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BARRIERS AND IMPROVEMENT STRATEGIES FOR THE USE OF AUTOCLAVED AERATED CONCRETE (AAC) BLOCKS IN BUILDING PROJECTS.

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ABSTRACT

Purpose: Autoclaved Aerated Concrete (AAC) has been in existence for over a century and used in Europe and other parts of the world, however, its adoption on building projects in Nigeria and Africa at large is still very low or non-existent. Thus, this study investigated significant barriers impeding the adoption of AAC blocks and improvement strategies for its adoption in Nigeria and South Africa.

Design/methodology/approach: The study adopted survey research for the investigation. The population of the study was construction professionals in Nigeria and South Africa using structured questionnaires. The study utilized multi-sampling method, where both convenience and snowball sampling techniques were deployed to select sample for the study. Data were analysed using descriptive statistical tools such as frequency, percentages, mean score and ranking; while Mann-Whitney U was used to test hypothesis.

Findings: The result revealed that the barriers impeding the adoption of AAC blocks on building projects in Nigeria include inadequate government policies and supports, market potentials and low level of awareness and knowledge on the concept of sustainability; whereas they were huge capital to set up AAC plant, lack of readily available accessible information and availability of conventional materials in South Africa. Strategies to improve the adoption of AAC in both countries were also discovered.

Research Limitations/Implications: The limitations include inexistent of construction professionals in Nigeria and few South African professionals who have used AAC blocks. The contribution to knowledge is that this study established barriers and strategies for the deployment of AAC blocks in Nigeria and South Africa.

Practical implications: It is recommended that appropriate strategies be deployed to combat the challenges of AAC implementation in the building industries. This can be achieved via creation of its awareness among construction stakeholders by governments, professional bodies and media organizations.

Originality/value: The study determined the differences and similarities between both countries on barriers and strategies for the usage of AAC blocks in Nigeria and South Africa.

Keywords: Autoclaved Aerated Concrete; Building projects; Nigeria; Sustainable materials; South Africa.

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1. INTRODUCTION

The global trend of seeking alternatives to conventional materials for construction and the push for sustainability in indigenous material and construction technology have prompted research activities on the suitability and usage of locally available raw materials for construction purposes. One of such materials in view is Autoclaved Aerated Concrete (AAC), which has been identified as a potential substitute for bricks in walls to provide eco-friendly solutions to greener environment (Rathi & Khandve, 2016). AAC, also known as Aircrete or Aerated Cellular Concrete (ACC), was invented in the early 1920s by a Swedish Architect named Eriksson, whose aim for producing AAC was to reduce usage of timber and provide a cheaper and sustainable building material. AAC has been described as an innovative material that focuses on eco-friendliness and directs a path to sustainable development as it satisfies the rule of 3R's: Reduce, Recycle and Reuse (Cheran, Shanthi & Krithigaa, 2017). Market and Research (2020) posit that AAC is one of the world most produced building materials after concrete and is mostly manufactured as blocks and panels. Unlike concrete masonry units, AAC blocks are solid with no moulded core holes. Four inches of AAC translates to a four-hour rating making it ideal in commercial buildings for encasing steel columns, surrounding elevator shafts and for other fire stopping requirements. The adoption of AAC blocks on building projects afford benefits such as reduction of construction costs by up to 20% and reduces the requirements of materials such as cement and sand by up to 50% (Rathi & Khandve, 2015). Moreover, the compressive strength of AAC block is greater than that of conventional brick. However, being aerated with up to 50-60% by volume of air, AAC block has lesser weight compared to that of conventional brick. This characteristic of AAC contributes to its lightweight property and low thermal conductivity (Pandey, Kirar, Singh & Rajak, 2018; Oo & Hlaing, 2018). AAC block is one of the eco-friendly and certified green building materials. The increased thermal efficiency of AAC makes it suitable for use in areas with extreme temperatures, as it eliminates the need for separate materials for construction and insulation, leading to faster construction and cost savings (Sahu & Singh, 2017).

1.1. Objectives of the Study

The objectives of the study are to:

i. evaluate barriers impeding the adoption of AAC blocks on building projects in Nigeria and South Africa, and
ii. propose strategies that can improve the adoption of AAC blocks on building projects in Nigeria and South Africa.

The outcome of this study is expected to reveal the barriers and strategies for AAC blocks' adoption, thereby enhancing the provision of sustainable building materials.

1.2. Research Hypotheses

Two hypotheses were postulated for the study. The first hypothesis states that there is no significant difference between the perception of Nigerian and South African professionals on barriers impeding AAC blocks' adoption. The second states that there is no significant difference between the perception of Nigerian and South African professionals on strategies to improve AAC block adoption. The results of the hypotheses will establish the difference and similarity between the two countries on the barriers and strategies for the adoption of AAC blocks on building projects.

2. LITERATURE REVIEW

It could be expected that with the diverse benefits of AAC, building firms would readily adopt the material for their building projects. Contrarily, building firms embraced other conventional walling materials (like sandcrete block, bricks, etc.) that they are acquainted with for their building projects. Falade and Ikponmwosa (2008) corroborates that stakeholder are addicted to the use of conventional construction materials like sandcrete blocks, concrete and the likes. Cost associated with AAC, lack of

awareness of AAC blocks, low market penetration, brittle nature of the material are also barriers of AAC block adoption (Market & Research, 2020). In this regard, Anderson, Bennett and Collopy (2000) and Davis (2001) stated that barriers to using sustainable building materials and products are the lack of awareness of construction practitioners to prevent the environment from being polluted through the use of unsustainable construction materials; absence of well-known sustainable building products to be used in construction; lack of sufficient environmental information about structural materials to make adequate comparison between alternatives and the absence of regulations and codes that encourage the use of green building materials. Similarly, Djokoto, Dadzie and Ohemeng-Ababio (2014) identified 20 barriers to sustainable construction in Ghana comprising lack of building codes and regulation**,** lack of incentives, higher investment cost, risk of investment**,** higher final cost, lack of public awareness, lack of demand, lack of strategy to promote sustainable construction, lack of design and construction team, lack of expertise, lack of professional knowledge, lack of database and information, lack of technology, lack of government support, lack of a measurement tool, increased documentation, extensive pre-contract planning, change resistance, lack of training, lack of cooperation. Additionally, Nikyema and Bluoin (2020) classified the barriers of green building materials into five comprising: government related barriers; human-related barriers; knowledge barriers and information related barriers; market related and cost and risk related barriers. In the same vein, Moshin and Ellk (2018) identified 14 barriers to the use of sustainable building materials in building construction and classified the barriers to administrative and technical. Gounder, Hassan, Shrestha and Elmualim (2021) also revealed that critical barriers to the adoption of sustainable materials are related to cost and profit considerations, unwillingness of key stakeholders to incorporate these materials into building projects, lack of incentives and government policies. In this regard, Akadri (2015) revealed that topmost barriers to sustainable material selection include the perception of extra cost incurred and lack of sustainable material information. In the same vein, Kang and Guerin (2009) reported that the main barriers in the use of sustainable materials are accuracy and accessible information and appropriate tools.

Several studies have also shed light on strategies that improve the usage of AAC Blocks inspite of the barriers. Pandey et al. (2018) recommended investment in high quality and automated equipment that uses the latest manufacturing technology. Market and Research (2020) posit growth in the infrastructural sector, rising demand for light weight construction materials, growth preferences for low-cost houses and an ever-increasing focus on green and soundproof buildings. Government policies should also be made in favour of sustainable construction and energy saving, especially in Nigeria (Davies & Davies, 2017). Ofori (2006) corroborates the revelations of Davies and Davies (2017) that the National building code of Nigeria was not based on sustainable development but rather on persistence collapse of buildings, paucity of referenced design standards for professionals and the use of unskilled professionals. The study recommended a total overhaul of the National Building Code that will incorporate sustainable concepts. Eley (2011); El-Gohary and El-Diraby (2010) opined that manufactures and suppliers should continue developing environmentally responsible products and broadening their product ranges, as with greater selection, designers and clients are more likely to choose this alternative.

The barriers of AAC could be more in developing countries like Nigeria and South Africa especially where AAC block adoption still grapples. This study is aimed at investigating barriers and improvement strategies for the adoption of AAC blocks, with a view to mitigating their hindrances.

3. METHODOLOGY

The study adopted survey research for the investigation. The population of the study was construction professionals in Nigeria and South Africa. Structured self-administered questionnaires were employed to elicit information from the Nigerian professionals in Lagos metropolis, while online questionnaires (through Google Forms) were engaged to collect data from the South African professionals. The sampling frame comprises construction professionals that have been involved in the use of AAC blocks for building projects in five South African provinces. In Nigeria, since AAC blocks have only been used in Lagos State, therefore professionals on construction projects in Lagos State was the sampling frame. The study utilized multi-sampling method, where both convenience and snowball sampling techniques were deployed to select sample for the study. Convenience sampling technique was used in Nigeria because

there is no list of professionals on construction projects in Lagos State. A total of 145 copies of questionnaire were distributed to the respondents in the Lagos metropolis of which a total of 99 questionnaires were duly completed, retrieved and used for the study representing a 68.3% response rate. Snowball sampling is usually used in an unknown and rare population in which research participants are requested to assist in identifying known potential respondents. Thus, 17 questionnaires were obtained from South African construction professionals that have been involved in the use of AAC block for building projects in five South African provinces, identified by a research participant working in a South African AAC firm. Data were analysed using descriptive statistical tools such as frequency, percentages, mean score and ranking; while Mann-Whitney U was used to test hypothesis. The first part of the research instrument sought to assess 23 barriers impeding the adoption of AAC. Each barrier was assessed on a scale of 1 to 5 in order to obtain the perceived ratings from the two categories of professionals. The description of the scale is as follows: 5 represents most significant, 4 represents more significant, 3 represents moderately significant, 2 represents slightly significant and 1 represents not significant. The latter section evaluates 18 important strategies that can improve the adoption of AAC on building projects. Each strategy was examined on a scale of 1 to 5 in order to obtain the perceived ratings from the two categories of professionals. The description of the scale is as follows: 5 represents most important, 4 represents more important, 3 represent moderately important, 2 represents slightly important and 1 represents not important.

4. PRESENTATION AND DISCUSSION OF RESULTS

4.1. Demographic Profiles

The respondents' and organization's profiles of the Nigerian professionals are presented in Table 1. Table 1 shows the demographic information of the Nigerian respondents as it captured the professional background of respondents that participated in the study. From the first category of respondents: - 7.1% were Architects, 38.4% were Builders, 45.5% were Civil Engineers while 9.1% were Quantity Surveyors. This result revealed that most of the respondents had civil engineering academic background. Also, 7.1% are registered with Nigerian Institute of Architects (NIA), 38.4% are registered with Nigerian Institute of Building (NIOB), 45.5% are registered with Nigerian Society of Engineers (NSE) while 9.1% are registered with Nigerian Institute of Quantity Surveyors (NIQS). Moreover, 10.1% of the respondents have Higher National Diploma (HND), 55.6% holds Bachelor of Science (B.Sc.) degree, 31.3% and 3.0% Master's and Doctorate degrees respectively. As many as 25.3% of the Nigerian respondents had experience ranging from 1 to 5 years, 29.3% had between 6 to 10 years, 26.3% had between 11 to 15 years, 12.1% had between 16-20 years, while 7.1% had between 21 and above years.

Furthermore, Table 1 sheds light on the organizations' demographic information. As much as 31.3% of the Nigerian respondents were from consulting organizations, 45.5% were from contracting organization, 5.1% from client organizations while 18.2% from design & build organizations. Moreover, 47.5% of the organizations were medium-sized, 43.4% were small-sized and 9.1% were large-sized. Moreover, 60.6% are indigenously owned, 5.1% are fully expatriate while 34.3% are partly indigenous and partly expatriate. A total of 27.3% of the respondents' organizations undertake new construction works, 5.1% undertake renovation/refurbishment works while 67.7% respondents do general contracting works.

Table 1: Demographic profile of the Nigerian respondents

Description	Frequency	%
Professional Background		
Architecture	7	7.1
Building	38	38.4
Civil Engineering	45	45.5
Quantity Surveying	9	9.1
Total	**99**	**100.0**
Professional Body		
NIA	7	7.1

NIOB	38	38.4
NSE	45	45.6
NIQS	9	9.1
Total	**99**	**100.0**
Highest Academic Qualification		
OND	0	0
HND	10	10.1
BSc/BTech	55	55.6
MSc/MBA	31	31.3
PhD	3	3
Total	**99**	**100.0**
Years of Experience		
1-5 Years	25	25.3
6-10 Years	29	29.3
11-15 Years	26	26.3
16-20 Years	12	12.1
21 Years and above	7	7.1
Total	**99**	**100.0**
Organisation Type		
Consulting	31	31.3
Contracting	45	45.5
Client Organisation	5	5.1
Design & Build	18	18.2
Total	**99**	**100.0**
Organisation Size		
Small sized with 1-50	43	43.4
Medium sized with 51-250	47	47.5
Large size with 250 or more	9	9.1
Total	**99**	**100.0**
Ownership and Management		
Fully Indigenous	27	60.6
Fully Expatriate	5	5.1
Partly Indigenous & partly expatriate	67	34.3
Total	**99**	**100.0**
Nature of work undertaken		
New construction	27	27.3
Renovation	5	5.1
General contracting	67	67.7
Total	**99**	**100.0**

Source: Researcher's field survey (2023)

Table 2 provides information on the South African respondents and organizations. The Table reveals that 5.9% of the respondents had years of experience ranging between 1 to 5 years, 17.6% between 6 to 10 years, 47.1% between 11 to 15 years, 17.6% between 16-20 years, while 11.8% had between 21 and above years. Furthermore 35.3% of the organizations were medium-sized, 41.2% were small-sized, 23.5% were large-sized. Additionally, 47.1% of the organizations are indigenously owned, 17.6% are fully expatriate while 5.3% are partly indigenous and partly expatriate respectively. Moreover, 23.5% of the respondents' organizations undertake new construction works, 5.9% carry out renovation/refurbishment works while 70.6% do general contracting works. Table 2 also reveal the provinces the professionals were located South Africa. It shows that 59% were in Western Cape, 11.8% each in Gauteng, Eastern Cape, Free State and KwaZulu-Natal.

Table 2: Demographic profile of the South African respondents

Description	Frequency	%
Years of Experience		
1-5 Years	1	5.9
6-10 Years	3	17.6
11-15 Years	8	47.1
16-20 Years	3	17.6
21 Years and above	2	11.8
Total	**17**	**100.0**
Organization Size		
Small sized with 1-50	6	35.3
Medium sized with 51-250	7	41.2
Large size with 250 or more	4	23.5
Total	**17**	**100.0**
Ownership and Management		
Fully indigenous	8	47.1
Fully expatriate	3	17.6
Partly indigenous & partly expatriate	6	35.3
Total	**17**	**100.0**
Nature of work undertaken		
New construction	4	23.5
Renovation	1	5.9
General contracting	12	70.6
Total	**17**	**100.0**
Province		
Western Cape	9	52.9
Gauteng	2	11.8
Eastern Cape	2	11.8
Free State	2	11.8
KwaZulu-Natal	2	11.8
Total	**17**	**100.0**

4.2. Barriers Impeding the Adoption of AAC Block for Building Projects.

Table 3 shows the responses of Nigerian and South African professionals on 23 barriers impeding AAC blocks' adoption on building projects. To determine significant barriers impeding AAC's adoption, a graduated scale of 1.00 to 5.00 was adopted and the mean scores were calculated. The results confirmed all the 23 barriers were significant because all means ranges between 3.29 to 4.00 in both countries. Moreover, results confirmed that 7 out of the 23 barriers were more significant to the referred South African Professionals, while the remaining 16 barriers were moderately significant to the respondents.

The findings further show that inadequate government policies & supports, low market potentials, low level of awareness and knowledge on the concept of sustainability and non- awareness of people towards the advantageous use of AAC products are barriers that significantly impedes AAC block usage in the Nigerian construction industry. These findings are corroborated with the revelations of Falade and Ikponmwosa (2008) that stakeholders in the built environment usually use conventional walling materials like sandcrete blocks, bricks, concretes and so on.

In the same vein, huge capital to set up AAC plant, lack of readily accessible information, availability of conventional materials and little demand for energy efficient buildings are barriers that significantly impedes AAC block adoption in the South African construction industry. Moreover, there is a significant difference in how these barriers were recognized by the 2 categories of respondents. The findings that

lack of readily available information is a major barrier impeding the adoption of eco-friendly material could be substantiated by studies conducted by (Moshin & Ellk, 2018).

Table 3: Barriers impeding AAC block adoption for building projects

Barriers	Nigerian Professionals			South African Professionals		
	N	MS	Rank	N	MS	Rank
Inadequate government policies and supports	94	3.88	1	17	3.35	15
Market potentials	95	3.81	2	17	3.53	5
Low level of awareness and knowledge on the concept of sustainability	96	3.80	3	17	3.18	21
Non-awareness of people towards the advantageous use of AAC products	96	3.79	4	17	3.35	14
Lack of interest in new products by buyers and house owners	96	3.78	5	17	3.47	8
Lack of readily available accessible information	95	3.78	5	17	3.59	2
Huge capital to set up AAC plant	95	3.76	7	17	4.00	1
Existing structure of the construction industry	95	3.76	7	17	3.47	8
Little interest in new products by Architects and Developers	95	3.76	7	17	3.53	5
Absence of design standards for AAC products	96	3.75	10	17	3.41	12
Availability of conventional materials	95	3.75	10	17	3.59	2
Startup costs associated with promoting and teaching the industry to build with AAC products	95	3.75	10	17	3.47	12
Inadequate exemplar demonstration project to infuse confidence for using AAC products	96	3.74	13	17	3.47	12
Low level of demand and knowledge of AAC products	96	3.74	13	17	3.12	23
Little demand for energy efficient buildings	93	3.72	15	17	3.59	2
Use of unstainable construction materials	95	3.72	15	17	3.35	14
Affordability	95	3.71	17	17	3.35	14
Unfavourable perception of home buyers to AAC block in the short term	95	3.71	17	17	3.47	8
Inadequate technical know-how and manpower to manufacture AAC products	93	3.69	19	17	3.53	5
Inadequate building codes and regulations	96	3.69	19	17	3.29	19
Costs of the 'learning curve' while working with a new product	96	3.68	21	17	3.18	21

Low demand for sustainable housing	96	3.66	22	17	3.35	22
Lack of easy rating systems for eco-friendly	97	3.65	23	17	3.29	23

Note: 1 represents not significant, 2 represents slightly significant, 3 represents moderately significant, 4 represents more significant, 5 represents most significant. While, N represents the number of Respondents; MS represents the Mean Score

4.3. Important Strategies that can Improve the Adoption of AAC for Building Projects

Table 4 shows the result on important strategies to AAC blocks' adoption on building projects. The mean scores of the respondents ranged from 3.71 to 3.88 and 4.12 to 4.94 for the Nigerian and South African professionals respectively; while, eight were 'most important' and ten 'more important' in South Africa. It was revealed in Table 4 that government encouragement; focusing research on specific green building materials; development of new construction materials and processes; and public private partnerships on energy efficiency and sustainable materials were the strategies by the first group of respondents. In the same vein, growth in the infrastructural sector; industrialization; demand for lightweight construction materials; focusing research on specific green building materials; and growth preferences in the for low-cost houses were strategies that can improve AAC block adoption on building projects in South Africa.

Table 4: Important strategies that can improve the adoption of AAC for building projects

Strategies	Nigerian Professionals			South African Professionals		
	N	MS	Rank	N	MS	Rank
Government encouragement	94	3.88	1	17	4.41	11
Focusing research on specific green building materials	95	3.81	2	17	4.59	4
Development of new construction materials and processes	96	3.80	3	17	4.35	13
Public private partnerships on energy efficiency and sustainable materials	96	3.79	4	17	4.18	17
Industrialization	96	3.78	5	17	4.82	2
Growth preferences for low- cost houses	95	3.78	5	17	4.59	4
Growth in the infrastructural sector	95	3.76	7	17	4.94	1
Education and training to built environment professionals about AAC products	95	3.76	7	17	4.47	9
The readiness of construction practitioners such as developers and contractors in adopting sustainable materials	95	3.76	7	17	4.29	15
Increasing funding for sustainable building materials	96	3.75	10	17	4.47	9
Government financial supports and subsidy	95	3.75	10	17	4.24	16
Demand for lightweight construction materials	95	3.75	10	17	4.65	3
Marketing strategy development	96	3.74	13	17	4.53	6
Integrating sustainability into formal curricula	96	3.74	13	17	4.35	13

Increasing focus in green and sound proof buildings	93	3.72	15	17	4.53	6
Creating demonstration and training centres	95	3.72	15	17	4.41	11
Government promotion of product	95	3.71	17	17	4.53	6
Use of tool ratings	95	3.71	17	17	4.12	18

Note: 1 represents not important, 2 represents slightly important, 3 represents moderately important, 4 represents more important, 5 represents most important. While, N represents the number of Respondents; MS represents the Mean Score.

4.4. Test of Hypotheses

The inferential results of the first hypothesis, using Mann-Whitney U test at 95% confidence interval (CI), are presented in Table 5. Table 5 shows that there is no significant difference in the perceptions on 15 out of the 23 hypothesized barriers because p-values are greater than the set 0.05 ($p>0.05$), Hence the null hypothesis is rejected. These barriers include: unfavourable perception of home buyers to AAC block in the short term; lack of interest in new products by buyers and house owners; little interest in new products by architects and developers; startup costs associated with promoting and teaching the industry to build with AAC products, market potentials, low demand for sustainable housing, existing structure of the construction industry; lack of readily available accessible information, inadequate exemplar demonstration project to infuse confidence for using AAC products; huge capital to set up AAC plant; lack of readily available accessible information; inadequate technical know-how and manpower to manufacture AAC products; use of unstainable construction materials; and availability of conventional materials and affordability. Whereas, barriers for which there is significant difference between the two categories of professionals with a p-value less than or equal to 0.05 ($p\leq0.05$), and for which the null hypothesis is rejected include: costs of the 'learning curve' while working with a new product; inadequate building codes and regulations; lack of easy rating systems for eco-buildings; absence of design standards for AAC products; inadequate government policies and supports; low level of awareness and knowledge on the concept of sustainability; low level of demand and knowledge of AAC products and non-awareness of people towards the advantageous use of AAC products. These findings are probably because in Nigeria little focus is placed on research to harness natural resources and develop new materials.

Table 5: Mann-Whitney U test results for comparing perception of Nigerian and South African professionals on barriers impeding AAC block adoption.

Barriers	Nigerian Professionals		South African Professionals		U	P-value	Remark
	N	MS	N	MS			
Unfavourable perception of home buyers to AAC block in the short term	95	58.26	17	46.65	640.000	.156	NS
Lack of interest in new products by buyers and house owners	96	59.29	17	44.09	596.500	.065	NS
Little interest in new products by Architects and Developers	95	58.18	17	47.12	648.000	.174	NS
Costs of the 'learning curve' while working with a new product	96	60.18	17	39.03	510.500	.010	S
Startup costs associated with promoting and teaching the industry to build with AAC products	95	58.89	17	43.12	580.000	.053	NS
Market potentials	95	58.87	17	43.24	582.000	.052	NS
Inadequate building codes and regulations	96	59.77	17	41.38	550.500	.026	S

Low demand for sustainable housing	96	59.08	17	45.26	616.500	.093	NS
Lack of easy rating systems for eco-buildings	92	57.54	17	41.26	548.500	.041	S
Absence of design standards for AAC products	96	59.43	17	43.29	583.000	.049	S
Inadequate government policies and supports	94	59.17	17	38.47	501.000	.011	S
Existing structure of the construction industry	95	58.40	17	45.88	627.000	.127	NS
Lack of readily available accessible information	95	58.01	17	48.06	664.000	.225	NS
Low level of awareness and knowledge on the concept of sustainability	96	60.17	17	39.12	512.000	.011	S
Low level of demand and knowledge of AAC products	96	60.47	17	37.41	483.000	.006	S
Inadequate exemplar demonstration project to infuse confidence for using AAC products	96	58.72	17	47.26	650.500	.160	NS
Non-awareness of people towards the advantageous use of AAC products	96	59.69	17	41.82	558.000	.028	S
Huge capital to set up AAC plant	95	55.89	17	59.88	750.000	.623	NS
Lack of readily available accessible information	93	56.66	17	49.18	683.000	.350	NS
Inadequate technical know-how and manpower to manufacture AAC products	93	56.63	17	49.29	685.000	.364	NS
Use of unstainable construction materials	95	58.47	17	45.50	620.500	.116	NS
Availability of conventional materials	95	57.86	17	48.88	678.000	.271	NS
Affordability	95	58.71	17	44.18	598.000	.074	NS

Note: P represents significant at P ≤ 0.05, U is Mann-Whitney, S represents significant difference, NS represents not significant

Similarly, the inferential results of the second hypothesis, using Mann-Whitney U test at 95% confidence interval (CI), are presented in Table 6. Table 6 shows that there is no significant difference in the perception on 16 out of the 18 hypothesized strategies to AAC blocks' adoption because the p-values are greater than 0.05 ($p>0.05$), hence, the null hypothesis is accepted. The strategies include: demand for lightweight construction materials; growth preferences for low cost houses; increasing focus in green and sound proof buildings; creating demonstration and training centres; integrating sustainability into formal curricula; increasing funding for sustainable building materials; focusing research on specific green building materials; education and training of built environment professionals about AAC products; public private partnerships on energy efficiency and sustainable materials, government financial supports and subsidy, government encouragement, development of new construction materials and processes; government promotion of product; the readiness of construction practitioners such as developers and contractors in adopting sustainable materials; and use of tool ratings and marketing strategy development.

Whereas, strategies for which there is significant difference between the two categories of professionals with a p-value less than or equal to 0.05 ($p\leq0.05$), and for which the null hypothesis is rejected include; growth in the infrastructural sector and industrialization.

Table 6: Mann-Whitney U test results for comparing perception of Nigerian South African Professionals on enhanced strategies of AAC block adoption.

Strategies	Nigerian Professionals		South African Professionals		U	P-value	Decision
	N	MS	N	MS			
Growth in the infrastructural sector	97	54.13	17	76.74	497.500	.003	S
Industrialization	97	55.08	17	71.29	590.000	.032	S
Demand for lightweight construction materials	97	55.79	17	67.24	659.000	.146	NS
Growth preferences for low-cost houses	96	55.70	17	64.32	691.500	.270	NS
Increasing focus in green and sound proof buildings	97	56.22	17	64.82	700.000	.279	NS
Creating demonstration and training centres	95	55.32	17	63.09	695.500	.324	NS
Integrating sustainability into formal curricula	95	56.33	17	57.47	791.000	.885	NS
Increasing funding for sustainable building materials	96	56.32	17	60.85	750.500	.563	NS
Research on specific green building materials	95	55.53	17	61.91	715.500	.397	NS
Education and training to built environment professionals about AAC products	96	56.32	17	60.82	751.000	.566	NS
Public private partnerships on energy efficiency and sustainable materials	95	57.91	17	48.62	673.500	.237	NS
Government financial supports and subsidy	96	57.80	17	52.50	739.500	.504	NS
Government encouragement	94	56.70	17	52.15	733.500	.546	NS
Development of new construction materials and processes	96	57.75	17	52.76	744.000	.523	NS
Government promotion of product	96	55.66	17	64.59	687.000	.262	NS
The readiness of construction practitioners such as developers and contractors in adopting sustainable materials	96	57.89	17	51.97	730.500	.453	NS
Use of tool ratings	94	56.15	17	55.15	784.500	.900	NS
Marketing strategy development	96	56.01	17	62.59	721.000	.403	NS

Note: P represents significant at $P \leq 0.05$, U is Mann-Whitney, S represents significant difference, NS represents not significant.

5. CONCLUSION AND RECOMMENDATIONS

The following conclusions are drawn on the findings of the study:

1. The barriers impeding AAC block adoption varies for both countries. While inadequate government policies and support impedes adoption of AAC blocks in Nigerian projects, but inadequate capital to set up AAC plant impedes its adoption in South African projects. This implies that there would lack of interest by Architects and developers in adopting the block on their projects.
2. Although, there are several barriers that impede the adoption of AAC blocks in both countries, however, government interventions and infrastructural growth can improve its usage in the two

nations. This implies that if government can play active roles in the employment of AAC blocks, its widespread usage can enhance the provision of sustainable buildings.

The following recommendations are made on the conclusion drawn from the findings of the study:

1. The study advocates for the extermination of barriers impeding AAC block adoption by providing government policies and supports to harness local materials so that our own type of AAC blocks would be produced. This can be achieved if funds are provided and small medium enterprises are protected by the government by reducing their taxes.
2. Appropriate strategies be deployed to combat the challenges of AAC implementation in the building industries. This can be achieved via creation of its awareness among construction stakeholders by governments, professional bodies and media organizations.

6. LIMITATION OF THE STUDY

This study is limited to the use few available professionals in five provinces in South Africa that have used AAC blocks. Therefore, the study could be improved by extending the research to other places in South Africa with such professionals. Additionally, AAC blocks are not used in Nigeria, hence, there were no Nigerian construction professionals to provide information on the usage. Thus, the study can still be improved when AAC blocks are used in Nigeria as a result of its awareness created by this study.

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