Social Science

Urban upgrades and tendency to alter indigenous building patterns in southwest Nigeria; a case study of Abeokuta city core, Nigeria

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Abstract

Urban upgrades are common in cities of Southwest Nigeria. They are executed to address socio-economic and environmental issues by resolving socio-spatial dysfunctionalism. The urban systems that are altered during upgrades may however not blend into a good fit with the existing buildings. This study was carried out in Abeokuta, Southwest Nigeria in 2019 to determine the tendency of residents to alter the designs of their buildings in upgraded areas of the city core. Areas within the city core that witnessed urban upgrades between 2009 and 2019 were identified and the buildings were investigated physically for evidences of change in designs. A closed ended questionnaire was also administered to building industry professionals around the area to confirm the field observation findings. By using the neighbourhoods that were not upgraded in the area as reference, it was confirmed that the residents in upgraded areas had altered their building designs significantly. The research proposes that alteration of building designs which subsequently affects the outlook of the environment should be envisaged and accommodated in planning of urban upgrades.

Keywords: building elements; building forms; commercialisation; indigenous architecture; postmodern style

1. Introduction

The city core of Abeokuta is the historic city centre which is a continuous sprawl of initial settlements where the city evolved. The major neighbourhoods are Ake, Itoku, Oke-Ijemo, Oke-Olumo, Ikereku, Itoko, Sodeke, Saaje and Berekodo. Newer settlements have evolved beyond this core area over the years. The city core has been selected for the case study because the oldest buildings in the city are located in the area and the locality has witnessed a lot of urban upgrade programmes in recent times. The area is easy to delineate due to natural boundaries like rocks and water bodies that surround it.

Urban upgrades are said to be instituted when urban systems are increased in efficiency and scope to improve the urban setting. The urban upgrade programmes that took place in the city core during the period were intended to improve the outlook of the urban setting with focus on modernising the city within the period (Yoade, 2018) [29]. The programmes were carried out mostly on urban infrastructure and municipal services (Oguntimehin & Bamidele, 2017) [20]. In the neighbourhoods of the Abeokuta city core where the upgrades were executed, there are visible changes in the urban landscape. In the other neighbourhoods where the upgrade programmes are yet to be instituted or not very visible, sedentary urban settings generally prevail. Urban infrastructure, especially roads and drains were newly constructed and improved upon as the visible form of government intervention in the development of the city. Municipal services like refuse collection are also being improved upon in the area. These activities to stimulate improvements in the urban setting are likely to raise the profile of the affected areas. It is generally assumed that the improvements in urban systems will cause the residents to change their building patterns (Thompson, 2020) [27] and the land use (Adebayo, Otun & Daniel, 2019) [1] to measure up with the new profile of the upgraded areas. The building morphology is thus affected. Since the city evolves with changing culture, improvements to the city are likely to alter the socio-cultural environment (Loli *et al*., 2019) [18]. The changing culture is subsequently reflected in the building morphology (Ferreira *et al*, 2021) [11]. This organic progression in building morphology has been emphasised in literature for a long time (Akıner *et al*, 2021; Askar *et al*, 2021) [2, 5]. Man keeps changing the elements and forms of his buildings in an endless process of achieving task performance to meet up with changes in human culture and extraneous factors (Hyde, 2018; Steadman, 2016) [14, 26] like the climatic elements foreign influences.

This study seeks to establish this relationship between urban upgrades and the propensity to alter building design in the study area as a microcosm of Southwest Nigeria. All the states of Southwest Nigeria have similar systems of urban planning and the evolution of the cities have all followed the same pattern (Asomani-Boateng, 2011; Omole & Akinbamijo, 2012) [6, 21].

2. Methodology

The study population consists of all the buildings in the delineated core area of the city. The total number of buildings was determined by counting from generated images from Geographical Information Systems (G.I.S) imaging. A total of 20,746 (twenty thousand, seven hundred and forty-six) buildings were manually counted.

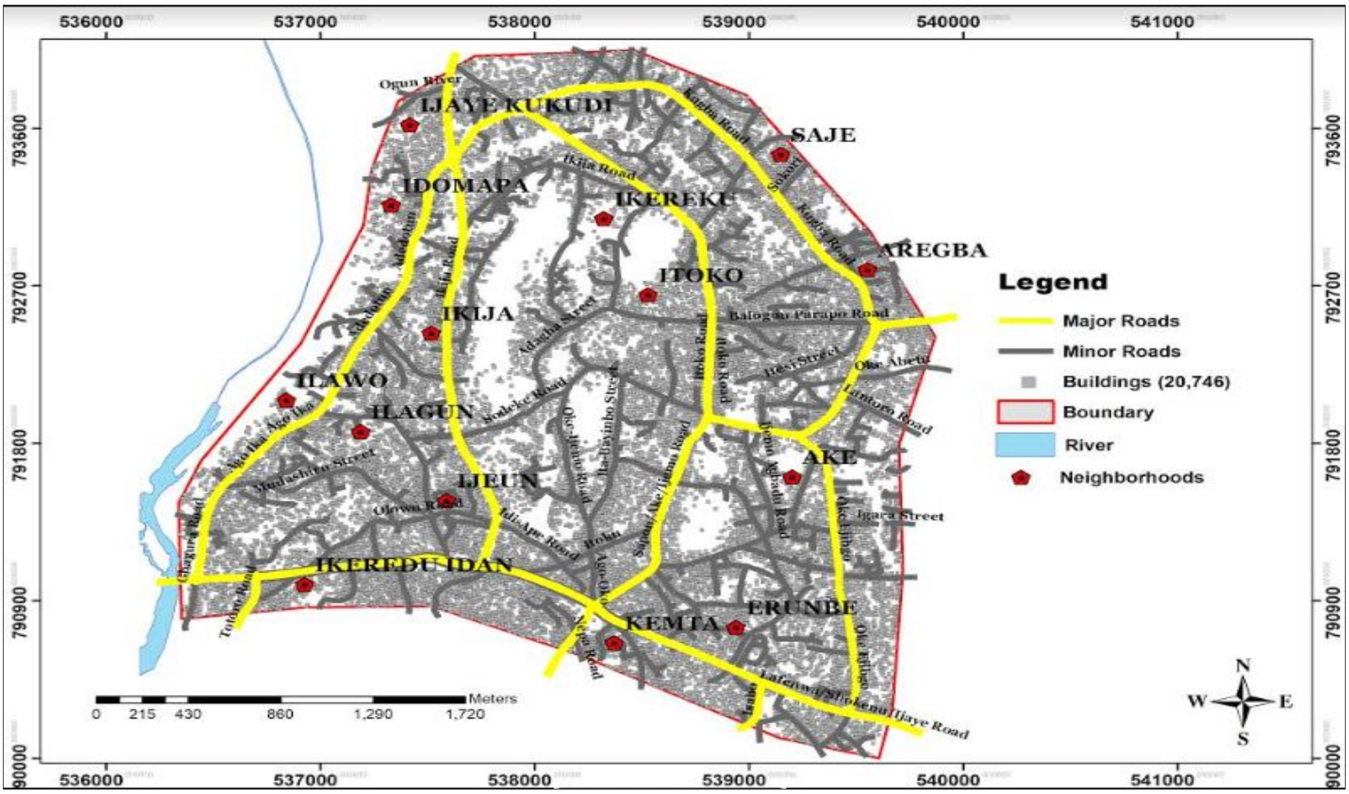

Plate 1: Imaging of buildings in the study area

A field survey was carried out in the area to determine the upgraded sections of the area based on guides from statutory documents on upgrade programmes carried out in the area during the study period. Upgraded sections of the city core that were physically confirmed were delineated on the generated image from G.I.S. and the buildings in the upgraded areas were counted and found to be 1,333 (one thousand, three hundred and thirty-five) buildings. From this a subtraction was made to confirm the number of buildings that form the bulk within the sedentary areas of the core where upgrades did not take place recently and was found to be 19,411 (nineteen thousand, four hundred and eleven) buildings.

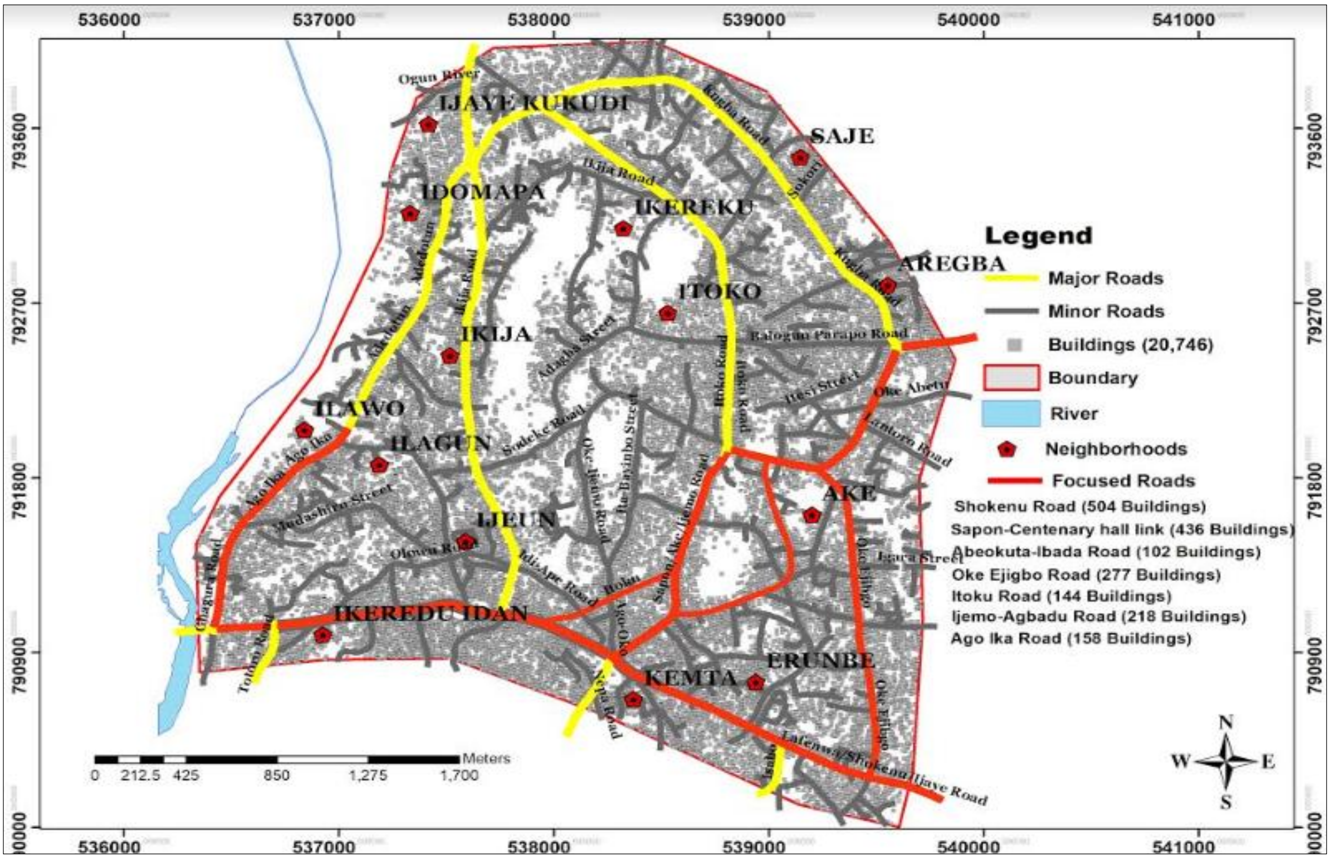

Plate 2: Map of study area showing the major roads with upgrades

The research being a case study, there is need to limit the error margins allowed in the sampling so that the statistical tools adopted can be representative of the whole population (Holton & Burnett, 2005; Kumar, 2018) [13, 17]. Confidence levels in the region of ninety-five percent (95%) and beyond are generally accepted for most research works (Apuke, 2017; O'Leary, 2004) [3, 19].

The total count of buildings along the streets that have witnessed urban renewal was 1,335 (one thousand, three hundred and thirty-five). Using Slovin's formula for sample space calculation for indeterminate outcomes with a 0.05 error margin, 308 buildings were calculated as sample size for the investigation.

$$n = \frac{N}{1 + [N \times e^2]}$$

Where, n is the sample size desired, N represents population size while e is the designed error margin.

310 copies of a close ended questionnaire were distributed to residents in buildings based on a systematic sampling procedure with preference for the property owners and building industry professionals. A questionnaire was administered to a respondent in every fourth building as the research progressed along the streets in the upgraded sections of the study area. The elemental approach to building analysis was used to determine the forms and elements that were subjected to evaluation. For the building forms, the following aspects of individual and collective geometries were assessed; Building shape; Symmetry in buildings and components; Door sizes and shapes; Window sizes and shapes; Building size; Opening ornamentation and Roof shapes. For the building elements the following components and their material assignments were also assessed; Wall finishing materials; Door finishing materials; Eaves & external ceiling materials; Roof finishing materials; Entrance area delineation and Window finishing materials.

Further investigations were carried out by direct observation and confirmation of the nature of the buildings and the details of the forms and elements in their elevations in both the sedentary and upgraded sections of the city. The summary of the findings is presented in Tables 2, 3, 4 and 5. Residents' perception of the changes in the building forms and elements were also extracted from the questionnaire and coded. The data obtained were subjected to statistical analysis. The outcomes are presented in Tables 7, 8, 9, 10, 11 and 12. The nature and content of urban upgrades in the area were obtained from the Department of Slum Regeneration in the state Ministry of Urban Planning and confirmed during the field visits. The major urban upgrade programmes that took place in the area are presented in Table 1. The field investigations were carried out between June and August of 2019.

Table 1: Recent upgrade programmes in Abeokuta core and the affected neighbourhoods

S/N	Urban Upgrade Programmes	Affected Neighbourhoods	Nature of Programme
1	Shokenu Road reconstruction (completed in 2017)	Erunbe, Oke-Olumo, Itoku, Oke-Bode, Ikeredu-Idan	Expansion to a dual carriage road, construction of 2 flyovers, construction of drains and erection of new electricity lines
2	Ikija Road construction (still under construction)	Ikoku, Ijeun, Itoko, Ikereku, IJaye, Kukudi	Expansion to a dual carriage road and construction of drains
3	Itoko Road construction (still under construction)	Ake, Itoko, Ikereku, Ijaye, Kukudi	Expansion to dual carriage and construction of drains
4	Sapon/Centenary Hall link road reconstruction (Completed in 2015)	Ake, Erunbe, Oke-Ijemo	Single carriage road expansion with drains and sidewalk.
5	Abeokuta-Ibadan road reconstruction (Section completed in 2016)	Ake, Aregba	Resurfacing of existing road and erection of median

3. New building typologies in the area

The new building typologies in the study area can be assessed from two points of view which are assessment based on building use and assessment based on architectural styles. The frequencies of occurrence based on building use in upgraded areas is presented in Table 2 while the frequencies of occurrence in the sedentary areas is presented in Table 3.

Three major types of buildings were identified within the study area based on their functions and these residential, commercial and mixed use. A fourth typology which is the indeterminate is created to capture other uses that do not come within the first three typologies. Some of these uses are religious buildings, schools, special structures like communal buildings that are not commercially oriented like town halls and structures that were not being used at the time of the investigation.

Of the three major types of buildings identified within the upgraded sections of the study area based on their functions, the residential buildings which are structures fully subjected to housing use accounted for the majority of the sample with a percentage distribution of 38%. They were mostly single-storey structures. There were also commercial buildings used for business purposes; mainly as shopping outlets and vocational services. They contributed 34% to the total sampled buildings within the upgraded sections of the study area. Furthermore, there were mixed-use buildings, which were buildings having multiple uses to which they were subjected simultaneously. These uses included residential, commercial, medical, educational and religious in instantaneous spatiotemporal admixture. These types of buildings comprised 14% of the total distribution.

In the sedentary sections of the study area, the distribution is more homogenous with the residential buildings taking up about seventy percent (70%) of the building use spread. The strictly commercial uses occupy about eight percent while the mixed use have an occurrence rate of about twenty percent (20%) of the building use spread. There were very few buildings of the indeterminate typology in the sedentary areas.The percentage differences in building typologies based on building use from the sedentary to the upgraded areas are presented in Table 4.

Table 2: Building typologies in the areas that have witnessed urban upgrades

Categories	Frequency	Percentage (%)
Residential	114	38.26
Commercial	103	34.56
Mixed use	42	14.09
Indeterminate	39	13.09

Table 3: Building typologies in the sedentary areas

Categories	Frequency	Percentage (%)
Residential	736	70.03
Commercial	85	8.08
Mixed use	214	20.37
Indeterminate	16	1.52

Table 4: Percentage change in building typologies in upgraded and sedentary areas

Categories	Percentage (%)	Percentage (%)	Percentage (%)
Residential	70.03	38.26	-31.77
Commercial	8.08	34.56	26.48
Mixed use	20.37	14.09	-6.28
Indeterminate	1.52	13.09	11.57

Based on the architectural building styles, the occurrence of building typologies in the study area as indicated in Table 5 are in five major categories. They are traditional, vernacular, international, postmodern, contemporary and indeterminate. There are midway categories like the late vernacular, and adaptations of the international, the postmodern and the contemporary. The late vernacular is the more modern variation of the original vernacular style like the Brazilian style. The adaptations of the other styles are variants that mix the original styles with some elements and forms of the vernacular style. The last style that is indicated as indeterminate is an aggregation of other styles that are present in the area but are not defined enough to fit into the outlined architectural styles. It also subsumes those building patterns that have evolved from a more complex mix of the mentioned styles. The percentage occurrences of the different building patterns are presented in table 5. The changing percentages indicate the drifts in preferences among the different architectural building styles as the study moved from the sedentary areas to the upgraded areas.

Table 5: Percentage occurrences of different architectural building styles in the sedentary and upgraded areas of the city core

Categories	Percentage (%) (Sedentary)	Percentage (%) (Upgraded)	Percentage (%) change
Traditional	8.75	2.29	-6.46
Vernacular	40.15	9.01	-30.67
Late vernacular/Brazilian	46.62	16.88	-29.74
International style	0.29	1.14	+0.85
Adapted international	1.24	16.56	+15.32
Postmodern style	0.67	1.80	+1.13
Adapted postmodern	0.19	29.01	+28.82
Contemporary	0.29	2.95	+2.66
Adapted contemporary	0.1	9.02	+8.92
Indeterminate	1.81	11.31	+9.5

4. Changes in forms and elements of buildings in the area

The percentages of change in the individual forms and elements from the sedentary to the upgraded sections of the study area are indicated in Table 6.

Table 6: Percentage changes in building forms and elements in the study area

Variable	Categories	Percentage (%) Sedentary	Percentage (%) Upgraded	Percentage Difference
Building shape	Rectilinear	93.9	89.1	-4.8
	Non-rectilinear	6.1	10.9	4.8
Symmetry	Symmetrical	70.03	15.08	-54.95
	Asymmetrical	8.08	84.12	76.04
Door sizes	0.7m-0.89m	20.36	19.01	-1.35
	0.9m-1.19m	77.35	62.46	-14.89
	1.2m-1.80m	1.62	2.79	1.17
	Above 1.80m	0.67	5.90	5.23
Window sizes	0.6m-0.89m	51.09	1.80	-49.29
	0.9m-1.19m	17.98	23.11	5.13
	1.2m-1.49m	19.22	46.39	27.17
	1.50m-1.80m	8.66	21.62	12.96
	Above 1.80m	3.04	7.02	3.98
Ornamentation	Present	70.03	0.98	-69.05
	Absent	8.08	99.02	90.94
Extraneous forms	Additive present	13.98	54.92	40.94
	Subtractive present	48.14	12.95	-35.19
	Both present	30.64	30.00	-0.64
	No extraneous forms	7.23	2.13	-5.1
Roof forms	Mono-pitched	4.19	5.41	1.22
	Flat	1.05	1.52	0.47

	Double-pitched	94.77	91.97	-2.8
Wall finishes	No finish	1.81	0	-1.81
	Rendered mud wall	46.91	3.11	-43.8
	Rendered block blbbbconcrete	50.71	96.39	45.68
	Others	0.57	0.49	-0.08
Door finish	Wood	92.48	63.61	-28.87
	Steel	5.80	30.49	24.69
	others	1.71	5.90	4.19
Window finishes	Wood	27.47	1.48	-25.99
Finishes	Alum/glass	61.94	91.31	29.37

Table 7 shows the summary of the 2-tailed T test to determine if relationships actually exist between the incidence of urban upgrades in the area which is the independent variable and the changes in building forms and elements which are the dependent variables. The aggregates of the building forms and that of the building elements were confirmed to have a relationship with the independent variable. All the individual forms and elements also returned a significance of 0.000 indicating that there is a relationship in each instance at 95% confidence interval

Having confirmed that there are indeed relationships between the independent and dependent variables, a one-way analysis of variance was carried out to determine if the relationships are significant. The results indicate that all the dependent variables except the wall finishing materials and window finishing materials have a significant relationship with the independent variable. The two dependent variables returned values in excess of 0.05. The variables were also subjected to a 2-tailed T test where urban upgrades were paired with each of the dependent variables. All the pairs returned significant relationships.

Table 7: Summary of results of 2-tailed test of significance, one-way analysis of variance and 2-tailed T test of relationships between urban upgrades and changes in individual and collective forms and elements in the study area

Variables	2-tailed test	One-way anova	2-tailed T test
Change in building forms	.000	.000	.000
Change in building elements	.000	.001	.000
Basic shapes of buildings have changed	.000	.039	.000
Symmetry in buildings and components has changed	.000	.008	.000
Basic shapes and sizes of doors have changed	.000	.002	.000
Basic shapes and sizes of windows have changed	.000	.000	.000
Basic sizes of the buildings have changed	.000	.000	.000
Ornamentation around openings has changed	.000	.001	.000
Basic shapes of roofs have changed	.000	.000	.000
Wall finishing materials	.000	.254	.000
Roof finishing materials	.000	.000	.000
Eaves and external ceiling structure	.000	.006	.000
Entrance area delineation	.000	.000	.000
Door finishing materials	.000	.004	.000
Window finishing materials	.000	.660	.000

To analyse the relationship among the three major variables, namely urban upgrades (VAR00001), building forms (VAR00002) and building elements (VAR00003), the General linear model was used to generate values for multivariate assessment. Pillai's Trace test value gave the strongest indication of relationship out of the four tests available (Pillai's Trace, Wilks' Lambda, Hotelling's Trace and Roy's Largest Root). The instrument gave the value for the calculated intercepts to be 0.784 (Table 8) for building forms and 0.872 (Table 9) for building elements.

To test for significance in the relationship between building forms and urban upgrades, Variable 1 is the presence of urban upgrades in selected areas which has a value of 0.129 while the explicit function is the change in building forms in the areas.

Table 8: Pillai's Trace test result table for significance of urban upgrades and change in building forms

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.784	533.035^b	2.000	294.000	.000
VAR00001	Pillai's Trace	.129	10.197	4.000	590.000	.000

The formula Design is Intercept + VAR00001

Change in building forms = intercept value + Variable 1 value.

The statistical summation is $0.784 + 0.129x_1$

The statistic is an upper bound on F that yields a lower bound on the significance level.

This indicates that at a 95% confidence interval, the relationship between the urban upgrades and the change in building forms is indeed significant.

The change in building elements was also subjected to the General Linear Model, using Pillai's Trace analysis (Table 9).

Table 9: Pillai's Trace test result table for significance of urban upgrades and change in elements

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.872	1000.890^b	2.000	294.000	.000
VAR00001	Pillai's Trace	.129	10.197	4.000	590.000	.000

Change in building elements = intercept value + Variable 1 value.

The statistical summation is $0.872 + 0.129x_1$
The statistic is an upper bound on F that yields a lower bound on the significance level.
This indicates that at a 95% confidence interval, the relationship between the urban upgrades and the change in building elements is indeed significant

To analyse the relationship among the three major variables, namely urban upgrades (VAR00001), building forms (VAR00002) and building elements (VAR00003) for multivariate analysis, the Pillai's trace instrument also indicated that the relationship among the variables is significant (Table 10).

Table 10: Pillai's Trace test result table for significance of urban upgrades, change in building forms and change in building elements

Effect		Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	.271	17.885[b]	6.000	288.000	.000
VAR00002	Pillai's Trace	.982	2659.564[b]	6.000	288.000	.000
VAR00003	Pillai's Trace	.199	11.901[b]	6.000	288.000	.000
VAR00001	Pillai's Trace	.492	15.697	12.000	578.000	.000

Design: Intercept + VAR00002 + VAR00003 + VAR00001
The statistical summation is $0.271 + 0.982x_2 + 0.199x_3 + 0.492x_1$
The statistic is an upper bound on F that yields a lower bound on the significance level
This indicates that at a 95% confidence interval, the relationship between the urban upgrades, change in building forms and the change in building elements is indeed significant.

The adjusted R-squared values which are the coefficients of determination of linear regression for all the building forms are high except for the changes in ornamentation around openings (Table 4.51). The range of the figures is between 0.41 and 0.84. This implies that between 41% and 84% of the changes in the individual building forms in the study area were caused by urban upgrades. The values for the building elements are presented in Table 11.

Table 11: Table of R^2 values for the linear relationship between the incident of urban upgrades and individual building forms in the study area

Building forms	R^2 value	Adjusted R^2 value
Basic shapes of buildings	0.830	0.828
Symmetry in buildings	0.846	0.844
Basic shapes and sizes of doors	0.647	0.642
Basic shapes and sizes of windows	0.632	0.627
Basic sizes of the buildings	0.752	0.749
Ornamentation around openings	0.230	0.407
Basic shapes of roofs	0.539	0.533

The adjusted R-squared values for the building elements range between 0.45 and 0.6 except the figures for the entrance area delineation and the window finishing materials (Table 12). This implies that between 45% (forty-five percent) and 60% (sixty percent) of the changes in five of the seven building elements in the study area were caused by the incidence of urban upgrades. Urban upgrades were responsible for 24.1% (twenty-four point one percent) of the changes in entrance area delineation and 21.9% (twenty-one point nine percent) of the changes in window finishing materials.

Table 12: Table of R^2 values for the linear relationship between the incident of urban upgrades and individual building elements in the study area

Building elements.	R^2 value	Adjusted R^2 value
Wall finishing materials	0.601	0.595
Roof finishing materials.	0.497	0.490
Eaves and external ceiling structure	0.465	0.458
Entrance area delineation.	0.251	0.241
Door finishing materials.	0.556	0.550
Window finishing	0.230	0.219

The summation is that all the individual building forms and building elements except the entrance area delineation and window finishes have been significantly altered with the coming of urban upgrades in the study area.

5. Discussions

The new building typologies in the area were determined from the field survey along two lines which are the building use typologies and the architectural building style typologies. For the architectural building style typologies, reference is made to table 5 where the adaptive styles of the international, the postmodern and the contemporary show marked increases in the percentage changes from the sedentary to the upgraded areas. The purely traditional and vernacular styles appear to wane in their representation in the upgraded areas.

Neighbourhoods within the city core that have not been upgraded are very sedentary in outlook. Most of the buildings are old looking and do not exhibit the attributes of the more recent architectural typologies. Majority of the buildings belong to the vernacular architecture tradition. Some of the older buildings are of the traditional architectural pattern which had become obsolete in Southwest Nigeria from the 1960s (Babatunde & Olakunle, 2014; Ikudayisi & Odeyale, 2021) [8, 15]. There are however very few renovated variants of the international style tradition where a few elements have been altered. The threshold of the evolving indigenous architecture within the sedentary sections of the study area is thus the late vernacular style. This is because the more recent patterns are not well represented in that section of the city. The style is a mix of more refined vernacular and Afro-Brazilian styles.

These styles and their adaptations had existed and evolved as the dominant vernacular building patterns in Southwest Nigeria from the beginning of the twentieth century up to the early 1980s (Arebanifo, 2017; Auwalu, 2019; Sabri & Olagoke, 2019) [4, 7, 24]. Since the major vernacular style adaptations of the international style, the afro-Brazilian Style and the late vernacular became obsolete at that time, the preponderance of these styles in the sedentary parts of the study area is an indication that very little changes were occurring in the building landscape for more than thirty years.

The neighbourhoods that have witnessed urban upgrades in recent times are different in outlook. Although there are no regular styles that can be identified as predominant, effort has been made to deviate from the vernacular continuum of the sedentary areas. Along the major streets, buildings exhibit the traditional forms with elements that depict the taste of international style and the post-modern styles. There are however a few buildings that stand out as complete departure from the indigenous styles having embraced the postmodern approach. The urban upgrades have stimulated changes in the building landscape and caused the indigenous architecture to evolve into more recent adaptations.

From the field findings, the building typologies with respect to building use have also been changing. The whole of the study area is designated as residential in the original land use map of the planning authority with the intention of granting land use conversion from residential to commercial to the properties that abut the major roads. From the sample survey of the upgraded areas, up to 48.65% of the buildings have been partly or fully commercialized (Table 4). This is an indication that the upgrades are stimulating change of land and building use from residential to commercial.

The overwhelming change in land use patterns especially along the major roads in the upgraded areas is a classic representation of the Markov chain model in urban upgrading and the subsequent land use changes (Zheng, Shen, Wang & Hong, 2015). Urban upgrading of the area may have instituted the onset of gentrification as witnessed in core areas of other cities (Nwanna, 2015). Some of the property owners had to fully or partly cede their property to give way for road and drain expansion. The lure of higher property values and extroversion of the neighbourhoods for higher patronage by commercial ventures is bringing in businesses to replace the residential occupiers (Tables 3 & 4). One of the major implications of gentrification in historic core areas is the change in urban land use (Ezema, Opoko & Oluwatayo 2016) [10].

In some instances, the downstream effects of urban upgrades are reflected on the built form (Daly *et al*., 2021) [9]. In such cases, other urban systems, mainly the infrastructure and municipal services are the primary targets of urban upgrade programmes. Such primary effects of urban upgrades can stimulate a drastic change in the socio-economic environment (Zemni, & Bogaert, 2011) [30]. The downstream effect is that people will start altering the built form. Urban upgrades in historic city centres like the study area tend to stimulate gentrification in the long run (Özdemir & Selçuk, 2017) [23]. In upgrade programmes that are intended to cause population displacement, population migration or gentrification, the socio-economic fabric is altered immediately and the new occupants of the area are likely to develop new socio-cultural values that may be different from that of the old inhabitants (Bontje, 2001). In such a situation, the new socio-cultural environment may express itself differently in its architecture and building disposition and the legacy is thus lost forever (Tighe & Opelt, 2016) [28]. The upgrades that took place in the Abeokuta historic core were carried out to address the spatial dysfunctionalism occasioned by limited access due to narrow roads and congestion. The alteration of building patterns from residential designs and more recent architectural styles is a farther concomitant that is arising from speculation and population displacement.

6. Conclusion

Urban upgrades are responsible for rapid changes in the socio-cultural environment which directly impact on the architecture of the communities. In historic city centres that possess high numbers of buildings of patrimonial stock and heritage values, the changes can result in loss of crucial legacies that can be otherwise exploited (Shin, 2010) [25]. In Southwest Nigeria and Abeokuta city core in particular, urban upgrade programmes were confirmed in this study to have promoted the adoption of foreign architectural building patterns with some of them having enough local contents that make the buildings compliant with the indigenous style which is culture based. They have also stimulated the change of building and land use from purely residential to commercial uses. Urban upgrades in Southwest Nigeria as in other parts of the world are mostly instituted to address socio-spatial dysfunctionalism (Gordon, 2003) [12]. It must be noted from the outcomes of this research that other concomitants like land use change and loss of building heritage value can occur after urban upgrades. Simulations can be attempted to predict the outcomes of urban upgrades beyond the socio-spatial effects and manage such outcomes to forestall undesirable situations during the policy planning stages.

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