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EXPLORING SPATIAL CONFIGURATION FOR EFFECTIVE WAY-FINDING IN THE DESIGN OF SHOPPING MALLS IN ABUJA - NIGERIA

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EXPLORING SPATIAL CONFIGURATION FOR EFFECTIVE WAY-FINDING IN THE DESIGN OF SHOPPING MALLS IN ABUJA - NIGERIA

Abstract

Shopping malls are an integral feature of the urban environment. Abuja is one of the fastest growing cities in Africa. With its thriving population, it has become a hub of urban activities. The presence of shopping complexes within the city is on a steady increase. Wayfinding is an activity that every shopper must engage in. The need for more wayfinding research in the Nigerian context is evident. A study was carried to explore spatial organization for effective wayfinding in shopping malls. Case study was carried out on three shopping malls in Abuja using a visual survey, questionnaire survey and Visibility Graph Analysis for space syntax. Results from the visual survey and questionnaire survey support findings from literature that users tend to rely on physical features and coded information for their wayfinding tasks before engaging social practices. The VGA run on the floor plans of the ground floors of the shopping malls revealed that linear floor plan configuration is more intelligible than non-linear configurations, thus users will find it easier to find their way in linear spatial configurations than in non-linear. This is primarily due to the interruption of visual sight lines. The paper recommends that architects should pay more attention to designing legible spaces that support efficient wayfinding by utilizing good spatial configuration as well as adequate coded information and use of landmarks.

Keywords

Wayfinding, Shopping-malls, Spatial configuration, Intelligibility, Space syntax

1. INTRODUCTION

Shopping malls can be defined as a group of retail stores, which are conceived, constructed, owned and managed as a unit (Kotler & Armstrong, 2017). They are a modern adaptation of the historical marketplace and have become an integral part of urban societies nowadays (Ahmed & Hassanain, 2020). In the pursuit of attracting and retaining customers, shopping mall designers and operators pay close attention to factors such as store layout, lighting, signage, and amenities (Ryu et al., 2019). One critical aspect that has been receiving increased attention in recent years is the role of spatial configuration in promoting efficient wayfinding within shopping malls (Gao et al., 2020). Wayfinding is the common and fundamental task that all shoppers must go through in a shopping mall (Dogu, 1997). Effective wayfinding, which refers to the ability of users to navigate a space with ease and accuracy, has been shown to have a significant impact on user satisfaction, engagement, and loyalty (Kwallek et al., 2011).

A number of wayfinding studies have been carried out in Nigeria in recent years that have contributed relevant information on the subject of wayfinding (Maina & Audu, 2016; Maina & Dauda, 2017; Ishaq, 2019; Inuwa & Maina, 2019; Ihunwo & Anthony, 2021). Some studies have examined the relationship between spatial configuration and wayfinding in specific contexts, such as hospitals (Bostrom and Ljungberg, 2012) and airports (Aga et al., 2011), but few studies have focused specifically on shopping malls (Ihunwo & Anthony, 2021; El-Hassawi et al, 2023).

With the rapid growth of urbanization in Nigeria, shopping malls have emerged as key centres of social and economic activity, attracting large numbers of users on a daily basis (Olayinka et al., 2019). In 2004, Nigeria's first international-standard shopping mall- The Palms Shopping Mall- was established in Lekki Peninsula, Lagos. Abuja, the capital of Nigeria, is one of the fastest growing cities in Africa (Bashir O.A. et al, 2021). With a population of over three million people (United Nations – World Population Prospects, 2022), it has become a hub of urban life and activities. Jabi Lake Mall is the first destination shopping mall situated in Abuja, Nigeria. The mall, which offers 25000 square meters of grade-A shopping space, is the first of its kind in Nigeria's capital city, Abuja. The presence of shopping malls within the city is on a steady increase and has become a major feature of the urban environment and an important part of the city's social and economic architecture.

Despite the growing popularity of shopping malls as urban gathering places, there is still much to be learned about the optimal design strategies for promoting efficient wayfinding in these environments. While a number of studies have investigated the role of spatial configuration in enhancing wayfinding in different indoor environments (Gao et al., 2020; Kaminaga et al., 2017; Laumann et al., 2017), very few have focused specifically on shopping malls. Moreover, most of the existing studies have been conducted in Western contexts, with limited attention paid to the unique cultural and social factors that may shape user preferences and behaviours in different regions (Kim et al., 2021). This study seeks to address this gap by investigating the role of spatial configuration in promoting effective wayfinding in shopping malls in Abuja, Nigeria.

This study aims at exploring how spatial configuration can be optimized to improve wayfinding in shopping malls. Specifically, the study poses three research questions. First, what are factors have been identified as contributing to effective wayfinding in shopping malls, and how have these factors been influenced by spatial configuration? Secondly, how do shoppers navigate shopping malls with different spatial configurations, and what are the commonalities and differences in their behaviour across these configurations? And thirdly, which spatial configurations are most effective for

promoting efficient wayfinding in shopping malls, and what design features or elements are most critical for supporting effective navigation?

This study will focus specifically on the relationship between spatial configuration and wayfinding in shopping malls, and will not address other architectural aspects of the shopping mall experience, such as building form, materiality, or structural systems. The case study analysis will be limited to a selected number of shopping malls in Abuja and their specific spatial configurations, in order to identify commonalities and differences in shoppers' navigation behaviour across these configurations.

This paper is structured along 6 sections following the introduction. The second section gives a brief review of literature on wayfinding which leads to the framework presented in the methodology. This is then followed by a discussion of results from the study. The paper is rounded up with conclusions and references pertinent to the study.

2. WAYFINDING

Al-Sharaa et al (2022) defines wayfinding as the process of finding one's way to a destination in a familiar or unfamiliar setting using any cues given by the environment. Dogu and Erkip (2000) in Tullio-Pow et al (2021) define wayfinding as "a set of tools devised to help people reach their destination in an unfamiliar environment" (p. 735). Although diverse opinions about all aspects of the concept of wayfinding abound, there has been a consistency in the overall meaning of the term. Wayfinding is generally viewed as a complex problem-solving behavioural activity which requires multiple cognitive resources (Inuwa, 2021).

The term "wayfinding" was first used and defined by Lynch in his book titled "The Image of The City" which was published in 1960. Subsequent definitions and theories relating to wayfinding and its principles across history can be subdivided into three phases (Hao and Ching Chiuan, 2009; Rooke, 2012) as reviewed by (Maina & Audu, 2016). These include the Pre-Passini Era (PrePE), Passini Era (PE) and Post-Passini Era (PoPE). Cognitive research such as the pioneering work of Lynch (1960) dominates the PrePE. Wayfinding is often discussed in terms of spatial orientation and cognitive maps. Spatial orientation refers to the inherent ability to create a sufficient cognitive map of a given setting in relation to the surrounding environment (Passini, 1984). On the other hand, a cognitive map is a mental representation or overall mental image of a layout or spaces (Arthur and Passini, 1992). During this period, research primarily centered on exploring spatial characteristics that facilitated cognitive mapping (ibid). However, a significant criticism of these approaches lies in their tendency to prioritize human perception and information processing, often neglecting the influence of the built environment in which wayfinding takes place (ibid). Moreover, assessing and reliably measuring cognitive mapping and externalized spatial knowledge present considerable challenges.

In contrast to the traditional notion of spatial orientation, Romedi Passini introduced the concept of spatial problem solving, which emphasizes the reliance of humans on information embedded within the built environment to facilitate information processing, decision-making, and decision execution (Passini, 1977, 1984). This perspective also extends to environmental communication, as discussed by Arthur and Passini (1992), where distinct architectural and informational elements of wayfinding are identified, and relevant evidence is compiled into design guides (Hunter, 2010). As part of the PoPE research efforts, there is a particular focus on developing design guides aimed at enhancing wayfinding.

Despite considerable efforts, there remains a lack of comprehensive theories and analytical techniques to effectively address spatial problem solving, including non-static

navigation and the predictability of factors influencing wayfinding. To address this gap, several studies utilizing space syntax have attempted to analyze individual human cognitive processes and behavior within complex buildings, focusing on parameters such as visual access and building configuration (Peponis, Zimring, and Choi, 1990; Haq and Zimring, 2003; Holsher, Meilinger, Vrachliotis, Brosamle, and Knauff, 2005; Holsher, Brosamle, and Vrachliotis, 2007). These studies often map participants' movement and behavior patterns to measurable parameters of the building layout. While they have achieved some success in correlating behavioral data from wayfinding experiments with formal spatial analysis of the setting using verifiable quantitative methods, there is a need for future research to actively vary the space syntax properties of wayfinding tasks and layout variants. This will help test the applicability of space syntax as a predictive theory of human spatial behavior (Holsher, Brosamle, and Vrachliotis, 2007, p. 161).

Over the years, numerous design principles and guidelines aimed at enhancing wayfinding design have been published. However, many of these resources lack a cohesive conceptualization. Heulat's principles effectively integrate a majority of these features, as depicted in Figure 1. Additionally, Heulat provides a comprehensive list detailing specific design guidelines to support the wayfinding improvement process.

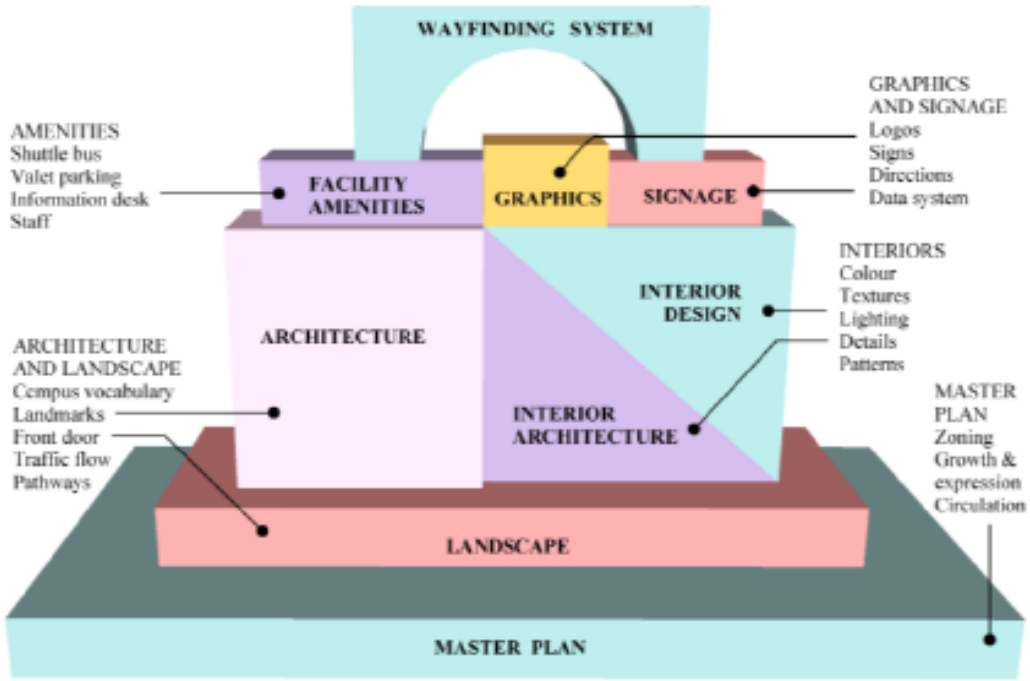

Fig.1: Building block model for successful wayfinding. Source: Huelat (2007).

In a wayfinding study conducted by Rooke C. N. (2012), three variables were identified for evaluating wayfinding issues in healthcare facilities (figure 2). These variables were elucidated within a broader prescriptive framework based on the tri-partite conception of knowledge flow. The variables, in sequential order, are:

- Physical features
- Coded information, and
- Social practices.

These variables are also applicable to wayfinding research in shopping malls and have been used in previous wayfinding studies (Inuwa, 2021; Maina & Dauda, 2017).

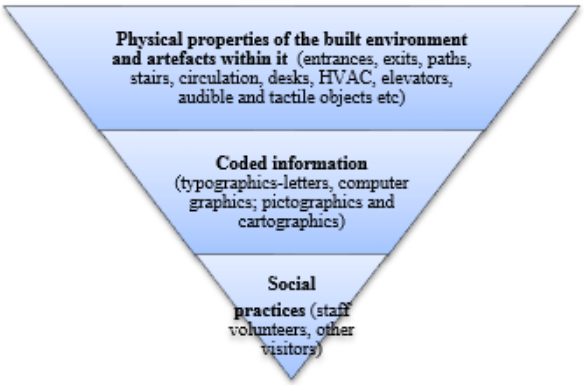

Fig.2: Prescriptive framework for addressing wayfinding problems.
Adapted from Rooke (2012)

2.1 Theory of Circulation in Shopping Malls

Kotler and Armstrong (2017) define shopping malls as a group of retail stores, which are conceived, constructed, owned and managed as a unit. The process of problem-solving to reach a destination through a complex environment is described as wayfinding (Authur & Passini, 1992). Wayfinding is an activity that all shoppers must engage in within shopping malls. A brief description of three types of wayfinding behaviour is given below:

- *Searching behaviour*: Alibali, (2005) stated that body movements or gestures (also called searching behaviours) play a vital role in the initial phase of wayfinding. During wayfinding, people make a decision plan based on the visual and written clues that they find by looking around.
- *Stopping behaviour:* During the second phase, to make a decision plan, people tend to stop their movement. This can be referred to as the stopping behaviour. Stopping behaviour helps people to focus on spatial information and process that information. Based on the decision plan, people move ahead and repeat the actions of the earlier phases till they find their destinations.
- *Help-seeking behaviour:* When people do not find the information they need in a consistent way they get lost. In such moments, they exhibit help-seeking behaviour to get help from others in order to find their way. It is assumed that the more wayfinding behaviours customers exhibit, the more their dissatisfaction with the signage system, the overall layout and with the perceived travel time that can negatively affect the legibility of the environment (Alam, 2018).

  Circulation in shopping malls is primarily influenced by the strategic positioning of anchor stores within the mall. The following are typical anchor shop arrangements:

- *Linear Arrangement*

  The most basic organizational design provides a linear layout of circulation space and accommodates smaller shops between two anchor shops. These designs are known as dumb-bell, linear, or gun-barrel malls, and they link two places designated by anchors. Figure 3 illustrates how the addition of one or more punctuation points via node spaces can change this simple structure. The number of punctuation spots along the length of the public circulation area will be determined by the amount of available space and the size of the site. The node space can be utilized to add an angle to the plan or to allow for the connection of two circulation routes.

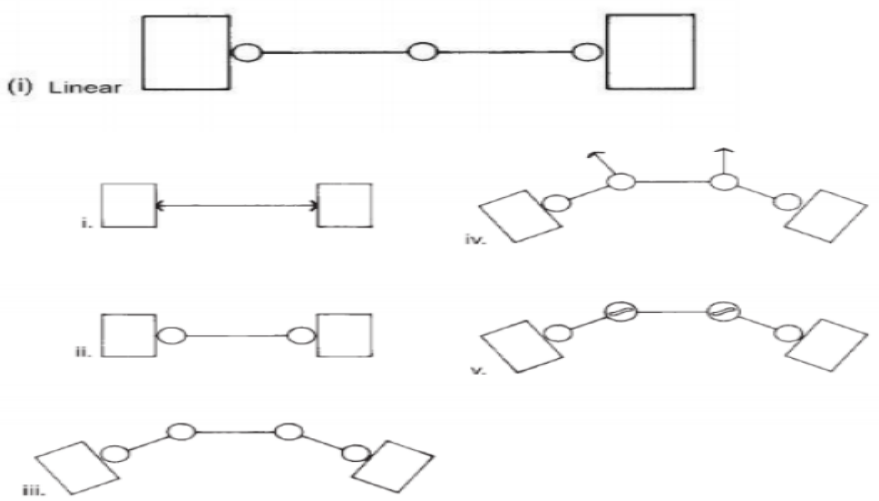

Fig.3: showing Linear arrangements: simple dumb-bell between two anchors; ii) dumb-bell with nodes; iii) nodes used to change angle; iv) nodes to receive other routes; v) nodes including vertical circulation.
Source: Peter, (2006).

- *Circuit Arrangement*

  Shop units should be organized in such a way that the public circulation creates a natural flow of pedestrian traffic. Circuit layout patterns (figure 4) encourage continuous circulation past all of the storefronts and a return to the starting location. The creation of a circuit in the design of a shopping centre allows customers to walk through the shopping centre without having to retrace their steps. Circuits can be created in three dimensions by considering both the vertical and plan arrangement of the layout. Circuits can be singular or multiple by adopting a figure of eight. Pedestrian flows in circuits are facilitated by strategically positioning an anchor element at the corners to capture and maintain interest. The anchor element should be visible from a distance to lead the customer on. Maintaining sight lines and clear visibility from one anchor element to the next are significant design considerations.

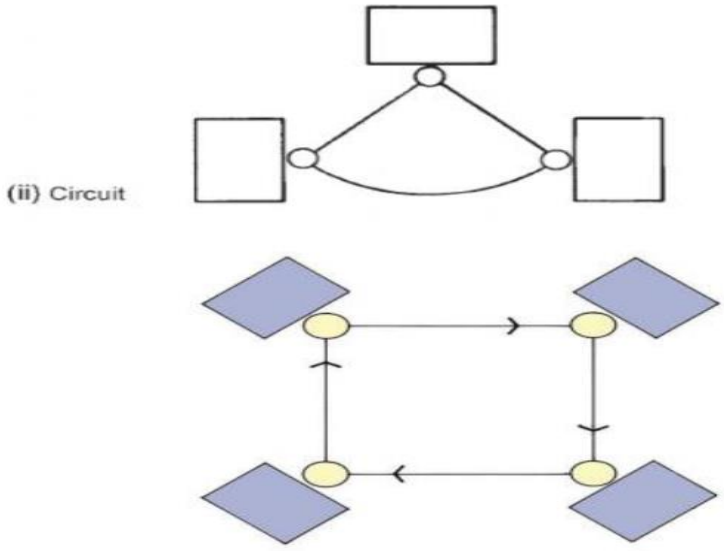

Fig.4: Showing the strategic positioning of anchors in a circuit generate footfall.
Source: Peter, (2006).

- *Keyhole Arrangement*

  This arrangement is based on a single point of entry and return from a high street. The focal point of this type of layout is usually one or more large anchor stores located at the end of the circulation route. It draws customers beyond all other frontages as they anticipate the destination. The keyhole layout is more suited to a multi-level system, where people enter and circulate to their destination on one level and return on another, thus avoiding having to retrace their steps past the same stores (Figure 5). In order to support entry and return routes being completed at different levels, a means of vertical level change will be necessary at the entrance, as well as anchor shops with entrances on each circulation level.

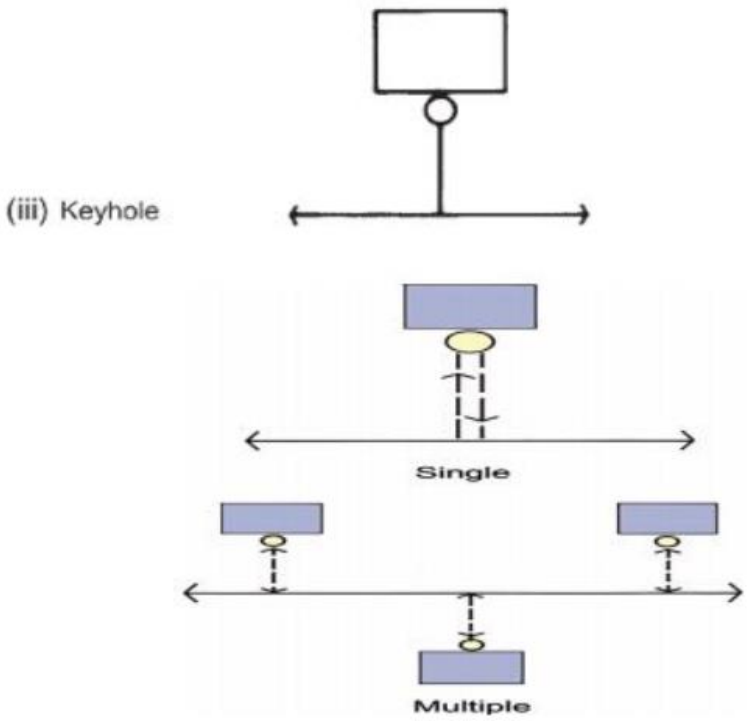

Fig.5: Showing a single point of entry and return onto a high street can also be used in multiples to form several keyholes.
Source: Steven, (2005).

3. METHODOLOGY

To adequately answer the research questions posed by this study, case study was chosen as the research strategy. The selection criteria for the case study was that it will consist of shopping malls of different floor plan configurations which are classified as regional centres that typically incorporate at least one full line department store, with around 50-100 shops and a retail area that ranges between 30,000 and 50,000 square meters, having a high number of visitors ranging between 500-1000 per hour and located in Abuja, Nigeria. Three shopping malls in Abuja were selected for the case study. These are Jabi Lake Mall, Novare Central Mall, and Silverbird Entertainment Centre. Three types of analysis were conducted. The first was a visual survey using a checklist, which was carried out to capture information relevant to answering the first research question, which explores the key factors identified as influential in facilitating effective wayfinding in shopping malls. Secondly, a questionnaire survey was used to gather subjective judgements from a group of participants in line with the second objective of

this study. The third involved the use of Visual Graph Analysis (VGA) to generate axial maps and depth maps, which were used to identify patterns of integration and connectivity within the malls, and determine the intelligibility of each mall's floor plan configuration. The research variables as identified from previous wayfinding studies (Rooke,2012; Inuwa, 2021; Maina & Dauda, 2017) are physical features, coded information, and social practices.

3.1 Visual Survey

A visual survey was carried out to capture information relevant to answering the first research question, which explores the factors identified as influential in facilitating effective wayfinding in shopping. To collect the data reported in this section pertaining to these factors, the visual survey was conducted utilizing a checklist approach shown in the table below using variables derived from the literature review.

3.2 Questionnaire survey

The questionnaire survey was used to gather subjective judgements from a group of participants in line with the second objective of this study to find out how shoppers navigate shopping malls with different spatial configurations and what are the commonalities and differences in their behaviour across these configurations. The questionnaires used in this study were close ended and used to measure wayfinding difficulty of the selected retail layouts. The questionnaire is in line with the research variables identified from literature (Rooke, 2012) and was adopted from similar wayfinding studies (Meziani & Hussein, 2017). The data collected from the questionnaires was used to assess users' perception of wayfinding in the different shopping malls that were considered. The complexity of each layout system was rated on a 1-5 Likert scale ranging from very simple to very complex.

The participant population comprised of a random selection of visitors within the shopping mall environment who were available and willing to participate. The total population of participants in the questionnaire survey is 73. 41 participants were gotten from Jabi Lake Mall, 17 from Novare Central Mall and 15 from Silverbird Entertainment Centre.

3.3 Visibility Graph Analysis

Visibility Graph Analysis (VGA), also known as Isovist analysis, proves valuable for analyzing the degree of visibility from specific locations within a building or urban area (Maina, 2014). An isovist field represents the view that an individual has from a given point or multiple points in an enclosed or urban space. This method is commonly employed for purposes related to wayfinding or orientation (van Nes, 2011). Notably, the isovist field constitutes one of the fundamental geometric elements in Space Syntax analysis (Klarqvist, 1993).

Space Syntax involves quantitatively expressing the relationship between geometries that define human activity within a comprehensive system or layout of interconnected spaces, utilizing specific mathematical measures like the integration value (IV). In essence, Space Syntax revolves around applying configurational measures to examine the patterns of various geometric elements created by buildings and cities (Hillier, 2005, p. 7). In VGA, a grid of points is superimposed on the plan, forming a graph connecting each point to all other points it can visually observe. The visual integration of a point is determined by the number of visual

steps required to reach any other point within the system (Turner, 2004). In the present study, VGA was utilized to address the research question focused on identifying the most effective spatial configurations for facilitating efficient wayfinding in shopping malls.

DepthmapX v0.8 software was used to run the VGA of the floor plans of the Shopping Malls. DepthmapX is a freely available software tool designed for conducting visibility analysis of architectural and urban systems. The application requires a system's plan as input and can generate maps illustrating visually integrated locations within the system (UCL, 2012). In this study, floor plans of the Shopping Malls were initially created in Revit and saved in DXF format. Subsequently, these floor plans were exported to Depthmap, and the visibility graph analysis (VGA) was executed on the floor plans, using grids with dimensions of 900mm.

4. DATA ANALYSIS AND PRESENTATION

The data from the visual survey was analysed and presented using tables. The data from the questionnaire survey was analysed using Google sheets and presented using charts and tables. The Visibility Graph Analysis was run using DepthmapX 0.8 software and results were presented using tables and figures.

5. RESULTS AND DISCUSSION

The case study was carried on three shopping malls in Abuja with different spatial layouts. Jabi Lake Mall is a 27,000sqm two-level shopping centre. The mall offers a wide range of retail, entertainment, and recreational amenities. It has a racetrack floor plan layout as shown in figures 6 and 7. The structural framework of the building is a concrete frame structure with suspended concrete floor slab and internal reinforced concrete columns.

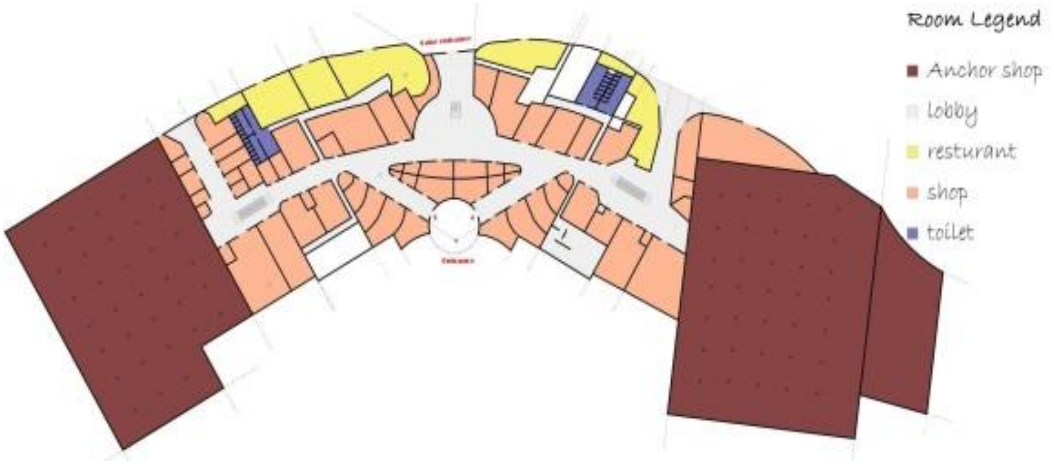

Fig.6: Sketch diagram of Jabi Lake Mall Ground Floor Plan
Source: Researcher's field work (2023)

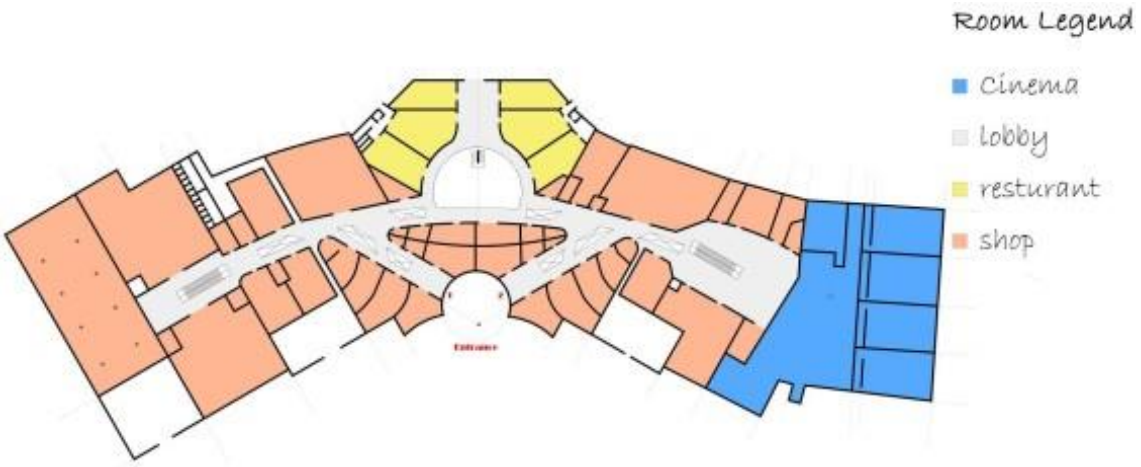

Fig.7: Sketch diagram of Jabi Lake Mall First Floor Plan
Source: Researcher's field work (2023)

Silverbird Entertainment Centre spans an area of 33,000sqm and comprises of 4-storeys with additional basement floor (figure 8) and one mezzanine floor. The ground and first floors (figures 9 and 10) are shops, with a life style section on the second floor (figure 11), 12 screen cinema on the third floor (figure 12) while the fourth floor is the penthouse floor (figure 13). The structure is made up of a concrete frame structure with suspended floor slabs supported by internal reinforced concrete columns.

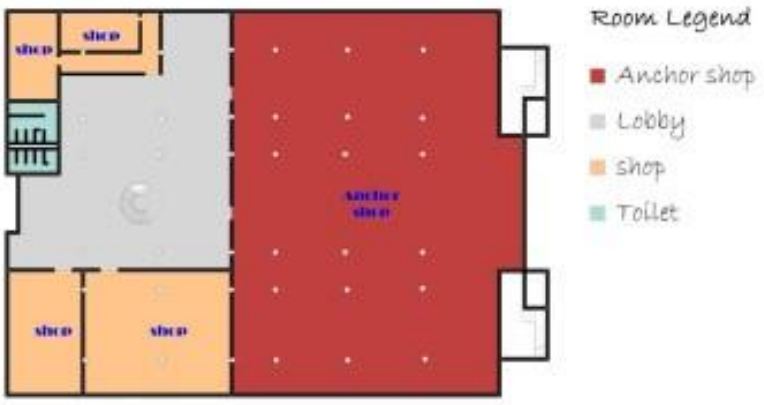

Fig.8: Sketch diagram of Silverbird Entertainment Centre Basement Floor Plan
Source: Researcher's field work (2023)

Fig.9: Sketch diagram of Silverbird Entertainment Centre Ground Floor Plan
Source: Researcher's field work (2023)

Fig.10: Sketch diagram of Silverbird Entertainment Centre First Floor Plan
Source: Researcher's field work (2023)

Fig.11: Sketch diagram of Silverbird Entertainment Centre Second Floor Plan
Source: Researcher's field work (2023)

Fig.12: Sketch diagram of Silverbird Entertainment Centre Third Floor Plan
Source: Researcher's field work (2023)

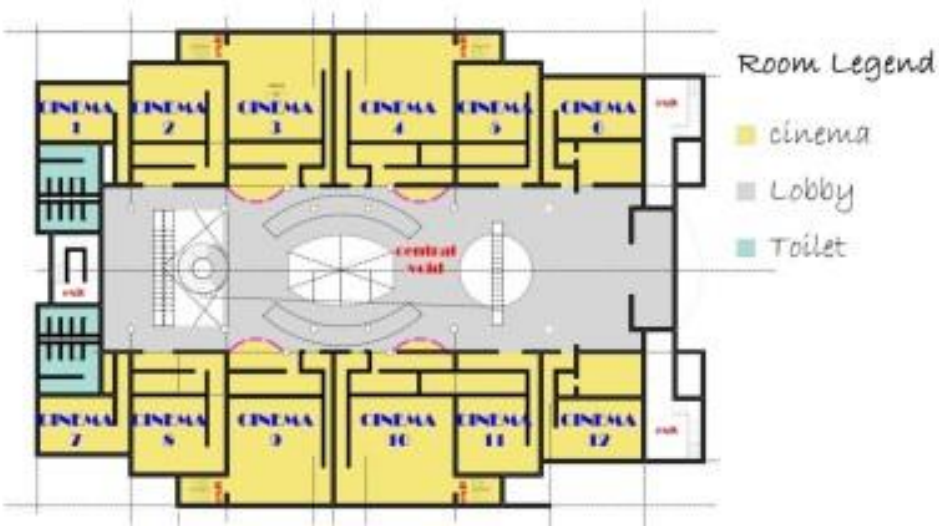

Fig.13: Sketch diagram of Silverbird Entertainment Centre Fourth Floor Plan
Source: Researcher's field work (2023)

Novare Central Mall is a development of four floors with a gross lettable area (GLA) of 12466sqm contemporary retail facilities and A-grade offices. The retail portion is made up of 7153sqm GLA and is situated on the ground floor (figure 14). The structure consists of a concrete frame structure with suspended slab in combination with internal columns with concrete column heads.

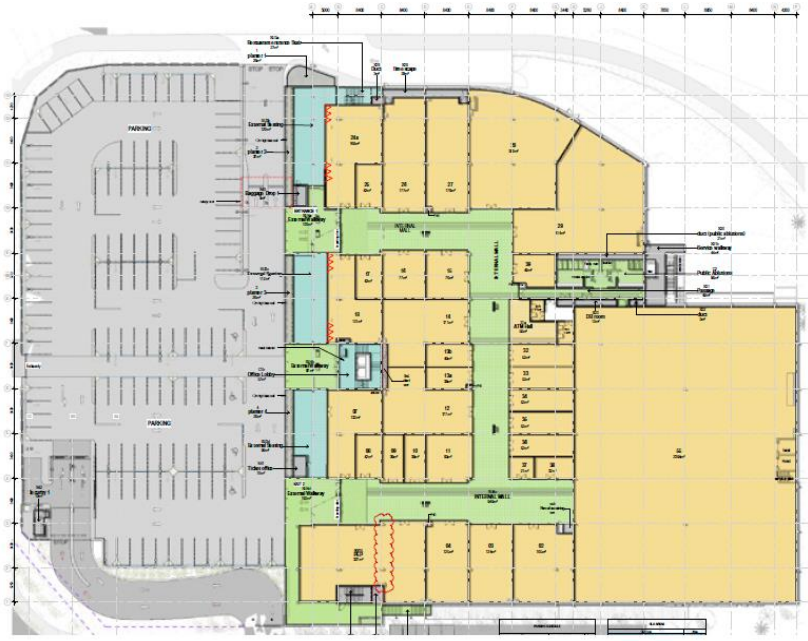

Fig.14: Sketch diagram of Novare Central Mall Ground Floor Plan (Retail Area)
Source: Novare Central Leasing Brochure Opening

5.1 Visual survey

Data from the visual survey was analysed with the aid of the checklist approach. The malls are represented by acronyms; JLM for Jabi Lake Mall, NCM for Novare Central Mall and SEC for Silverbird Entertainment Center. The Level of Application of identified variables in each mall is presented using H for High, M for Medium and L for Low as shown in table 1 below:

Table 1. Presentation of results from visual survey using checklist

S/N	Variable	Result	Level of Application			Remark
			JLM	NCM	SEC	
1.	Master plan	-Growth and expansion - Zoning	L H	L H	L M	There was no clear provision for future expansion in all three malls. Adequate zoning was done in JLM and NCM where units of similar function were integrated in defined locations.
2.	Landscape	-Parking area -Accessible walkway -Landmark -Indoor plants	H L L M	H H M M	M H H L	There is sufficient parking space in JLM and NCM but not in SEC. The landscaping in NCM and SEC integrate accessible pedestrian walkways but not in JLM
3.	Architecture and interior design	-Entrance -Level change devices -Openings -Materials -Colours -Lighting	H H H H M H	H L H H M H	H H M H M M	The entrances to all three malls are well defined and celebrated JLM & SEC have clearly visible and well positioned level change devices. .Openings that provide natural lighting which aid users in wayfinding are well available in JLM & NCM, but insufficient in SEC. The use of colour was satisfactory JLM & NCM are well designed for natural lighting.
4.	Signage and graphics	-Signs -Graphic devices	H H	H L	L M	In all the malls studied, units can be identified by signage placed above doors with some directional signs placed at strategic points. Graphic devices were used only in JLM and SEC.
5.	Facility amenity	-Information desk	L	L	M	An Information desk is available only in SEC.

Landscaping features, such as shrubs, flowers, and trees, were adequately incorporated along the walkways and access roads in Novare Central Mall and Silverbird Mall. However, Jabi Lake Mall lacked sufficient landscaping elements. The entrances of all three malls were well-designed and prominently displayed. In terms of vertical circulation, stairs, elevators, ramps, and escalators were conveniently positioned and easily accessible for users in Silverbird Mall and Jabi Lake Mall. On the other hand, in Novare Central Mall, the vertical circulation was not visible or accessible within the mall itself since it occupied only the ground floor. The vertical circulation was exclusively accessible through a separate entrance leading to the administrative section and offices.

Architectural elements, such as door types, walling materials, and floor finishes, were utilized in the three case studies to differentiate between public and non-public areas. In the interior design of Jabi Lake Mall, indoor plants and various wall materials were employed, particularly in the administrative section. However,

there was not a significant emphasis on the use of colors and artworks in any of the malls. All three malls incorporated both natural and artificial lighting. Information desks were absent in the malls, except for Silverbird Mall, where one was available. In Jabi Lake Mall and Silverbird Mall, a kiosk was utilized to provide individuals with a visual indication of the different floors. Signage was implemented in all the malls, although the signage in Silverbird Mall was deemed inadequate.

5.2 Questionnaire Survey

The Questionnaire was divided into four sections, the first section collected information about the participants' demographics while the other three contained questions accessing Spatial Perception, Wayfinding Experience, and Spatial Configuration respectively. The questionnaires were administered to users of the selected malls, both visitors and staff. The total population of participants in the questionnaire survey is 73. 41 participants were gotten from Jabi Lake Mall, 17 from Novare Central Mall and 15 from Silverbird Entertainment Centre. The results were compiled using Google Forms and analysed using Google Sheets.

The table below shows the modal responses from the questionnaire survey:

Table 2. Presentation of results from questionnaire survey

SECTION	VARIABLE	RESULTS (n= modal response)					
		JLM		NCM		SEC	
		n	%	n	%	n	%
Section A: Demographics	- Age	21-30	48.8	21-30	58.8	21-30 31-40	40 40
	- Gender	Female	60	Male	70.6	Female	60
	- Mall visit history	Several	84.6	Several	71.4	Several	66.7
	- User Category	Visitor	74.4	Visitor	73.3	Visitor	73.3
Section B: Spatial Perception	- How would you describe your sense of direction?	Very good	43.9	Good	58.8	Good	46.7
	- How would you rate your spatial memory?	Good	56.1	Good	70.6	Good	46.7
	- How often do you visit the shopping mall being surveyed?	Regularly	29.3	Very Frequently	35.3	Regularly	40
	- How easy is it for you to locate a store in the shopping mall?	Easy	51.2	Very Easy	64.7	Easy	66.7
	- How easy is it for you to find your way back to a previously visited store?	Easy	51.2	Very Easy	58.8	Easy	60
Section C: Wayfinding Experience	- How do you typically navigate the shopping mall?	Signs	48.8	Signs	52.9	Landmarks	46.7
	- How often do you get lost while navigating the shopping mall?	Rarely	34.1	Never	52.9	Rarely	46.7
	- How easy is it to find the way to the nearest exit from the shopping mall?	Easy	46.3	Easy	56.3	Easy	60
	- How easy is it to find the way to the nearest restroom from your current location?	Easy	41.5	Very Easy	52.9	Easy	53.3

SECTION	VARIABLE	RESULTS (n= modal response)					
		JLM		NCM		SEC	
		n	%	n	%	n	%
	- How easy is it to find the way to the nearest ATM from your current location?	Easy	48.8	Very Easy	76.5	Neutral	33.3
Section D: Spatial Configuration	- Which areas of the shopping mall do you find most confusing?	None	27.6	None	46.2	None	33.3
	- Are there any areas of the shopping mall that you avoid because of difficulty in navigating them?	No	86.8	No	93.8	No	60
	- Which parts of the shopping mall do you think are well-designed for easy navigation?	Main Entrance	55	Main Entrance, Corridors	82.5	Main Entrance	66.8
	- What types of features do you think could improve wayfinding in the shopping mall?	Signage	50	Signage	47.1	Signage	60.1

The findings from the questionnaire survey reveal that the majority of the shoppers do not experience difficulty finding their way within the malls surveyed. This may be influenced by previous knowledge of the building layout, as the findings also revealed that majority of the shoppers visited the malls regularly. The findings also reveal that the primary elements shoppers utilize for navigation and wayfinding within the malls are signage and landmarks. Some shoppers also employ social practices by asking for directions from either staff or other visitors to the mall. Jabi Lake Mall recorded a higher percentage of shoppers indicating difficulty in wayfinding within the mall.

5.3 Visibility graph analysis

By employing visibility graph analysis (VGA), an examination was conducted on the ground floor areas which are the primary user floors within all three malls and so have the highest amount of footfall and traffic. The resulting data was recorded, categorizing it according to the sections associated with the facility's users. Visual Integration quantifies the average distance or depth between a given space and all other spaces within a system. In terms of classification, spaces can be ranked on a spectrum from highly integrated (represented by warmer colours such as red) to more segregated or disconnected (represented by cooler colours such as blue) (Klarqvist, 1993). Highly integrated spaces are characterized by their accessibility from all other spaces within the system (Hillier, 1996), making them more frequently utilized by visitors. Connectivity refers to the quantification of the direct connections between a given space and its immediate neighbouring spaces. It represents a static and localized measure of spatial relationships (Klarqvist, 1993). By assessing the connectivity levels of spaces in relation to their specific functional requirements, such as public or private use, circulation patterns, or the display of goods, it becomes possible to identify spaces that offer greater potential for accessibility and visibility. Consequently, these highly connected spaces are more likely to attract higher visitation rates. In contrast, spaces with low connectivity,

particularly within circulation areas, may hinder proper functionality, leading users to actively avoid them during their navigation. In table 3 below, the spatial attributes data for each of the case studies, illustrating the minimum and maximum connectivity between spaces, as well as the minimum and maximum visual integration are presented.

Table 3. Presentation of connectivity and visual integration values in Jabi Lake Mall, Novare Central Mall, and Silverbird Entertainment Centre

MALL	ATTRIBUTE	MINIMUM	AVERAGE	MAXIMUM
Jabi Lake Mall	Connectivity Visual Integration	1 1.59257	994.73 5.11844	2089 9.39348
Novare Central Mall	Connectivity Visual Integration	5 2.07183	1464.74 6.32294	3714 11.6088
Silverbird Entertainment Centre	Connectivity Visual Integration	8 2.67345	638.679 6.92726	1819 11.0557

Intelligibility, as a static global measure, assesses the degree of correlation between global and local variables, particularly between global integration and local connectivity (Araba, 2018). It indicates the level of clarity and comprehensibility of a spatial system for its users. Intelligibility is represented by a regression coefficient ranging from 0 to 1. A higher intelligibility value (R^2) corresponds to a clearer understanding of the space for its users. Generally speaking, if R^2 is greater than 0.5, it can be considered that the space is easier to understand, and the function distribution of the scattered points represents the magnitude of the intelligibility (Qinghua & Ziqi, 2021).

The figures below (figures 15, 16 and 17) are Scatter Plots showing correlation values between visual integration [HH] and connectivity in the case study malls:

The scatter plot in figure 15 below shows the intelligibility of the ground floor of Jabi Lake Mall which is the busiest floor with the highest footfall. The intelligibility (R^2) reads 0.334997, which is the lowest among the cases studied.

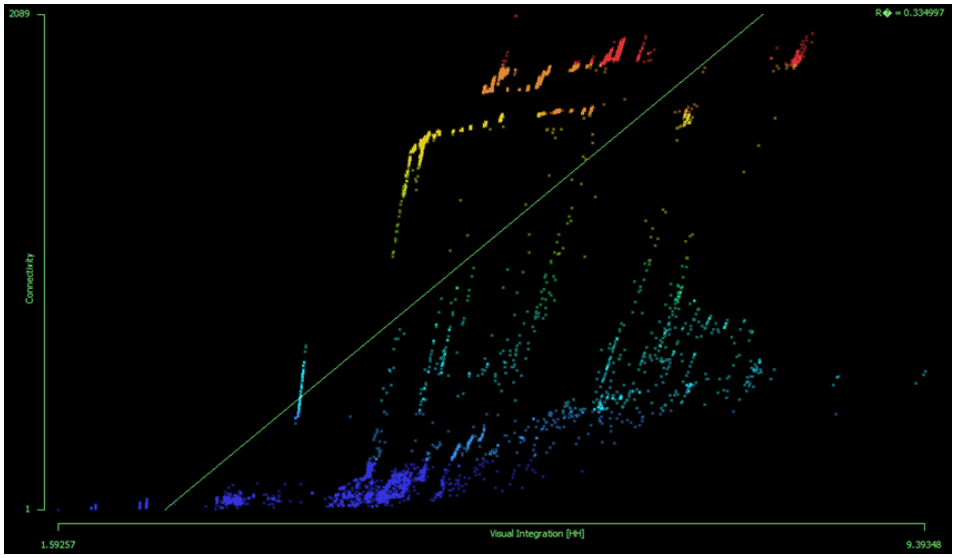

Fig.15: Scatter Plot showing correlation values between visual integration [HH] and connectivity in Jabi Lake Mall Ground Floor

The scatter plot in Figure 16 shows the intelligibility of the ground floor of Novare Central Mall which is the retail floor and the floor with highest user traffic. The intelligibility (R^2) reads 0.521816.

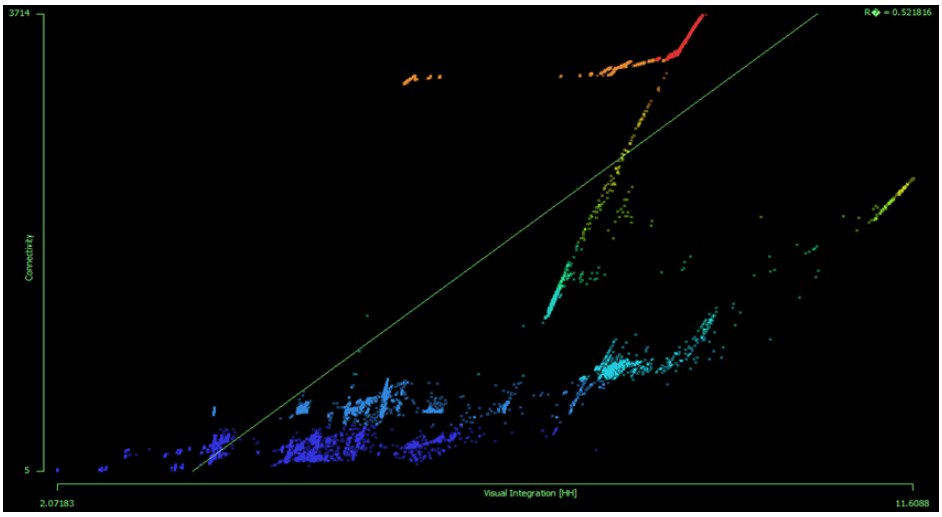

Fig.16: Scatter Plot showing correlation values between visual integration [HH] and connectivity in Novare Central Mall Ground Floor

The scatter plot in Figure 17 below shows the intelligibility of the ground floor of Silverbird Entertainment Centre which is the floor with the highest user traffic. The intelligibility (R^2) reads 0.860606, which is the highest among the cases studied.

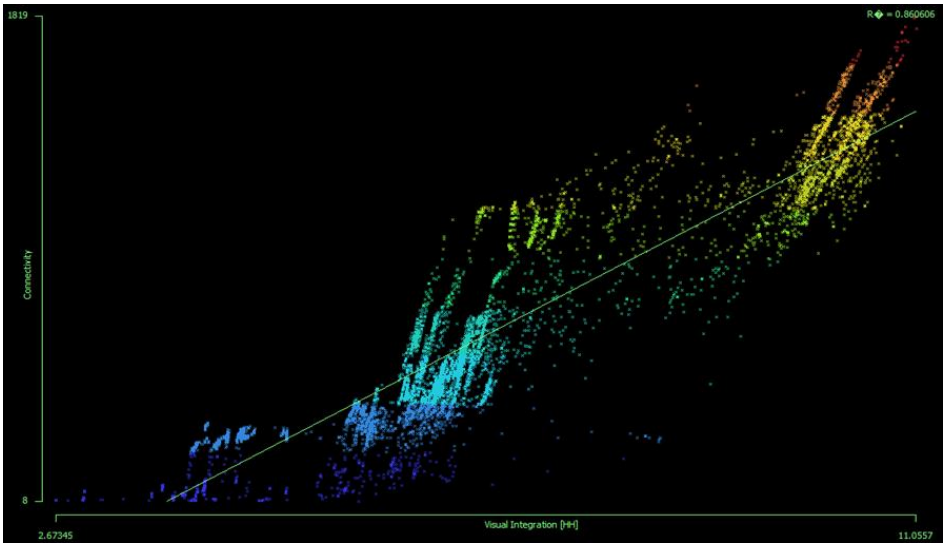

Fig.17: Scatter Plot showing correlation values between visual integration [HH] and connectivity in Silverbird Entertainment Centre Ground Floor

Based on the results gotten from the space syntax tool used, the R^2 values that were obtained reveal that Silverbird Entertainment Centre has the highest space intelligibility value of 0.860606 followed by Novare Central Mall with an R^2 value of 0.521816, while Jabi Lake Mall which has an R^2 value of 0.334997 has the least intelligibility value.

6. DISCUSSION ON FINDINGS

The Visual Survey was carried out to examine the physical aspects of the environment that support wayfinding, specifically examining how interior and exterior cues aid and guide individuals in navigating towards their intended destinations. The findings which were presented in Table 1 show that in all the examined malls a combination of both soft and hard landscaping elements was employed to enhance the cognitive memory of wayfinders. The study identified and analysed the internal and external circulation systems present within the malls. The findings revealed that there was no accessible external walkway for pedestrians in Jabi Lake Mall and landmarks to aid users' orientation and cognitive mapping was insufficient in comparison with the other two malls surveyed. Additionally, the vertical circulation systems were identified and ranked according to their proximity to the building entrance. Silverbird Entertainment Centre had the most legible circulation system among the three malls surveyed. Architectural elements and building materials utilized in the construction of the malls were also identified and assessed based on their effectiveness in assisting wayfinders in differentiating various zones within the buildings. All three malls had well-designed entrances which aid differentiation and legibility. The use of colours for architectural differentiation of spaces and zones within the malls was satisfactory. Natural lighting was excellent within Jabi Lake Mall and Novare Central Mall but Silverbird Entertainment Centre had relatively poor natural lighting. Signage and graphics were well utilized in Jabi Lake Mall as compared to the other two malls. An information desk was available only in Silverbird Entertainment Centre. The findings of the visual survey as shown in Table 1 generally examined the physical features and signage provisions within the malls as well design features that support social practices during wayfinding tasks such as the information desk.

Findings from the questionnaire responses shown in table 2 validate the variables identified from Rooke's (2012) tri-partite concept of knowledge flow. The findings show that shoppers typically navigate their way within the malls by utilizing physical features, signage & graphics, and social practices. The findings also reveal that users prefer to find their way around the malls by making use of physical features in the environment such as landmarks and also by utilizing signage systems before resorting to social practices (i.e asking for directions). In two of the shopping malls surveyed (Jabi Lake Mall and Novare Central Mall), when asked how they typically navigate the shopping mall, the highest percentage of respondents indicated the use of signs as their primary means of navigation. This is most likely influenced by their level of literacy as all the respondents could read, write and respond to the questions by themselves. This is in line with findings by Inuwa and Maina (2019) who conducted a study on differences in navigation behaviour based on literacy levels. The demographics section revealed that the majority of mall visitors are youths between the ages of 21-30. This buttresses the need for an engaging and immersive shopping experience and also recreational facilities within the shopping malls to further increase their appeal. The findings also revealed that a major building feature that shoppers utilize as a landmark to aid orientation and navigation is the main entrance. Traditionally, entrances and exits are designed with emphasis from exterior facades of buildings. This finding suggests that architecturally, main entrances and exits also need to be carefully designed from within buildings to aid wayfinding. The findings from the questionnaire survey reveal that generally the shoppers in the malls surveyed experience little or no difficulty in carrying out wayfinding tasks within the malls. This may be due to the youthful age range of majority of the shoppers and also the fact that majority of the shoppers had visited the malls several times. Age and mall visit history have been identified to be among the factors

that affect wayfinding experience and cognitive mapping. Jabi Lake Mall recorded a higher percentage of shoppers indicating difficulty in wayfinding within the mall, compared to the other two malls. This aligns with the findings from the space syntax analysis below.

The Space Syntax Analysis revealed the level of intelligibility (R^2) in the design of the primary user space in all the malls studied. It also showed the degree of integration that exists between the spaces. The R^2 Values obtained are 0.860606, 0.521816, and 0.334997 for Silverbird Entertainment Centre, Novare Central Mall, and Jabi Lake Mall respectively. This indicates that the best mall in terms of intelligibility in design with regards to wayfinding is Silverbird Entertainment Centre and the least is Jabi Lake mall. This addresses the second objective of this study which is to identify commonalities and differences in how shoppers navigate shopping malls with different spatial configurations and to determine which configurations are most effective for promoting efficient wayfinding. Silverbird Entertainment Centre had the highest intelligibility due to its linear dumbbell layout. This means that shoppers would find it easier to perform wayfinding tasks in Silverbird Entertainment Centre than in the other two malls analysed. Jabi Lake Mall had the least intelligibility factor which means that shoppers would find it more difficult to find their way within Jabi Lake Mall relative to the other two malls analysed. This finding corresponds with the findings from the questionnaire survey where more users reported difficulty in finding their way within Jabi Lake Mall than in the other malls surveyed.

7. CONCLUSION AND RECOMMENDATIONS

This paper explored spatial configuration for effective wayfinding in shopping malls. Findings from the study enabled the researcher to answer the research questions. The first question asked what factors have been identified as contributing to effective wayfinding in shopping malls, and how have these factors been influenced by spatial configuration. From literature, it was deduced that factors that influence wayfinding in shopping malls can be broadly divided into two: Legibility of the environment and Individual factors. Legibility of the environment encompasses the utilization of signage, floor plan configuration, architectural differentiation, and visual access, which are all critical factors contributing to effective wayfinding in shopping malls. Individual factors include age, gender, literacy/educational status and familiarity with the environment. Spatial configuration falls under legibility of the environment and is a key factor contributing to effective wayfinding in shopping malls, and thus having a direct influence on all the other factors identified. These key factors were identified in the case studies considered. The key factors pertaining to the environment were identified via the visual survey and documentations, while the questionnaire survey helped identify the individual factors.

The second research question asked how do shoppers navigate shopping malls with different spatial configurations, and what are the commonalities and differences in their behaviour across these configurations. The answer to this question was deduced from the case study and also from literature. Findings from the questionnaire survey which are backed by literature reveal that shoppers navigate shopping malls with different spatial configurations similarly, by utilizing physical features(environmental cues), coded information (signage) and social practices (such as asking for directions from staff or other shoppers). Three wayfinding behaviours were deduced from literature. These are Searching behaviour, Stopping behaviour, and Help-seeking behaviour. This was also identified during the case study exercise via observation. Although these three behaviours are common across different spatial configurations in

shopping malls, stopping and help-seeking behaviours are more pronounced in spatial configurations with lower environmental legibility.

The final research question asked which spatial configurations are most effective for promoting efficient wayfinding in shopping malls, and what design features or elements are most critical for supporting effective navigation. From the space syntax analysis carried out using the Visual Graph Analysis (VGA), it was seen that straight linear floor plan configurations are most efficient for wayfinding in shopping malls. Silverbird Entertainment Centre had the highest intelligibility, due to its linear floor plan configuration, followed by Novare Central Mall which has a floor plan configuration that is a horseshoe layout, and finally Jabi Lake Mall has the least intelligibility owing to its racetrack layout spatial configuration which spans a greater Gross Floor Area than the other two malls considered. From the study, the design features or elements identified as most critical for supporting effective navigation are floor plan configurations that maintain sight lines and clear visibility of anchor stores and landmarks within the mall, architectural differentiation within the mall and good signage system.

As a recommendation for practice, architects need to pay more attention to designing legible spaces that support efficient wayfinding by utilizing good spatial configuration as well as adequate coded information and use of landmarks. Legible built public spaces will improve user wayfinding experience and thus improve user satisfaction and the overall efficiency of the buildings.

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