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A Review of Decision-making Models in Developed Countries towards Enhancing the Quality of Built Heritage Assets in Developing Countries

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Abstract
Modernization in city development is slowly eroding away historical values of heritage properties due to premature decision-making. Persistently, built heritage conservation practice is common in Europe and Asia but unusual in African countries including Nigeria. Hence the paper aimed at reviewing decision-making models adopted in developed countries to enhance a quality built heritage assets in developing countries. Meta-analysis was conducted to explore characteristics and method of the decision-making models in reusing heritage assets. Seven decision-making models were deduced. Practical implications and limitations of the decision-making models were acknowledged. This enhances new findings and quality of heritage assets in developing countries.
Keywords: Adaptation, Built Heritage conservation, Decision-Making Models, Developing Countries

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1.0 Introduction

Heritage buildings are valuable assets that have legacy potentials of the past. They are embedded with cultural artifacts, natural resources, artistic, architectural, historical, economic, and socio-cultural values. Hence, they play a significant role in social and economic dynamics both in developed and developing countries. They express a sense of place or identity within a city corridor. According to Zalina and Rodzyah (2012) in the corridor of a city, the most preferred using area is visiting places with a sense of place such as heritage streets. Above all, heritage building depicts the place identity and quality of people's lives in a community, district, city, and country at large. Therefore they deserved to be protected, preserved, conserved and specifically enhanced to a more status of quality and revival process.

Preservation, conservation, and adaptation are processes conducted at the implementation stage. Prior to this stage, there is preliminary revival process that is carried out during decision-making conceptualization, precisely decision-making or reuse selection of the built heritage assets. For example, whenever the decision-making and reuse of a particular or multiple built heritage assets arises, it is associated with complex decisions and alternative questions such as (1) should the asset be demolished or not to, (2) which the best method is needed to be applied to the building, (3) which building should be reused, (4) or have more potential, and (5) how the design criteria of heritage asset can be integrated into use (Henehan and Woodson, 2004). Kincaid (2002) suggests that adaptive reuse is a complex process which requires participants in the process that have the potential understanding on how to determine the most appropriate future of a building in respect to a particular time and location. Indeed, a collaborative dedication and rigorous effort of several complex decisions carefully identified and resolved at a preliminary stage will definitely yield a quality implementation. Contemporarily, there are several models that intervene decisions and proper reusing of the built heritage assets. They are known as

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the decision-making models. Hence, this paper is looking towards exploring the characteristics of these models enhancing the quality of built heritage assets.

2.0 Definition of Terms

Adaptation can broadly be defined as the process that is involved in retaining the cultural heritage value of a historic building through modifying a compatible space for a new usage to suit new condition (ICOMOS New Zealand Charter, 2010). Then, conservation is regarded as a phenomenon that intervenes the concept of understanding and promoting socio-cultural concern of safeguarding cultural heritage value of a historic building (ICOMOS New Zealand Charter, 2010). Followed by sustainability, which is a rigid principle that upholds the successful delivery of the past to the future generation. Thereby, describing how the present generation has enjoyed at that time without tempering or diminishing the past. It is also a process that promotes economy and a high quality of life. Meanwhile, protecting the environment by sustaining the natural resources (Clough *et al.,* 2006). Finally, decision-making models are technique or methods for evaluating a set of several alternatives in form of complexity by resolving considered factors and finally arriving at a prime decision. An example of the factors needed to be considered includes values of an architectural relic, culture, continuity, economic, environmental concern, legal, political, historical background, policymakers, stakeholders, and community participation. In brief, this clearly shows that effective revival process performance of built heritage asset can be optimized by both at conceptualization stage (model techniques) and implementation stage. The focus on this paper is at the conceptualization stage by reviewing historical building decision-making models adopted in the developed countries to enhance the quality of the present built heritage asset in the developing countries to the future generation as seen in fig 1 below. Ultimately, by so doing will improve the well-being and quality of life of people surrounded by their environment with the built asset. Thereby connecting their past with history and events having psychological happiness with better place identity. Hashimah and Ismail (2013) mention that the process of conserving heritage buildings is through recycling them for contemporary uses.

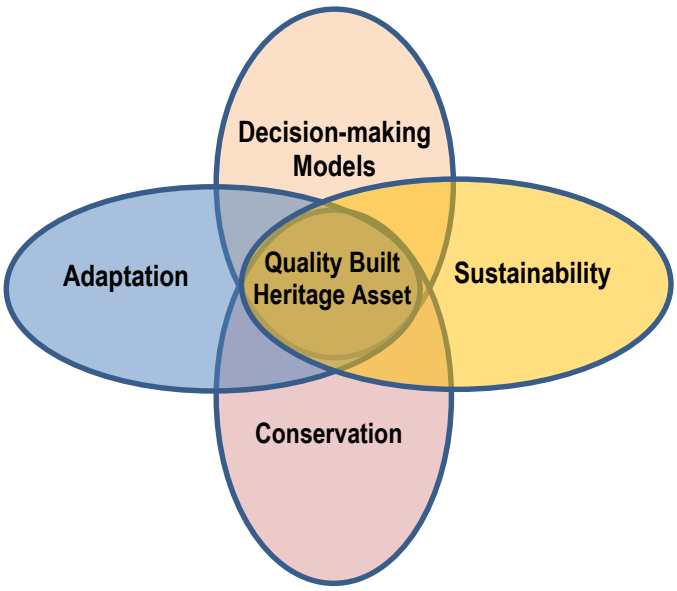

Fig. 1: Revival Process Concept of the built heritage asset from the definition of terms

In addition, the process of maintaining place identity of an area is through preservation, thereby keeping the urban heritage and sense of place intact. Likewise, Farhanah and Mohamed (2012) mentioned that conservation of heritage building is a process that has no exception to every country, as they functionally provide evidence of historical past, environmental setup, and heritage of the nation. Shahrul *et al.* (2013) also did mention that conservation is a process that involves repair, restoration, preservation, maintenance, repurposing and in particular adaptive reuses is known as adaptation. Indeed, world cities need to keep their identity due to a rapid growth of population (Nurlisa and Vinky, 2016). In this case, Langston (2012) maintains that rather than vacating and destroying of the buildings short of their lives, the solution is more effective to leave the basic structure intact, then change its use. This approach is called adaptive reuse, breathing new life into existing building, sustaining buildings to the next generation. Whereas Hasnizan *et al.,* (2016) comment that historical buildings do not only play a significant role representing the cultural identity and historical background but also serve as a source of generating income to the nation. For example, Salleh *et al. (*2009) take the view that conserving historical buildings through adaptive reuse are converted to commercial use from their original use as museums, libraries, offices, and hotels. Examples in Kano city, Nigeria, abandoned buildings adapted in use to suit new function such as warehouses to school classrooms, proposed hotel to an academic institute, former investment building to a state university, and office building into a private university. Therefore, building adaptation is a significant strategic phenomenon that enhances the quality of the historic buildings regenerating them to the future.

Hence, these buildings deserved to be conserved, preserved, protected, reused and enhanced to subsequent future generations. Consequently, this will promote the prevention of these valuable assets from becoming redundant, damaged, deteriorated, demolished, and permanent loss. Thereby avoiding falling into a state of irreversible loss of heritage. For this reason, one of the strategies of promoting sustainability through conservation is by adaptive reuse. As adaptive reuse is a phenomenon that can depict the lifespan of a building, by prolonging it through building conservation and innovation, meanwhile having minimum impact on the heritage significances on the buildings and its surrounding (Prihatmanti, 2015).

3.0 Problem Statement

Shahrul et *al.* (2013) mentioned that it is mostly found in the western part of the world, conservation of historic towns and cities is found to be common, particularly developed countries like Europe and the United States of America. While many non-western world countries particularly developing countries including Nigeria are still in debate on whether to demolish or develop. Contemporarily, adaptive reuse decision-making comprises largely depends on a team of experts to accomplish a complex set of consideration that is needed to be resolved for proper reuse selection. In addition, reuse of heritage buildings in a society is generally seen as a complex decision problem because of the presence of different objectives to be pursued such as the stakeholders, cultural and historical values, and presence of different actors. The actors are public government representatives, agencies, bodies, architects, architectural historians, engineers, developers, and owners. At present, there are models that aids in resolving a set of complex consideration and proper evaluation reuse selection problem of a built heritage asset. Contemporarily, the adaptation and implementation of decision-making models of reusing the built heritage asset through empirical studies are found common in Europe and Asia. However, it is unusual in African countries including Nigeria. Hence, the research aim of this paper reviews the decision-making and reuse selection models adopted in developed countries to enhance the quality of built heritage assets in developing countries. Thirty journal articles will be reviewed on decision-making and reuse selection models. The objective of the study is to conduct a meta-analysis of the adopted decision-making models in the developed countries to explore substantive findings.

4.0 Relationship of Built heritage assets Adaptation between Sustainability and Quality of Life

Indrawati (2008) mentioned that the history of a region is easily identified and recorded from historical heritage buildings. In addition, a source of knowledge that has fundamental significance to a place identity is embedded within the heritage building fabric (Widodo, 2000). Therefore, the presence of heritage property makes it possible for the present generations to understand their place in history. Nurlisa and Vinky (2016) strongly suggest that it is necessary for every city needs to conserve and preserve the useful life of its heritage properties, to keep the place identity intact due to the rapidly growing population as time is continually changing. Therefore, built heritage assets play a significant role in the social, historical, cultural and economic dynamics of every country, as they express a sense of place or identity within a city corridor. Nowadays, the preference of adapting and reusing cultural and heritage buildings rather than abandoning and destroying them is worldwide fast growing and accepted (Ball, 1999; DEH, 2004; Wilkinson and Reed, 2008; Wilkinson et al., 2009; Bullen and Love, 2009). Moreover, these buildings are built assets and have heritage characteristics with cultural, historical and economic resources. For this reason, Bullen and Love (2010) mentioned that adaptive reuse is one of the sustainable policy nowadays used in regenerating our existing buildings because it has the potentials of preventing heritage crime and waste of finite resources, reducing possible impact to the immediate environment.

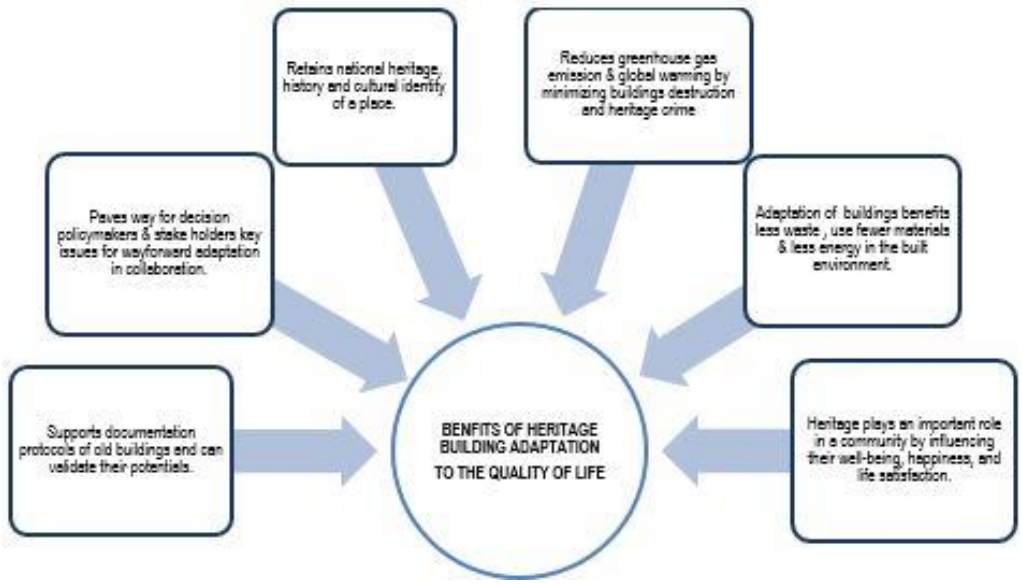

Fig. 2: Benefits of Heritage building adaptation to a quality of life

Ultimately, adaptive reuse of heritage buildings is needed by the community, it enlightens significant of socio-cultural benefits and social concerns. Hence, Farida *et al.,* (2016) suggest that for every country there should be a provision of one historic center as a heritage. This is because it regenerates a sense of historical background of the building and to the community at large. In addition, heritage buildings are significant as they symbolize and give glimpses from related past periods. They should be sustained as evidence of the people's lifestyle and cultural identity instead of destroying such buildings (Damla and Kagan, 2016). Ahmad *et al.,* (2012) further mentioned that historical buildings have architectural, aesthetic, historic, documentary, economic, social, political and symbolic values. Hence, According to Noorfadhilah and Shamzani (2012) cautioned that people/users tend to overlook the existing aesthetic, culture and architectural relics and intervene to modify the building to suit their requirement thereby slowly fading away from the historical value and loss of identity. Similarly, Siti *et al.,* (2016) suggested that in the process of reusing heritage building to perform functions, preservation of heritage buildings is ultimately needed. The preservation tremendously improves the social well-being and the happiness of the community. Equally, Bullen and Love (2009) mentioned that adaptive reuse may promote social inclusion and cohesion among stakeholders and community to reduce the cost of new development by destroying potential existing buildings short of their lives due to urban development activities. Other significances of heritage building adaptation, enhancing sustainability and quality of life can be seen in Fig. 2

5.0 Linking the act of adaptive reuse between decision-making and public participation

Generally, heritage buildings are associated with potential values and factors including artistic, economic, social, historical environmental, cultural, spiritual, architectural, and other physical attributes. On the other hand, it includes the interest of the public/community/citizen, investors, developers, regulators, local and planning authorities, and project stakeholders. There are an increasing complexity and interplay between all the issues associated with heritage building decision problems. Kincaid (2002) suggests that adaptive reuse is a complex process which requires participants in the process that have the potential understanding of how to determine the most appropriate future of a building in respect to a particular time and location. Damla and Kagan (2011) mentioned that the factors affecting decision-making are actors, analysis of existing fabric, the original function of a building, physical character, heritage value, needs of the district, adaptive potential reuse, and functional changes. Meanwhile, building adaptation is a phenomenon that promotes the deconstruction of the heritage buildings and at the same time support community participation in accomplishing a decision-making task successfully. Hence, collaborative planning and decision is the process that has to do with the engagement of relevant stakeholders to develop plans. These plans are drawn to with consensus reflecting all relevant interest of stakeholders group (Shida I.O et al., 2013). In addition, Azni and Nuraisyah (2013) also mentioned that empowerment, responsibility, and communication are key factors of effective participation. Particularly, empowerment is not about public's right but as well having influence in decision-making. According to Rodzyah M. Y et al., (2013) concludes that it is crucial for every decision we make should be a wise one. Hence, Sara *et al.,* (2014) conclude that for a successful adaptation and sustainability of buildings be accomplished, there should be rigorous repetition process of discussions and decisions before reaching final outcomes to be realized. Furthermore, due to the complexity of decision-making, to assist and simplify stakeholders and decision-makers in reaching mutual concession, a framework and decision making tools are needed.

6.0 Current Practice of Conservation and Regulation in Nigeria

Nigeria is currently a developing country blessed with natural sites and beautiful scenes with historical significance both in tangible and intangible heritage. Moreover, as a colonized territory and developing country, it is largely embedded with old buildings, at pre-colonial and post-colonial period both in rural and urban areas. The conservation of these historic buildings is under the Cultural Heritage Legislation and Management (CHLM), which was consolidated in 1979. After then, the government proposed a subordinate agency known as the National Commission for Museums and Monuments (NCMM) Act. The Commission is responsible for cultural heritage management conservation, preservation, and restoration. However, these laws are often offended in practice by destruction or unauthorized transformation or removal of monuments due to economic & political interest.

7.0 Method

The research method of the study entailed a review, scoped to 30 journal articles for a period of 18 years (1999-2017) and two book chapters. This is because to have a wide range of literature review. Also, the paper focuses only on decision-making models of built heritage assets through empirical studies in developed countries. The articles and books were sourced electronically from Science Direct (including AMAR ABRA Procedia articles publications), Web of science, e-library, and Google Scholar. The multidisciplinary approach that contributed in the literature includes architecture, facility management, engineering, construction management, social sciences, history, and geography. 8 journal articles were finally deduced from the review precisely identifying the models adopted and implemented in the developed countries. The deduced 8 journal articles were categorized into three domains in a tabular form for further meta-analysis as seen in table 1 below. This table depicts the evaluation of the substantive findings of the historical buildings decision-making models

7.1 Data Collection

The eight articles deduced from the reviewed thirty journal articles are seen in Table 1. The table showcases the research objective, evaluating the substantive findings of the decision-making models adopted and implemented in the developed countries. The table showcases the decision-making models of the built heritage asset adopted and empirically implemented in different part of developed countries. The table further lists each of the title paper of the reviewed articles and explaining their brief practical implications of the adopted model in the study area.

Table 1: Research findings

s/n	Author/Year/Country	Model / Paper title	Study area
1	Mousumi & Zakir (2009) ***(INDIA)***	**Multi-criteria Decision-Making (MCDM)** Paper Title: *An application of Multicriteria Decision Making to built heritage. The case of Calcutta*	The tool was used in resolving complex decision between policymakers and stakeholders in Calcutta, India. To grade different heritage sites in order to find priorities for conservation and redevelopment.
2	Ignacio Pi ˜neroa, José T. San-Joséb,∗, Patricia Rodríguezc, Milagros M. Losá˜nez (2017) ***(CUBA)***	Paper Title: *Multi-criteria decision-making for grading the rehabilitation of heritage sites. Application in the historic center of La Habana*	The MCDM model was used in the center of La Habana, capital of Cuba for practical cultural protection of an urban zone. The urban zone was embedded with thousands of disrepair and abandoned buildings needing emergency of urban regeneration and redevelopment
3	Ferretti, Bottero &, Mondini (2014) ***(ITALY)***	**Multi-Attribute Value Theory (MAVT)** Paper Title: *Decision making and cultural heritage: An application of the Multi-Attribute Value Theory for the reuse of historical buildings.*	In this research, MAVT has been applied in the metropolitan Turin (Italy)resolving problem decision about the reuse of a set of historical buildings. The tool provides resolving conflicting objectives and disagreement issues. It supports and provides a checklist of elements able to support planners and decision-makers in understanding which buildings are worthwhile to be preserved and conserved.
4	Huey-Jiun and Zhi-Teng ***(TAIWAN)*** (2010)	**Analytic Network Process(ANP)** Paper Title: *A multi-objective decision-making process for reuse selection of historic buildings*	The tool is effectively efficient for resolving the reuse selection problems, particularly of interdependence criteria. The tool has been demonstrated its workability of reuse of historical two building in Taiwan.
5	Bullen & Love (2011) ***(AUSTRALIA)***	**Adaptive Reuse Decision Making Model** Paper Title: *A New Future for the Past: A Model for Adaptive Reuse Decision-making*	The model was propagated in Perth, Western Australia. It is model that provides a reference point in concluding a decision-making among stakeholders on demolition or reuse. As it provides check-list of key issues to arrive at the certain decision.
6	Conejos, Langston, & Smith (2013) ***(AUSTRALIA)***	**AdaptSTAR model** Paper Title: *AdaptSTAR model: A climate-friendly strategy to promote built environment sustainability*	12 selected successful case studies in New South Wales (NSW) and Melbourne, Australia were taken into consideration. The model embeds a design decision into adaptive reuse projects during design conceptualization process.
7	Langston et al. (2008) ***(AUSTRALIA)***	**Adaptive reuse potential model (ARP Model)** Paper Title: *Strategic assessment of building adaptive reuse opportunities in Hong Kong*	The model predicts the useful life of a building for the intervention of potential reuse. High ARP scores have been shown to lead to superior economic, social and environmental benefits in practice via an Australian Research Council grant (2008-2010).
8	Assefa & Ambler (2017) ***(CANADA)***	**The Life Cycle Assessment (LCA)** Paper Title: *To demolish or not to demolish: Life cycle consideration of repurposing buildings*	The project was carried to investigate and compare the potential life cycle environmental impacts of a Tower Library (MLT) in Canada that was under threat of demolition.

8.0 Results and Discussions

Consequently, seven decision-making models of built heritage assets were deduced from the 30 reviewed journal articles as seen in table 2 below. The decision-making models of the built heritage asset include Analytical Network Process (ANP), Multi-criteria Decision-making (MCDM), Multi-Attribute Value Theory (MAVT), Adaptive-reuse Decision-Making Model, AdapSTAR model, Adaptive Reuse Potential Model (ARP Model) and Life Cycle Assessment (LCA) model. The meta-analysis, explores the findings, describing the common and different characteristics of the decision-making model of built heritage assets adopted and implemented from the different part of the developed countries. The analysis further explains the methodological processes and the practical implication of each of the historical building decision-making model. According to the result, firstly it is realized that the methodological process of four (4) decision-making models, including Analytical Network Process (ANP), Multi-criteria Decision-making (MCDM), Multi-Attribute Value Theory (MAVT) and Adaptive Reuse Potential Model (ARP Model) applies mathematical equations in resolving identified several alternatives of considered

factors. Followed by Life Cycle Assessment (LCA) model as it uses software (EcoCalculator 3.7.1) to forecast the impact. While Adaptive-reuse Decision-Making Model and AdapSTAR model largely involves case studies and in-depth interviews in exploring and resolving considered factors from experts. Then finally resolved factors serve as the key issues to be addressed for that particular model determining the decision-making of built heritage asset(s) as seen in Fig 4.

Table 2: The advantages and limitations of the deduced decision-making models

S/n	Model	Method	Advantages and	LIMITATIONS	Further Research
1	**Analytical Network Process (ANP)**	Experts + Interview + Saaty's Supermatrix equation + Analytical Hierarchy Process	Evaluates and resolves identified multiple criteria that are interdependent to each other	The tool does not evaluate criteria where there is no interdependence.	For the further application, a software can be developed on the basis if the tool.
2	**Multi-criteria Decision-making (MCDM)**	Experts + Value Function/index Equation	Evaluate and assess in ranking or priority result, a set of continuous comparative multiple criteria alternatives that have merit values and drawbacks to each other	The tool does not take acknowledge value preferences of decision makers.	Development of Fuzzy MCDM model to rank heritage sites more proper.
3	**Multi-Attribute Value Theory (MAVT)**	Experts + Participants + Interview & questionnaire + Value functions (mathematical representation of human judgments).	Evaluates and resolves identified multiple criteria on basis of conflicting objectives and disagreement that have finite alternative options.	The tool acknowledges the criteria of any given objectives that have different measurement scales in measuring the performance from weak to strong.	It is expected to look forward and consider the uncertainty of predictions and risk attitude of decision makers switching values functions to utility functions. For instance where public decision arises and cannot be predicted precisely.
4	**Life Cycle Assessment (L.C.A)**	Experts + Athena EcoCalculator 3.7.1	Forecast the benefit and environmental impact of a project on demolition or reuse decision debate.	In the empirical study then, only a few of the building components were not assessed and as they are not available in the software, EcoCalculator.	It is recommended to look forward to life cycle assessment covering both at use phase and detailed end-of-life phase based on data from advanced design documents is recommended.
6	**Adaptive Reuse Potential (ARP)**	Program Evaluation and Review Technique (PERT)	Predicts useful life of a building by assessing the physical life (structural integrity) and the period of obsolescence.	Identifies adaptive reuse potentials of existing buildings in ranking order.	_
7	**Adaptive Reuse Decision-Making Model**	Interviews with stakeholders	It provides a reference point and key issues needed to be addressed by practitioners on demolition or reuse decision-making.	It resolves factors in form of complexity and provides an important reference point to future evaluation models for its investment justification.	_
8	**AdapSTAR model**	Case study + Expert+ Interview + Factors	Provides design decision for future adaptive reuse project during design conceptualization.	_	An electronic structured questionnaire survey to registered architects in Australia for further ranking and weight listing of design criteria.

Secondly, it is found that the methodological revival processes that are involved among all the seven reuse selection decision-making models are more or less are found to be similar in the process as learned from the empirical study. In summary, the revival methodological process can be categorized briefly into three stages; Collaboration, frame working and implementation as shown in Fig. 5. The collaboration stage is the process that includes developing of project team of related experts which may include owners, community, project stakeholders, and policymakers (government). The team selection depends on the historical building adaptation reuse project.

This applies to all the decision-making models. The second stage, frame working, which includes two steps. The first step is to identify sets of unresolved considered criteria (example, architectural aspect, economic aspect, cultural aspect, historical aspect, the social aspect, continuity aspect, and environmental aspect) understanding their complex relationships. Then, the second step is effective to optimize the best reuse selection options which will be integrated with the resolved criteria in the first step previously. The Four (4) decision-making models as mentioned earlier, including the Analytical Network Process (ANP), Multi-criteria Decision-making (MCDM), Multi-Attribute Value Theory (MAVT) and Adaptive Reuse Potential (ARP) resolve the identified considered several objectives using mathematical equations in a unique methods, series of processes and steps differently among the tools. For instance, in this review, the Analytical Networking Process (ANP) tool used the basic Matrix manipulation (Saaty's Supermatrix) in resolving the weights and impact of the criteria that are interdependent to each other. While the Multi-criteria Decision-making (MCDM) adopts a means of mathematical value equation method or index by further making a comparative assessment of several alternative criteria in form of complexity. Example, heterogeneous measures or projects mixed with merits and drawbacks, or selecting options that are ranked by policymakers or stakeholders. For example, in Lahabana Cuba, a heritage cultural protection of an urban zone was brought up by the government with many degraded buildings that were in a condition of risk to collapse. As a result of applying the MCDM model, 1033 buildings were in need of emergency action, 169 awaiting demolition, 597 in need of urgent repair. Finally, Multi-Attribute Value Theory (MAVT) in this

review, used the additive model simply represented in an equation to resolve set of alternative actions that have to be evaluated on the basis of conflicting objectives and disagreement among the stakeholders. For example in this review, five conflicting objectives were identified to resolved reuse selection of seven historical industrial buildings in Italy. The objectives include quality of context, economic activities, the flexibility of buildings, accessibility, and conservation level. Eventually, one of the building out of the seven turned out to be the best on the basis of weight ranking of the aforementioned objectives. Then Adaptive Reuse Potential (ARP) is a model that predicts the useful life of a building by assessing the physical life function (structural integrity) and obsolescence to balance or evaluate the potential of the building. Due to the fact that obsolescence objectively reduces the useful life of a building. The model mathematically uses the Program Evaluation and Review Technique (PERT) in assessing the range of obsolescence to determine the building potentials known as ARP score(%). The model will now determine whether to reuse the built asset either long term or short term. 64 adaptive reuse projects were globally conducted using this model successfully. Therefore ARP model is considered a robust strategic model and widely accepted. For example, an urban renewal project of shop houses under threat of demolition led by the government in Hong Kong. When the ARP model was tested upon the historical traditional shop houses about eight shops were found with high potentials and saved from demolition. The model resolved decision-making by retaining the place identity of the community by preserving the few shop houses.

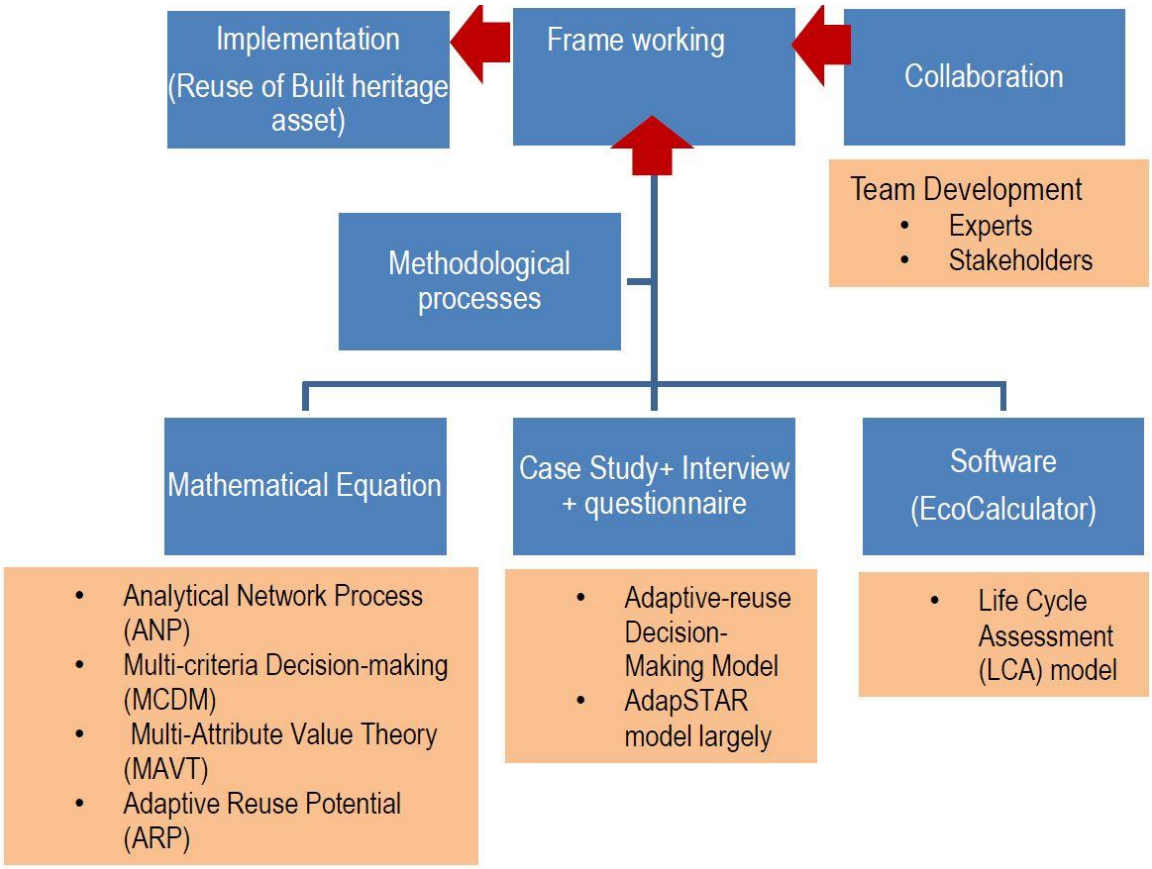

Fig. 4: Decision-making models Methodological processes

Followed by the Adaptive Reuse Decision-Making Model, which is a model purposely invented to provide a room in concluding a debate on decision-making on whether to reuse or demolish a built asset. The model bridges the gap between owners, project stakeholders and policymakers arriving at a point of reference. The proposed model identifies key adaptive reuse issues needed to be addressed and reviewed by the owners, project stakeholders, and policymakers. The key issues include 3 factors, Capital investment (owners), asset condition (project stakeholders) and Regulations (policymakers). Once these issues are addressed in reference to the built heritage asset through the model, the verdict on whether to demolish or reuse the built asset will practically be determined, then implementation takes place thereafter. Then AdapSTAR model is a design evaluation tool that upholds to make purposeful design decision during design conceptualization to assess the adaptive reuse potentials of future buildings. The determining factors the model is relying on the 7 factors of obsolescence which are political, social, economic, legal, environmental, physical and technological. Meanwhile, to make the model more effective and reliable, the tool is validated by ARP model to support and function as a weighted checklist of design strategies that leads to future successful adaptive reuse. Finally the Life Cycle Assessment (L.C.A) among the deduced tool forecast the benefit and environmental impact of a building project. Especially, if a building is in a state of a decision on whether to demolish or reuse by repurposing. In this review paper, the tool uses/employs EcoCalculator, a software that can further assist in understanding the potential benefits and environmental impacts of a repurposing project with the goal of informing future building

stock management. The tool works by thoroughly assessing both every building component and spaces to evaluate the resulting impact. The impact result is in percentage (%).Example, When the LCA was employed and intervened, about 33% of global warming and 34% fuel consumption impacts respectively were avoided by not demolishing a Library tower in Canada rather was repurposed and reused.

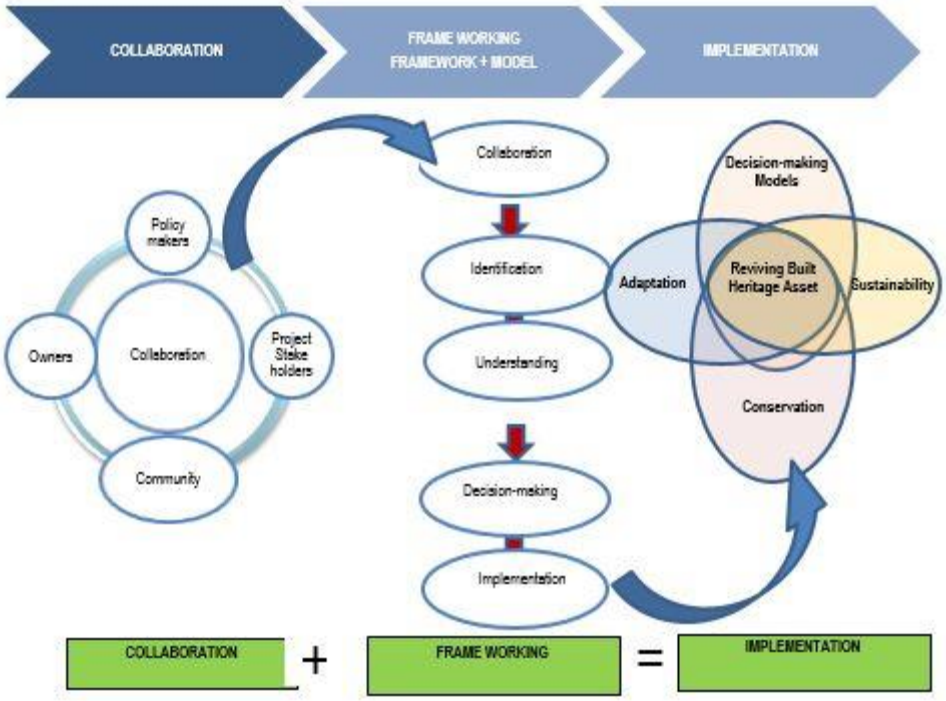

Fig. 5: Methodological revival processes of the historical building Decision-making Models

On the whole, having identified and resolved the prime reuse decision-making by proper evaluation, next is the implementation of the final stage. This is the stage of implementing the prime reuse decision-making of the built heritage assets during the conceptualization into practice by conservation through adaptation and enhancing the sustainability and quality of the built heritage assets improving the quality of life as seen again in the Fig. 5.

However, the paper explores that the different decision-making models have limitations with further recommendations. A scientific research on adopting multi-use of the models will certainly yield to a unique pattern of revival processes outcome enhancing a more quality conservation of the built heritage assets. Crucially, this may bridge the limitation gap, enhancing a more comprehensive and rigorous method of regenerating the quality life of built heritage assets as seen in Fig. 6 below;

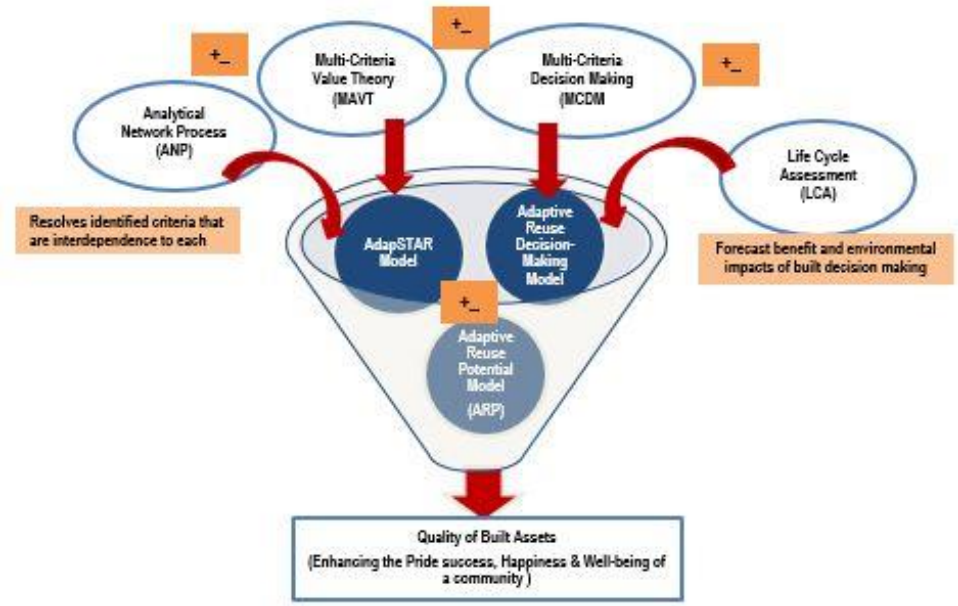

Fig. 6: Future research possibilities

9.0 Conclusion and Recommendation

Substantively seven decision-making models of built heritage assets were deduced including Analytical Network Process (ANP), Multi-criteria Decision-making (MCDM), Multi-Attribute Value Theory (MAVT), Life Cycle Assessment, Adaptive-reuse Decision Making Model, AdapSTAR model, and Adaptive Reuse Potential Model (ARP Model). Meta-analysis was conducted on the deduced decision-making models and evaluated in tabular form. The result shows that the implementation of the decision-making models for built heritage assets is found adopted in the developed countries. This indicates that the protection, control, management and enhancement of the quality of built heritage asset is a common practice in developed countries. Also, the meta-analysis showcases the common and different characteristics of the models and tools describing the methodological revival processes and advantages of the adopted models to the built heritage assets. The Methodological revival processes of the historical building Decision-making Models are categorized into three (3) stages including the collaboration stage, frame working stage and implementation stage. Four (4) decision-making models of the built heritage assets including the Analytical Network Process (ANP), Multi-criteria Decision-making (MCDM), Multi-Attribute Value Theory (MAVT) and Adaptive Reuse Potential (ARP) resolve the identified considered factors by a mathematical equation. Then Two (2) of the models including Adaptive-reuse Decision-Making Model and AdapSTAR model arrive at a prime decision-making of built heritage assets by conducting case studies, interviews and questionnaire to experts. Finally, the Life cycle Assessment (LCA) also determine the decision-making on built heritage assets by forecasting possible impact using EcoCalculator software. The benefits explored include predicting the useful life of built heritage asset, justifying reference key issues to be addressed in concluding demolition and reuse of a built heritage asset, embedding a design decision into an adaptive reuse projects of historical building during design conceptualization and as well the tool that measure the benefits an impact of a decision prior to implementation.

Briefly, the practical implications explored from this paper review by means of adopting and implementing models in reusing built heritage assets include urban regeneration through the integration of conservation scheme (revival process) in city development preserving heritage assets. The decision-making models provide a strong basis to urban planners on decision-making in reusing historic buildings in urban renewal projects. Ranking of potential buildings for reuse intervention based on prioritization and government budget. Reducing green gas emission and other environmental and climatic hazards in the built environment. This is achieved significantly by minimizing the rate of building demolition short of their purposeful life through forecasting the benefit and environmental impact of a project. On the whole, the common practice of built heritage conservation is found common in the developed countries. Indeed, acknowledging the adaptation and implementation methods of the models from the perspective view and approach of the developed countries will tremendously enhance the revival processes and quality of built heritage assets in the developing countries. Furthermore, it is recommended that current researchers in Nigeria and other developing countries should collaboratively persist to review the revival processes of the developed countries by surveying the empirical study. Subsequently, research validation may yield to exploring new findings. Whether the research affirms, modify or reject the revival processes conducted in the developed countries. This could be an opportunity for improving or coming up with new findings and ideas of the decision-making models of built heritage assets in the approach view of other developing countries including Nigeria.

For future research, as a result of the review, it could also be said that the different adopted models have few limitations in conducting the revival processes. Hence, it is recommended to look at the possibilities of scientifically harmonizing multiple-use of the relevant decision-making models of the built heritage assets through empirical study. The scientific approach harmonization, will crucially yield to a more standard and high-quality outcome of the heritage assets in the built environment.

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