choosing between insourcing and outsourcing options for maintenance services as there is a lack of a comprehensive maintenance management framework to guide the decision-making process (Lateef, Khamidi & Idrus, 2010). Oftentimes, maintenance management decision makers choose the option that seems right at a time and then learn from the outcomes later. This trial-and-error approach often results in unexpected consequences (Faremi et al., 2013). This study seeks to fill the identified gaps. The development of a systematic approach to assist maintenance decision-makers on the choice of the most appropriate sourcing option for any particular maintenance service in an institution is therefore vital.

The aim of this study is to develop a decision support framework that could assist insourcing and outsourcing maintenance services decisions in tertiary institutions in Southwest, Nigeria. In order to achieve the aim, two objectives were established:

(1) to evaluate factors influencing the decision to insource or outsource building maintenance in tertiary institutions in Southwest, Nigeria.
(2) to develop a decision support framework that would assist tertiary institutions' policy makers in decision-making on building maintenance insourcing and outsourcing.

The hypothesis postulated for the study is:

Ho: There is no significant difference in the factors influencing building maintenance sourcing decision across the categories of tertiary institutions in Southwest, Nigeria.

2. Literature Review

2.1 The Concept of Insourcing and Outsourcing Services

Faremi et al. (2013) assert that the decision to source maintenance or facilities management services can be made through insourcing, outsourcing or a hybrid of both insourcing and

outsourcing. According to Atkin and Brooks (2009), the approach taken depends on the priority set by the organisation for the services to be procured.

Insourcing or in-house option of procuring maintenance services refers to a form of service provision in which maintenance services is provided by a dedicated resource directly employed by the client organisation and where monitoring and control of performance is normally conducted under the terms of conventional employer to employee relationship. In this case, Kamarazaly (2007) notes that internal service-level agreements may be employed as regulating mechanisms. Association for Public Service Excellence (APSE, 2011) posits that insourcing represents a means of delivering efficiency and savings in the face of mounting budgetary pressure. Although Goure (2011) argues, on the one hand, that the expectation of efficiencies and cost savings through insourcing public projects are seldom met. Outsourcing, on the other hand, results from an economic climate where the emphasis is on cost-savings and increased quality especially for lean operations (Faremi, Adenuga & Ameh, 2017). Ikediashi et al. (2012), Brown and Fersht (2014) argue that the guiding principle of outsourcing is that non-core activities of an enterprise or organisation could be handed over to companies with lower labour costs and with expertise in those activities, thereby freeing internal resources to focus on enhancing the value-add of the organisation's core business.

2.2 Factors Influencing the Decision to Insource or Outsource Maintenance Services

The decision to insource or outsource maintenance services in any tertiary institution emanates from the ability of the institution's policy makers to define maintenance requirements and the ability to relate asset performance to maintenance effectiveness (Toossi, 2011). Dawne (2011) opines that the factors that influence any decision to insource maintenance services include: timing and coordination of activities, potential damage to the reputation of institution by outsourced vendor's action, consideration of maintenance activities as core to the institution and difficulty in finding vendors with compatible organisational culture. Others include subcontractors acting in their own interest to the detriment of the institution, difficulty in finding vendors that are trustworthy, economies of scale, difficulty in contracting unpredictable activities, difficulty in appraising vendor's performance and vendors feeling exposed to potential loss of investment among others.

Stanimirovic (2013) opines that the five reasons why companies outsource include; the need to focus resources on core activities, cost reduction, the need to convert fixed costs to variable costs, benefit from supplier's investment and innovation, and improved time to market. Similarly, Assaf, Hassanain, Al-Hammad, and Al-Nehmi (2011) discuss thirty eight (38) factors that could influence the decision to outsource maintenance services. These set of factors were grouped into six major categories comprising: strategic factors, economic factors, management factors, technological factors, function characteristics, and quality factors.

Comparatively, Jin, Chua, Ali, and Alias (2014) assert that in making the decision to insource or outsource maintenance services, the importance of a number of factors has to be ascertained. The recommended factors include strategic, technical and economic factors such as; execution speed, time certainty, price or cost certainty, degree of service complexity, degree of service flexibility, client's in-house technical capability, client's financial capability, price competition and government policy respectively.

This study examines all the factors for insourcing and outsourcing decision as presented in the various literature reviewed for this study. This is done with a view to determining those that are significant in influencing the decision of policy makers of tertiary institutions within the study area, thus contributing to the existing body of knowledge.

2.3 Conceptual Framework

The conceptual framework for this study was supported by the models of previous researchers on insourcing and outsourcing services (Adelakun, 2003; Natukunda & Pitt, 2011; Vasiliauskiene, Snieska, & Venclauskiene, 2011; Pena, 2012) and maintenance management of buildings (Marilyn, 2006; Lateef, Khamidi & Idrus, 2010; Jolaoso, Musa & Oriola, 2012; Adenuga, 2012; Choka, 2012).

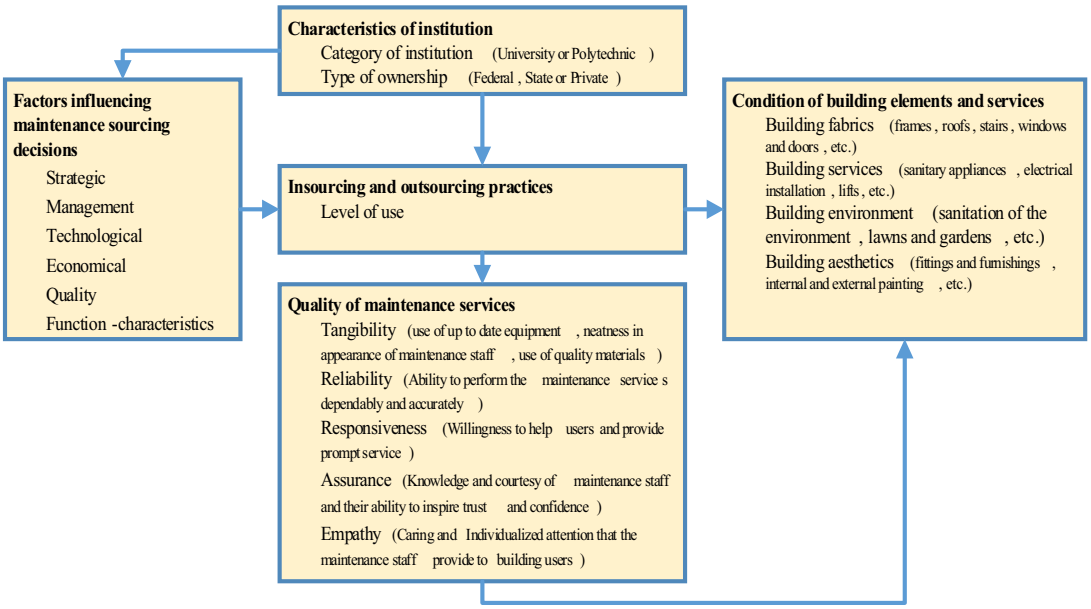

Figure 1: Conceptual Framework for Maintenance Management Sourcing in Tertiary Institutions (developed by the research)

The conceptual framework shown in Figure 1 presents five interdependent concepts for assessing and evaluating the implications of insourcing and outsourcing practices in the maintenance management of tertiary institution buildings. It presents the fundamental variables that have to be studied in the course of this research and how each of the variables interconnects down the stream.

The framework shows that the condition of building elements and services can be predicted by the quality of maintenance services based on insourcing or outsourcing practice. Also, the framework suggests that the characteristics of each institution would influence the factors that are considered when contemplating to insource or outsource maintenance services in the institution. The level at which an institution insources or outsource maintenance services was conceptualised to be influenced by both the decision factors and the institution characteristics.

3. Research Methods

3.1 Research Design

The research design is the procedure of inquiry for a study (Creswell, 2003). For this study a cross-sectional survey design was adopted.

3.2 Research Study Area

This study was conducted across tertiary institutions in South-West Nigeria including Lagos, Ogun, Oyo, Osun, Ondo and Ekiti states respectively. The tertiary institutions surveyed were universities and polytechnics in these states. They include six (6) tertiary institutions in Lagos, seventeen (17) tertiary institutions in Ogun, four (4) tertiary institutions in Ondo, five (5) tertiary institutions in Oyo, seven (7) tertiary institutions in Osun and four (4) tertiary institutions in Ekiti.

3.3 Population of the Study

The population of this study comprise maintenance staff and users of forty-three (43) government approved universities and polytechnics in South-West Nigeria.

3.4 Sample Frame

The number of universities and polytechnics in Nigeria approved by National Universities Commission (NUC) and National Board for Technical Education (NBTE) retrieved on the 15th July 2016 from the archives of NUC (http://nuc.edu.ng/#) and NBTE (http://www.nbte.gov.ng/institutions.html) were 143 and 103 respectively. 43 of the tertiary institutions comprising 29 universities and 14 polytechnics from the approved institutions were located in South-West Nigeria thereby constituting the sample frame for this study. Ogolo (1996) opines that for finite population, at least 10% of the population must be researched. The 29 universities and 14 polytechnics represent 20% and 14% of the total universities and polytechnics in Nigeria. This satisfied the 10% threshold which implies that the study of forty-three (43) tertiary institutions in South-West Nigeria is a good representation of the whole tertiary institutions in Nigeria.

3.5 Sample Size

Three sample sizes were determined for this study as shown in Table 1. The first sample size was a census of each of the forty-three (43) maintenance managers across the institutions because the population of the maintenance managers was small.

Table 1: Sample sizes and survey rate of returns for this study

State	NOI	Maintenance manager					Maintenance technical staff					Building users				
		N	SS	NA	NR	RR	N	SS	NA	NR	RR	N	SS	NA	NR	RR
Lagos	6	6	6	6	6	100%	31	29	31	29	94%	146,750	54	90	78	87%
Ondo	4	4	4	4	4	100%	12	12	12	12	100%	65,500	36	60	43	72%
Oyo	5	5	5	5	5	100%	20	19	20	19	95%	83,000	45	75	48	64%
Ogun	17	17	17	17	17	100%	72	61	72	65	65%	181,500	152	255	156	61%
Osun	7	7	7	7	7	100%	27	25	27	26	96%	82,000	62	105	65	62%
Ekiti	4	4	4	4	4	100%	14	14	14	14	100%	37,700	36	60	38	63%
Total	**43**	**43**	**43**	**43**	**43**		**176**	**160**	**176**	**165**		**596,450**	**385**	**645**	**428**	**66%**

Note: NOI = Number of institutions, N = Population size, SS = Sample size, NA = Number of questionnaires administered, NR = Number of questionnaires retrieved, RR = Response rate.

The second sample size was for the maintenance technical staff and was determined using the simplified formula for proportions proposed by Yamane (1967) as stated in equation 1. At 95% confidence level and 0.05 precision level, the proportionate sample sizes for each state stratum of the population were calculated.

$$\text{Minimum sample size (SS)} = \frac{N}{1 + N(e)^2} \qquad \text{equation 1}$$

Where SS is the minimum sample size, N is the population size and e is the level of precision. The desired degree of accuracy adopted for this study is ±5%, hence the calculated sample size of 160 maintenance technical staff was obtained. This comprises twenty-nine (29) maintenance technical staff for Lagos, twelve (12) for Ondo, nineteen (19) for Oyo, sixty-one (61) for Ogun, twenty-five (25) for Osun and fourteen (14) for Ekiti. The third sample size was for the building users which comprises of academic staff, non-academic staff (excluding those of the maintenance unit) and students of the tertiary institutions. The cumulative population of building users for the 43 tertiary institutions used for this study was 595,450.

Conroy (2006) posits that a population is considered large when the elements are larger than five thousand (5,000). Consequently, Israel (2013) opines that the use of Cochran (1977) formula is one of the appropriate methods for determining the sample size for large population. Hence using the Cochran (1977) formula as shown in equation 2 a sample size of 385 was determined as building users sample size for this study.

$$\text{Minimum sample size (SS)} = \frac{Z^2 X p X (1-p)}{e^2} \qquad \text{equation 2}$$

Where SS is the minimum sample size, Z is the abscissa of the normal curve that cuts off an area α at the tails (1-α equals the desired confidence level i.e., 95%), p is the expected or probability of previous similar studies (taken as 50% for this study) and e is the desired level of precision.

4. Data Analysis

4.1 Objective 1: Evaluation of Factors Influencing the Decision to Insource or Outsource Building Maintenance in Tertiary Institutions in Southwest, Nigeria

Factors influencing building maintenance sourcing decision was assessed using the scale; 1 = not at all influential to 5 = extremely influential. The relative influence index (RII) score of each of the factors were calculated as shown in Table 2. The calculated RII values were interpreted using the scale RII ≥ 0.76 means most significant , 0.67 ≤ RII ≤ 0.75 means significant, 0.45 ≤ RII ≤ 0.66 means less significant and RII ≤ 0.44 means not significant (Waziri & Vanduhe, 2013; Magutu & Kamweru, 2015).

Table 2: Factors influencing decision to insource or outsource maintenance services in tertiary institutions

Factors influencing maintenance sourcing decision	Insourcing			Outsourcing		
	RII	Rank	Remark	RII	Rank	Remark
Strategic Factors						
Developing internal staff	0.93	1	MS	0.31	48	NS
Maintenance is core to institution	0.9	2	MS	0.36	45	NS
Potential damage to reputation of institution	0.73	9	S	0.35	47	NS
Accelerate re-engineering benefits	0.69	16	S	0.68	31	S
Regulations governing outsourcing practices	0.45	25	LS	0.64	38	LS
Improve flexibility to the changing market dynamics	0.43	32	NS	0.67	35	S
Strategic alliance with contractors	0.37	43	NS	0.91	2	MS
Freeing resources for core activities	0.36	44	NS	0.68	30	S
Risk sharing with contractors	0.35	46	NS	0.66	36	LS
Focus on core activities	0.27	48	NS	0.71	19	S
Access to world class capabilities	0.27	49	NS	0.7	25	S
Management Factors						
Difficulty in appraising subcontractor's performance	0.89	3	MS	0.39	39	NS
Difficulty in getting trustworthy subcontractors	0.88	4	MS	0.2	49	NS
Timing and coordination of maintenance activities	0.81	5	MS	0.37	41	NS
Potential conflict of interest between subcontractor and institution	0.79	6	MS	0.36	42	NS
Difficulty of getting subcontractors with compatible organisation culture	0.76	7	MS	0.35	46	NS
Safety management	0.72	14	S	0.7	23	S
Consolidation and decentralisation	0.7	15	S	0.68	29	S
Function difficult to manage and control	0.68	17	S	0.79	10	MS
Increase the speed of implementation	0.62	20	LS	0.72	14	S
Reduce management load	0.43	30	NS	0.71	17	S
Save management time	0.43	35	NS	0.71	20	S
Need for specialised management	0.36	45	NS	0.91	3	MS
Economic Factors						
Economies of scale	0.75	8	S	0.36	44	NS
Potential loss of investments	0.64	19	LS	0.36	43	NS
Cash infusion	0.53	21	LS	0.69	26	S
Accountability	0.53	22	LS	0.89	4	MS
Transform fixed cost into variable costs	0.45	23	LS	0.67	34	S
Increase the economic efficiency	0.44	26	NS	0.72	13	S
Improve the cash flow	0.44	28	NS	0.68	28	S
Make capital funds more available for core activities	0.43	29	NS	0.72	15	S
Overall maintenance cost reduction	0.43	36	NS	0.87	6	MS
Quality Factors						
Improve process responsiveness and cycle time	0.45	24	LS	0.67	32	S
Procure higher reliability and competency	0.43	33	NS	0.84	8	MS
Improve quality requirements	0.42	37	NS	0.84	7	MS
Improve service quality	0.42	38	NS	0.83	9	MS
Achieve high quality of service for competitive advantage	0.42	40	NS	0.74	11	S
Technological Factors						
Initiate innovative ideas and techniques	0.73	10	S	0.72	16	S
Improve the technology for competitive advantage	0.73	11	S	0.71	18	S
Acquire new skills or technical knowledge	0.42	39	NS	0.72	12	S
Need for specialised expertise	0.39	41	NS	0.92	1	MS
Achieve flexibility with changing technology	0.38	42	NS	0.71	21	S
Technology requirements uncertainty	0.66	18	LS	0.65	37	LS
Function Characteristics Factors						
Complexity of function	0.73	12	S	0.7	24	S
Difficulty in contracting unpredictable activities	0.72	13	S	0.38	40	NS
Lack of spare parts	0.44	27	NS	0.67	33	S
Lack in equipment /tools availability	0.43	31	NS	0.69	27	S
Function integration and structure	0.43	34	NS	0.7	22	S
Lack of internal resources for a service	0.34	47	NS	0.88	5	MS

Note: Most Significant at: *RII ≥ 0.76; MS = Most significant, S = Significant, LS = Less significant.

The results, on the one hand, shows that the most significant factors influencing decision to insource maintenance services in tertiary institutions include; the development of internal staff (RII = 0.93), the consideration of maintenance activities as core to tertiary institutions (RII = 0.90), difficulty in appraising subcontractor's performance (RII = 0.89) and difficulty in getting trustworthy contractors (RII = 0.88) among others. On the other hand, the most significant factors influencing decision to outsource maintenance services in tertiary institutions include; the need for specialised expertise (RII = 0.92), strategic alliance with contractors (RII = 0.91) and the need for specialised management (RII = 0.91).

4.2 Hypothesis

There is no significant difference in the factors that influences building maintenance sourcing decision across the categories of tertiary institutions in Southwest, Nigeria. In analysing the hypothesis, the data were grouped into four categories: universities insourcing data, universities outsourcing data, polytechnic insourcing data and polytechnic outsourcing data respectively. This resulted into four sub-hypotheses and each were tested using Welch's ANOVA. The Welch's ANOVA was adopted in order to accommodate for the unequal variances and unequal sample sizes across the institutions(Cooper & Schindler, 2014). The results of the analysis are shown in Table 3.

Table 3: Welch's ANOVA of factors influencing decision to insource or outsource maintenance services in tertiary institutions in Southwest Nigeria

S/N	Sub hypotheses		F	df1	df2	p-value
1	There is no significant difference in the factors influencing building maintenance insourcing decision in Federal, State and Private Universities in Southwest Nigeria	Welch's test	3.5	2	207	0.17
2	There is no significant difference in the factors influencing building maintenance outsourcing decision in Federal, State and Private Universities in Southwest Nigeria.	Welch's test	2.08	2	202	0.26
3	There is no significant difference in the factors influencing building maintenance insourcing decision in Federal, State and Private Polytechnics in Southwest Nigeria.	Welch's test	1.35	2	22	0.35
4	There is no significant difference in the factors influencing building maintenance outsourcing decision in Federal, State and Private Polytechnics in Southwest Nigeria.	Welch's test	1.65	2	22	0.37

Note: Significant at: *$p \leq 0.05$

The result shows that $p > .05$ for all cases therefore the null hypothesis was accepted. This implies that there is no significant difference in the factors influencing decision to insource or outsource maintenance services across the various categories of tertiary institutions in South-West, Nigeria.

4.3 Objective 2: The Decision Support Framework

This study proposes a decision support framework for insourcing and outsourcing maintenance services as shown in Figure 2. The framework comprises five main processes, grouped into three phases.

The first phase is the pre-decision phase. This phase identifies the process of defining the scope of building maintenance activities based on the characteristics of the institution. During this phase, the decision maker is expected to identify all building elements and services in the institution bearing in mind the size and magnitude of each of the building elements and services. The scope definition exercise should take into cognisance the potential influence of the institution's category (i.e. whether the institution is a university or a polytechnic) and the institution ownership (i.e. whether the institution is owned and funded by government or private entity) on the prioritising or grouping of maintenance services.

The second phase is the decision phase and it comprises of the process of evaluating decision influencing factors for both insourcing and outsourcing options. The decision to insource or outsource maintenance service(s) should be based on the results of the evaluation. The option with the most significant set of factors should be adopted.

The final phase is the post decision phase. This phase focuses on the evaluation of the quality of maintenance services for the purpose of implementation control. The phase comprises of processes to ensure that satisfactory results are achieved from the delivered quality maintenance services and consequently improved condition of the buildings. The main processes and sub-processes in the framework were connected to each other with the aid of link arrows. The bottom-most process arrow recommend that the best sourcing practice is sustained. It also canvasses for the implementation of actions for continuous improvement of the process chain. This shows that the framework processes are cyclical. It is expected that feedback from the evaluation of gaps in the quality of maintenance services and the condition assessment results for building elements and services are fed into the process chain with a view to achieving optimum results.

The developed framework takes a clue from Mojela (2012) and Ikediashi (2014). However, the former framework was limited to highlighting the roles of various stakeholders in the maintenance of public schools in Gauteng Province in South Africa while the latter was limited to highlighting the key processes for outsourcing facilities management services in public hospitals in South-South Nigeria. The segmentation of the framework developed by this study in processes and sub processes makes this framework easily accessible to building maintenance management decision makers in tertiary institutions.

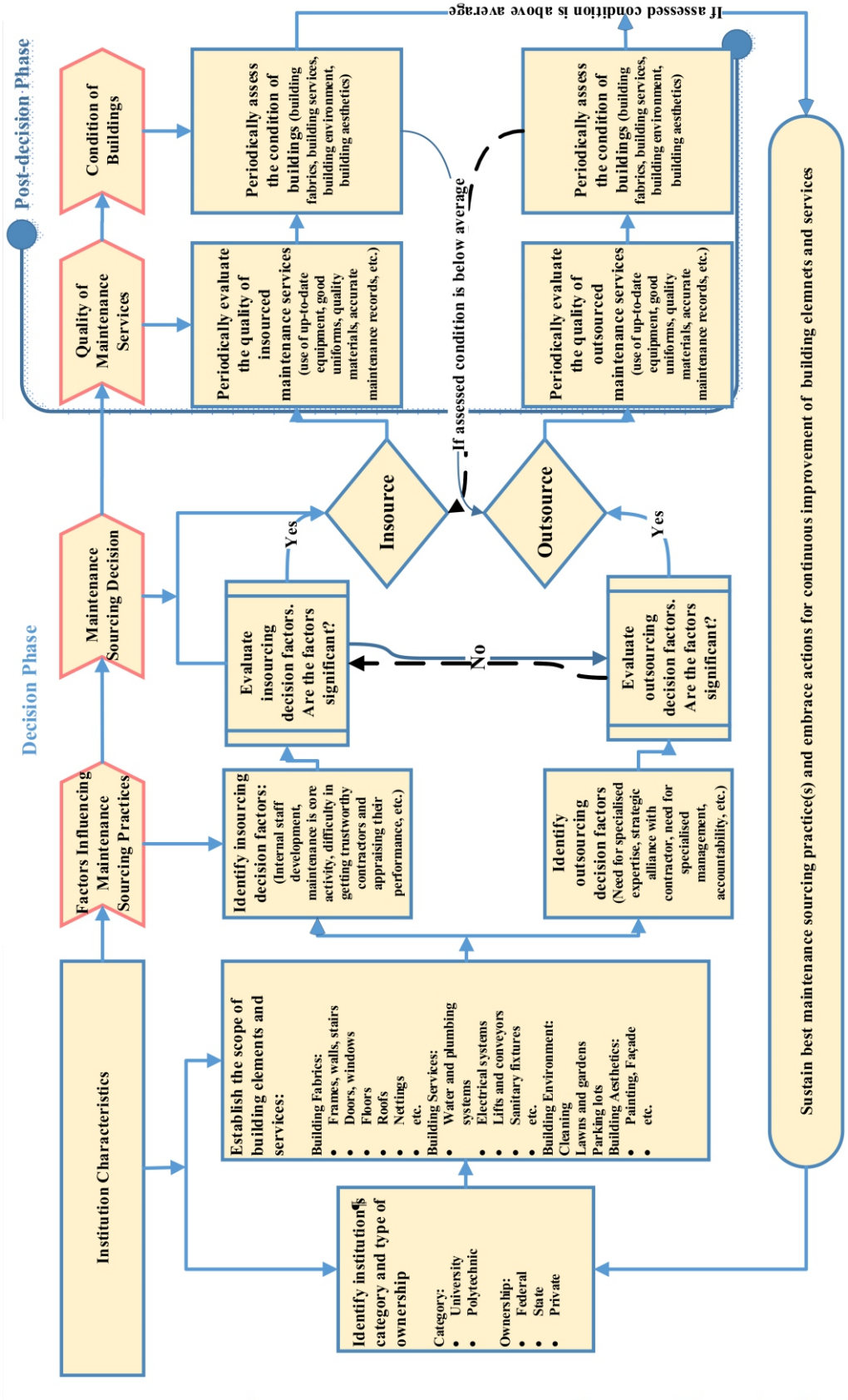

Figure 2: Building maintenance sourcing decision support framework (Developed by the researcher)

4.4 Validation of the framework

The developed framework was validated by selected nineteen experts in building maintenance management. Using a structured questionnaire, each of the experts validated the framework on criteria of logical structure, clarity and intelligibility, comprehensiveness, practicability, efficiency and applicability. The experts considered that the logical arrangement of the framework is adequate and agreed that the framework would be useful because of its flexibility and adaptable nature. Furthermore, participants believe that when the framework is put to use, it would assist tertiary institution maintenance policy makers and maintenance units in realising maintenance objectives more effectively.

4.5 Discussion of Findings

The result shows that insourcing decision are influenced by strategic reasons such as the development of in-house maintenance staff through such medium as on-the-job training. In addition, the consideration of maintenance activities as core institution function was found to be among the most significant factors. The result suggest that maintenance activities are critical to the preservation of buildings in tertiary institutions. This justifies the position of – Lateef, Khamidi, and Idrus (2011) that buildings in tertiary institutions are meant to create suitable, conducive and adequate environment to support, stimulate and encourage learning, teaching, innovation and research activities. However, outsourcing decisions are influenced by technological and strategic reasons such as the need for specialised expertise to maintain services requiring specialised expertise and the leverage that may accrue to tertiary institutions from strategic alliance with contractors. This result aligns with the findings of Muchai and Acosta, (2012) that institutions oftentimes engage the services of third-party vendors to execute maintenance activities that requires high-level specialty. Furthermore, the result shows that the factors that influence decision to insource or outsource maintenance services do not differ across the institutions. This result supports the findings of Steenbeek, Wijngaert, Brand and Harmsen (2005) that similar factors are likely to influence the decision of firms or organisation with similar business goals.

5. Conclusion

Based on the findings from the study, the conclusions that emanate from the findings are: (a)The decision to insource building maintenance activities in tertiary institutions are influenced by strategic factors such as the development of internal staff and the consideration that building maintenance is a core activity that supports the day-to-day running of tertiary institutions. (b) The decision to outsource building maintenance activities are influenced by both technological and strategic factors such as the need for specialised expertise and strategic alliance with contractors.

This study develops a decision support framework to assist policy makers and maintenance managers of tertiary institutions surmount the complex task of making decision to insource or outsource maintenance services. The framework could serve as a requisite tool for maintenance managers and policy makers in the decision-making process of choosing the most effective sourcing practice for each of the maintenance services in their portfolio.

The study recommends that policy makers and maintenance managers in tertiary institutions should employ the decision support framework in this study as a tool to evaluate the most appropriate maintenance sourcing route for the various scopes of maintenance services in their respective institutions. The decision to insource or outsource maintenance services should be made after adequate process evaluation as presented in the framework. In addition, frequent

condition assessment and users' satisfaction survey on the quality of maintenance services should be conducted by those saddled with the responsibility of maintenance management of buildings in tertiary institutions. These would provide the much-needed feedback to drive actions for the overall improvements of the buildings.

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