

APPLICATION OF THE AHP MODEL TO DETERMINE PREFAB HOUSING ADOPTION FACTORS FOR DEVELOPERS IN LAGOS STATE

Bolajoko Nkemdim Dixon-Ogbechi
University of Lagos, Lagos, Nigeria
bdogbechi@gmail.com

Anthony Kayode Adebayo
University of Lagos, Lagos, Nigeria
aadebayo@unilag.edu.ng

ABSTRACT

Research has shown that there is presently a housing deficit of about 17 million housing units in Nigeria, yet it appears that the concerted efforts that have been put in place by the government to address this issue have not yielded the expected results. Although the Nigerian government in its Vision 2020 policy document recognized that one of the ways of resolving the issue of providing adequate housing in Nigeria is to change from the traditional brick and mortar system to modern construction methods like prefab housing, not much has been done to promote the adoption of this new method by the relevant stakeholders, among whom are the developers. This study employed a survey research approach using the AHP (Analytic Hierarchy Process) to investigate the most important factors that developers take into consideration when they build a house. There are several different types of prefab housing and knowledge of what the developers' consider key factors and priorities would make it possible to determine the type of prefab housing that best fits their needs. This information could provide the basis to design a government marketing strategy to promote prefab housing to both the developers and their customers. Since the judgments will be provided by developers in Lagos State, they will be customized for the conditions and preferences of the developers and citizens there. Therefore, the government and organizations will be able to give priority to these identified factors when formulating relevant strategies to promote the building of more prefab housing.

Keywords: developers; prefab housing; strategy; AHP; Lagos State

1. Introduction

A shortage of housing has been a major problem in Nigeria in recent years. Research has shown that there is presently a housing deficit of over 17 million housing units in Nigeria, yet it appears that the concerted efforts that have been put in place to address this issue by the government have not yielded the expected results (Adebayo & Dixon-Ogbechi, 2017a). Although the Nigerian government, in the Vision 2020 policy document, recognized that one of the ways to resolve the issue of the provision of adequate housing in Nigeria is to move from the traditional brick and mortar system to modern construction methodology like the prefab housing system, not much may have been done to promote

the adoption of this new methodology by relevant built environment stakeholders among whom are developers (Report of the Vision 2020 National Technical Working Group on Housing, 2009; Adebayo & Dixon-Ogbechi, 2017a). This is in support of Johnson's (2006) view that although the prefab housing system is one of the solutions to a nation's housing needs, there is still little scholarly research on this topic especially in developing countries. In fact, to the best of the researchers' knowledge, not much research has been done in this area in Nigeria. This study seeks to bridge this gap in knowledge by investigating the factors that can promote the adoption of the prefab housing technology by developers in Nigeria using the Analytic Hierarchy Process model (AHP). This is of significance given that research by scholars such as Wei, Gibb and Dainty (2008) on house builders' utilization of offsite construction methods revealed that although the level of usage of offsite modern method of construction (MMC) by large house builders is low, the level is likely to increase, given the pressures to improve quality, time cost, productivity, and health and safety.

1.1 Statement of problem

Developers are private corporate bodies some of whom are registered with the Real Estate Developers Association of Nigeria (REDAN), who engage in the business of building houses for sale/rent to the public. Aside from the government, developers are the main stakeholders that engage in medium to large scale building of houses in Lagos State. However, they may not have been able to make as much of an impact as possible in ameliorating the housing shortage problem because they mostly adopt the traditional brick and mortar system of construction (Adebayo & Dixon-Ogbechi, 2017a).

In their study, Adebayo and Dixon-Ogbechi (2017a) sought to investigate the perception of developers on the use of the prefab methodology to deliver housing in Lagos State with the aim of determining their willingness to accept this modern method of construction (MMC). They discovered that although developers are aware and quite knowledgeable about the prefab construction methodology, not many of them have used it extensively in their business despite their belief that it is marketable. Nevertheless, the majority of the developers who were contacted in this study believed that they would adopt the prefab construction methodology to deliver housing if its advantages were effectively communicated.

Adebayo and Dixon-Ogbechi (2017a) further discovered that developers believe that 16 factors could promote their adoption of the prefabricated methodology for housing delivery in Lagos State. The most prominent of these factors are Faster Project Completion Time (FPT), Greater Quality Control (GCT), Usage of Specialized Production Labor (USPL), Reduced Site Labor (RSL), Minimal Environmental Impact (MEI), Less Site Material (LSM), and Cost Effectiveness (CE). Therefore, there is a need to determine the relative importance of these factors to enable the government to formulate appropriate policies and strategies to promote the adoption of the prefab housing system by developers. We used the AHP to determine these priorities by administering questionnaires to a sample of developers in the built environment in Lagos State.

2. Literature review

2.1 The concept of prefab

The concept of prefabrication refers to the manufacturing processes in factories whereby various materials are combined to form a component part of a final installation which is then transported to the site (McGraw Hill Construction, 2011). Prefabrication is based on off-site technology; off-site technologies are structures that are manufactured in different locations than the location of usage with the aim of saving cost and time (Panjehpour & Abang Ali, 2013). These offsite technologies are also called modern methods of construction or MMC (Wei, Gibb & Dainty, 2008). This construction technique uses assembly line manufacturing strategies to produce the components of a house prior to its arrival at a construction site in order to produce prefab homes (Tam, 2013). In Johnson (2016), the US Department of Commerce defined prefab homes as homes made up of components such as walls, floors, roofs, panels, etc., which have been assembled in a factory prior to erection on the building foundation. Prefab homes differ from traditional brick and mortar homes because of the factory assembly-line production method used in their construction (Johnson, 2006).

2.2 Types of prefab systems

Scholars such as Tam (2013) and Smith, Asiz and Gupta (2007) identified the following types of prefab systems which vary in terms of degree of flexibility, labor and transportation costs, namely: manufactured systems, modular systems, panelized systems, and pre-engineered systems. Smith, Asiz and Gupta (2007) opined that manufactured systems are the prefab homes that are fully completed before arriving on the building site; modular systems are made up of multiple modules which are assembled together on the site and are also mostly produced in the factory; panelized systems are those highly flexible prefab systems made up of a prefab floor, roof, and wall panels that are assembled on the building site; and pre-engineered systems are the simplest types of prefab systems made up of individual components produced in the factory but whose components are easily assembled at the site without the need for any additional work. On the other hand, Johnson (2006) categorized the types of prefab systems as precut, panelized, sectional, and preassembled. According to Johnson, the precut system entails incorporating an assembly-line method of production by cutting/processing the lumber at the factory; the panelized system is similar to the precut system but its framing members are cut to specification and then the individual pieces are assembled into larger units, called panels, that are connected with bolts at the factory (Carr, 1947); the sectional prefab system entails manufacturing the building in units of three dimensional modules which are completed in the factory and subsequently sent to the building site for assembly into a complete house (Graff, 1947); and the preassembled prefab system is where prefab houses are fully constructed at the factory and then transported to be permanently installed at the building site.

3. Objectives of study

The main objective of this study is to add to the body of existing knowledge by employing the AHP as a tool to investigate the priorities of the factors and types of prefab housing to help the government plan a strategy to promote the adoption of the prefab housing technology by developers in Lagos State. Precisely, it sought to:

- i. Determine the relative importance of factors that determine the adoption of prefab housing by developers in Lagos State.
- ii. Identify the prefab system that is the most likely to be adopted by developers in Lagos State.
- iii. Recommend appropriate strategy(ies) that will promote the adoption of the prefab system by developers in Lagos State.

4. Research design/methodology

Research design: The survey research method using a quantitative approach mainly based on the Analytic Hierarchy Process (AHP) model was adopted for this study.

Population: The population is made up of developers who engage in the business of building houses for sale/rent to the public in Lagos State. The size is unknown because it is a hidden population with no official record of membership.

Sample size and procedure: A sample of 50 developers in the building environment in Lagos State was selected using a combination of purposive and snowball sampling techniques.

Sources of data: Primary and secondary data sources were used. Primary data was obtained through the administration of questionnaires to developers in Lagos State while secondary data was obtained from a literature review. The literature review enabled us to identify the most popular evaluative criteria for the adoption of the prefab system as well as to identify the alternatives (prefab housing systems that are marketable to consumers in Lagos State). These data were subsequently used to construct the AHP model as well as develop the questionnaire.

Research instrument: A questionnaire was used to gather data (see Appendix 1). The questionnaire was divided into two parts. Part I sought information on the respondents' characteristics and was designed using multiple choice and open-ended response questions. Part II was designed using the relative importance scale of the AHP (Saaty, 1980; 2001) based on variables identified from previous studies by Adebayo and Dixon-Ogbechi (2017a; 2017b).

In order to ensure that the respondents had the proper knowledge to answer the survey, the purposive sampling procedure was adopted. In addition, we used trained research assistants who interacted with the respondents and explained what was required of each of them before the instrument/survey was administered. Apart from this, each survey instrument had an explanation of the criteria and the alternatives as well as instructions to guide the respondents in filling it out. The questionnaire was given to a respondent by a research assistant who explained the process and retrieved it later at a mutually agreed upon date.

Limitations: Most of the challenges faced in the course of data collection revolved around the difficulty in getting respondents to fill out the survey during the visit to the respective companies. Also, most senior staff at the companies that were visited seemed to be too busy to fill out the questionnaires, some were very busy working at different

project site locations. At different times, the research assistants had to wait for hours for some of the staff to finish their jobs before they could be persuaded to fill in the questionnaires. However, with the help of insiders at the various companies who assisted in monitoring the retrieval of the instruments, an overall response rate of 76% was achieved.

Data analytical procedure: The data that was gathered was edited, coded, and analyzed using descriptive statistics from the SPSS (Statistical Package for Social Sciences) version 21, Excel and the SuperDecisions software for the AHP/ANP version 3.0. The SPSS version 21 was used to analyze the demographic data while Microsoft Excel was used to obtain the geometric means of the priorities that were obtained based on the individual assessments of developers. These were then used as inputs for the SuperDecisions software.

AHP model for the study:

The elements used in the AHP model (Saaty, 2001) are presented in Figure 1 as follows:

Goal: To determine the most important preferred factors to promote the adoption of prefab housing by developers in Lagos State.

Criteria: The most popular evaluative criteria for the adoption of the prefab system as identified in a study by Adebayo and Dixon-Ogbechi (2017a) are as follows: Faster Project Completion Time (FPCT), Greater Quality Control (GQC), Usage of Specialized Production Labor (USPL), Less Site Material (LSM), Reduced Site Labor (RSL), Minimal Environmental Impact (MEI), and Cost Effectiveness (CE).

Alternatives: The prefabricated housing systems that are marketable to consumers in Lagos State as identified in previous studies by Adebayo and Dixon-Ogbechi, 2017b) are as follows: Panelized Prefab System (PPS), Hybrid Prefab System (HPS), Other Prefab System (OPS), Preassembled Completed Prefab System (PCPS) and Volumetric Prefab System (VPS).

These alternatives are described in detail below:

- A Panelized Prefab System (PPS) is prefab units produced in a factory and assembled on-site to produce a three dimensional structure. They could be open or closed panels.
- A Hybrid Prefab System (HPS) is a combination of both volumetric/pod and panel systems.
- Other Prefab Systems (OPS) are prefab units that include floor cassettes, roof cassettes, pre-cast concrete foundation assemblies, pre-formed wiring looms and mechanical engineering composites.
- A Preassembled Completed Prefab System (PCPS) is completed prefab houses that are fully constructed at the factory.
- A Volumetric Prefab System is prefab houses in which the building is manufactured in units of three dimensional modules in controlled factory conditions prior to transport to the site. These include a toilet pod, kitchen pod, electrical pod, and lift pod.

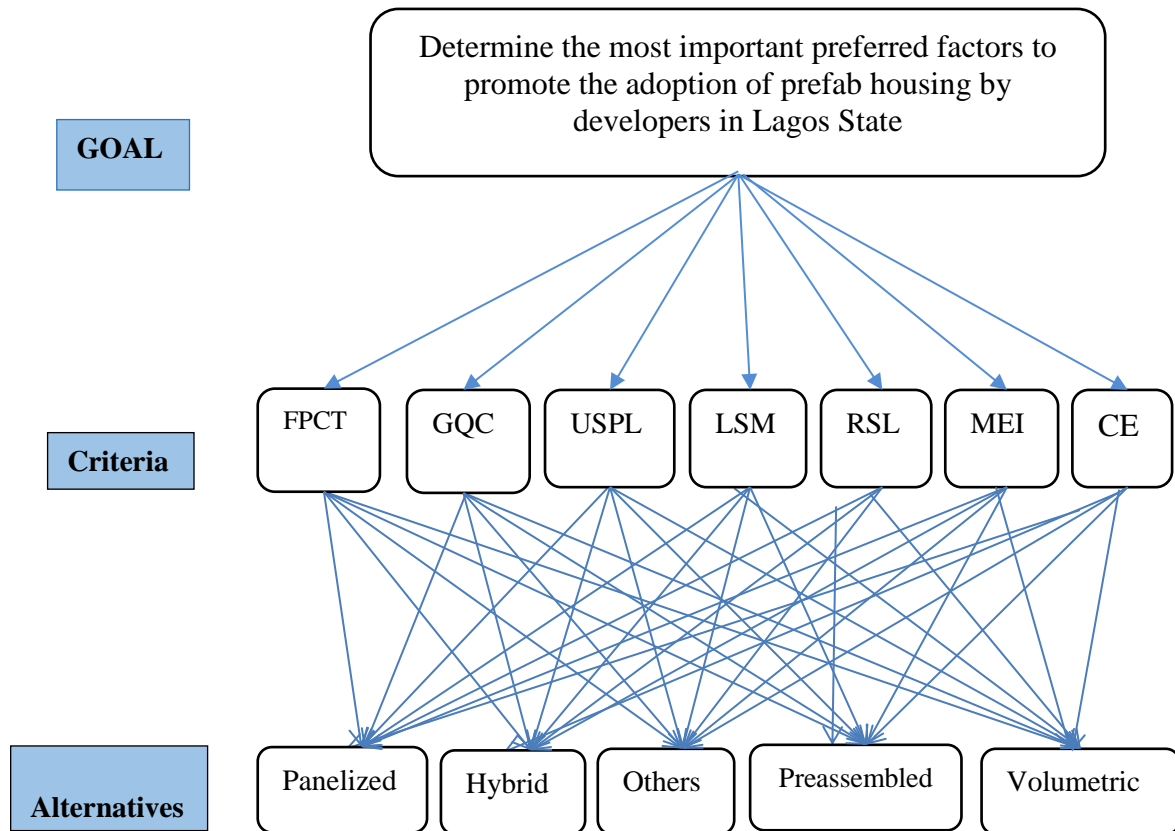


Figure 1 Analytic Hierarchy Process model of the most important preferred factors to promote the adoption of prefab housing by developers in Lagos State

5. Data/model analysis and discussion

5.1 Response rate

Of the 50 questionnaires administered to developers in Lagos State, 38 were correctly filled out and returned resulting in a response rate of 76%.

5.2 Respondent characteristics

The characteristics of the respondents are shown in Table 1.

Table 1
Demographic distribution of respondents

		Frequency	Valid Percentage (%)
Age	20 to below 30 years	14	36.8
	30 to below 40 years	13	34.2
	40 to below 50 years	11	28.9
	Total	38	100
Highest educational qualification	WASC/GCE/NECO	1	2.6
	B.Sc. or equivalent	21	55.3
	M.Sc.	16	42.1
	Total	38	100
What is the staff strength (number of employees) in your organization?	Less than 100	8	21.1
	Above 100	30	78.9
	Total	38	100
What is the volume (number of houses) your company builds per annum?		16	16.2
		9	24.3
		11	29.7
		10	27
		1	2.7
	Total	37	100
Years of work experience	Less than a year	1	2.6
	1 to less than 5 years	7	18.4
	5 to less than 10 years	14	36.8
	10 years and above	16	42.1
	Total	38	100

Our findings, in Table 1 show that the respondents were primarily between 20 to 40 years of age (71.1%), graduates with at least a B.Sc. or equivalent (97.4%), and that the organizations have a staff strength of above 100 (78.9%). Furthermore, they have built from 5 to less than 20 houses per annum (81.1%), and have at least five years of work experience (78.9%).

5.3. Model analysis: Part II

5.3.1 Consistency Index (CI)

The consistency ratios of all of the pairwise comparison matrices were below 0.1, therefore the judgments of the respondents were all consistent and acceptable.

5.3.2 Composite priorities

The priorities for the relative importance of the factors for the adoption of prefab housing by developers in Lagos State and the prefabricated housing systems that are preferred by developers in Lagos State are presented in Tables 2, 3 and 4. The geometric mean composite priorities were obtained by first, inputting the individual judgment of the

developers into Microsoft Excel, and then computing the geometric mean of the priorities that were obtained based on the individual assessments of the developers. Second, the geometric mean of the priorities was input into and analyzed with the SuperDecisions software (see screenshots in Appendix 2). The individual assessments of the developers were obtained from the judgments that were recorded in the relative importance scaled section of the questionnaires that were administered (see Appendix 1). The relative importance scaled questionnaire items were obtained from the judgment model on the SuperDecisions software.

Table 2
Geometric mean composite priorities and relative importance ranking of preferred factors to promote the adoption of prefab housing by developers in Lagos State

Criteria	FPCT	GQC	USPL	LSM	RSL	MEI	CE
Pooled Composite Priority	0.248	0.202	0.110	0.110	0.110	0.110	0.110
Relative Importance Ranking	1	2	5	5	5	5	5

Table 2 shows the relative importance ranking of the factors that determine the adoption of prefab housing by developers in Lagos State. These values were the results that were obtained from the criteria node comparisons with respect to the goal as calculated by the SuperDecisions software. It reveals that the respondents believe that the factor that most determines the adoption of prefab housing by developers in Lagos State is Faster Project Completion Time (FPCT) which had the highest ranking and a pooled composite value of 0.248. This is followed by Greater Quality Control (GQC) with a pooled composite priority of 0.202. Interestingly, after these two factors, they considered all of the other five factors of equal importance, namely Usage of Specialized Production Labor (USPL), and Less Site Material (LSM), Reduced Site Labor (RSL), Minimal Environmental Impact (MEI), and Cost Effectiveness (CE) of equal importance, with pooled composite priorities of 0.110.

Table 3
Geometric mean composite priorities of the prefab housing systems by developers in Lagos State with respect to criteria

Prefab Housing System	CRITERIA						
	FPCT	GQC	USPL	LSM	RSL	MEI	CE
PPS	0.427	0.422	0.236	0.333	0.330	0.425	0.264
HPS	0.218	0.212	0.234	0.167	0.248	0.213	0.201
OPS	0.109	0.120	0.169	0.167	0.140	0.121	0.193
PCPS	0.130	0.140	0.169	0.167	0.140	0.121	0.174
VPS	0.116	0.106	0.192	0.167	0.140	0.121	0.168
Inconsistency	0.051	0.026	.049	0.00	0.013	0.013	0.04

Table 3 gives the geometric mean composite priorities of the preferred prefab housing system by developers in Lagos State with respect to each criterion. These values were obtained by inputting the geometric mean of the judgements of the developers into the SuperDecisions software and then analyzing/synthesizing them. It can be seen that when the alternatives, that is the prefab housing systems, are compared with respect to each criteria, the PPS (panelized prefab system) is ranked highest across all of the criteria, and this is followed by HPS (hybrid prefab system) which is ranked second highest across all of the criteria.

Table 4
Geometric mean composite priorities and relative importance ranking of the preferred prefab housing system by developers in Lagos state

Prefab Housing System	PPS	HPS	OPS	PCPS	VPS
Pooled Composite Priority	0.366	0.214	0.138	0.145	0.137
Relative Importance Ranking	1	2	4	3	5

Table 4 reveals the relative importance ranking of the preferred prefab housing system by developers in Lagos State. These values were obtained from the synthesized final output of the data that was analyzed with the SuperDecisions software. It reveals that the respondents believe that the most preferred prefab housing system by developers in Lagos State is panelized prefab system (PPS) which had the highest ranking and a pooled geometric mean composite priority of 0.366. This is almost twice the pooled composite priority for the hybrid prefab system (HPS) of 0.214, which is the next most preferred prefab housing system by developers in Lagos State. This is followed by preassembled completed prefab system (PCPS) with a pooled composite priority of 0.145. This is closely followed by other prefab systems (OPS) and volumetric prefab systems (VPS), with pooled composite values of 0.138 and 0.137, respectively.

5.3.3 Sensitivity analysis

A sensitivity analysis was done for all of the seven criteria, and the results revealed that the panelized prefab system (PPS) and the hybrid prefab system (HPS) were always the best. However, as the importance of cost effectiveness (CE) increases, the prefab systems became almost equally preferred with only the panelized prefab system (PPS) remaining as the most preferred. Figures 2 and 3 show the sensitivity graphs for two criteria. The screen shots of the sensitivity analysis graphs for all of the criteria are presented in Appendix 3.

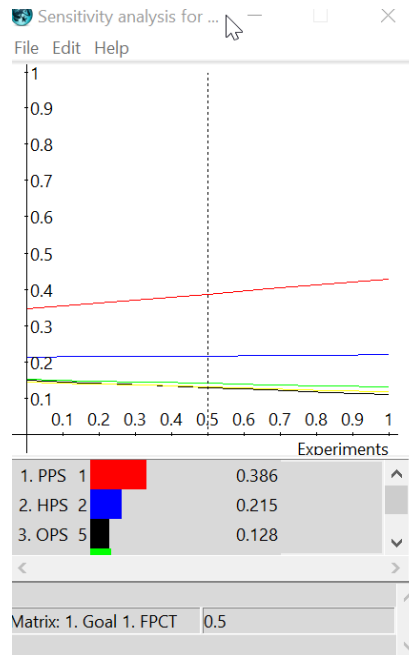


Figure 2 Sensitivity graph for FPCT (Faster Project Completion Time) criterion

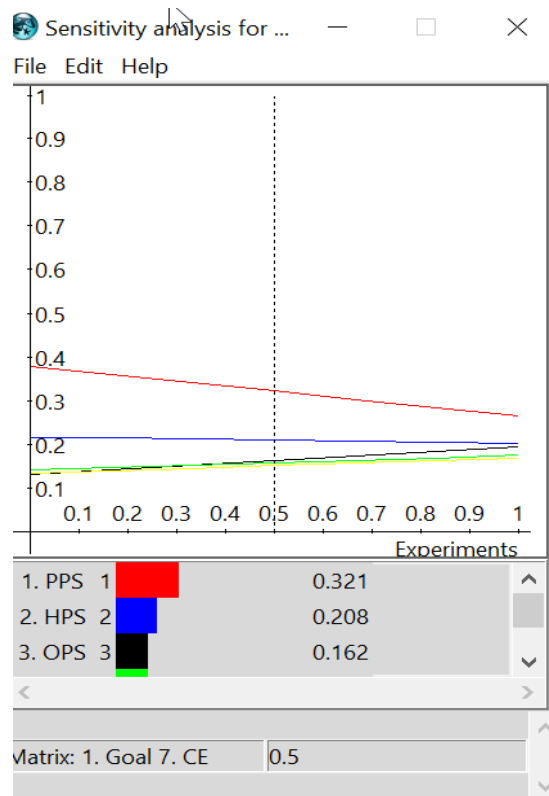


Figure 3 Sensitivity graph for CE (Cost Effectiveness) criterion

6. Conclusions

Based on our findings, it can be concluded that the relative importance of factors that can promote the adoption of the prefab housing technology by developers in Lagos State is as follows: Faster Project Completion Time (FPCT - 0.248) ranks first, Greater Quality Control (GQC - 0.202) ranks second, and other factors such as Usage of Specialized Production Labor (USPL - 0.110), Less Site Material (LSM - 0.110), Reduced Site Labor (RSL - 0.110), Minimal Environmental Impact (MEI - 0.110), and Cost Effectiveness (CE - 0.110) all have an equal rank. Also, the most adoptable prefab system by developers in Lagos State is the panelized prefab system (PPS). The strategy that will promote the adoption of prefab housing by developers in Lagos State is to allocate 24.8% of the resources to ensure that the project is completed on time, 20.2% of resources should be used to ensure greater quality control and the remaining 55% of the resources should be shared equally (11% each) to ensure that specialized labor is used, less site materials are used, reduction in site labor, minimal environmental impact and cost effectiveness.

The conclusions from our study further buttress the fact that the AHP methodology can be successfully applied to solve a wide variety of complex decision making problems in the built environment and other contexts.

Therefore, to promote the adoption of the prefab housing by developers in Lagos State it is recommended that:

- a. The Lagos State government should put in place adequate infrastructure to ensure that developers who adopt the prefab system can complete their projects on time.
- b. Developers should invest in systems that will enable them to complete their projects on time and also have better quality control strategies.
- c. The Lagos State government should encourage entrepreneurial development in panelized prefab system components building by putting in place relevant policies.
- d. The Lagos State government should also develop an infrastructure that enables panelized prefab system developments both at the state and national levels.
- e. Financial institutions should also make facilities available to encourage investment in the prefab housing industry.
- f. Tertiary educational institutions in Lagos State should include prefab housing systems in their architecture curriculum at the undergraduate and postgraduate levels.

In addition, for future research, the scope of this study could be broadened by replicating it and performing a comparative study across all built environment professionals.

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APPENDIX 1

Questionnaire

University of Lagos

Akoka-yaba, Lagos

Date:

Dear Respondent,

REQUEST FOR INFORMATION

We are academics at the University of Lagos conducting a study on: **Determining a Strategy for the Adoption of Prefabricated Housing by Developers in Lagos State: An AHP Approach.** Prefabrication is the production of building components or even the whole building in a specialized facility usually located off-site and later transported to the building site for installation. The AHP (Analytic Hierarchy Process) is an operations research model that enables decision makers to rank items in order of relative importance, and it results in both quantitative and qualitative outcomes. This model is based on the following:

Goal = Determine prefab housing adoption factors for developers in Lagos State

Criteria = The most popular evaluative criteria for the adoption of the prefab system as identified in a study by Adebayo and Ogbechi (2017a) are: Faster Project Completion Time (FPCT), Greater Quality Control (GQC), Usage of Specialized Production Labor (USPL), Less Site Material (LSM), Reduced Site Labor (RSL), Minimal Environmental Impact (MEI), and Cost Effectiveness (CE).

Alternatives = The prefabricated housing systems that are marketable to consumers in Lagos State as identified in previous studies by Adebayo and Dixon-Ogbechi, 2017b) are:

Panelized Prefab System (PPS): These are prefab units produced in a factory and assembled on-site to produce a three dimensional structure.

Hybrid Prefab System (HPS): This is a combination of both the volumetric/pod and panel systems.

Other Prefab Systems (OPS): These are also called casements. They are prefab units that include floor cassettes, roof cassettes, pre-cast concrete foundation assemblies, pre-formed wiring looms and mechanical engineering composites.

Preassembled Completed Prefab System (PCPS): These are prefab systems in which the panels come with fittings and in some cases, other finishing like paint. They are assembled on site to form complete buildings.

Volumetric Prefab System (VPS): These are prefab houses in which the building is manufactured in units of three dimensional modules (pod) in controlled factory conditions prior to transport to site which include: toilet pod, kitchen pod, electrical pod, lift pod.

This study is being undertaken for purely academic and applied research purposes. Kindly assist by objectively completing the following questionnaire. The information obtained will be treated with utmost confidentiality. While thanking you in anticipation of your co-operation and sincere responses, we remain,

Yours faithfully,

Dixon-Ogbechi, Bolajoko N. (08077525263)

Adebayo Anthony Kayode (08096592878)

RESEARCH QUESTIONNAIRE

PART 1: RESPONDENTS' CHARACTERISTICS

Instruction: kindly tick (√) the appropriate option or fill in your response in the spaces provided.

- 1. Sex: a. Male () b. Female ()

- 2. Age:
 - a. Below 20 years () b. 20 to below 30 years () c. 30 to below 40 years ()
 - d. 40 to below 50 years () e. 50 years and above ()

- 3. Marital status:
 - a. Single () b. Married () c. Divorced ()
 - d. Separated () e. Widow/er () f. Others (Please specify).....

- 4. Religion:
 - a. Christian () b. Muslim () c. Others (Please specify).....

- 5. Highest educational qualification.
 - a. WASC/GCE/NECO () b. B.Sc. or equivalent ()
 - c. M.Sc. () d. Ph.D. ()
 - e. Others () (Please specify).....

- 6. What staff strength (number of employees) does your organization have?
.....
.....

- 7. What is the volume (number of houses) your company builds per annum?
 - a. Less than 5 ()
 - b. 5 to less than 10 ()
 - c. 10 to less than 15 ()
 - d. 15 to less than 20 ()
 - e. 20 and above. ()

- 8. Position held in your organization:

- 9. Years of working experience:
 - a. Less than a year ()
 - b. 1 to less than 5 years ()
 - c. 5 to less than 10 years ()

d. 10 years and above. ()

**PART II: DATA ON RELEVANT VARIABLES
RELATIVE IMPORTANCE SCALED QUESTIONS**

The following questions are aimed at investigating **the relative importance of factors that can promote the adoption of the prefab housing technology by developers in Lagos State** using the Analytical Hierarchy Process. They require your input, and we sincerely desire your opinion in assigning values to the questions asked based on the explanation box below.

EXPLANATION BOX

Verbal Scale & Numerical Values	Verbal Scale & Numerical Values
Equally important = 1	Equally important = 1
Fairly Moderately more important = 2	Fairly Moderately less important = -2
Moderately more important = 3	Moderately less important = -3
Fairly Strongly more important = 4	Fairly Strongly less important = -4
Strongly more important = 5	Strongly less important = -5
Fairly Very strongly more important = 6	Fairly Very strongly less important = -6
Very strongly more important = 7	Very strongly less important = -7
Fairly Extremely (absolutely) more important = 8	Fairly Extremely (absolutely) less important = -8
Extremely (absolutely) more important = 9	Extremely (absolutely) less important = -9

Note: *When the elements are placed in matrix form, by convention the comparison of strength is always of an activity appearing in the column on the left against an activity appearing in the column on the right.*

Criteria Explanation

The most popular evaluative criteria for the adoption of the prefab system as identified in a study by Adebayo and Ogbechi (2017a) are:

- FPCT:** Faster Project Completion Time; **GQC:** Greater Quality Control.
USPL: Usage of Specialized Production Labor; **LSM:** Less Site Material.
RSL: Reduced Site Labor; **CE:** Cost Effectiveness
MEI: Minimal Environmental Impact.

Alternatives (Types of Prefabricated Housing Systems) Explanation

The prefabricated housing systems that are marketable to consumers in Lagos State as identified in previous studies by Adebayo and Dixon-Ogbechi, 2017b) are:

- PPS:** Panelized prefab system; **HPS:** Hybrid prefab system,
OPS: Other prefab systems; **PCPS:** Preassembled completed prefab system
VPS: Volumetric (Pod) prefab system

INSTRUCTION: Given the above explanations, kindly indicate the relative importance of the factors/systems listed below by kindly ticking (√) the value you choose in the empty space in each cell.

A. PREFAB ADOPTION FACTORS FOR DEVELOPERS CRITERIA WITH RESPECT TO GOAL

INSTRUCTION: Kindly tick (√) your value on the relative importance of factors that can promote the adoption of the prefab housing technology by developers in Lagos State by comparing the factors listed on the left side against the ones on the right side where 9.5 is the highest and -9.5 is the lowest as indicated on the explanation box given earlier.

	>= 9.5	9	8	7	6	5	4	3	2	1	-2	-3	-4	-5	-6	-7	-8	-9	>=- 9.5	
FPCT																				GQC
FPCT																				USPL
FPCT																				LSM
FPCT																				RSL
FPCT																				MEI
FPCT																				CE
GQC																				USPL
GQC																				LSM
GQC																				RSL
GQC																				MEI
GQC																				CE
USPL																				LSM
USPL																				RSL
USPL																				MEI
USPL																				CE
LSM																				RSL
LSM																				MEI
LSM																				CE
RSL																				MEI
RSL																				CE
MEI																				CE

B. PREFAB ADOPTION FACTORS FOR DEVELOPERS CRITERIA WITH RESPECT WRT Faster Project Completion Time (FPCT)

Kindly tick (√) your rating of the importance of Faster Project Completion Time (FPCT) in the selection of prefab housing system in Lagos State by comparing the prefab housing system listed on the left side against the ones on the right side where 9.5 is the highest and -9.5 is the lowest as indicated on the explanation box given earlier.

	>= 9.5	9	8	7	6	5	4	3	2	1	-2	-3	-4	-5	-6	-7	-8	-9	>=- 9.5	
PPS																				HPS
PPS																				OPS
PPS																				PCPS
PPS																				VPS
HPS																				OPS
HPS																				PCPS
HPS																				VPS
OPS																				PCPS
OPS																				VPS
PCPS																				VPS

C. PREFAB ADOPTION FACTORS FOR DEVELOPERS CRITERIA WITH RESPECT WRT Greater Quality Control (GQC)

Kindly tick (√) your rating of the importance of Greater Quality Control (GQC) in the selection of prefab housing system in Lagos State by comparing the prefab housing system listed on the left side against the ones on the right side where 9.5 is the highest and -9.5 is the lowest as indicated on the explanation box given earlier.

	>= 9.5	9	8	7	6	5	4	3	2	1	-2	-3	-4	-5	-6	-7	-8	-9	>=- 9.5	
PPS																				HPS
PPS																				OPS
PPS																				PCPS
PPS																				VPS
HPS																				OPS
HPS																				PCPS
HPS																				VPS
OPS																				PCPS
OPS																				VPS
PCPS																				VPS

D. PREFAB ADOPTION FACTORS FOR DEVELOPERS CRITERIA WITH RESPECT WRT Usage of Specialised Production Labour (USPL)

Kindly tick (√) your rating of the importance of Usage of Specialized Production Labor (USPL) in the selection of prefab housing system in Lagos State by comparing the prefab housing system listed on the left side against the ones on the right side where 9.5 is the highest and -9.5 is the lowest as indicated on the explanation box given earlier.

	>= 9.5	9	8	7	6	5	4	3	2	1	-2	-3	-4	-5	-6	-7	-8	-9	>=- 9.5	
PPS																				HPS
PPS																				OPS
PPS																				PCPS
PPS																				VPS
HPS																				OPS
HPS																				PCPS
HPS																				VPS
OPS																				PCPS
OPS																				VPS
PCPS																				VPS

E. PREFAB ADOPTION FACTORS FOR DEVELOPERS CRITERIA WITH RESPECT WRT Less Site Material (LSM)

Kindly tick (√) your rating of the importance of Less Site Material (LSM) in the selection of prefab housing system in Lagos State by comparing the prefab housing system listed on the left side against the ones on the right side where 9.5 is the highest and -9.5 is the lowest as indicated on the explanation box given earlier.

	>= 9.5	9	8	7	6	5	4	3	2	1	-2	-3	-4	-5	-6	-7	-8	-9	>=- 9.5	
PPS																				HPS
PPS																				OPS
PPS																				PCPS
PPS																				VPS
HPS																				OPS
HPS																				PCPS
HPS																				VPS
OPS																				PCPS
OPS																				VPS
PCPS																				VPS

F. PREFAB ADOPTION FACTORS FOR DEVELOPERS CRITERIA WITH RESPECT WRT Reduced Site Labour (RSL)

Kindly tick (✓) your rating of the importance of Reduced Site Labor (RSL) in the selection of prefab housing system in Lagos State by comparing the prefab housing system listed on the left side against the ones on the right side where 9.5 is the highest and -9.5 is the lowest as indicated on the explanation box given earlier.

	>= 9.5	9	8	7	6	5	4	3	2	1	-2	-3	-4	-5	-6	-7	-8	-9	>=- 9.5	
PPS																				HPS
PPS																				OPS
PPS																				PCPS
PPS																				VPS
HPS																				OPS
HPS																				PCPS
HPS																				VPS
OPS																				PCPS
OPS																				VPS
PCPS																				VPS

G. PREFAB ADOPTION FACTORS FOR DEVELOPERS CRITERIA WITH RESPECT WRT Minimal Environmental Impact (MEI)

Kindly tick (✓) your rating of the importance of Minimal Environmental Impact (MEI) in the selection of prefab housing system in Lagos State by comparing the prefab housing system listed on the left side against the ones on the right side where 9.5 is the highest and -9.5 is the lowest as indicated on the explanation box given earlier.

	>= 9.5	9	8	7	6	5	4	3	2	1	-2	-3	-4	-5	-6	-7	-8	-9	>=- 9.5	
PPS																				HPS
PPS																				OPS
PPS																				PCPS
PPS																				VPS
HPS																				OPS
HPS																				PCPS
HPS																				VPS
OPS																				PCPS
OPS																				VPS
PCPS																				VPS

H. PREFAB ADOPTION FACTORS FOR DEVELOPERS CRITERIA WITH RESPECT WRT Cost Effectiveness (CE)

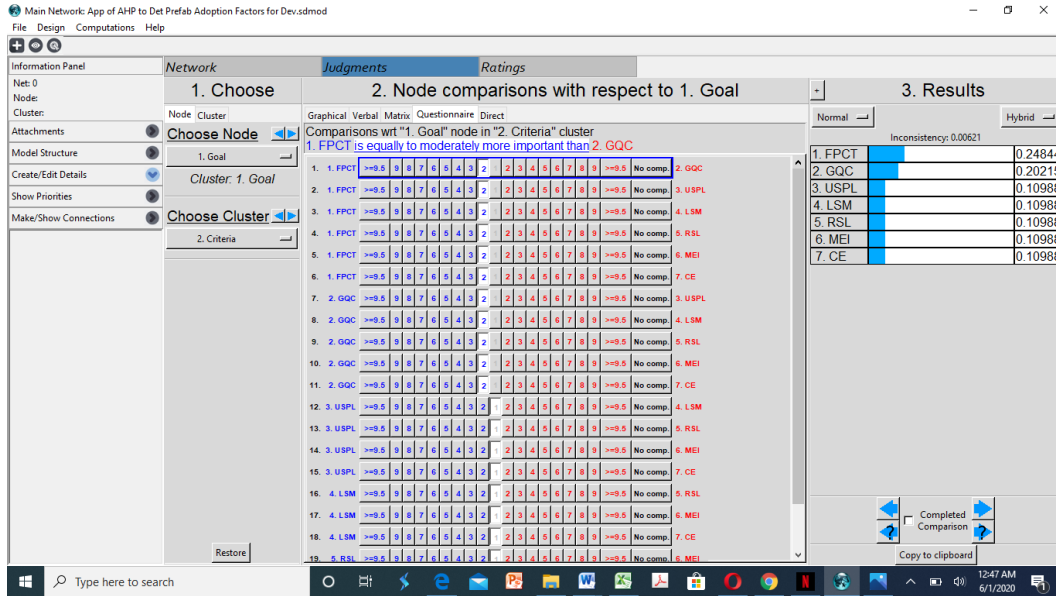
Kindly tick (√) your rating of the importance of Cost Effectiveness (CE) in the selection of prefab housing system in Lagos State by comparing the prefab housing system listed on the left side against the ones on the right side where 9.5 is the highest and -9.5 is the lowest as indicated on the explanation box given earlier.

	>= 9.5	9	8	7	6	5	4	3	2	1	-2	-3	-4	-5	-6	-7	-8	-9	>=- 9.5	
PPS																				HPS
PPS																				OPS
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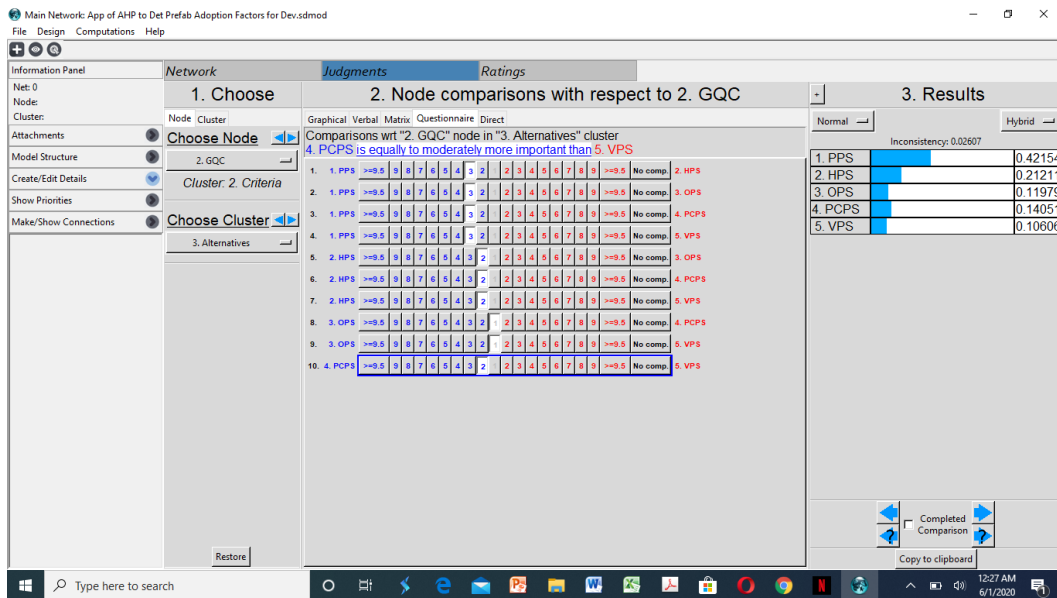
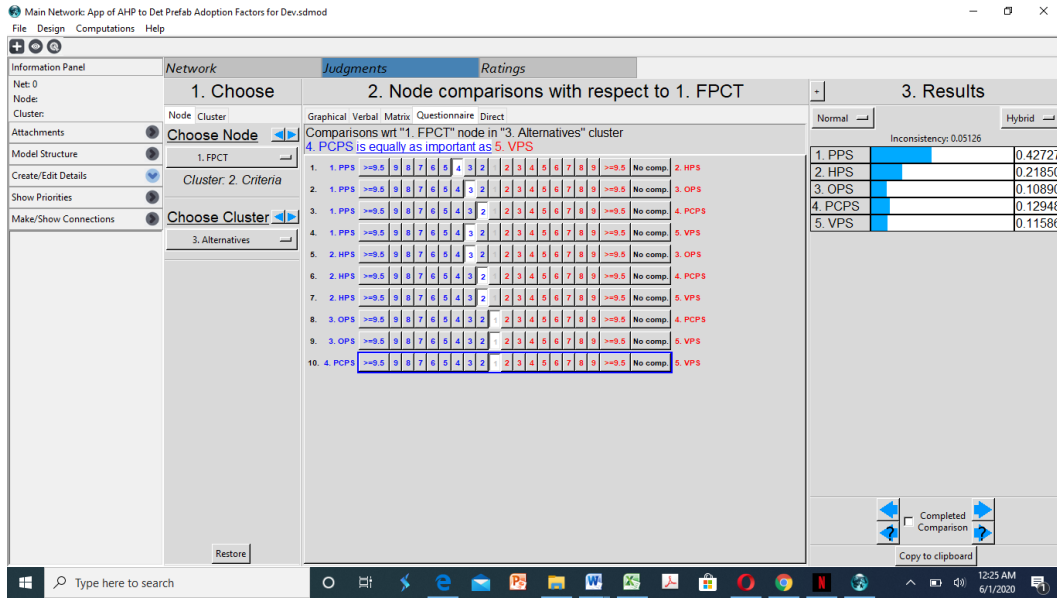
Thank you.

APPENDIX 2

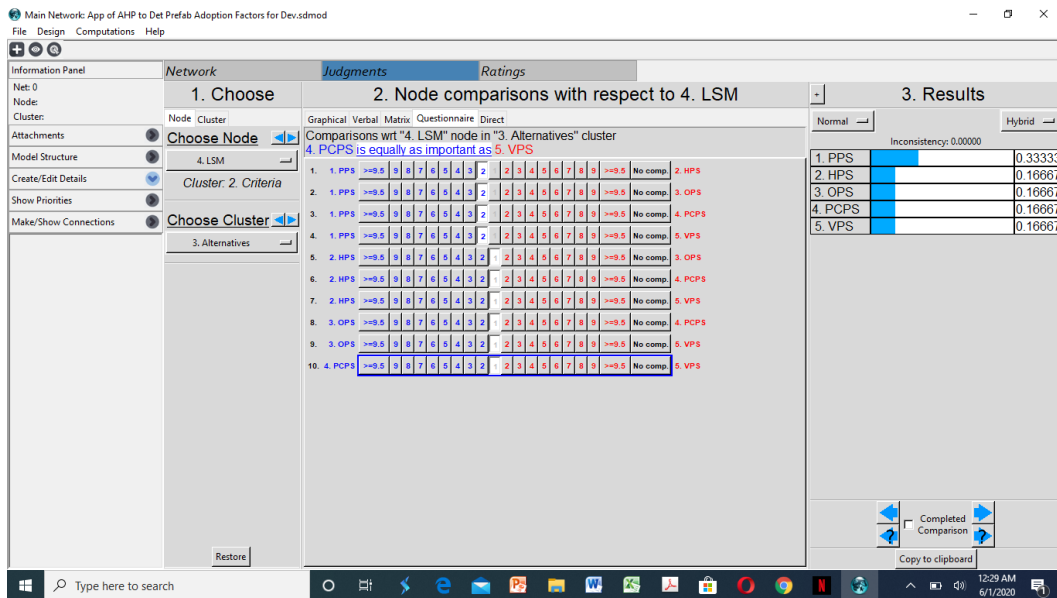
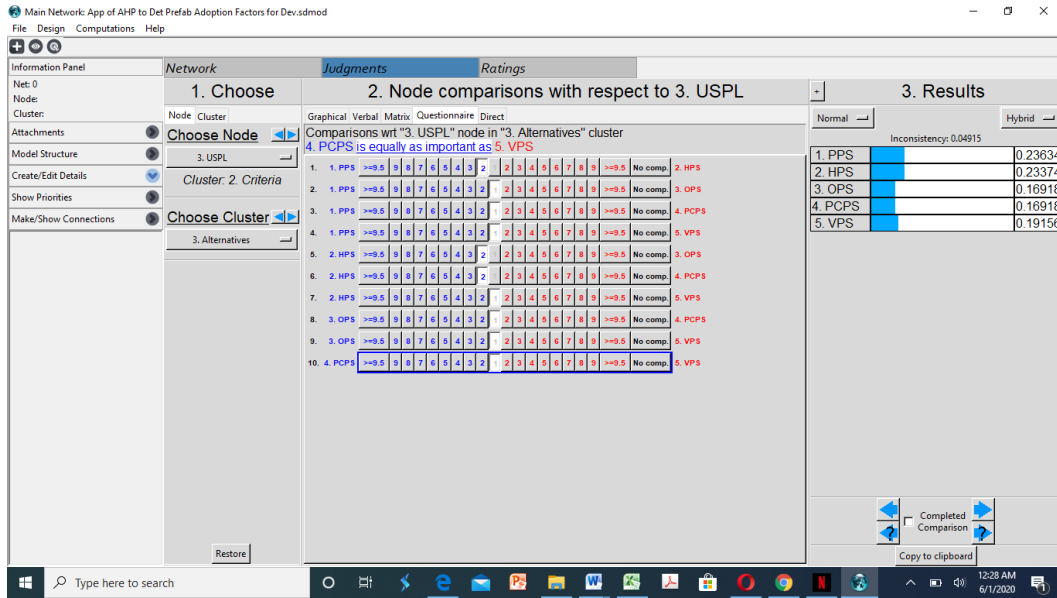
Screenshots of SuperDecisions Software Analysis



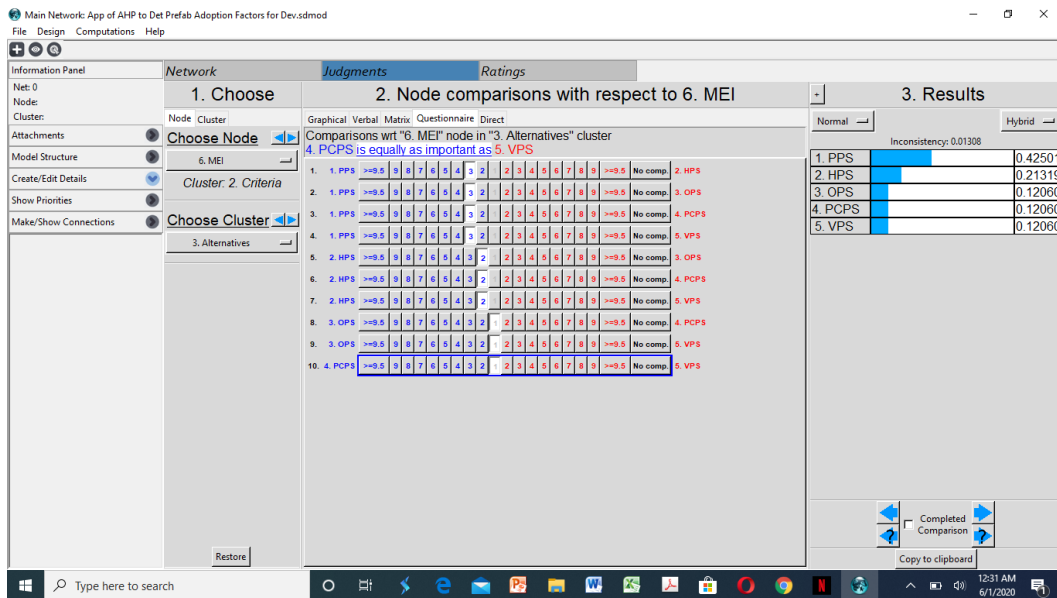
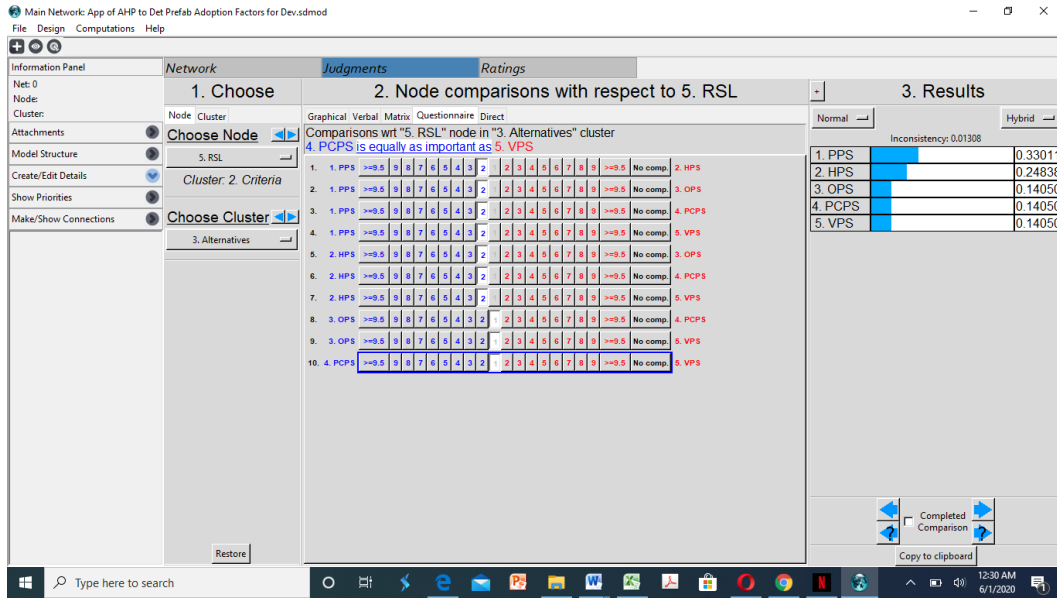
IJAHP Article: Dixon-Ogbechi, Adebayo /Application of the AHP model to determine prefab housing adoption factors for developers in Lagos State



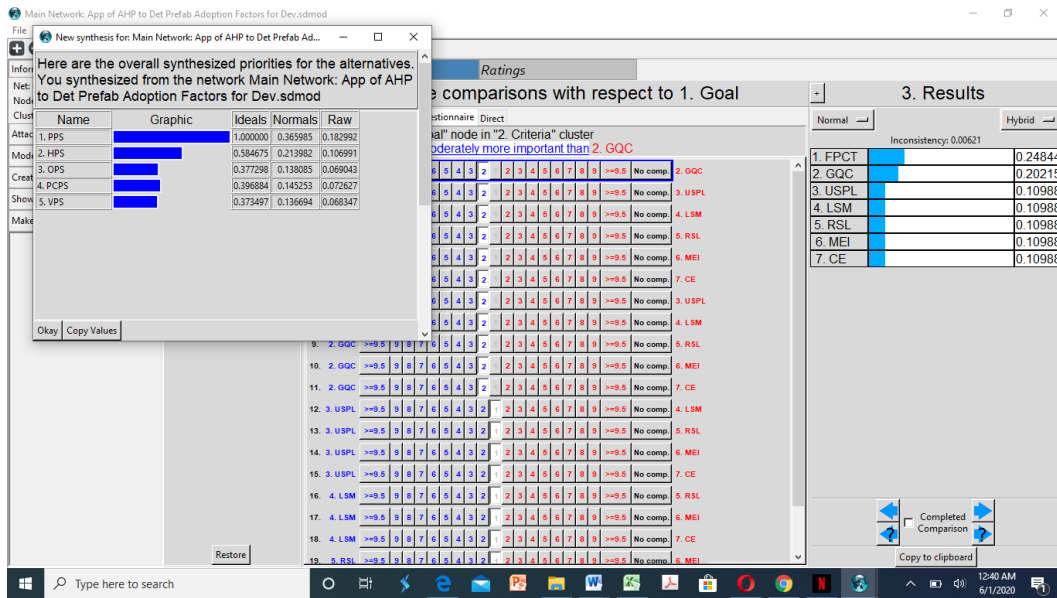
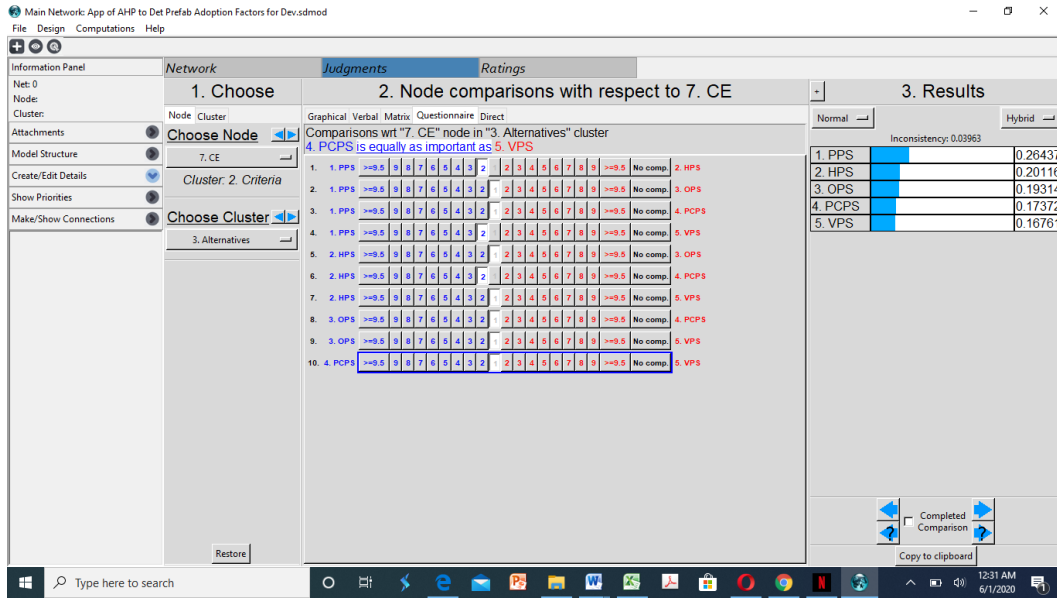
IJAHP Article: Dixon-Ogbechi, Adebayo /Application of the AHP model to determine prefab housing adoption factors for developers in Lagos State



IJAHP Article: Dixon-Ogbechi, Adebayo /Application of the AHP model to determine prefab housing adoption factors for developers in Lagos State

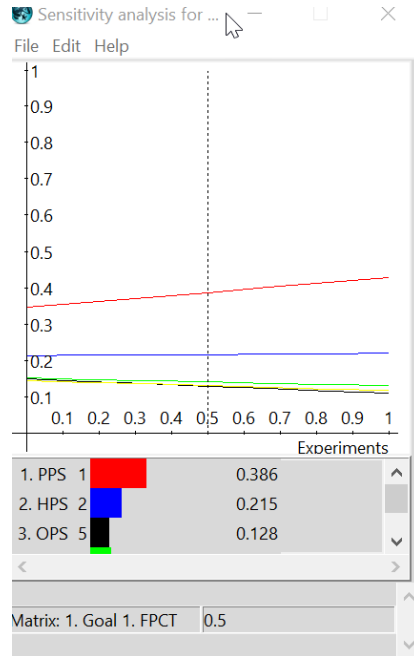


IJAHF Article: Dixon-Ogbechi, Adebayo /Application of the AHP model to determine prefab housing adoption factors for developers in Lagos State

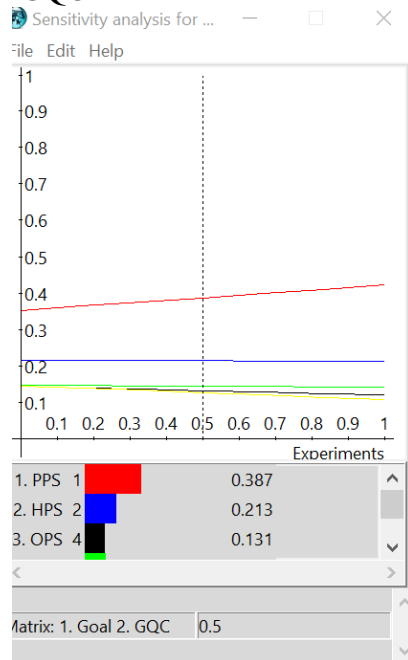


APPENDIX 3 Sensitivity Graphs

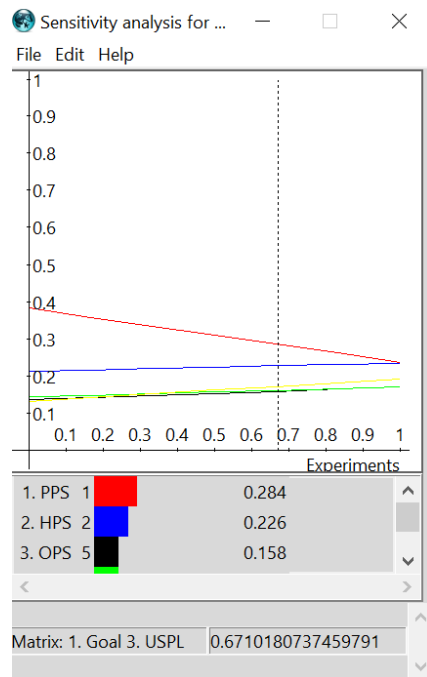
1. FPCT



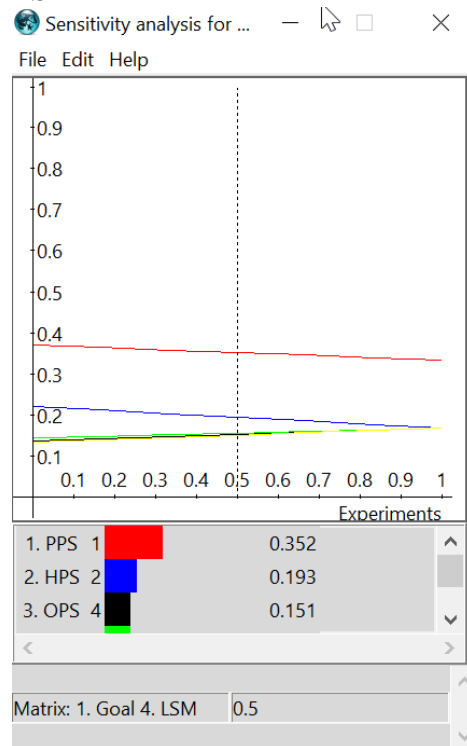
2. GQC



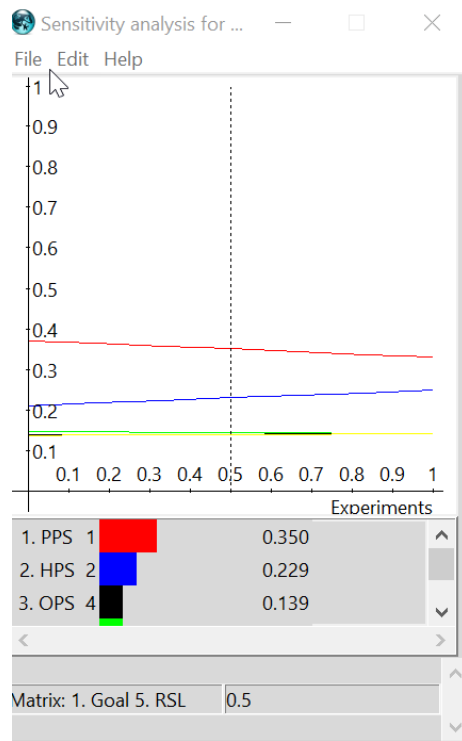
3. USPL



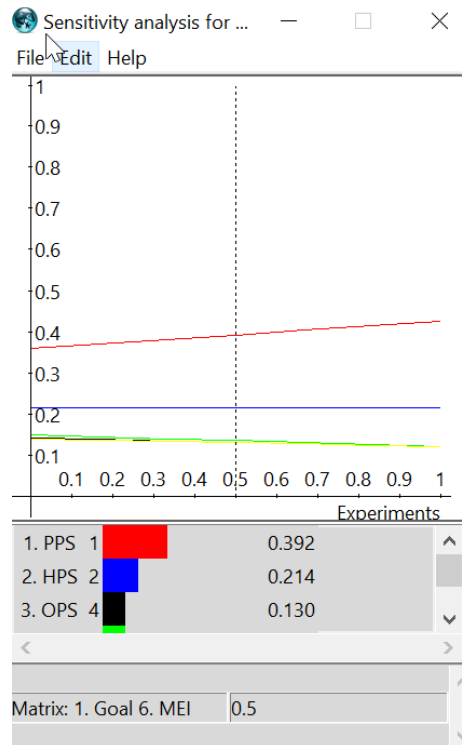
4. LSM



5. RSL



6. MEI



7. CE

