

APPLICATION OF INDUSTRIALIZED BUILDING SYSTEM: A CASE STUDY IN KANO STATE, NIGERIA

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ABSTRACT: Development of infrastructures are needed due to the growing population, increasing demand for housing and other building activities and the improvement in the quality of life of the populace. This study has been conducted with the aim to capture the perspective of Nigerian construction industries on the industrialized building system (IBS), specifically in Kano State. The methods adopted for this study comprises of interview session with 5 expert respondents and questionnaire survey with 73 respondents of professionals within the Nigerian construction industries. Data obtained was analyzed using content, frequency and factor analysis through SPSS software. Research findings shows that majority of the construction industry in Kano are commonly practicing traditional cast on site method and IBS implementation is considered in early stage. The setback of IBS application in Kano found from this study is due to insufficient IBS manufacturer, unfamiliarity and resistance to change, enormous capital cost and lack of government interest. In order to overcome these barriers, majority of the respondents agreed that improving the educational curriculum and adopting intensive training for the related parties will help in improving IBS implementation in Kano state and indirectly to Nigeria. The study further concludes that Government support and increase awareness on IBS benefits will result in successful IBS implementation in the state.

Keywords: Industrialized building system, Nigeria, Content analysis, Frequency analysis, Factor analysis

1. INTRODUCTION

The construction industry plays a vital role in the wheel propelling the Nigerian economy. The continuously problems faced by Nigerian construction industry, includes poor performance of time and cost, poor productivity, failed structures, unequitable and unjustified contractors and consultants, too much reliance on foreign skills and workers and much more [1].

Nigeria, just like any other developing country, considers the construction industry as one of the main contributors to its Gross Domestic Product (GDP). It influences the country's economic activity, adds up to government revenue, creates investment benefits and provides employment opportunity to specially trained workers. The construction industry plays an essential role in the economic development of any developing nation [2], and especially in an expanding economy like Nigeria [3], [4]). Okeola [5] averred that at least 50% of the investment in various development plans is primarily in construction and the industry is the next employer of labour after agriculture in underdeveloped countries.

The population of Nigeria is about 186.9 million (2016) and with a claim of about 17 million housing

deficit, the country will continue to embark on developing an affordable and sustainably low and medium house. Furthermore, infrastructures are needed due to the growing population, the increasing demand for construction witnessed shall continue as long as the population increases and there is improvement in the quality of life of the populace. Meeting the infrastructural needs of Nigeria within the framework of sustainable development will require that new technology and sustainable strategies to be adopted.

Despite lots of problems faced by Nigeria, the need for infrastructures for the growing populace is one of the problems, implementing IBS to help in overcoming such problems. The outlook for IBS implementation in Nigeria is bright, but great work is still needed from both the government and individuals to be able to adopt IBS construction method. Therefore, this research is focused on determining the implementation of IBS and how it can be improved to solve the infrastructure and housing needs in Nigeria.

The aim of this study is to capture the Nigerian construction industry player's perception of Industrialized Building System (IBS) application in Kano State. To accomplish this particular aim, several case objectives are outlined, which are:

- i. To identify the current IBS implementation in Nigeria.
- ii. To determine the barriers and issues regarding lack of IBS application in Nigeria.
- iii. To develop strategies on improving the application of Industrialized Building System in Nigeria, particularly in the state of Kano.

2. LITERATURE REVIEW

2.1 Industrialized Building System

The Industrialized Building System (IBS) is a term used for a technique of construction where by components are manufactured in a controlled environment, either at site or off site, placed and assembled into construction works.

Various researchers defined IBS base on their position and philosophy, but the common view among most authors is that they define it on either a technique or a process. Summary of these definitions based on the latter is presented in Table1.

Table 1 The Ontology of Building System

No.	Authors	Process	Techniques
1	CIDB (2003)	x	
2	Lessing (2005)	x	
3	Marsono (2006)	x	
4	Rahman & Omar (2006)		x

2.2 Barriers of Industrialized Building System

There are problems faced in the implementation of IBS. The construction requires high initial investment capital purposely for machineries, steel mold, foreign technology, transportation and the wages of skilled workers for the installation process. According to Ng (2006) [6], there is lack of research and inadequate knowledge of IBS. He posited that the lack of knowledge leads also to another barrier of IBS adoption which is high construction cost.

The major barriers restricting the use of IBS between contractors were seen to be high capital investment, difficulties in achieving economies of scale, inability to freeze design early and complex interfacing, and lack of knowledge and expertise in IBS. Other than that, the level of information technology (IT), building regulation, and code and standard is also included, however, this factor is not seen fitting to contractors [7].

Hassim et al., pointed out the reversal of role in an IBS project a contractor just acts as an assembler of building components instead of building. This

made more imperative for contractors to be equipped technologically with IBS knowledge and skill if they were to promote their IBS products and compete in the industry [8]. The IBS require more skill from the workers when compared to the conventional construction methods. Unlike the latter, the skills required in IBS are more machine-oriented on and off sites (in factories). According to Hamid et al. [9], this leads to a transformation requiring the education and training of human resource in an organization.

2.3 Construction Industry in Nigeria and Need for IBS

Organized building practices in Nigeria dates back to the 1930s when the very few construction activities of significance in the country were handled by the Public Works Department (PWD) and the Royal Army Engineers which was later transformed into the Nigerian Army Engineers. Direct labor was the mode of construction project delivery at this time. Construction contracting in Nigeria began in the 1940s with a few British and Italian companies coming into operation [10]. Nigeria's independence in 1960 brought an upward trend in construction activities and until the late sixties, most of the available construction organizations were over-stressed with contracts. The 'oil boom' that followed about 10 years after Independence led to an upsurge in construction and demand for construction services, as the country at that period opened up to foreign and local investments and the obvious needs for infrastructure to drive economic growth.

The IBS which is practiced but just mostly in some areas developed two decades back. It is quite into practice in the capital city and some of the main cities. However, IBS is mostly applied in bridge construction. Majority of projects done under IBS construction method are bridges, high rise buildings and housing estates. Figure 1 illustrates a bridge recently completed in 2015 using the modern means of construction. The bridge covers over 780 metres and was completed within a short period of time and it was one of its kind in the history of infrastructural projects in Kano state.



Fig. 1 Dr. Rabi'u Musa Kwankwaso Bridge in Kano

2.4 Development of IBS in Kano State

Kano is one of the thirty-six states or thirty-seven including the Federal Capital Territory of Nigeria and it is located on the northern part of Nigeria, more specific north western part. Kano State is the state with highest population in Nigeria with a population of over 11million people. Major economic sources in Kano are manufacturing, agriculture, construction, tourism and commercial activities which is the most common just as the state motto denotes “centre of commerce”. Although, construction industry in Kano is not as vast as in other states within Nigeria, but it is very important in the development of other industries.

Kano metropolis alone requires large amount of housing due to the teaming population in the state. The state, according to 2016 statistics, is the most populous state in the country with the major commercial, industrial, administrative and religious centre [11]. Therefore, with the growth of commercial and industrial activities and the corresponding increase in population, there arises a gradual demand for land and housing [11]). In Nigeria (Kano inclusive), governments have made several efforts to improve housing delivery. These efforts include the establishment of the Federal Mortgage Bank; Federal Housing Authority; policy pronouncement and provisions in the Third National Development Plan 1975-1980 to spur large scale activity in housing delivery by government at all levels; the introduction of public-private partnership in housing; provision of licenses to primary mortgage institutions in the year 2000; and private real estate developers from 2000 to date. Despite these efforts, there remains a huge gap between the available housing stock and the need for the houses [12].

Factors affecting the constraints and challenges militating against housing provision in Kano city are mostly related to the economic and political environment, the building costs, accessibility to land and lack of finance [11]. Apart from that, project completion delay is also a major concern which needs to be addressed in maintaining the construction performances [13].

IBS offers a lot of benefits and believed to enhance the performances of construction, although the number of IBS projects in Kano is quite small. It is, therefore, essential to study the perception of industrialized building system to get the general motivation thereby to help in improving the industry by enhancing and implementing the IBS in construction.

3. METHODOLOGY

This research was conducted through survey

following the interview and questionnaire instruments. The summary of the method, instrument and types of analysis are summarized in Table 2.

Table 2 Research methods and types of analysis

Objectives	Method	Instrument	Type of Analysis
Respondent Background	Survey	Interview	Content Analysis
		Questionnaire	Frequency Analysis
First Objective	Survey	Interview	Content Analysis
Second Objective	Survey	Interview	Content Analysis
		Questionnaire	Mean & Factor Analysis
Third Objective	Survey	Interview	Content Analysis
		Questionnaire	Mean & Factor Analysis

3.1 Questionnaire Design

The survey was devised to contain areas affiliated to the perception of respondent on IBS application. More also, background information and experience in construction of respondents are put into consideration.

The questionnaire survey forms comprise of four main parts. The first part, i.e. Part A covers the personal information of respondents and experience in construction. Participation on IBS application are marked out in the second part, i.e. Part B, while the third part, Part C is related to problems and barriers identified associated to IBS application in Kano. Lastly, Part D is on the ways and strategies to overcome and improve the implementation of IBS in Kano State.

Method used to analyze the answers of the questionnaire data are designed based on Likert's Scale of five ordinal measurement of agreement towards each statement (from 1 to 5).

3.2 Interviews

Interview method was applied in order to get clearer information as the questionnaire survey questions is confined and also to validate the output of the questionnaire. The questions were prepared

in written form and are open-type questions related to IBS application in Kano. Five respondents have been chosen for the interview session, the questions that was presented during the interview was provided in advance to each of the selected panels. Through face-to-face interview, the researcher was able to encourage the panels to elaborate more on the questions asked, and allowing them to express their view beyond that has been asked. The interview has been conducted within a controlled time so as not to take much time of the respondent. The questions are as follows:

- i. What is/are the current construction method(s) practiced in Kano and what is/are the advantage(s) and disadvantage(s) of this construction method?
- ii. Are you aware of Industrialized Building System (IBS) and do you think Nigeria need to implement or improve IBS construction method?
- iii. In your own view what is/are the main advantage(s) of IBS?
- iv. What is/are the barrier(s) or the main problem(s) regarding lack of IBS implementation?
- v. What is/are your own suggestion(s) on how to improve the implementation of IBS?

3.3 Selection of Respondents

The selection of respondent in this study are the main groups in construction industries such as developers, consultants and contractors around Kano state. This includes civil engineers, architects, builders and quantity surveyors. The respondents are such that, all are currently practicing their respective profession in the construction industries. Respondents with professional registration are mostly preferred. This is done so that the feedback received would meet the objective of the study. Appropriate respondents for the interview have been identified based on their experience and knowledge on IBS.

3.4 Data Analysis Method

The method developed to analyze the data in this research is by the use of computer software, which is Statistical Package for Social Science (SPSS) and Microsoft Excel. SPSS is among the best statistical software and are commonly used by researchers to analyze data, whereas MS Excel is used in plotting graphs. In this study, SPSS was used to analyze the variables of frequency and average score from the data inserted using the SPSS Data Editor Window. The process of entering the data can be done directly from the questionnaire whereby each question is to be considered as a variable.

The respondent background analysis for both

interview and questionnaire was analyzed using content analysis and frequency analysis respectively. Content analysis is used for the interview data to achieve the first objective. Moreover, with the use of SPSS, mean analysis was carried out to determine the mean score of each question from the questionnaire, and factor analysis was carried out to determine which variables falls under which factors and which variables are to be removed from the questionnaire in order to achieve the second and third objectives of the research.

Factor Analysis is an explorative analysis. Much like the cluster analysis grouping similar cases, the factor analysis group's similar variables into dimensions. This process is also called identifying latent variables. The factor analysis can be used as a data reduction tool, removing redundancy or duplications from a set of correlated variables and also represent correlated variables with a smaller set of derived variables.

Factor analysis for this study is done using the SPSS software, the general steps in carrying out factor analysis are as follows:

- i. Collect and explore data: choose relevant variables
- ii. Extract initial factors (via principal components)
- iii. Choose number of factors to retain
- iv. Choose estimation method, estimate model
- v. Rotate and interpret
- vi. Decide if changes need to be made (i.e. drop item(s) or include item(s))
- vii. Repeat the procedure from step 4
- viii. Construct scales and use in further analysis

Reliability analysis for the questionnaire was done, in which the Cronbach alpha was determined using the SPSS software, with the value of Cronbach alpha between 0.7 to 0.9 signifies the consistency of the questions with the measurement scale.

4. RESULT AND DISCUSSION

4.1 Respondent Background Analysis

The five respondents selected are registered and certified professionals with high profile in the construction industry. They participated in quite number of projects at least more than 20 projects within the construction industry from different professions. One of the respondents is from the Kano state ministry of works housing and transport while the remaining are contractors, developers and consultants in construction industry. All the respondents are professionals and registered with respective professional bodies within the country. They involved in projects of more than 20 projects

and experience of more than 20 years within the construction industry.

The study gained 73 respondents for the questionnaire survey. The questionnaire survey respondents are personnel within the construction industry with minimum of bachelor's degree or higher national diploma. The respondents were classified based on the type of company they represented, profession and also their work experiences in the construction industry. The demographic characteristics of the respondent is analyzed using frequency analysis in descriptive statistics with the aid of SPSS software.

4.2 Analysis for IBS Implementation

The first objective of the research is the current IBS implementation status and the data was obtained from the interview. The method of analysis for the interview data is a content analysis. Two of the respondents believed that traditional and precast construction methods are mostly used and the remaining stated that only traditional cast on site is practiced. They all agreed that IBS needs to be implemented as the current construction method which is traditional cast on site has a lot of disadvantages such as material wastage, delay in construction and low quality of structures.

4.3 Analysis for Barriers of IBS Implementation

From the second objective, the following barriers were summarized from the content analysis:

- i. Research and educational courses on IBS unavailable
- ii. Not economic for small rise buildings and small projects.
- iii. Unfamiliarity.
- iv. Insufficient manufacturers.
- v. Resistance to change from traditional method to other methods.
- vi. High capital cost.
- vii. High payment of skilled labor.
- viii. Transportation access.
- ix. Lack of technology reference.

The mean and factor analysis obtained from the questionnaire are shown in Figure 2. Factor analysis was conducted for the related data on barriers regarding lack of IBS implementation in order to summarize and describe the variables under a few factors. For this research, SPSS was used to carry out the factor analysis. Eight variables were described by two factors.

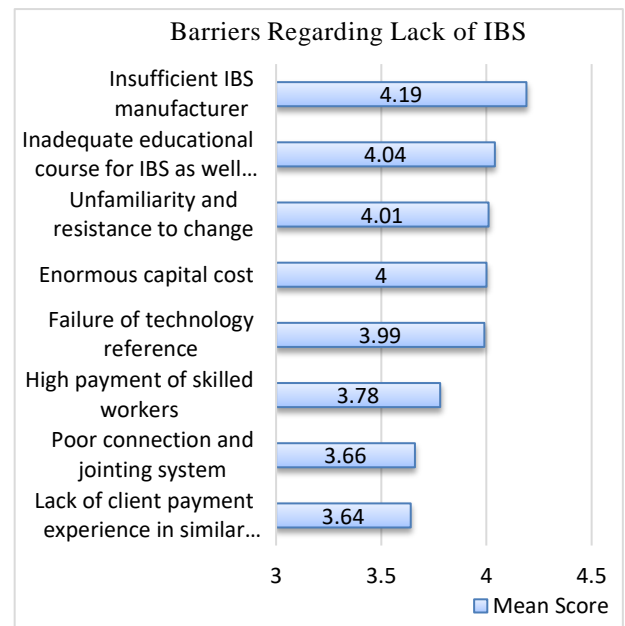


Fig. 2 Mean score of barriers regarding lack of IBS implementation

The scree plot shown in Figure. 3, reveals two factors with Eigen value greater than 1 under the extraction method of principal component analysis. This means out of the factors, the first two factors together account for 54.05% of the total variance.

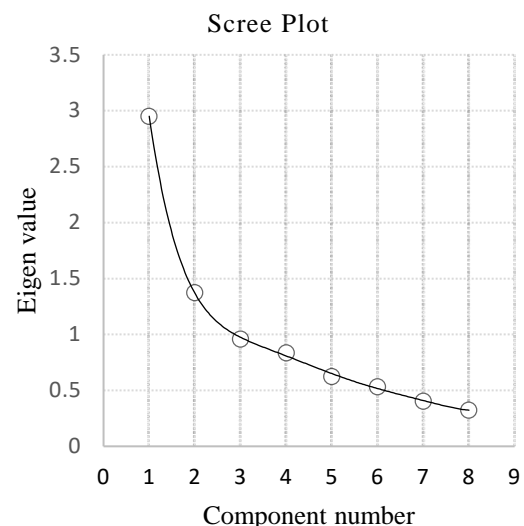


Fig. 3 Scree lot showing the Eigen values for barrier of IBS implementation

Moreover, the reliability of each factor was tested to check the internal consistency, the Cronbach alpha values for factor one and two are 0.729 and 0.704 respectively. Therefore, within Cronbach alpha, the acceptable range is 0.7 to 0.9.

4.4 Analysis for Strategies on Improving of IBS Implementation

From the third objective, the following barriers were summarized from the content analysis:

- i. Educational courses on IBS in institutions.
- ii. Application of IBS in big projects.
- iii. Training courses on IBS.
- iv. Companies should upgrade their construction method to IBS by sponsoring staffs on IBS courses.
- v. Government support with startup capital and also intervene.
- vi. Specialist and experts on IBS should present IBS as an alternative construction method.

From the questionnaire, the following results are obtained through mean and factor analysis (Figure 4).

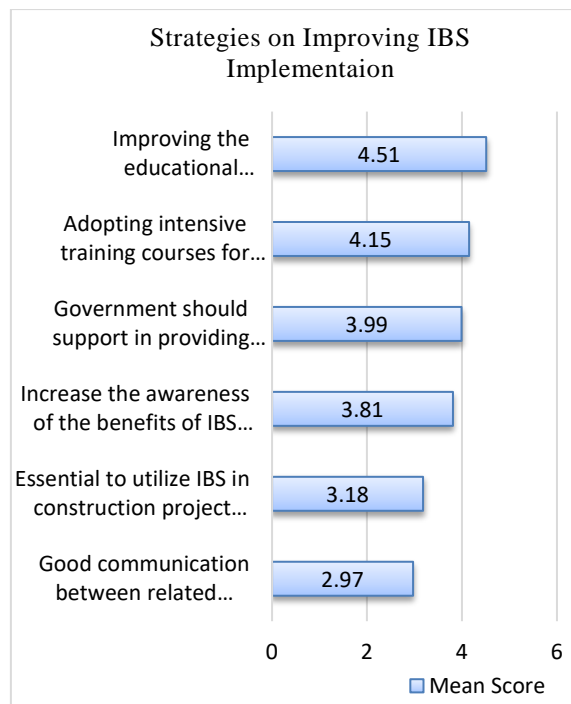


Fig. 4 Mean score of strategies on improving IBS implementation

In this study, Factor analysis was conducted for the related data on strategies of improving IBS implementation in order to summarize and describe the variables under a few factors. For this, SPSS was used to carry out the factor analysis. The scree plot (Fig. 5) shows three factors with Eigen value greater than 1 under the extraction method of principal component analysis, meaning out of 6 variables the first three factors together account for 67.587% of the total variance.

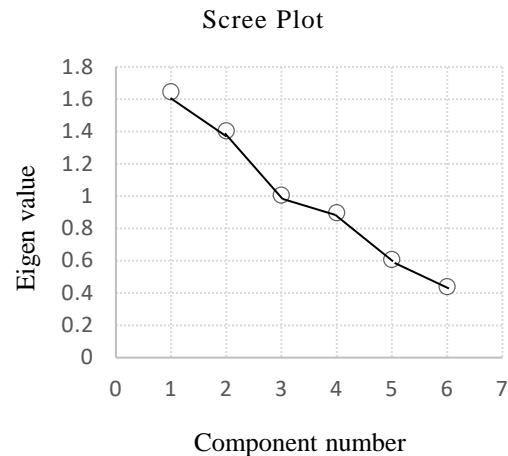


Fig. 5 Scree plot showing Eigen value for improving IBS implementation.

4.5 Reliability Analysis

The reliability analysis was run to check and confirm that there is internal consistency within the set of variables that are scale for measurement and are free from error. In this study, the Cronbach's alpha greater than one measures of reliability was, however, used and adopted. The reliability of the questions with the Cronbach's Alpha of 0.795 of the 21 variables, which check the internal consistency of the variable used in the questionnaires for analysis. The observation made in this study is consistent with the measurement scale of responses with the recommended acceptable value of > 0.7 [14-16].

5. CONCLUSION

The following conclusions were drawn from the results of the analysis carried out in the study.

- i. It is found that the current construction method that is widely practiced is the traditional cast on site, whereas IBS is rarely practiced in the state. The IBS implementation progress is also considered to be very slow.
- ii. The study reveals that the main barriers of IBS implementation are based on components, such as factors concerning insufficient IBS manufacturers, inadequate knowledge and researches on IBS and unfamiliarity with resistance to change.
- iv. It is suggested that the strategies should be adopted through improving the curriculum in educational institutions, and also adopting intensive training for the related parties along with the government support, especially in providing standard guidelines and capital cost.

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