

# SUSTAINABLE STRATEGIES

IN THE  
BUILT ENVIRONMENT  
AND ARCHITECTURE



*Edited by*

**Chinedu Uchechukwu OLUIGBO**

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**SUSTAINABLE STRATEGIES IN THE BUILT  
ENVIRONMENT AND ARCHITECTURE- 2026**

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# **SUSTAINABLE STRATEGIES IN THE BUILT ENVIRONMENT AND ARCHITECTURE**

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## **PREFACE**

This volume brings together a collection of scholarly contributions that explore key issues at the intersection of urban development, architecture, and sustainable resource management. In a rapidly urbanizing and environmentally challenged world, the need for integrated, inclusive, and sustainable approaches to planning and design has become increasingly critical.

The chapters in this book address diverse yet interconnected themes. The analysis of physical planning and development provides valuable insights into the challenges and opportunities associated with urban growth and spatial organization. The discussion on architecture and inclusive education highlights the importance of universal design principles in creating accessible and equitable learning environments. In addition, the exploration of sustainable energy management in hospitality facilities emphasizes the growing need for efficiency and environmental responsibility in the service sector.

By adopting an interdisciplinary perspective, this volume integrates insights from urban planning, architecture, education, and sustainability studies. It contributes to academic discourse while also offering practical implications for policymakers, designers, and practitioners working toward more resilient and inclusive built environments.

It is hoped that this book will serve as a valuable resource for researchers, students, and professionals interested in development, design, and sustainability, while encouraging further exploration of innovative solutions to contemporary urban and environmental challenges.

**Editorial Team**  
**April 2026, Türkiye**

**CHAPTER 1**  
**PHYSICAL PLANNING AND DEVELOPMENT:**  
**EVIDENCE FROM BAYELSA STATE, NIGERIA**

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# *SUSTAINABLE STRATEGIES IN THE BUILT ENVIRONMENT AND ARCHITECTURE*

## **INTRODUCTION**

Physical planning remains an essential tool for structuring spatial organization, regulating land use, and developing sustainable cities. Interestingly, contemporary physical planning priorities sustainable development goals (SDGs), integrating smart city technologies, and climate change adaptation. Some studies on planning practices emphasize optimal land-use frameworks, sustainability, and spatial development trends. According to Mehari and Genovese (2023) there is increasing interest in systematic spatial planning that integrates environmental, economic, and social goals globally. On the other hand, Jinollo et al. (2025) examined mixed land-use planning impacts on spatial development, taking cognizance of how coordinating various land uses within localities can significantly ameliorate spatial equity and minimize fragmentation in urban environments. Global trends underscore proactive development control in lieu of reactive, with accelerated focus on green infrastructure and disaster risk reduction, especially post-pandemic, where urban spaces were reconsidered for public health. In Nigeria, physical planning continues to be an instrument for regulating urban growth, guiding land use, and addressing development challenges amidst persistent issues and barriers. Importantly, physical planning in Nigeria shows chronic implementation challenges due to institutional and regulatory weaknesses, limited enforcement capacity, and gaps in stakeholder engagement (Anyanwu et al., 2025). Daramola's study (2025) on Akure assesses the effectiveness of physical planning agencies, indicating areas for improvement especially in plan enforcement and local spatial regulation. Abubakar et al. (2025) examined alternatives to Master Plans as development control tools, revealing scholarly interest in strategic, participatory, and flexible planning instruments suited to the dynamic Nigerian environments. Critical issues associated to land tenure and disputes between development control agencies and informal developers, and dearth in funding for urban development projects has characterized physical planning in Nigeria. Generally, literature on Nigeria presents physical planning in legal and institutional terms as well as a policy tool masked with broader development control, governance, and spatial justice objectives.



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In Bayelsa State, acute developmental barriers persist owing to its riverine geography. Studies buttress that urgent planning must prioritize flood control, land reclamation, and building codes. More so, the Bayelsa State Physical Planning and Development [BSPPD] Law (2015) is the core legal framework, requiring developers to get proper permits for sustainable growth. Thereto, planning discourse intersects with environmental challenges, governance failures in plan enforcement, and community planning engagement. Basically, Bayelsa state physical environment has been laden with unorganized spatial development posing threat the livelihood of the residents and the ecosystem. Hence, this study is aimed at reviewing the proceedings from the 2022 Bayelsa State Physical Planning and Development Board [BSPPDB] summit in order to demystify associated issues and roll out evidence-based recommendation thereto. To achieve this, the objectives of the study is structured to; identify contributions made by stakeholders in Bayelsa State built environment, analyse the presentation / submission of the stakeholders, and propose a holistic measure towards the sustainable growth of the BSPPD.

### **1. BAYELSA STATE PHYSICAL PLANNING AND DEVELOPMENT SUMMIT**

The Bayelsa State Physical Planning and Development Board Summit were organized to bring stakeholders to brainstorm, interact, dialogue, share experiences and ideas and come up with workable outcome that will pragmatically resolve planning and development issues, as well as sustainable strategies for effective planning and development of the state. The 3-day Summit had participants drawn from the Bayelsa State Government functionaries, Bayelsa State Physical Planning and Development Board [BSPPDB], Traditional rulers, Nigerian Institute of Town Planners (NITP), allied Professional bodies, diverse Institutions in and outside the state; the media, security personnel and other stakeholders. The Summit had over 1200 participants, including the resource persons, staff of the Board, and stakeholders in the infrastructure sector, students, the media and visitors. It was a robust engagement of intellectuals, scholars, experts and practitioners in the built environment. Interestingly, the 3-day Summit featured a total number of ten (10) papers; two (2) on the 1st day and four (4) for day 2 and 3 respectively.

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The welcome address was given by the Executive Chairman of the Board, Alabo Gideon O. Ekeuwei, who thanked the Government of Bayelsa State under the leadership of His Excellency Senator Douye Diri on whose directive this 3-day summit became a reality. He further stated that the summit was organized for all relevant stakeholders and sectors of the society to proffer better and sustainable ideas on building and development control in the State. This was followed by a presentation by Ebikekeme Ere (Ere Aeronautics), who in his presentation explicated on the need for a holistic data collection on flooding and other effects of climate change in Bayelsa State. Goodwill messages were presented by various stakeholders, notably, the Chairman of NITP, Tpl. Julius Iyorakpo, FNITP who in 'his message commended the Board for the thoughtfulness in initiating the summit, but however, called for the establishment of local planning authorities as provided for in the extant law. He also commended the Executive Governor for his initiative for urban renewal effort. In the same vein, the former Deputy Governor, Rear Admiral Gboribioha John Jonah (Rtd.) commended the Board for organising the summit and urged them to be courageous in the implementation of the useful ideas that will spring up thereto. The Keynote address was delivered by Arc. Harcourt Adukeh, the Managing Director of Megastar Technical and Construction Company Limited. In his paper titled: "The role of Master Planning in Bayelsa State as a Tool for Sustainable Development" who expressed concern why successive administrations have failed to implement the Yenagoa Master Plan. He also identified lack of funding resulting from lack of political will on the part of government as factors militating against implementation of Yenagoa Master Plan.

More so, the Special Guest of Honour, His Excellency, (Sen.) Douye Diri, the miracle Governor of Bayelsa State, who was represented by the Deputy Governor (Sen.) Lawrence Ewhrudjakpo declared the summit open. He urged the Board to carry out the enforcement of Physical Planning and Development [PPD] Law objectively without sparing anyone, including himself and any other government officials that violates the laws.

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Furthermore, he observed that the haphazard development pattern in the State Capital was as a result of impunity by land vendors and developers as well as lack of political will on the part of the Government. Accordingly, he declared the summit open.

### **2. TECHNICAL SESSIONS**

The technical session was divided into 1st and 2nd Sessions respectively. The Second Plenary session of the Opening ceremony commenced with the presentation of the Theme paper titled: Physical Planning and Development in Bayelsa state - The Way Forward presented by Prof. Kingsley Ogboi of the Department of Urban and Regional planning, University of Nigeria, Enugu Campus.

#### **2.1 Day One**

Papers presented on day one includes; "Physical Planning and Development in Bayelsa State: The way forward by Prof. Kingsley Ogboi who stressed the need to review the Yenagoa Master plan 2004, climate change and urban renewal studies. The second paper titled "The Role of Master Planning in Bayelsa State as a Tool for Sustainable Development" was presented by Arc. Harcourt Aukeh. Discussants in the session emphasised on the involvement of community participation in the planning and implementation process. The need for integrity on the part of policy makers as well as enforcement was also underscored. In addition, the second paper buttressed the relevance of developing sustainable land use, physical and master plans to improve the urban landscape of Yenagoa and other communities in Bayelsa State. The paper called for periodic revision of the physical plans for development and the efficacy of implementation and enforcement for a flood-resilient and climate responsive environment.

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### **2.2 Day Two**

On day four (4), papers titled: "Operative State Physical Development Plan (OSPDP) as a Tool for Effective Regional and Economic Development; and Challenges in the Preparation and Implementation of Physical Development planning in Bayelsa State" were delivered by Tpl. Dr. Olutoyin Ayinde, FNITP and Tpl. Dr. Ezekiel Gunn, FNITP respectively. Furthermore, the following papers titled: "X-raying for Bayelsa State Physical Planning and Development Law 2015 and its Regulations", and "Land Tenure System in Nigeria; implication on Physical Development in Bayelsa State" were presented by Kesiye Wodu, SAN and Chief Iboro Ige-Edaba, FNIVS respectively. This was buttressed by the discussants; Prof. Innocent Aprioku, and Prof. Kingsley Ogboi as well as various contributors.

### **2.3 Day Three**

On the day four (4), papers titled "Imperatives in Urban Renewal in Yenagoa Capital Territory"; and "Preparations of Drainage Master Plan as a way of Addressing the Challenges of Flooding in Yenagoa" were presented by Prof. Innocent Aprioku, FNJTP and Surv. Furoebi Akiene, FNIS, FNES respectively. Furthermore, papers titled: "The Imperatives of Planning a City-the Local Content Paradigm" and "Road Network and its Implications on Security Architecture and Physical Planning and Development in Bayelsa State" were presented by Engr. Simbi Wabote and Mr. Ben Okolo, FCD respectively. Technical sessions were held to discuss the papers extensively.

## **3. OBSERVATIONS**

From the presented papers, submissions, and discussions at the summit, the following PPD issues were deduced, viz.:

- The communities that constitute Bayelsa State have not been critically involved and sensitized in the generation of physical development plans. This non-inclusiveness has, over the years posed a great setback in the implementation of PPD plans.
- The majority of the violators of the Bayelsa State Physical Planning and Development (BSPPD) Law and Regulations are those that are highly placed in the society.

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**Table 1.** List of papers presented at the summit from 13th to 15th December, 2022

DAY	S/N	ARTICLE	AUTHOR / PRESENTER
<b>Day 1</b>  13-12- 2022	1.	Physical Planning and Development in Bayelsa State: The way forward	Kingsley Ogboi
	2.	The Role of Master Planning in Bayelsa State as a Tool for Sustainable Development	Harcourt Adukeh
<b>Day 2</b>  14-12- 2022	3.	Operative State Physical Development Plan (OSPDP) as a Tool for Effective Regional and Economic Development, and Challenges in the Preparation and Implementation of Physical Development planning in Bayelsa State	Olutoyin Ayinde
	4.	Challenges in the Preparation and Implementation of Physical Development Plans in Bayelsa State	Ezekiel Gunn
	5.	X-raying for Bayelsa State Physical Planning and Development Law 2015 and its Regulations	Kesiye Wodu
	6.	Land Tenure System in Nigeria; implication on Physical Development in Bayelsa State	Iboro Ige-Edaba
<b>Day 3</b>  15-12- 2022	7.	Imperatives in Urban Renewal in Yenagoa Capital Territory	Innocent Aprioku
	8.	Preparations of Drainage Master Plan as a way of Addressing the Challenges of Flooding in Yenagoa	Furoebi Akiene
	9.	The Imperatives of Planning a city: The Local Content Paradigm	Simbi Wabote
	10.	Road Network and its Implications on Security Architecture and Physical Planning and Development in Bayelsa State	Ben Okolo

- Most communities that do not fall under the Yenagoa city have experienced a high level of distortion such as encroachment of developments into right of way, easements, setbacks and even access roads as evidenced in some parts of Amassoma, Okolobiri, and Kaiama.

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- Improper and partial implementation of Physical Development Plans, the BSPPD Laws, and associated Regulations chokes the essence of physical planning in Bayelsa State.
- Lack of political will in the part of the government to champion the course of physical planning and development in the state over the years. Where this exists will lead to the implementation of the physical planning and development of the State.
- Poor Public Private Partnership (P.P.P) in the provision of infrastructure, basic amenities, houses, jobs and other necessities of life.
- Slow and unplanned urban renewal process of some communities in Bayelsa state.
- Inadequacy of the BSPPD Law in regulating development within the State.
- Local Government Areas in the State fail to enforce compliance of physical planning and development plans.
- The use of impunity by some politicians and eminent citizens to disrupt and endanger the activities of the board as well as her personnel. Relying on the "Above the Law Syndrome" they make the work of the Board very difficult to execute and some cases brutalize her staff sent out for development control.
- Attitudinal anomaly where enforcement officers see themselves as above the law.
- Indiscipline exhibited by some members of the Board.
- Lack of confidence on Government and the Board, allied Professionals by the residents of Bayelsa State. This is orchestrated by the negative perception of developers in the State.
- Existence of quacks in the State who cast negative spell on the Professional bodies in the State.
- Poor remuneration, welfare, indemnity, and protection of the staff of the Board as well as members of the professional bodies in the built environment.
- The need to value and support the input of professionals in the State by the Government remains pivotal for sustainable PPD in the State.

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- All players involved in the development of the State were not seriously carried along.
- Physical and Development Plans are usually passed into Law in the State making it
- difficult for Government to implement them.
- Inadequate inter relationship and synergy between professional bodies, agencies and other sister organisations in the State particularly in the area of research, consultancy and practice. This collaboration will aid in flood and disaster management in the State to mention but a few.
- Failure to critically review the OSPPDP by the Government to correct the deficiencies of the past, integrate the needs of the present and make provision for the sustainable growth of Bayelsa State.
- No serious attention to the issues of climate change and energy use in the State as regards physical planning and development.
- The need to intensify the search and protection of Heritage sites. However, physical and development plans should respond and promote the cultural heritage of the people of Bayelsa State.
- Several developments going on in the state lacks the approval and permission of the Board.
- Government acquires lands in some cases and allot it to individuals. Nevertheless, this is against the laws governing land acquisition in Nigeria.
- The uncontrollable growth of slums in the inner cities of Bayelsa State.
- Poor funding for research and innovation in the natural and built environment.
- The need for Government to acquire lands, plan, and develop them to accelerate coordinated development in the state and generate revenue thereof.
- The rampant issues of neighbourhood inconveniences such as heat radiation from flaring sites, gas plants, pollution emanating from facilities and structures within the residential environments (land use), radiation from masts of telecommunication companies among others in our environment.

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- Dearth in synergy among professional bodies in the state as regards holistically driving sustainable physical developments.

### **3.1 Thematic Analysis of the Issues Affecting Physical Planning and Development in the State**

Thematically analysed, the issues affecting PPD in Bayelsa State can be broadly categorized into: Weak governance and political will; Regulatory and enforcement failures; Institutional and legal deficiencies; Stakeholder exclusion and lack of public trust; Unplanned urban growth and environmental challenges; Poor professional coordination and research funding. Importantly, addressing these challenges requires stronger political commitment, inclusive planning processes, improved enforcement mechanisms, institutional reforms, environmental sustainability integration, and enhanced collaboration among all stakeholders.

#### ***Weak Community Participation and Stakeholder Exclusion***

A major issue identified is the lack of meaningful involvement and sensitization of communities in the preparation and implementation of physical development plans. Many stakeholders—including local communities, professionals, and development actors—are not adequately carried along in planning processes. This exclusion has resulted in poor ownership of plans, resistance to implementation, and widespread non-compliance. Additionally, there is a general lack of public confidence in government institutions and planning authorities, partly due to negative perceptions and distrust.

#### ***Weak Enforcement and Regulatory Failures***

There is widespread violation of the BSPPD Law and Regulations. Ironically, many violators are influential individuals and highly placed members of society who operate with impunity. Politicians and eminent citizens often disrupt enforcement activities, sometimes harassing or intimidating board officials. Local Government Areas also fail to enforce compliance, while several developments proceed without official approval. Improper and partial implementation of physical development plans further weakens the planning system.



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In some cases, government actions such as unlawful land acquisition and allocation contradict established land laws, undermining regulatory credibility.

### ***Institutional and Legal Inadequacies***

The BSPPD Law is considered inadequate in effectively regulating development across the state. Furthermore, the practice of passing physical development plans into law makes them rigid and difficult to implement or review. There has also been a failure to critically develop an OSPPDP to address past deficiencies and align it with current and future needs. Poor synergy among professional bodies, agencies, and related organizations—especially in research, consultancy, and disaster management—limits coordinated development efforts.

### ***Political and Governance Challenges***

A notable constraint is the lack of political will to prioritize and champion PPD in the State, thus, without strong government commitment, enforcement and implementation remain weak. Furthermore, indiscipline among some enforcement officers and board members, along with attitudinal issues such as the “above the law” mindset, weakens institutional integrity. Poor remuneration, welfare, and protection for staff of the Board and professional bodies also reduce morale and effectiveness of concerned players and stakeholders.

### ***Unplanned Urban Growth and Spatial Distortion***

Communities outside Yenagoa, such as Amassoma, Okolobiri, and Kaiama, experience high levels of spatial distortion. Common issues include encroachment on rights-of-way, setbacks, easements, and access roads. Urban renewal processes are slow and largely unplanned, contributing to the uncontrolled growth of slums and informal settlements. These trends undermine coordinated development and environmental orderliness.

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### ***Poor Infrastructure Development and Public–Private Partnership***

There is inadequate Public–Private Partnership (PPP) in providing infrastructure, housing, jobs, and essential services. Government has not fully utilized land acquisition, planning, and development as a strategy to facilitate coordinated growth and generate revenue. This has slowed socio-economic development and infrastructure expansion across the State.

### ***Environmental and Climate Concerns***

Physical planning in Bayelsa State pays insufficient attention to climate change, energy use, and environmental sustainability. Environmental challenges include pollution, gas flaring heat radiation, telecommunications mast radiation, and other neighborhood inconveniences. There is also weak collaboration in flood and disaster management, despite Bayelsa's vulnerability to flooding. Addressing these environmental risks requires integrated and climate-responsive planning approaches.

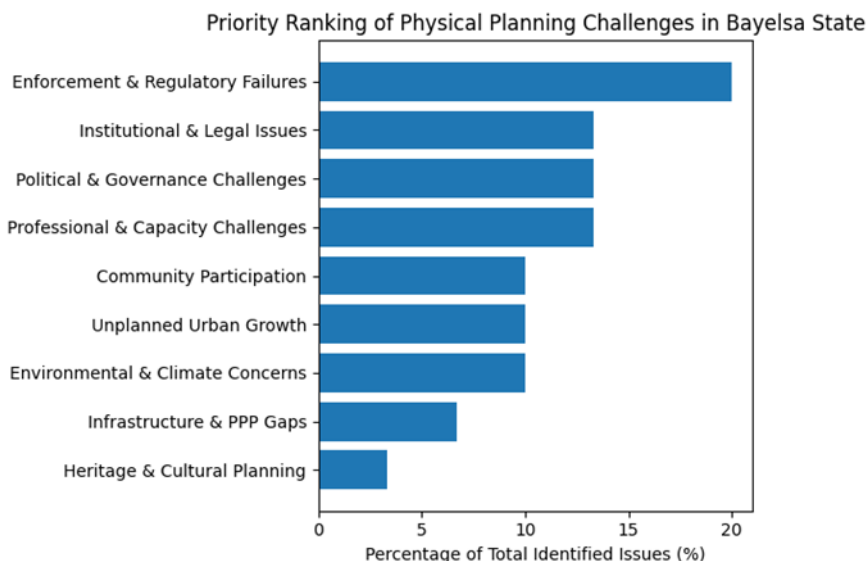
### ***Professional and Capacity Challenges***

The presence of quacks in the built environment sector undermines professional standards and damages the reputation of recognized professional bodies. There is inadequate synergy among professional organizations, and poor funding for research and innovation in both the natural and built environment sectors. Essentially, there is a strong need for government to value and support the contributions of professionals in achieving sustainable development goals.

### ***Heritage and Cultural Considerations***

There is inadequate attention to identifying, protecting, and promoting heritage sites. Physical and development plans should integrate and reflect the cultural heritage of the people of Bayelsa State to ensure culturally responsive development.

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**Figure 1.** Priority ranking of PPD issues identified in Bayelsa State

The chart above presents a priority ranking based on percentage distribution of identified issues. Enforcement & Regulatory Failures (~21%) rank as the highest priority concern. Institutional & Legal Issues, Political & Governance Challenges, and Professional & Capacity Challenges (~14% each) form the second tier of critical challenges. Community Participation, Unplanned Urban Growth, and Environmental Concerns (~11% each) represent moderate-level priorities. Infrastructure & PPP Gaps (~7%) require improvement but are less dominant compared to governance issues. Heritage & Cultural Planning (~4%) is currently the least emphasized but still pivotal for sustainable PPD.

Additionally, based on Policy Priority Matrix, PPD challenges in Bayelsa State can be categorized into four strategic quadrants based on Impact and Urgency.

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### ***High Impact – High Urgency (Immediate Policy Action Required)***

The PPD challenges in this category include; Enforcement & Regulatory Failures; Political & Governance Challenges; Institutional & Legal Issues. Professional & Capacity Challenges. These represent the most critical leverage points. Reforming enforcement systems and strengthening governance structures should be government's top priority.

### ***High Impact – Moderate Urgency (Strategic Structural Reforms)***

On the category of High impact are; Unplanned Urban Growth, Environmental and Climate Concerns. These issues significantly influence long-term sustainability and require coordinated planning reforms.

### ***Moderate Impact – Moderate Urgency (Supportive Interventions)***

A key issue requiring moderate urgency is Community Participation. Thereto, strengthening stakeholder inclusion will improve plan implementation effectiveness.

### ***Low Impact – Lower Urgency (Gradual Policy Attention)***

Lastly, Infrastructure & PPP Gaps' Heritage & Cultural Planning while essential can follow after core governance and enforcement reforms are stabilized.

## **4. RESOLUTIONS**

Based on the above observations, players and stakeholders at the summit resolved as follows:

- The need for an all-inclusive approach in the preparation of physical development plans. This should be characterized by the organization of regular town hall meetings and the ample use of other adaptive forms of communicating to the people.
- Adequate and timely funding of the BSPPDB by the Government to facilitate the ordered development of Bayelsa State.

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- The BSPPD with the support of Government shall ensure that all developments in Bayelsa State obtains necessary approvals and permits before construction.
- Adequate funds should be allotted for research in the State to promote the PPD
- Topographical maps and supportive deliverables should be able to capture the flow, level, risk zones and other information on flooding for a climate responsive.
- The 2004 Master plan of the State should be reviewed as matter of urgency. Subsequently, such reviews should be at least every two (2) years.
- There should be swift implementation of the BSPPD Laws and Regulations.
- There is need to foster the mobility, technical and manpower of the BSPPD by the Government to ameliorate inspection, monitoring, and supervision of physical planning and development in the State.
- Basic amenities should be made available for the people while some considerable levies collected from the public to maintain those amenities.
- There is urgent need to constitute the Physical Planning and Development Units at the Local Government and Community level. More so, urban regeneration and renewal processes should commence immediately to save our communities.
- All players and stakeholders in the infrastructure sector should regularly synergize in the development of Bayelsa State.
- The Board should be encouraged to exhibit a high level of integrity, discipline and diligence in carrying out her functions.
- Remuneration, welfare and enhancement of staff of the Board should be upgraded by the government.
- The government should support Professionals in the built environment in carrying out functions geared towards the development of the State.
- The General Public should be sensitized and enlightened to have confidence in the Government, the Board, the Professionals and other stakeholders in the built environment.

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- State laws should be enacted to protect Professionals in the infrastructure sector.
- Physical Development Plans should be passed into Law before they are adopted as a working document prior to implementation and enforcement.
- Global challenges like Climate change, Energy use and others should be studied, captured and considered in the planning, design and development of our communities.
- New developments should promote the cultural heritage of our people.
- Government should acquire lands, develop it and supply houses to the public at affordable rates.
- There is need for all stakeholders in the state's infrastructure sector to preserve green and open spaces.
- The BSPPDB should prioritize issues associated with neighbourhood developments geared towards the protection of the environment and lives.
- The need to furnish Local Government Areas, traditional rulers, Community Development Chairmen, and other members of the public with copies of the Operative State Physical Planning and Development Plans (OSPPDP) when developed is essential to draw collaborative effort towards promoting sustainable PPD in the State.

### **CONCLUSION**

Physical planning and development have become imperative in ensuring environmental sustainability and socio-economic growth. However, stakeholders in the built environment have described the planned Bayelsa Physical Planning & Development Summit as apt. Thus, a critical appraisal of the summit presentations reveals that it is the surest road map towards achieving the State's "Operative State Physical Development Plan (OSPDP) in line with the Yenagoa master plan, and the Bayelsa Physical Planning & Development Law 2015 as amended, for a planned and well-structured Bayelsa State with the state capital exhibiting characteristics of urban districts.

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Furthermore, an analysis of the discussions had at the summit showed that stakeholders in the infrastructure sector are willing to brainstorm, interact, share experiences, and come up with strategic frameworks that will pragmatically confront problems of physical planning and bring about viable solutions for policy implementation & sustainable development of Bayelsa State. Importantly, the summit identified partners, key priorities and programmes imperative for sustainable physical Planning & development of Bayelsa State. The summit improved synergies and interactions, strengthened collaborations between and among sectorial partners, and proposed recommendations to enhance the natural and built environment of Bayelsa State. Among the encumbrances experienced in Bayelsa State; unregulated land development, susceptibility to floods, paucity in the provision of infrastructure, and poor development control are critical owing to rapid urbanization especially in Yenagoa. These suggest strategic institutional, legal, environmental, and community-based solutions to encourage effective physical planning and sustainable development in Bayelsa State specifically by improving governance systems and planning systems. Despite the fact that Bayelsa State is being governed under the BSPPD regulations, the regulations have lacked its enforcers making most people (developers) unresponsive to the rules relating to the development controls. Hence, planning laws should be effectively enforced in view to avoid hap-hazard construction and lack of conformity in land use. Notably, the BSPPDB mandates developers to procure development permits before construction but this is not consistently done. Thereto, development of monitoring systems, harsher punishment of offences and adequate funding of the planning authorities as well as boosting their technical know-how would enhance effectiveness in regulations. Echendu (2022) claims that well-developed urban governance frameworks with professional autonomy and accountability dramatically boost the results of planning. Thus, reorganising the planning agencies in the Bayelsa State and ensuring their proper resource endowment would enhance improved coordination and policy execution. The other significant action is the renewal and proper execution of spatial plans especially the Yenagoa Master Plan.

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The fast development of urban sprawl without strict compliance to master plans is a problem that leads to the inefficiencies of the infrastructures. Aduku et al. (2021) posits that for urban environments to be sustainable proper applied spatial planning systems that combine population projections, infrastructure development, and environmental protection are pivotal. Relatively, revision of master plans that are outdated and use of Geographic Information System (GIS) to plan based on evidence would be beneficial in Bayelsa in terms of spatial coordination. Moreover, Abubakar et al. (2025) state that master plans in Nigeria are traditionally not flexible or responsive. They also suggest that alternative development management tools, including participatory planning systems and incremental zoning systems, should be integrated to enhance flexibility and locally relatability. The implementation of these strategies in Bayelsa would enable the planning systems to react to the socio-economic realities and informal development pressures. Unarguably, Social participation is also important in ensuring proper physical planning. Much of the violations that happen during planning are as a result of less awareness among the people or opposition to the laws and regulations in place. In addition, education, and public sensitization programmes are pertinent to enhance the awareness of developers and members of the general public to prioritize obtaining PPD permits in view to enjoy the benefits of a planned environment. To reinforce this, the BSPPDB should intensify efforts in communicating to developers formal building approval procedures prior to developing their physical plans in the entire State. It is also necessary to involve traditional rulers and community leaders as they have a great impact on land distribution and local government systems. According to the Independent Newspaper Nigeria (2017), building a partnership between professional planners and the institutions in the community can increase adherence and grassroots support of the planning programs. The inclusion of participatory planning would mean the development policies are based on the needs of the locals yet on regulatory levels.

The Bayelsa State is also vulnerable to ecological factors why sustainable and climate-sensitive planning should be a priority. Bayelsa being a coastal and riverine state in Niger Delta, floods and environmental degradation are common in the state.



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It is thus important to incorporate disaster risk reduction measures in the systems of physical planning. Urban resilience would be enhanced by climate-adaptive land use policies such as development of green infrastructure, enhanced drainage systems and controlled development in flood-prone regions. A study of climate-responsive urban planning in Bayelsa State shows that environmental sustainability as a part of land use planning is an important way of minimizing the long-term vulnerability and loss of infrastructure. As such, the planning system in Bayelsa needs to be in line with the principles of sustainable development so as to protect the human settlements as well as the ecological systems. In addition, evidence-based decision-making will be boosted by encouraging evidence-based planning and research. The infrastructure planning and delivery of services as well as land allocation require reliable demographic and spatial information. Irekponor et al. (2022) stress that the accuracy of micro-level planning can be enhanced by the use of spatially disaggregated population estimates, as well as geospatial technologies. The projections of planning and development forecasting would be enhanced by investing in GIS systems, satellite mapping and research institutions of urban research in Bayelsa. Furthermore, transparency in data collection and management as well as digitizing land administration would mitigate corruption and stimulate efficiency in the development control procedures. To sum up, PPD promotion in Bayelsa State will need a multi-level approach that would buttress governance frameworks, enforce planning legislations, regenerate spatial frameworks, motivate communities, implement climate-sensitive policies, and use data-driven planning instruments. With these measures, the Bayelsa State will be able to attain proper urban development, environmental sustainability, and enhance living standards of its inhabitants. Therefore, the study outcome shows that revising the BSPPDB regulations, developing community-inclusive master plan and facilitating barrier-free implementation in the eight (8) local government areas of Bayelsa State is a pivotal step towards reshaping the infrastructural development of the state.

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## **REFERENCES**

- Abubakar, A. T., Muritala, A. O., Popoola, O. Y., & Mbamara, B. E. (2025). Alternatives to Master Plan as a development control tool in Nigeria: A review. *International Journal of Research and Innovation in Social Science*, 9(5), 7043–7053.
- Aduku, E., Eboh, I., & Egbuchulam, C. (2021). Urbanization and sustainable cities in Nigeria. *International Journal of Economics Development Research*, 2(1), 16–31.
- Anyanwu, I. U., Umunnakwe, H., & Egbu, A. (2025). Contemporary issues in physical planning in Nigeria: The case study of Abia State. *International Journal of Built Environment and Earth Science*, 10(4). <https://doi.org/10.70382/tijbees.v10i4.062>
- Daramola, O. P. (2025). Awareness and evaluation of physical planning agencies in Akure, Nigeria. *Town Planning Review*, DOI search. <https://doi.org/10.3828/tpr.2024.60>.
- Echendu, A. J. (2022). Adapting the Singapore model to Nigeria's urban management: Possibilities and challenges. *REGION*, 9(1), 115–133.
- Independent Newspaper Nigeria. (2017, December 13). NITP calls for improved physical planning framework.
- Irekponor, V. E., Abdul-Rahman, M., Agunbiade, M., & Bustamante, A. J. (2022). A framework to determine micro-level population figures using spatially disaggregated population estimates.
- Jinollo, G. T., Habtemariam, L. W., & Belete, D. A. (2025). The impacts of mixed land use planning on spatial development. *Discover Cities*, 2, 8. <https://doi.org/10.1007/s44327-025-00047-5>
- Mehari, A., & Genovese, P. V. (2023). A land use planning literature review: Literature path, planning contexts, optimization methods, and bibliometric methods. *Land*, 12(11), 1982. <https://doi.org/10.3390/land12111982>.

**CHAPTER 2**  
**ARCHITECTURE, UNIVERSAL DESIGN FOR**  
**LEARNING, AND GEOMETRIC DRAWING:**  
**TOWARDS AN INCLUSIVE MODEL IN UPPER**  
**SECONDARY EDUCATION**

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## **INTRODUCTION**

### ***The Challenge of Structural Inclusion***

"As long as art remains foreign to the facts of life, it only interests a few people." This reflection by Bruno Munari synthesizes the essence of the educational problem in geometric drawing: the perceived distance between formal abstraction and lived experience. In contemporary Italian schools, the transition from integration (based on individual support for the "different") to structural inclusion represents a necessary evolution that can no longer be postponed. Student variability is not an exception to be managed, but an intrinsic characteristic of every classroom. When the teaching of geometric drawing ignores this reality, it generates demotivation, which is a symptom of a design barrier. Knowledge, in its social dimension, is dynamic, local, and relative; it must be conceived as a shared construction. The goal of this work is to demonstrate that adopting the UDL framework allows for a shift from an "ex-post adaptation" model to an "ex-ante universal design." By investigating the shift in students' perspectives, this research aims to validate a model in which the architecture of the curriculum becomes the primary tool for ensuring equity and educational success for every student.

## **1. THEORETICAL FRAMEWORK: FROM UNIVERSAL DESIGN TO PEDAGOGY**

Universal Design for Learning (UDL) should not be considered merely a toolkit of compensatory measures, but rather a profound and radical cultural and philosophical revolution in how teaching is understood. It shifts the center of gravity for adaptation responsibility from the student to the curriculum, making the latter more inclusive and flexible. In this sense, "disability" becomes a term that no longer defines a person but is the result of a dysfunctional interaction between their needs and a school, or more generally social, environment that is too rigid and insensitive to diversity.

### **1.1. Genesis of UDL: From Architecture to Noetics**

The concept evolved from Ronald Mace's (1980) Universal Design (UD), which theorized environments usable "for all" without the need for subsequent adaptations.

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The famous example of the "curb cut," created for wheelchairs but proving essential for parents with strollers or travelers with luggage, finds its pedagogical transposition in the work of CAST (Center for Applied Special Technology). However, true progress is realized when design stops focusing solely on physical space and begins to explore the noetic dimension. A universal curriculum not only breaks down barriers for students on the margins but also improves learning effectiveness for everyone, elevating the general qualitative level. Noetics, which deals with the study of mental processes and knowledge, works to overcome cognitive barriers. In this context, learning is no longer a passive act but becomes an activity of the intellect (noēsis) that must be stimulated through various channels. It remains understood that "The designer is anyone who assumes, partially or completely, the function of making a project sustainable and effective, mainly by activating dialogue with all the protagonists of a social system" (Karim, 2014).

The heart of this transformation lies in the management of barriers and facilitators defined by the WHO in the ICF model. Accurate knowledge of the definitions of barrier and facilitator is a necessary prerequisite to understanding the enormous work carried out by Mace. According to this classification, barriers are defined as "factors in a person's environment that, through their absence or presence, limit functioning and create disability," including not only physical obstacles but also negative attitudes and exclusionary policies. Conversely, facilitators are "factors in a person's environment that, through their absence or presence, improve functioning and reduce disability," acting as strategic supports that enhance an individual's capabilities.

This vision converges in the regulatory definition of Universal Design provided by the UN Convention on the Rights of Persons with Disabilities. More precisely:

"Universal Design" means the design of products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. "Universal design" shall not exclude assistive devices for particular groups of persons with disabilities where this is needed.

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This inclusive design paradigm comes from a field other than education; its origins can be traced back to the discipline of architecture and the main reference author of this theory is the architect Ronald Mace... who had the merit of defining and naming a system of principles and guidelines, an inclusive design paradigm that serves as a compass and a handbook for those who want to take diversity into account within a design process. (Mangiatorti, 2019).

The ultimate goal is the creation of a system where the environment, whether physical or intellectual, no longer represents a limit but becomes a dynamic support capable of responding to the complexity of the human person.

### **1.2 The Three Pillars of the Model**

The Universal Design for Learning (UDL) approach aims to remove learning obstacles by acting on three fundamental pillars, which are closely linked to the functioning of our neural networks. First, through recognition networks, the objective is to provide multiple means of representation, ensuring varied options for the perception and comprehension of materials (the "what" of learning). In parallel, strategic networks require the provision of multiple means of action and expression, thereby ensuring flexibility in how students respond to and interact with tasks (the "how"). Finally, by engaging affective networks, the model promotes different forms of engagement to capture students' interest and sustain their motivation over time (the "why").

### **1.3 Semiotics and Noetics: Why UDL is Necessary in Geometry**

By integrating the theories of Raymond Duval, a substantial piece of evidence emerges: geometric entities are not tangible objects; they are accessible only through semiotic representations (figures, symbols, diagrams). Cognitive confusion arises when the student fails to distinguish between the mathematical object (noetics) and its representation (semiotics). In this context, the first principle of UDL is not merely a "support for accessibility" but a cognitive necessity. Providing multiple representative registers (3D physical models, digital simulations, verbal descriptions) allows the student to decouple the concept from a single figure, fostering true noetic apprehension, where noetics is understood as the phenomenological description of the subjective aspects of experience.

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The variability of representative media is the only way to prevent learning from remaining confined to the sterile manipulation of meaningless signs.

### **2. RESEARCH QUESTIONS AND HYPOTHESES**

The research question serves as a North Star for an investigation intended to measure the transformative impact of accessibility on the student's psyche.

Research Questions:

- What is the ontological vision of geometry held by students at the beginning of the path?
- To what extent does the implementation of an itinerary based on UDL's representative plurality modify this vision and the perception of competence?

Research Hypotheses:

- External Locus of Control: It is hypothesized that the initial vision is burdened by negative past experiences, leading students to attribute success to external factors (luck, innate predisposition), drastically reducing self-efficacy.
- Restoration of Agency: It is predicted that the use of multiple forms of representation will allow the student to perceive success as the outcome of concrete actions and manageable strategies, shifting the Locus of Control inward and improving a proactive appreciation of the discipline

### **3. METHODOLOGY AND RESEARCH DESIGN**

The scientific validity of the research lies in a rigorous sequential design that integrates diagnostics and intervention.

For some time, clinical psychologists have emphasized that in the contemporary world, the emerging theme is coexistence, which requires the ability to deal with those who are different.

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**Table 1.** Study Phases, Activities, and Analytical Objectives

Phase	Activity	Analytical Objective
Phase 1	Diagnostic Questionnaire	Identifying previous vision and perceived self-efficacy.
Phase 2	UDL Intervention (Itinerary)	Application of the Three-Block Model with a focus on Representation.
Phase 3	Verification Questionnaire	Analysis of the differential in spatial and metacognitive vision.

The data collection tools are not limited to verifying technical skills but investigate the affective-emotional dimension and the perceived utility of the tools, providing a holistic picture of the change.

Here is the complete translation of Section 6, including the specific details of the pedagogical itinerary:

### **4. THE EDUCATIONAL ITINERARY: DESIGNING FOR VARIABILITY**

The itinerary is carried out within the school setting and is not limited to transmitting content; instead, it orchestrates an accessible learning environment based on a plurality of communication channels. The research hypothesis is realized through two main phases:

- **Initial Hypothesis:** It is hypothesized that students in upper secondary school (Drawing and Art History course) hold a vision of geometry that is negatively influenced by previous experiences of difficulty or failure in mathematics. Furthermore, it is assumed that students do not feel sufficiently competent to tackle geometric demands or to visualize geometric situations. Finally, it is hypothesized that students attribute their success and failure to multiple and diverse factors, both internal and external, and thus fail to maintain a sense of power and control over their own learning process.
- **Predicted Outcome:** It is predicted that following the implementation of the educational itinerary based on the first principle of UDL, the students' vision of geometry will shift, meaning they will feel more capable of influencing their learning through concrete actions.



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Consequently, it is hoped that the successful completion of the itinerary will lead to greater confidence in tackling geometric drawing exercises, as well as increased satisfaction in successfully resolving the various proposed situations. All of this would lead students to a greater appreciation for the field of geometric representation.

The structure of the initial and final questionnaires to be administered to students for the geometric drawing learning units, considering inclusive pedagogy, will be organized effectively according to the following scheme:

### ***Introduction and Context***

- Brief description of the questionnaire's objective and the context of the learning units on geometric drawing.
- Explain that this is an opportunity for students to reflect on their own experiences and knowledge.

### ***Vision and Self-Efficacy Questions***

- Investigate students' perspectives on the field of geometry.
- Explore perceived self-efficacy in addressing geometric requirements during previous school years.

### ***Strategies and Tools Questions***

- Investigate what students attribute their success and failure to when facing geometry exercises and problems.
- Examine the perceived utility of the tools used to tackle exercises and problems in previous school years.

### ***Understanding and Application Questions***

- Explore whether addressing geometric topics linked to daily life aids comprehension.
- Investigate the utility of the tools used for exercises and geometric drawings in practice.

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The final questionnaire will provide a comprehensive overview of student learning, focusing on their vision, self-efficacy, strategies, and practical application. Specifically, the final questionnaire must detect the following aspects compared to the initial one:

### ***Reflection on Learning***

- Ask students to reflect on their experiences and knowledge acquired during the geometric drawing units.
- Investigate whether they have developed a clearer vision of the field of geometry.

### ***Self-Efficacy and Success***

- Explore whether students have acquired greater confidence in tackling geometric tasks.
- Investigate whether they attribute their success or failure to specific strategies or tools used.

### ***Utility of Tools and Strategies***

- Investigate whether the tools used were effective.
- Explore whether students found the application of specific strategies useful during learning.

### ***Practical Application***

- Investigate whether addressing real-life geometric topics improved student understanding.
- Evaluate the utility of the tools used for geometric exercises and drawings in practice.

### ***Conclusions and Feedback***

- Ask students for comments or suggestions to improve the teaching and learning of geometry.

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In summary, the structure of the questionnaires should be clear, engaging, and adapted to the diverse needs of students, reflecting an inclusive teaching approach.

### **4.1 Educational Itinerary**

Following the initial questionnaire, a geometric drawing itinerary will be proposed, structured and designed based on the first principle of UDL. The itinerary includes eight lessons on the theme of geometric solids, focused on their representation:

#### ***Introduction and Context***

- Present the objective: acquiring skills in the graphic representation of geometric solids.
- Explain that the UDL approach aims to create an inclusive learning environment adapted to diverse student needs.

#### ***Lessons 1-2: Norms and Conventions of Geometric Drawing***

- Introduce the basics, including nomenclature, geometric definitions, and graphic conventions.
- Provide examples of graphic representations of solids.

#### ***Lessons 3-4: Geometric Constructions and Practical Applications***

- Deepen geometric constructions of plane and solid figures.
- Perform practical exercises: polygons, closed polycentric curves, and conic curves (ellipse, parabola, hyperbola).

#### ***Lessons 5-6: Orthographic Projections***

- Explain the fundamental principles of orthographic projections.
- Practice representing plane figures and solids through orthographic projections.

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## ***Lessons 7-8: Development of Solids and Axonometry***

- Explore the surface development (unfolding) of geometric solids.
- Introduce orthogonal and oblique monometric axonometry.

The itinerary will be flexible, adapting to various abilities and learning styles, providing multiple modes of presentation and engagement. The ultimate goal is to create an inclusive learning environment that fosters success for all students.

## **5. ARCHITECTURE AND HEALTH**

Architecture and medicine, although operating in distinct fields, share a fundamental goal: improving the human condition. While medicine intervenes directly on the body, architecture shapes the environment that hosts it, influencing health, behavior, and psychophysical well-being. This link, rooted in ancient thought, is currently experiencing a new renaissance. Concepts such as therapeutic architecture and biophilic design are no longer niche visions but guiding principles for the design of hospitals, schools, and cities. They scientifically demonstrate how natural light, contact with greenery, and the quality of spaces can accelerate healing and reduce stress. In parallel, healthcare urbanism plans urban contexts that promote healthy lifestyles. This essay intends to trace the "common thread" linking these disciplines, showing how their synthesis can offer innovative solutions not only for new constructions but also for the redevelopment and enhancement of our historical heritage.

## **6. HISTORICAL ROOTS: A DIALOGUE BETWEEN BODY AND CONSTRUCTION**

The dialogue between the form of the body and architectural form has its roots in the classical world. Marcus Vitruvius Pollio, in his treatise *De Architectura* (1st century BC), was the first to systematically theorize this connection. His principles of *firmitas* (solidity), *utilitas* (functionality), and *venustas* (beauty) were not pure aesthetic abstractions; they were anchored in the observation of nature and the human body, considered the canon of perfect proportion. Vitruvius also anticipated the foundations of building hygiene, recommending precise criteria for site selection and building orientation to ensure healthiness.

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The designer is anyone who assumes the function of making a project sustainable and effective, above all by activating a dialogue with all actors in the social system in which they operate.

This holistic vision was inherited and magnified by the Renaissance. Leonardo da Vinci, with his famous Vitruvian Man, did not merely illustrate classical theories but fused them with his revolutionary anatomical studies. For Leonardo, anatomy, engineering, and architecture were sides of the same coin. His conception of an "Ideal City" on multiple levels, designed to separate flows and improve hygienic conditions, is a striking example of how medical knowledge could inform urban design to prevent the spread of disease. Furthermore, his analyses of biomechanics anticipated modern principles of ergonomics applied to spaces.

The classical legacy was taken up and developed by other key figures. Leon Battista Alberti, in his treatise *De re aedificatoria* (1452), not only revisited Vitruvius's studies but expanded the discourse on healthiness, dedicating entire sections to site selection, air quality, and urban planning for public health. Similarly, Filippo Brunelleschi, through his work, applied principles of order and proportion with a direct impact on well-being. His design for the Ospedale degli Innocenti in Florence is considered one of the earliest and finest examples of architecture designed for care, with its harmonic loggias, studied lighting, and a human-scale approach, anticipating the modern idea of architecture that "welcomes" and "heals."

### **7. THERAPEUTIC ARCHITECTURE IN THE CONTEMPORARY WORLD**

In the 20th and 21st centuries, scientific research has validated and expanded upon the intuitions of the ancients. In social design, it is fundamental to consider relational and emotional dimensions. When designing, one often faces components of emotional investment, carrying the risk of frustration. Designing any activity increasingly means designing in a social way, interacting with people who have different skills, experiences, motivations, and mindsets, and promoting cooperation. No projects exist that are not social, because every project involves people and relationships.

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Design is a group activity, not just the result of one person's thought. It is a competence that must be shared with operators and contexts, where the technician works at the service of others and whose proposals can be valued and shared.

Social design consists of creating synergy between existing resources, creating work that implies exchanges between people to counter ever-looming isolation. This type of design activates communication rather than closure. The goal of social design is to promote and protect relationships that favor the development of the interests of the subjects involved. Professional design intervention consists of creating opportunities for encounters between people with evident diversities. Social service is realized through the construction of relationships with users, which often represents the primary product. In this context, interaction, production, and consumption occur simultaneously and collaboratively.

"The term sustainability has many different meanings depending on the object it is paired with, but in the social sphere, it refers not only to the possibilities of economic survival but also to the process that identifies specific ways and means to relate adequately to the different spheres of life, aimed at coordinating and regulating, in a project, the dynamics between institutions, the typified relations between individuals and, simultaneously, surpassing a deterministic approach, confronts the expectations, demands, and projects that develop in intersubjective relations. Without repressing participatory instances and authoritatively proposing transformation objectives upon which to build a new consensus, it composes and converges the actions and will of individuals" (Siza, 2002a, p. 101).

A project is considered truly sustainable when it manages to combine and align the various wills of the people involved. The sustainability of a project depends not only on the final result but also on how it is realized. Therefore, a project is sustainable if, already in its implementation phase, it takes into account the needs and expectations of everyone involved. The sustainability of a project is thus an aspect that must be considered in every phase of its development. Consequently:

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"A sustainable project composes and converges wills, and it is sustainable or not even during its realization; sustainability is, in part, linked to the possibility of integrating different motivations. One might wonder why it is necessary to compose the wills of individuals, groups, organizations, or various components of society; in a sense, every subject is capable of acting according to their own will and realizing which other wills are systemic and potentially compatible with their own; without professional action specifically oriented to this purpose, in reality, there are many cases in which the wills and projects of individuals are conflicting and divergent because the relationship is not constructed and presided over; social design, therefore, proposes itself as an action of promotion and protection of relationships aimed at the development of the interests, whether conscious or not, of the subjects. In this perspective, one does not design predefined changes but implements a process of protecting the will and development possibilities of the people involved; one designs and prefers a method and a way of managing the changes produced" (Karim A.J., 2014).

Today, therapeutic architecture is a consolidated discipline that designs environments capable of actively supporting healing processes. Evidence-Based Design (EBD) studies demonstrate that elements such as views of green areas, an abundance of natural light, and the use of natural materials can reduce patient anxiety, decrease the need for pain medication, and accelerate post-operative recovery.

Biophilic design, theorized by biologist E.O. Wilson, fits into this trend, supporting the innate human need to connect with nature. Exemplary projects such as the Meyer Pediatric Hospital in Florence or the New Policlinico in Milan (designed by Stefano Boeri Architetti, Barreca & La Varra) embody these principles, integrating gardens, light, and colors into an environment that ceases to be a place of suffering to become a space of hope and healing. As highlighted by urban space scholars such as Leonardo Benevolo and Marc Augé, the quality of the built environment is a determining factor for individual and social well-being.

## **8. ENHANCING CULTURAL HERITAGE AS A SPACE FOR WELL-BEING**

The most fascinating challenge of our time is not only to build new healthy buildings but to reinvent existing ones. The enhancement and enjoyment of cultural heritage can and must intertwine with the principles of architecture for health. This is not merely about preserving the past, but about infusing it with a new social function, transforming historical sites into resources for community well-being.

The restoration of ancient hospitals, convents, or rural complexes can follow a therapeutic and inclusive logic, creating wellness centers, rehabilitation clinics, or senior residences that benefit as much from historical architectural quality as from modern healthcare design principles. Within the field of design, it is possible to identify a significant contribution from Italian designers in the contemporary architectural landscape. Gianmichele Aurigemma, specializing in healthcare architecture, has demonstrated how the principles of design well-being can be applied to very specific territorial contexts, as seen in his numerous on-site interventions in Irpinia. Alongside this practical materialization of architectural theories stands Francesco Venezia, whose reflections on the link between physical space and sensory perception provide architects with conceptual and operational tools to design spaces that are not "only" functional but contribute positively to the human state of mind through the emotion of the place. Finally, the vision of Paolo Portoghesi and organic architecture provides the cultural context for this contemporary synthesis between the built environment and habitat: the ideal continuity between building and nature sought by Portoghesi proves to be an infallible prerequisite for the operational inclusion of "biophilic design" strategies in the recovery of existing building heritage, ensuring the necessary continuity of the vital flow between history and landscape. Redeveloping heritage through a therapeutic lens means creating a well-being economy rooted in culture, turning places of memory into places of life and care.



## **9. INTENDED RESULTS AND DISCUSSION**

For decades, the Italian school system has adopted the integration of students within compulsory education classes, including all learners without scholastic or personal distinctions. This has led to an increase in students with specific educational needs. Since the beginning of my Professional Practice (PP), I have engaged with Special Educational Needs (SEN/BES), which has driven me to research teaching theories and practices aimed at ensuring both well-being and effective learning.

In recent years, the concept of an inclusive school has emerged, one that adapts to the diverse needs of students, allowing each individual to develop their full potential. To meet this challenge, educational materials based on the Universal Design for Learning (UDL) model are being piloted. This framework is rooted in the awareness of student variability and the design of learning environments that foster inclusion. The model aims to personalize education through a flexible and inclusive approach, offering all pupils equal opportunities and equity in learning. UDL incorporates the principles of Universal Design (UD), adapting them to the specificities of the teaching and learning process. The goal is to overcome barriers and activate effective strategies to guarantee the well-being and academic success of all students. This approach is fully aligned with international inclusive education standards, focusing on:

- Individual differences: considering the diverse abilities and characteristics of students as the norm.
- Removal of barriers: creating inclusive learning environments that welcome all students.
- Specific strategies: integrating effective strategies tailored to various student profiles within a global pedagogical framework.

UDL serves as a vital pillar for a school of accessibility and inclusion, and this thematic in-depth project aims to provide a significant contribution to the educational community.

To create an inclusive learning environment that involves all teachers and accounts for student needs, a project will be implemented within the field of geometric drawing.

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This project involves the application of the UDL model, specifically focusing on its first principle: providing multiple means of representation for materials and the content of the Learning Unit (UDA). The focus on geometric representation arose from the initial demotivation observed in students regarding this subject. The objective is to investigate how students' perspectives on the topic may shift after following a UDL-based instructional itinerary. It is hoped that this work will serve as an inspiration and a resource for colleagues and fellow educators.

Pedagogical differentiation and Universal Design for Learning (UDL) are two approaches aimed at creating inclusive learning environments, yet they possess key differences. Pedagogical differentiation focuses on adapting teaching to the individual needs of each student. Teachers use various strategies, materials, and teaching methods to accommodate student needs within the same classroom. The goal is to personalize learning by considering abilities, learning styles, interests, and readiness levels. The text "*Prosocialità, tecnologie inclusive e progettazione universale nei disturbi specifici dell'apprendimento*" by Felice Corona provides a significant scientific contribution to this research. It explores how universal design fosters accessibility and inclusion through innovative technologies. By creating inclusive learning environments, students can perform at their best. UDL, when integrated with the Flipped Classroom, a teaching methodology that bears his signature, can promote inclusion by making the learning process meaningful and accessible to all. Universal Design for Learning (UDL) focuses on designing a single learning environment accessible to all students from the outset. UDL seeks to eliminate learning barriers by designing flexible materials and strategies usable by a wide range of students without the need for subsequent adaptations. The goal is to create an inclusive environment that responds proactively to student differences. Both approaches, if effectively implemented, contribute to a more inclusive learning environment suited to diverse student needs.

The expected outcome of the research is not limited to simple geometric performance but aims for a profound transformation of the teacher's professional profile. Through the adoption of the UDL "three-block model," the teacher evolves from a mere "content provider" to a true designer of learning environments (Industrial Designer).

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By integrating Social-Emotional Learning (SEL) with affective neural networks, the intervention primarily aims to reduce extraneous cognitive load: the use of multiple representations allows the student to focus on the conceptual essence of the problem. This approach fosters student empowerment, transforming them from passive users into proactive subjects capable of perceiving geometry no longer as a foreign art, but as a tool for interpreting reality. Finally, systemic inclusion is pursued, demonstrating how strategies essential for students with Special Educational Needs (SEN), such as visual and concrete supports, actually represent a model of excellence for the entire class.

### **10. RICCARDO DALISI: INCLUSION, PARTICIPATION, AND THE CREATIVE CITY**

In the vast landscape of contemporary architecture, Riccardo Dalisi occupied a singular and profoundly innovative position. Architect, designer, university professor, artist, and theorist, Dalisi was among the first in Italy to promote an idea of architecture as a social, creative, and inclusive practice. His work transcends disciplinary barriers and challenges design conventions to shape spaces born from dialogue, shared narrative, and collective intelligence. He maintained that "One must design not for others, but with others, transforming space into a place of collective expression where diversity becomes a resource and not a limit" (Dalisi, 2006, p. 87). In his famous workshops in the Rione Traiano of Naples during the 1970s, Dalisi involved children and young people in participatory design processes, restoring dignity to the creative act even when devoid of means. Using "poor" materials and artisanal techniques, he brought to life an aesthetic of the everyday, where elegance depends not on economics but on care, relationship, and imagination. This approach, defined as "tecnica povera" (poor technique), is a tangible testimony to a poetics of inclusion: creating with those on the margins, thinking about the city with those who inhabit it.

However, Dalisi's reflection on the city goes far beyond design activity. He imagined the city as a pedagogical environment, a space in which to mutually educate one another in respect, beauty, and creativity. His vision was that of a "creative city," not in the contemporary sense of smart cities, but as an open, democratic, and affective system.

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For Dalisi, the true designer is one who knows how to renounce authorship to build meaningful places together with the community. Dalisi was firmly convinced of this, stating that "There is no space that cannot be reinvented through play and participation, breaking down that formal rigidity that often excludes the individual instead of welcoming them" (Dalisi, 1972, p. 15). Furthermore, for Dalisi, "Participation is not a technical fact, but a fact of culture, of life, of deep communication between men; it is the overcoming of every barrier that divides the architect from the user, the learned from the unlearned" (Dalisi, 2006, p. 42). His thought links directly to the participatory approach of urbanists like Bernardo Secchi and landscape artists like Gilles Clément, with whom he shared the idea of a dialogic territory capable of changing over time and evolving with its inhabitants. Dalisi did not design static spaces, but environments capable of welcoming transformation, error, play, and the unexpected.

Today, his legacy is recognized not only in museums and schools of architecture, engineering, and design, but above all in neighborhoods and civic laboratories. Remembering him in this publication means emphasizing how much architecture can be a relational attribute, a means of emancipation, and a tool of hope. His thought invites every architect-urbanist to "look with new eyes" and to design with a holistic perspective, not against, but together.

### **CONCLUSION**

Architecture and medicine, after following parallel paths for centuries, are now converging toward a holistic approach that considers the person in their entirety. The integration of biophilic design, therapeutic architecture, and healthcare urbanism is no longer just a choice, but a necessity to face global health challenges. Applying this vision to the redevelopment of cultural heritage represents one of the most promising frontiers.

Riccardo Dalisi rightly claimed that "Architecture must become pedagogy; it must know how to listen to unspoken needs and give shape to the creativity of those who are habitually excluded from decision-making processes" (Dalisi, 2006, p. 115). The concept of structural inclusion is directed toward an inclusion that seeks to consider everyone's problems in order to activate effective strategies to overcome them.

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This concept of structural inclusion is also taken up by Andrea Canevaro, who, re-examining reflections on school inclusion, specifies how the dynamics underlying inclusive processes are themselves characterized as "structural." With this adjective, he indicates the need to move beyond logic centered on individual subsidies, with the awareness that a structural intervention designed for a specific individual can be extended to multiple beneficiaries (Canevaro, 2021). Building inclusive environments is a way to honor our past while creating a healthier, more sustainable, and more human future. Creating environments that heal and include is, ultimately, what it truly means to build.

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### **REFERENCES**

- Alberti, L. B. (1485). *De re aedificatoria* [On the Art of Building].
- Aminian, J. K. (2014). *La progettazione sociale. Esperienze e riflessioni* [Social Design: Experiences and Reflections] (Vol. 298). FrancoAngeli.
- Augé, M. (1992). *Non-lieux: Introduction à une anthropologie de la surmodernité* [Non-Places: Introduction to an Anthropology of Supermodernity]. Seuil.
- Barreca, G., & La Varra, G. (2018). *Nuovo Policlinico Milano: Un modello di ospedale contemporaneo* [New Policlinico Milan: A Model of a Contemporary Hospital].
- Benevolo, L. (1960). *Storia dell'architettura moderna* [History of Modern Architecture]. Laterza.
- Canevaro, A. (2021). *Un'altra didattica è possibile. Esempi e pratiche di ordinaria didattica inclusiva* [Another Teaching Method is Possible: Examples and Practices of Ordinary Inclusive Education]. Erickson.
- Center for Applied Special Technology [CAST]. (2018). *Universal Design for Learning Guidelines Version 2.2*.  
<https://udlguidelines.cast.org/binaries/content/assets/udlguidelines/udlg-v2-2/udlg-graphicorganizerv2-2-italian-nonnumbers.pdf>
- Corona, F., & De Giuseppe, T. (2016). *Prosocialità, tecnologie inclusive e progettazione universale nei disturbi specifici di apprendimento* [Prosociality, Inclusive Technologies, and Universal Design in Specific Learning Disorders]. Edizioni Il Papavero.
- Cottini, L. (Ed.). (2019). *Universal Design for Learning e curriculum inclusivo. Imparare a progettare una didattica funzionale ai bisogni della classe e dei singoli* [Universal Design for Learning and Inclusive Curriculum: Learning to Design Instruction Functional to the Needs of the Class and Individuals]. Giunti Edu.
- Crowther, G. J., Adjapong, E., & Jenkins, L. D. (2023). Teaching science with the “universal language” of music: alignment with the Universal Design for Learning framework. *Advances in Physiology Education*, 47(3), 491-498. <https://doi.org/10.1152/advan.00006.2023>
- Dalisi, R. (1972). *Architettura dell'imprevedibilità* [Architecture of Unpredictability]. Jaca Book.

## *SUSTAINABLE STRATEGIES IN THE BUILT ENVIRONMENT AND ARCHITECTURE*

- Dalisi, R. (1999). La caffettiera del filosofo: Trama e ordito del design [The Philosopher's Coffee Pot: Plot and Warp of Design]. Edizioni Kappa.
- Dalisi, R. (2006). Architettura della partecipazione [Architecture of Participation]. Liguori Editore.
- Da Vinci, L. (16th Century). Codici anatomici [Anatomical Manuscripts].
- Demo, H., & Veronesi, D. (2019). Universal Design for Learning nelle interazioni in classe [Universal Design for Learning in Classroom Interactions]. In D. Ianes (Ed.), Didattica e inclusione scolastica (pp. 31-50). FrancoAngeli.
- Dovigo, F. (2008). L'Index per l'inclusione: una proposta per lo sviluppo inclusivo della scuola [The Index for Inclusion: A Proposal for the Inclusive Development of the School]. In T. Booth & M. Ainscow, L'Index per l'inclusione (pp. 7-42). Erickson.
- Duval, R. (1988b). Approche cognitive des problèmes de géométrie en termes de congruence [Cognitive Approach to Geometry Problems in Terms of Congruence]. Annales de Didactique et de Sciences cognitives, 1, 57-74.
- Duval, R. (1993). Registres de Représentations sémiotiques et Fonctionnement cognitif de la Pensée [Registers of Semiotic Representations and Cognitive Functioning of Thought]. Annales de didactique et de sciences cognitives, 5, 37-65.
- Duval, R. (1998). Signe et objet (I). Trois grandes étapes dans la problématique des rapports entre représentation et objet [Sign and Object (I): Three Major Stages in the Problematic Relationship Between Representation and Object]. Annales de Didactique et de Sciences cognitives, 6, 139-163.
- Folci, I., & Baroni, F. (2022). Progettare l'inclusione tra Differenziazione didattica e Universal Design for Learning [Designing Inclusion between Differentiated Instruction and Universal Design for Learning]. Italian Journal of Special Education for Inclusion, Pensa MultiMedia.
- Hunt, J., Taub, M., Marino, M., Duarte, A., Bentley, B., Holman, K., & Banzon, A. (2022). Enhancing engagement and fraction concept knowledge with a universally designed game based curriculum. Learning Disabilities: A Contemporary Journal, 20(1), 77-95.

## *SUSTAINABLE STRATEGIES IN THE BUILT ENVIRONMENT AND ARCHITECTURE*

- Karim, A. J. (2014). Il design dei servizi per l'innovazione sociale: Il ruolo del progettista come facilitatore di processi partecipativi [Service Design for Social Innovation: The Role of the Designer as a Facilitator of Participatory Processes]. Design Diffusion.
- Mace, R. (1985). Universal Design, barrier free environments for everyone. Designers West.
- Mangiatorti, A. (2019). Costruire inclusione. Progettazione Universale e risorse digitali per la didattica [Building Inclusion: Universal Design and Digital Resources for Teaching]. Guerini Scientifica; GoWare.
- McMahon, D. D., & Walker, Z. (2019). Leveraging emerging technology to design an inclusive future with Universal Design for Learning. CEPS Journal, 9(3), 75-93. <https://doi.org/10.26529/cepsj.639>.
- Meyer, A., Rose, D. H., & Gordon, D. (2014). Universal Design for Learning: Theory & Practice. CAST.
- Mitchell, F. (2023). Promoting inclusive practice for autistic learners: Universal Design for Learning. Kairanga, 24(2), 30-51.
- North Carolina State University [NCSSU]. (1997). Principles of Universal Design. <https://design.ncsu.edu/wp-content/uploads/2022/11/principles-of-universal-design.pdf>
- Novak, K. (2021). Introduzione. In W. W. Murawski & K. L. Scott (Eds.), Universal Design for Learning in pratica [Universal Design for Learning in Practice] (pp. 29-45). Erickson.
- United Nations [UN]. (2006). Convention on the Rights of Persons with Disabilities. <https://www.fedlex.admin.ch/eli/cc/2014/245/it>
- Portoghesi, P. (1999). Natura e architettura [Nature and Architecture]. Skira.
- Savia, G. (2016). Universal Design for Learning. Progettazione universale per l'apprendimento e didattica inclusiva [Universal Design for Learning: Universal Planning for Learning and Inclusive Teaching]. Erickson.
- Vitruvius Pollio, M. (ca. 15 BC). De architectura [On Architecture].
- Wilson, E. O. (1984). Biophilia. Harvard University Press.



**CHAPTER 3**  
**SUSTAINABLE ENERGY MANAGEMENT**  
**FRAMEWORK FOR HOTEL FACILITIES**

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## **INTRODUCTION**

The concept of sustainable development introduced by the Brundtland Report (World Commission on Environment and Development) in 1987 is primarily concerned with development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Thus, sustainable development has become a major global concern focusing on issues that support harnessing resources for developmental purposes that assure a productive link between the human environment, economic growth and social interaction in different parts of the world and between generations (Melissen, Ginnekan, & Wood, 2016).

Energy is a strategic commodity vital for fueling economic growth and social development. The global energy use, in which the building sector accounts for about 40% consumption and 35% carbon dioxide (CO<sub>2</sub>) emissions, has continued to rise, resulting in various environmental issues, including greenhouse gas (GHG) emissions, which are central to the global warming problem (Batagarawa, 2013; Lai, 2016; United Nations Development Programme, 2010).

The hospitality industry constitutes an important sector of the economy in many countries around the globe, contributing significantly to their Gross Domestic Product (GDP) (Bodach et al., 2016; Hui & Wan, 2013). However, hotels are rated high amongst energy-consuming public buildings (Chung & Park, 2015; Järvensivu, 2014; Priyadarsini, Xuchao & Eang, 2009). This is ascribed to the nature of their operations that requires energy for 24 hours, irrespective of seasonality, number of guests and location (Kasim, 2007; Deng, 2005). The diversified energy resources consumed by hotels are typically for space heating, cooling, and ventilation, heating water, lighting, lighting, laundry, kitchen, recreation etc. and responsible for estimated harmful gas emissions of between 160kg and 200 kg of carbon dioxide per square meter of room floor area (Bohdanowicz, 2008; Kirk, 2008; Bohdanowicz & Martinac, 2008). Moreover, this is further influenced by physical and operational parameters of the hotel (Dascalaki & Balaras, 2007; Hotel energy solutions, 2012). The situation therefore, critically calls for deserved attention to energy conservation. There are profound business and other non-business reasons to conserve energy in hotels (Shiming & Burnett, 2002).

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The business reasons may include increased profitability through reduced operational cost and the improved market share potentials, while the non-business reasons may include preserving natural resources and enhanced social integration that will promote sustainable development.

The concept of sustainable energy management, based on fundamental principles of sustainable development, aimed at resource conservation, environmental protection, and cost savings, provides energy security for present and future generations (IEA & World Bank, 2015). Currently, energy efficiency, energy conservation and renewable energy integration characterise the concept of energy sustainability (Burkhard & Kadakia, 2010; Järvensivu, 2014).

Accordingly, more interests to study hotel energy management and performance, as well as promoting good operational practice in hotels by various parties concerned, was recorded (Shiming & Burnett, 2002). For instance, in the United Kingdom (UK), the United States (US) and Hong Kong, there are general guides such as Minimum Energy Efficiency Performance Standards (MEPS), Collaborative Labelling and Appliances Standards Programme (CLASP) and Energy Efficiency Standards for appliances (EES) for achieving better energy efficiency in hotel buildings. These are made available by relevant government departments such as the Energy Efficiency Advisory Committee, the Department of Energy, and the Energy Efficiency Office (Shiming & Burnett, 2002). These government agencies provide good operational practices that may lead to reduced energy use in hotels, such as good housekeeping practices and technical guidelines to efficiently operate building engineering services systems. Good operational practices for better energy efficiency have also been promoted by hotel professional's association (e.g. international Environment initiative, 1993). Normally, managing energy use in a hotel building may be seen as part of the overall environmental management. However, most examples of successful environmental management in the area of energy management were motivated by financial savings that can be achieved (Kirk, 1995; Shiming & Burnett, 2002).

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On the other hand, energy use performance, which is about the effective use of various types of energy supplied to hotels, has also been studied by building professionals interested in energy use performance in buildings, as in Lai (2016), Nižic and Bracic (2014), Priyadarsini, Xuchao & Eang (2009), Bohdanowicz (2006), and Chan et al. (2003).

According to Goldstein and Primlani (2012), the past decades witnessed growing awareness among hoteliers and investors regarding the environmental and social impacts of hotel development and operations to the extent that sustainability issues have permeated nearly every aspect of the industry. This has been driven by multiple factors, including the desire to reduce operational costs, changing attitudes toward the environment and the coinciding emergence of corporate social responsibility programs that increased regulatory focus on facility operations and development, which signifies a general shift towards the paradigm of sustainability. The hotel energy sustainability practices in developed countries have positively impacted the performance and profitability of the hotel organisations (Zengeni et al. 2013; Nižic and Bracic, 2014; Lai, 2016). This is achieved through energy consumption reduction, realised operational cost savings, environmental friendliness and social benefits (Alexander, 2002; Mensah, 2006; Hotel Energy Solutions, 2011).

Therefore, within this context, the national energy efficiency program considered the promotion of a large-scale demand-side management (DSM) initiative. This is to help reduce the energy consumption of a series of major end-use appliances, particularly air-conditioners, refrigerators, electrical motorised equipment, heating equipment and lighting (UNDP-Gef, 2012). However, the attempt has not yielded the much-needed positive outcome. This chapter proposes a sustainable energy management framework for hotel facilities.

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### *Literature Review*

Hotels are universally recognised as having high energy intensities responsible for soaring operational costs. Accordingly, the concept of sustainable energy management has been widely used by various industries, including hotels, particularly in developed economies, to exploit its numerous advantages, most significantly reduced energy expenditures and minimised emissions (Xu et al., 2015, Nerves et al., 2010, Sun & Liu, 2007). Moreover, it is considered a valuable tool for optimising performance and meeting their sustainability goals (Zangeni et al., 2014, Zaiton et al., 2012; Kapiki, 2012; Mensah, 2006).

According to Goldstein & Primlani (2012), Sustainability issues in the hospitality industry touch on nearly all aspects of ownership and management, necessitating alignment between environmental, social, and economic factors to promote responsible business operations over time. This is evident in the combination of energy resources utilised, design energy efficiency consideration of new and retrofitting of existing buildings, as well as adopting energy conservation practices in their operations. In contrast, it is predicted that the major increase in energy consumption and thus, carbon emission will happen in the developing world, particularly in the building sector (Bodach S., Lang W., & Auer T., 2016). This is apparent in the hotel sector, where climate-responsive design strategies and energy-efficient technologies are often neglected by stakeholders in the industry (Bodach et al., 2016).

Nigeria is not an exception in the aforementioned problem; moreover, the country's electricity supply has been characterised as inadequate and unstable for decades, attributed to an overburdened and failing energy system. The situation earned the country the lowest rating in per capita electricity consumption in Africa (Oluseyi et al., 2016; Batagarawa, 2013). This is evident in the high incidences of power outages forcing a large portion of industries, businesses, and households to rely on expensive diesel and petrol generators for a primary or back-up source of electricity, which constitutes a source of noise and air pollution to ensure uninterrupted operations.

In addition, Akindele and Adejumobi (2017) reported that businesses, manufacturers and banks, among others, spend between 30-40% of their revenue in generating electricity.

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The hospitality industry is among the hardest hit by the awful situation due to its nature of operations that requires energy for 24 hours, irrespective of season, number of guests accommodated and reliance upon its availability to deliver affordable services (Oluloye et al. 2012). Consequently, complaints on unsatisfactory levels of services and exorbitant charges not commensurate with the value of services rendered impact negatively on the popularity of Nigerian hotels to the advantage of neighbouring countries, as observed in Felix (2014), Nasiru et al.(2013), and Oluloye et al. (2012), with resultant negative impact on the Nigerian economy. Moreover, Al-Salem et al. (2012) observed that the quality of services provided by hotels and other hospitality businesses is an indicator of a country's economic health, reflected in steady growth in the rates of popularity and visitors' influx year after year. In addition to the income losses to the country, the National Electricity Regulatory Commission (NERC) also estimated in 2010 that Nigerians spend up to ₦769.4 billion annually (\$89.5 million) in fueling generators (UNDP- GEF, 2012).

Abuja, accounting for over 10% of the total annual electricity delivered from the national grid, was also figured to consume about 12-13 million litres of fuel daily, largely diesel for powering generators to supplement the city's electricity supply shortfalls, with all sectors actively pursuing this indulgence (Muazu, 2012). The emissions from these generating sets, which pose potential adverse environmental and health implications, have been subject to critical global discussions due to the release of lots of greenhouse gases to the atmosphere (Ajayi, 2010).

The practice contributed to making Nigeria the highest emitter in Africa, contributing 3% out of Africa's 4% contribution to global greenhouse gas (GHGs) emissions (UNDP-GEF, 2012). Although the chunk of the emission has been ascribed to the gas flaring in the Niger delta region, the back-up generators used by a large portion of industries, businesses and households share in the menace. Moreover, this is a major political drawback to the country; in spite of efforts towards enhancing its clean development mechanism (CDM) status encapsulated in the country's economic vision 20:20:20 targets cited in Nadabo (2010). Considering the health hazards, about 10,000 deaths from 2000 to 2014 in Nigeria were linked to inhalation of fumes and generator explosions (Good Governance Initiative, 2014).

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A review of several studies conducted on hotel energy management shows few numbers of studies covering the Nigerian hospitality industry. Moreover, studies by Bohdanowicz (2006), Shiming and Burnett (2002), Bohdanowicz and Martinac (2008), Priyadarsini, Xuchao and Eang (2009), Moia, Cladera and Rossello (2010), Hui and Wan (2013), Chan (2012), Järvensivu (2014), Lai (2016), Mendes and Santos (2014), Nižic and Bracic (2014), Xu et al. (2015) Mosgaard et al. (2016) were conducted in developed and stabilized economies, with vibrant industrialized systems that allows for development and employment of innovative technologies for efficient energy conservation as well as harnessing other sources of energy. However, none was carried out in a depressed economy with an overburdened and failing energy system like Nigeria. Similarly, studies by Bohdanowicz (2006), Järvensivu (2014), Mendes and Santos (2014), Nižic and Bracic (2014), and Martinac et al. (2008) focused on energy and water consumption in European hotels. The studies further investigate the influence of different hotel physical factors on resource consumption indicators. However, operational factors were not considered; the results stand to present a lopsided energy management evaluation, which is less reliable for drawing the entire hotel energy management performance picture.

A study conducted by Priyadarsini, Xuchao and Eang (2009) assessed both the hotel's physical and operational characteristics to draw a comprehensive energy performance of the hotels under study in Singapore. However, due to geographical and socioeconomic disparities, the improvement measures suitable for addressing identified inefficiencies in previous studies could be quite different from the Nigerian context. Although the study conducted by Bodach et al. (2016) was in Nepal, a developing country like Nigeria. The study was restricted to the design guidelines for energy-efficient hotels in the country. However, little is known about the influence of hoteliers' perceptions on sustainable energy management on hotels' energy use and energy cost.

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Therefore, this study bridged the above-identified gaps by identifying the dominant hotels' features, services and energy use profile and also assessed the effects of hotels' service provision, design efficiency responsiveness, energy management strategy and hoteliers' perception of sustainable energy management on the hotels' energy use profile, appliances energy efficiency and hotel energy costs.

### *Scope of the Chapter*

The study focused on developing a sustainable energy management framework in hotel facilities. The study is delimited to only the 25 rated hotels located in phase I districts of Abuja, Federal Capital Territory of Nigeria, as provided by Abuja Tourism Development Board, which consists of one (1) 5-star, five (5) 4-star, fifteen (15) 3-star and four (4) 2-star hotels for the survey. The study opted to cover 5, 4, 3 and 2 stars respectively for the interview because the 5 and 4 stars provide top-line and opulent services, which are complex to operate and have a high tendency of higher energy consumption, while 3 and 2 stars enjoy higher patronage (Felix, 2014). The study was conducted within three years (2015-2018) through a cross-sectional survey. Data were collected using questionnaires and interviews specifically seeking to determine how sustainable in terms of energy use and management, and the effect on energy cost reduction of hotels and value delivery to customers.

### *Summary of the Chapter*

This chapter discusses the major background concepts that guide the purpose of carrying out the study. Thus, this chapter describes the need for securing a sustainable energy management framework for hotel facilities. In this regard, the chapter describes the importance of energy as an essential commodity critical for efficient service delivery for hotel facilities, which ranks them among high-energy-consuming public buildings. The universality of the hotel energy intensity prompted the use of sustainable energy management in addressing the problem.



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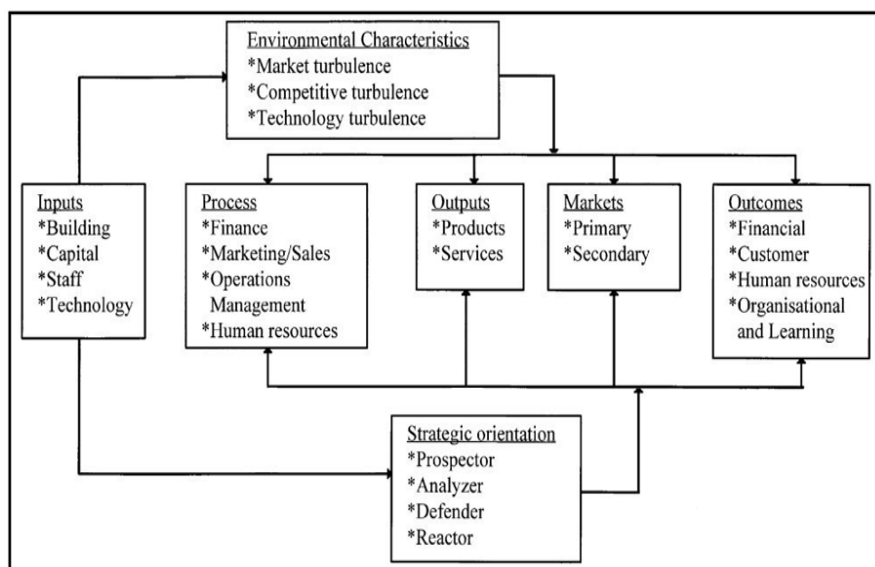
However, Nigerian electricity supply has been characterised as inadequate and unstable for decades, attributed to an overburdened and failing energy system, earning the country the lowest rating in per capita electricity consumption in Africa, which justified the need for the study. The chapter also highlights the research questions to be answered, the objectives expected to be achieved and the study hypotheses. The chapter also explained the potential beneficiaries of the research as well as the area of the benefits. This chapter also explained as well the scope to be covered by the study.

### **1. CONCEPTUAL FRAMEWORK**

Phillips (1999) proposes a conceptual performance framework for evaluating hotel performance and addresses three categories of factors, which include physical characteristics, the market-determined factors, and management-controlled factors. The framework considered physical characteristics of the building (i.e. number and mix of rooms), although not under the control of the hotel general manager; however, it is regarded as an important determinant of performance, and included with other factors as inputs. Market forces such as the average room occupancy and room rates of competitor hotels influence performance and have been included with others as environmental characteristics, which both relate to the hotel features construct, further subdivided as hotel building features and operational features of this study, both covering the former and later respectively.

Also related to the study's hotel energy costs construct are some resources (i.e. rooms expenditure, food and beverage expenditure, and energy costs) consumed by the hotel unit that are normally controllable by the hotel general manager. A better-performing hotel will have superior processes and will be included in the framework. The central theme of the framework is that inputs, processes, outputs, market, strategic orientation and environmental characteristics are associated with outcomes.

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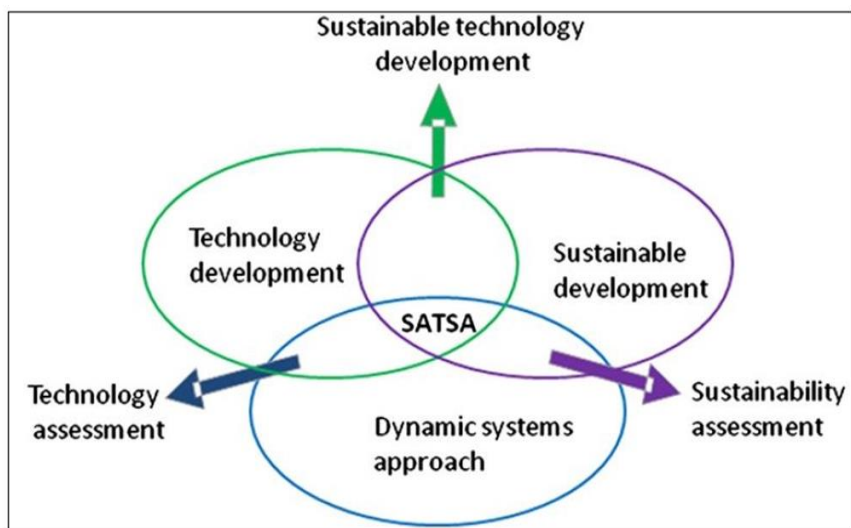
**Figure 1.** A multidimensional contingency framework of hotel performance

Source: Phillips (1999)

Although the conceptual framework extends to consider a collection of performance measures that ensure competitive advantage for hotel organization; however, energy cost has been relegated to an item of resources consumed by hotels. Moreover, achieving a breakthrough level of performance improvement requires regarding the hotel energy use and management because hotels are among the most energy-intensive of all building categories, and the nature of their services and competitiveness revolves around the hotel energy performance.

Musango and Brent (2011) proposed a conceptual framework for energy technology sustainability assessment. The framework aimed at demonstrating the linkages between the key elements proposed as important for an improved technology sustainability assessment practice. These encompass technology development, sustainable development, and a dynamic systems approach. According to Musango and Brent (2011), pairing these elements renders the understanding of sustainable technology development, technology assessment, and sustainability assessment, while integrating the three elements provides the foundation for a system approach to sustainability assessment (SATSA).

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**Figure 2.** Systems approach to technology sustainability assessment

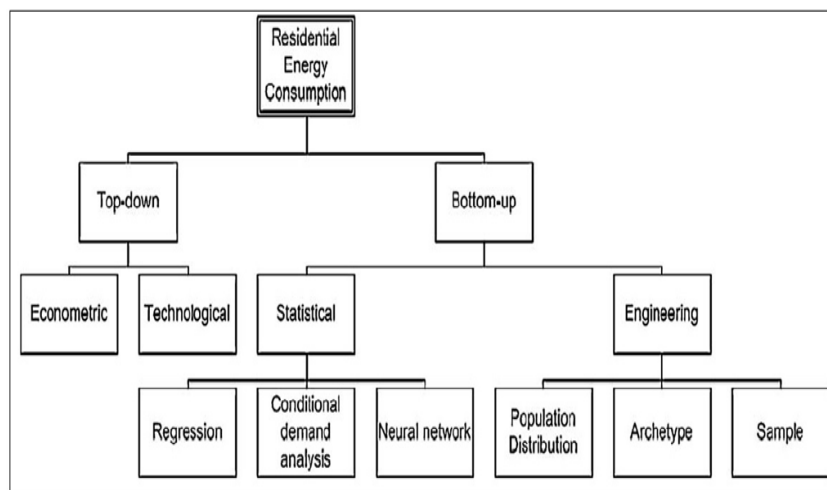
Source: Musango and Brent (2011)

Although the framework acknowledged developments in technology assessment from an analytical tool for technology evaluation, which depends heavily on quantitative and qualitative modelling methodologies, into a strategic planning tool for policymaking concerning the acceptability of new technologies. However, the conceptual framework has not stressed the need for assessing the societal perception of the importance, benefits, as well as barriers towards the new technology, which is critical in the effective diffusion of the new technology and its sustainability. Moreover, it recognises that the goal of technology assessment is to generate policy options for solutions of organisational and societal problems, which, at the operational level, utilise new technologies coupled with technological uncertainty due to the existence of several solutions to achieve a particular task best when all economic, social, technical, and environmental factors are taken into account.

Swan and Ugursal (2008) proposed a conceptual framework of Top-down and bottom-up modelling techniques for estimating regional or national residential energy consumption. The framework considered the estimate of total residential sector energy consumption and other pertinent variables to attribute the energy consumption to characteristics of the entire housing sector.

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The variables used include macroeconomic indicators (gross domestic product (GDP), employment rates, and price indices), climatic conditions, housing construction/demolition rates, and estimates of appliance ownership and number of units in the residential sector. These were further grouped into two econometric and technological models. Econometric models are based primarily on price (of, for example, energy and appliances) and income, which relates to the energy use profile and appliances energy efficiency constructs of this study while the Technological models attributes the energy consumption to broad characteristics of the entire housing stock, which also relates to hotel facility's features/ service and design responsiveness constructs of the study. The Econometric and Technological models operate on an equilibrium framework, which balances the historical energy consumption with the estimate based on input variables.



**Figure 3.** Top-down and bottom-up modelling techniques for estimating regional or national residential energy consumption Source: Swan and Ugursal (2008)

Although the framework was meant for residential energy consumption estimates, the framework did not consider the building occupiers' perception, which is related towards reducing energy consumption, which is also a critical attribute in increasing or reducing the energy consumption estimates.

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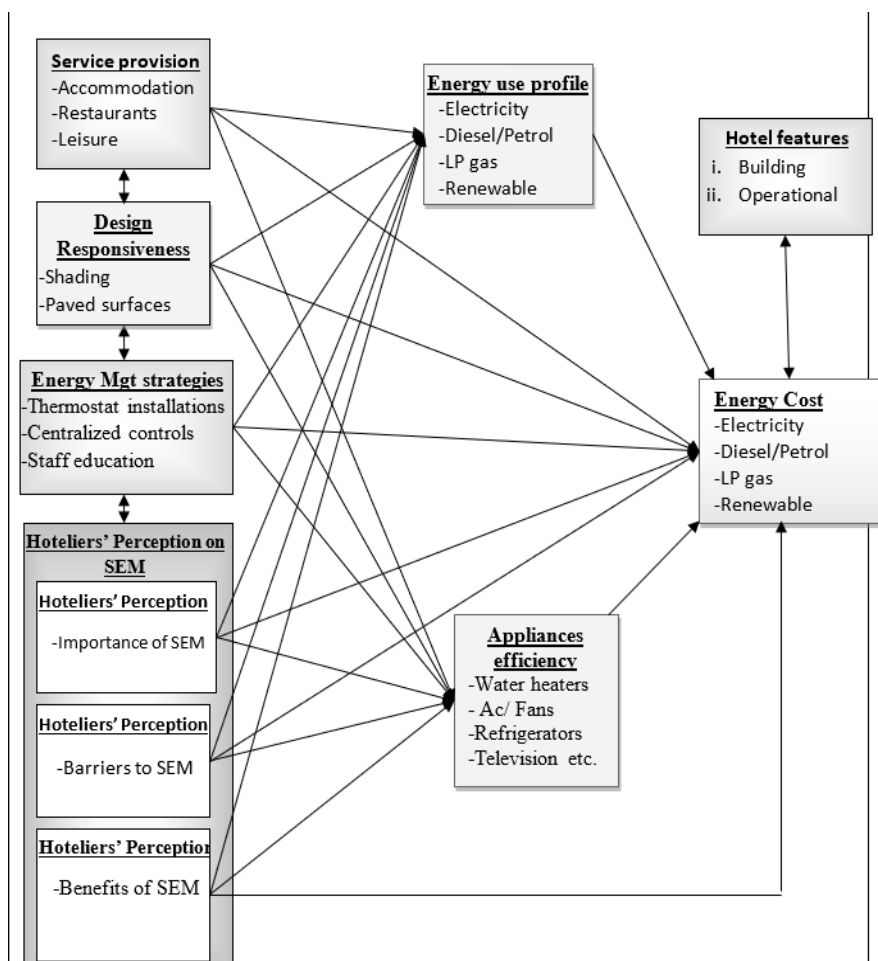
In addition to that, the framework did not indicate any causal relation between the energy consumption estimates and the econometric as well as technological attributes.

Hence, to bridge the identified gap in literature with respect to the irresponsiveness of the conceptual framework, can comprehensively demonstrate the relationships between hotel service provision, design efficiency responsiveness, energy management strategies and hoteliers' perception on SEM; framework in Figure 4 was forwarded. The framework indicated causal effects of hotel service provision and design responsiveness on energy use profile, appliance energy efficiency and hotel operational costs. It also demonstrated the effects of energy management strategy on energy use profile, appliance energy efficiency and hotel operational costs. The framework also hypothesised causal effects of hoteliers' perception on energy use profile, appliance energy efficiency and hotel energy costs. As such, it was tested to propose an energy management framework for achieving a minimised energy cost that could substantially reduce hotel operating costs.

### **2. RESEARCH METHODOLOGY**

The study adopted a mixed-methods research approach, combining quantitative and qualitative techniques to evaluate sustainable energy management in hotel facilities. The research was grounded in positivist epistemology, emphasising objective measurement and generalizable findings, while incorporating interpretive elements for deeper contextual understanding. The ontological stance aligned with realism, seeking to identify causal relationships between hotel features, energy management strategies, and energy costs. A combination of exploratory, descriptive, and interpretive research designs was employed. The exploratory design facilitated initial investigation of the research problem through a literature review. Descriptive design enabled systematic identification and quantification of hotel characteristics, energy use patterns, and management practices. Interpretive design provided qualitative depth through expert interviews to benchmark energy performance against established standards. The study focused on 25 rated hotels in Phase I districts of Abuja, Nigeria's Federal Capital Territory, comprising one 5-star, five 4-star, fifteen 3-star, and four 2-star hotels.

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**Figure 4.** Conceptual framework for the study

The target population included management and technical staff from housekeeping, engineering, food and beverage, and accounting departments areas with significant energy consumption and management responsibilities.

For quantitative data, 24 hotels were sampled using disproportionate stratified sampling based on district location, supplemented by cluster sampling by hotel category and purposive sampling for departmental respondents. The sample yielded 480 questionnaires targeting five respondents per department across four departments per hotel.

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For qualitative data, five hotels (one from each star category, with two 3-star hotels due to their 60% population representation) were purposively selected for structured interviews with managers and technicians from engineering departments.

A semi-structured interview schedule with two sections addressed respondent profiles and expert views on building characteristics, energy use intensities, design efficiency considerations, and appliance efficiency. A self-administered structured questionnaire with 11 sections captured demographic data, hotel features, service provision, design efficiency and responsiveness, energy use profiles, energy costs, appliance efficiency, energy management strategies, and hoteliers' perceptions on SEM importance, barriers, and benefits. A five-point Likert scale was employed for attitudinal measurements. Pre-testing with 10 academic experts refined question wording and structure. A pilot study of 50 questionnaires (43 retrieved) assessed normality (skewness and kurtosis within  $\pm 2$ ) and reliability (Cronbach's alpha  $> 0.7$  for most constructs). Field survey reliability was confirmed with Cronbach's alpha values ranging from 0.706 to 0.920 across constructs.

Quantitative Analysis: Descriptive statistics (mean ranking, frequencies) identified dominant hotel features and energy profiles. Inferential statistics employed Pearson correlation to examine relationships between constructs, chi-square tests with Cramer's V to assess associations between hotel features and energy costs, and Partial Least Squares Structural Equation Modelling (PLS-SEM) to evaluate causal effects between constructs, including measurement model evaluation (reliability, convergent validity, discriminant validity) and structural model assessment (path coefficients,  $R^2$ , effect sizes, predictive relevance). Qualitative Analysis: Interview data were analysed interpretively by comparing hotel energy use intensities, design efficiency, and appliance efficiency against documented benchmarks, including the Nigerian Building Energy Efficiency Guidelines, CIBSE Guide F, Energy Consumption Guide 36, and existing building evaluation standards. The study adhered to four ethical principles: truthfulness, thoroughness, objectivity, and relevance. Respondents participated voluntarily with assured confidentiality, and all data were used solely for research purposes.

### **3. RESULTS**

This chapter outlines the data collection process and analysis results, providing insights into the response rate from a questionnaire administration. A total of 480 questionnaires were distributed, achieving a retrieval rate of 88.3% or 424 responses, while 56 were discarded due to incomplete responses or the presence of univariate and multivariate outliers. Specifically, questionnaires deemed incomplete had less than 50% of responses filled, making them unsuitable for analysis. Nevertheless, questionnaires with a few unanswered items were included, with missing values addressed using the mean method from SPSS software, resulting in 407 valid responses (84.8%) for analysis. The high response rate was facilitated by the involvement of lower-level staff in the collection process. Furthermore, statistical normality tests crucial for factor analysis were conducted, utilising skewness and kurtosis criteria which should not exceed  $\pm 2$  for a normal distribution. All values reported in Appendix D fell within this acceptable range. The reliability of the questionnaire was assessed through Cronbach's alpha, producing a maximum value of 0.920 and a minimum of 0.706, indicating satisfactory reliability across constructs, as benchmarks suggest values above 0.7 are acceptable.

#### **3.1 Presentation of Results**

Demographic profiles from a study on the hotel sector in Abuja, Nigeria, highlighted that 407 cases were presented post-screening. The gender distribution showed 78% males and 22% females among respondents. Educationally, 33% possessed less than a first degree or Higher National Diploma (HND), while 67% held an HND or degree and above. Management Staff made up over 68% of respondents, with Technical Staff at 28% and Auxiliary Staff at 4%. Hotel categorisation indicated that 21% were below a 3 Star rating and 79% above it. Regarding hotel features, about 60% were aged 1 to 15 years, with 54% having floor areas exceeding 5,001 m<sup>2</sup>. Most hotels (over 96%) had 1 to 20 floors and over half had 1 to 150 rooms, with 55% facing East-West and Cross-Nodal orientations—considered more energy-efficient. Approximately 65% of the hotels utilised a compact building design, favourable for passive energy strategies suited to the region's hot, dry climate.



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Operationally, more than 70% recorded occupancy of at least 301 guests weekly, and over 201 staff members were employed, illustrating Abuja's appeal due to significant governmental activities. However, fluctuating guest numbers complicated accurate energy consumption measurements. Renovation practices revealed that about 62% of hotels are renovated every 4-6 years, with 89.2% upgrading engineering systems every 5-10 years, raising concerns over maintenance culture and its effects on energy efficiency. The literature points to a relationship between maintenance practices and energy usage, emphasising that operational attributes heavily influence energy consumption. Service offerings prioritised accommodation, restaurant, internet, and laundry services, while leisure and shopping facilities were less available, with electricity-heated swimming pools being the least common service provided.

The analysis of mean ranking results for ten hotel services indicates that accommodation is the most commonly provided service, with a mean score of 4.8790, while electricity-warmed swimming pools ranked the lowest at 2.2102. This finding corroborates previous studies that position accommodation as the primary offering, while services like restaurants (4.6879), internet (4.3439), and laundry (4.2420) fall under ancillary services. Conversely, outdoor catering (3.3567) and shopping centres (3.3885) were among the least provided, highlighting significant gaps in recreational and shopping facilities noted in earlier research.

Regarding energy resources, the study identifies grid-supplied electricity, diesel, and gas as the main sources, whereas petrol and renewable resources are the least utilised. Water heating and air-conditioning emerge as the largest energy consumers, with mean scores of 4.7898 for electricity and 4.6095 for diesel, respectively. The preference for electricity, which has a high mean ranking of 4.8662, mirrors the substantial infrastructure reliance in Abuja despite supply shortages. Diesel, noted as the second most utilised energy source at 4.2293, serves primarily in backup generation, diverging from other studies that ranked gas higher. Gas contributes minimally at about 8% of total energy consumption, mainly for cooking, while renewable resources show a low mean usage of 1.2803, attributed to high costs and long payback periods.

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The study's findings indicate that water heating demand is unexpectedly high, likely influenced by guest control over water heating systems, differing from prior research by Shimming and Burnett (2002) that emphasised air-conditioning as the major energy consumer. Ventilation recorded the least energy consumption (2.9371 for electricity and 2.9749 for diesel), facilitated by the use of fans alongside air-conditioning. Additionally, lighting and electronics ranked fifth and sixth in energy consumption, primarily due to the adoption of energy-efficient systems, aligning with findings from Bohdanowicz (2006) and Hotel Energy Solutions (2011), where significant percentages of hotels implemented energy-efficient practices.

Correlation analysis unveiled significant relationships among hotel service provision, design efficiency, responsiveness, energy management strategies, and hoteliers' perceptions of sustainable energy management (SEM). A strong correlation ( $r=.736$ ) was found between design efficiency, responsiveness and energy management strategies, with substantial connections to hoteliers' perceptions of SEM and its barriers and benefits ( $r=.601$ ,  $.537$ , and  $.535$ , respectively). Moderate correlations existed between hotel service provision and design responsiveness, energy management strategy, and perceptions of significance ( $r=.488$ ,  $.416$ , and  $.442$ ). However, weak correlations were found between service provision and barriers, alongside negligible correlations with the benefits of SEM and design efficiency responsiveness.

The study outcomes for research objective two indicate a positive relationship among various constructs, notably between design efficiency, responsiveness, energy management strategies, and hoteliers' perceptions of sustainable energy management. It emphasises that energy-efficient building design aligns with a systematic action plan driven by hoteliers' perspectives, supporting Shimming and Burnett's (2002) findings that effective environmental management should be integrated into hotel management systems. Chi-square tests revealed significant links between hotel characteristics and energy costs, finding a moderate relationship between electricity consumption and attributes like age, gross floor area, number of floors, and room count, while observing weaker associations with building orientation.

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For diesel consumption, stronger correlations were identified with gross floor area and room number, with moderate ties to age and number of floors. In contrast, petrol consumption demonstrated generally weak associations across the features.

Gas consumption showed strong connections to gross floor area and room count, with moderate ties to the number of floors. Moderate correlations were also found between average monthly energy costs and factors such as hotel age and size. Operational features strongly impacted energy costs, particularly regarding electricity and diesel consumption in relation to occupancy levels, employee counts, and renovation frequencies. The analysis concludes that hotel characteristics significantly influence energy consumption and costs, with noted weak connections to building orientation and plan form, confirming previous studies suggesting energy-efficient design can optimise consumption.

Furthermore, weak correlations for petrol consumption suggest limited usage as an energy source, while strong links between gas consumption and hotel occupancy reflect the relationship between guest volumes and meal provisions. The study endorses findings from Deng and Burnett (2002) and Priyadarsini et al. (2009), which highlighted food coverage's role in gas consumption, and the factor loadings indicate that manifest variables correlate more strongly with their respective constructs than with others in the study.

### **3.2 Evaluation of Structural Model**

Figures 5 and 6 show the final model of the research, which depicts both the direct and indirect effects of the exogenous constructs on the Hotel energy cost. The exogenous constructs jointly explained about 53.1 % of the variation in hotel energy cost ( $R^2=0.531$ ). Similarly, the exogenous constructs, Energy Mgt. Strategies, Service Provision, hotelier's perception on barriers of sustainable energy management, Hotelier's Perception on Importance of Sustainable energy management, hotelier's perception on benefits of sustainable energy management explained about 48 % and 20 % of the variance in appliances energy efficiency and hotel energy use profile, respectively.

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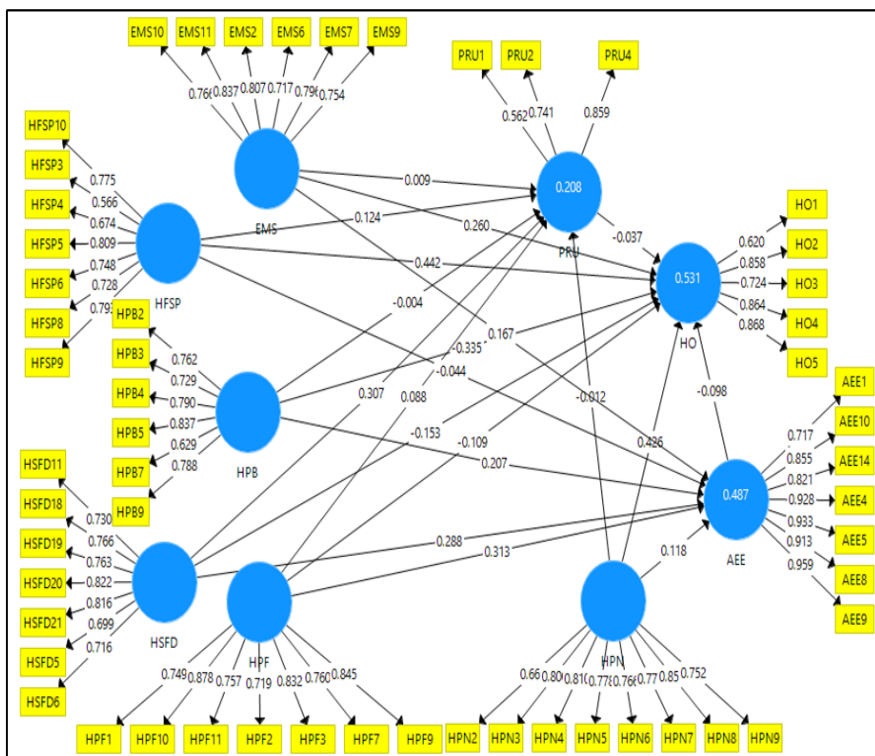


Figure 5. Research's Final Model

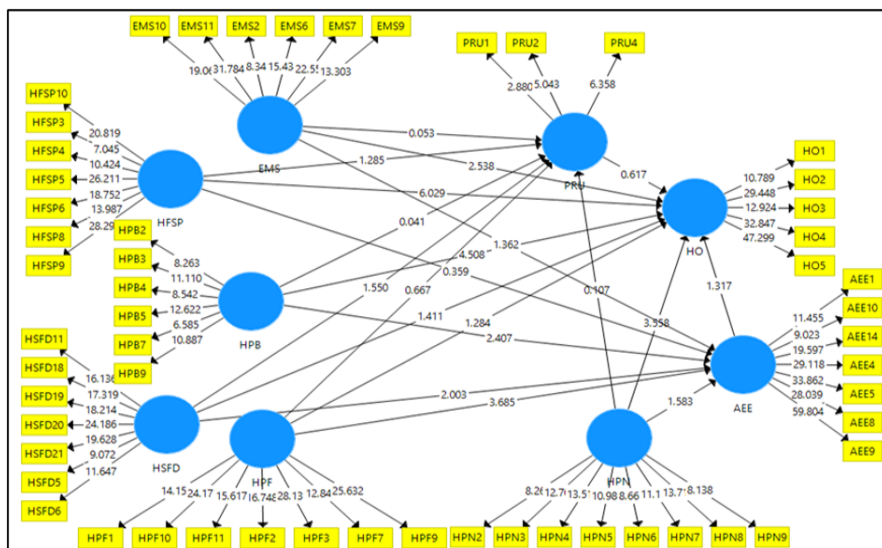


Figure 6. T-statistics

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The individual effect of the exogenous constructs on the endogenous constructs is presented in Table 1.

**Table 1.** Final Model's T-Statistics

Endogenous	Paths	Coefficients	S-Error	T-value	P-value	Remark
<b>Hotel energy cost</b>	HFSP → HO	0.442	0.073	6.029	0.000	Significant
	HPB → HO	-0.335	0.074	4.508	0.000	Significant
	HPN → HO	0.426	0.120	3.558	0.000	Significant
	EMS → HO	0.260	0.102	2.538	0.011	Significant
	HSFD → HO	-0.153	0.108	1.411	0.158	Insignificant
	AEE → HO	-0.098	0.074	1.317	0.188	Insignificant
	HPF → HO	-0.109	0.085	1.284	0.199	Insignificant
	PRU → HO	-0.037	0.060	0.617	0.537	Insignificant
<b>Appliances Energy Efficiency</b>	HPF → AEE	0.313	0.085	3.685	0.000	Significant
	HPB → AEE	0.207	0.086	2.407	0.016	Significant
	HSFD → AEE	0.288	0.144	2.003	0.045	Significant
	HPN → AEE	0.118	0.074	1.583	0.114	Insignificant
	EMS → AEE	0.167	0.123	1.362	0.173	Insignificant
	HFSP → AEE	-0.044	0.122	0.359	0.719	Insignificant
<b>Hotel energy Use profile</b>	HSFD → PRU	0.307	0.198	1.550	0.121	Insignificant
	HFSP → PRU	0.124	0.096	1.285	0.199	Insignificant
	HPF → PRU	0.088	0.132	0.667	0.505	Insignificant
	HPN → PRU	-0.012	0.113	0.107	0.915	Insignificant
	EMS → PRU	0.009	0.169	0.053	0.958	Insignificant
	HPB → PRU	-0.004	0.086	0.041	0.968	Insignificant

The main endogenous construct of the research, hotel energy cost, is influenced by 4 exogenous constructs (Table 1). The result shows that hotel service provision ( $\beta=.442$ ,  $t\text{-value}= 6.028$ ,  $P=.000$ ), hotelier's perception on barriers of sustainable energy management ( $\beta=-.335$ ,  $t\text{-value}= 4.508$ ,  $P=.000$ ), hotelier's perception on benefits of sustainable energy management ( $\beta=.426$ ,  $t\text{-value}= 3.558$ ,  $P=.000$ ), and Energy Mgt. Strategies ( $\beta=.260$ ,  $t\text{-value}= 2.538$ ,  $P=.011$ ) have a significant causal effect on hotel energy cost. Hotel service provision has the strongest influence on hotel energy cost, as indicated by the highest standardised coefficient, followed by hoteliers' perception of sustainable energy management.

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However, the relationship between hoteliers' perception of barriers to sustainable energy management and hotel energy cost is negative, indicated by a path coefficient of -0.335. This means that any 1-unit improvement in hoteliers' perception of sustainable energy management causes hotel energy cost to decrease by 0.335 units. The construct with the least significant effect on hotel energy cost is Energy Mgt. Strategies that are preceded by the hotelier's perception of the benefits of sustainable energy management.

Apart from hotel service provision, hoteliers' perception on barriers of sustainable energy management, hoteliers' perception on benefits of sustainable energy management, and Energy Mgt. Strategies; the other exogenous constructs do not have a significant effect on hotel energy cost. Design efficiency responsiveness ( $\beta = -.153$ ,  $t\text{-value} = 1.411$ ,  $P = .158$ ), appliances energy efficiency ( $\beta = -.098$ ,  $t\text{-value} = 1.317$ ,  $P = .188$ ), Hotelier's Perception on Importance of Sustainable energy management ( $\beta = -.109$ ,  $t\text{-value} = 1.284$ ,  $P = .199$ ), and hotel energy use profile ( $\beta = -.037$ ,  $t\text{-value} = .617$ ,  $P = .537$ ) have  $t$ -values and  $p$ -values below the recommended minimum of 1.96 and above the recommended maximum of 0.05 respectively.

Appliances' energy efficiency, as an endogenous variable, is conceptualised to be influenced by energy management strategies, hotel service provision, hotelier's perception on barriers of sustainable energy management, hotelier's Perception on the importance of Sustainable energy management, hotelier's perception on the benefits of sustainable energy management, and design efficiency responsiveness. Out of these exogenous constructs, Hotelier's Perception on Importance of Sustainable energy management ( $\beta = .313$ ,  $t\text{-value} = 3.685$ ,  $P = .000$ ), hotelier's perception on barriers of sustainable energy management ( $\beta = .207$ ,  $t\text{-value} = 2.407$ ,  $P = .016$ ), and design efficiency responsiveness ( $\beta = .288$ ,  $t\text{-value} = 2.003$ ,  $P = .045$ ) were found to have a significant causal effect on appliances' energy efficiency. However, Energy Mgt. Strategies, hotel service provision, and hoteliers' perception of the benefits of sustainable energy management do not have a significant causal effect on appliance energy efficiency as indicated by  $t$ -values and  $p$ -values below the recommended minimum of 1.96 and above the recommended maximum of 0.05, respectively.

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Hotel energy use profile, as an endogenous construct, is conceptualised to be influenced by Energy management Strategies, hotel service provision, hoteliers' perception of barriers to sustainable energy management, hotelier's Perception on Importance of Sustainable energy management, hoteliers' perception of the benefits of sustainable energy management, and design efficiency responsiveness. However, none of the exogenous constructs was found to have a significant causal effect on hotel energy use profile as indicated by t-values and p-values below the recommended minimum of 1.96 and above the recommended maximum of 0.05, respectively.

### **4. SUMMARY OF FINDINGS**

Based on the outlined research objectives, the study has the following summary of findings. The hotels in the study area have divergent physical and operational characteristics, implying varying energy consumption and efficiency positions. Although the findings show a fairly favourable energy-efficient hotel features, there are indications related to such features pointing towards energy leakages and prodigal use of energy, as proven by the high energy use intensity of the hotels. The services provided by hotels were found to be limited to core hotel services, and no extra energy-consuming services were provided, which justifies the huge amount of energy consumed with attendant immense energy costs. Predominantly, three types of energy resources are consumed by hotels in the study area. These are grid-supplied electricity, diesel and cooking gas.

The study also determines that the utilisation of grid-supplied electricity and diesel, which closely compete, is because diesel is widely used for powering generators as an alternative source to supplement the grid electricity supply deficit. The usage of renewable energy by hotels in the study area, which is concluded to be negligible, indicates the poor combination of energy resources consumed with regard to sustainability bottom lines. Moreover, diesel, a fossil fuel, closely competes with grid-supplied electricity in terms of wide utilisation despite the inauspicious environmental and cost implications, negating the motives of sustainability.

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Water heating and air-conditioning are the high-ranking energy-consuming end-uses concerning grid-supplied electricity and diesel consumption, implying profligate use of energy and the hot tropical climate of the study area as explanatory factors for the duo situation.

Furthermore, a varying degree of relationship was determined between the hotel service provision, design responsiveness, energy management strategies and hoteliers' perception on sustainable energy management (SEM) in the study area, indicating the level of interaction, role and relative importance assigned to each study construct by hotels in the study area. Design efficiency, responsiveness, energy management strategies, and hoteliers' perception on importance, barriers and benefits of sustainable energy management are principal determinants of hotel energy sustainability.

In addition, a divergent degree of relationship between both hotel physical and operational features, as well as various energy resources consumed by the hotels, and their attendant costs in the study area. Hotel age, gross floor area, number of floors and number of rooms among the building features are strongly related to hotel energy costs. Economies of scale apply to entire hotel operational features (occupancy level, number of employees, frequency of renovation), in relation to hotel energy costs.

The study also unveils that hotel energy management strategy, service provision, design responsiveness and hoteliers' perception influence on appliances energy efficiency is 49.6%, demonstrating that they collectively influence appliances energy efficiency. However, there are varying individual levels of effect significance. While hoteliers' perceptions on both barriers and the importance of Sustainable energy management, as well as design efficiency responsiveness, exhibit a significant causal effect on appliances' energy efficiency, hotel energy management strategies, service provision, and hoteliers' perceptions on the benefits of sustainable energy management were found not to have a significant effect on appliances' energy efficiency.

Apparently, a variety of energy resources were used by hotels in the study area to meet the demands for various set of services they provide. Nonetheless, assessing the effect of hotel energy management strategy, service provision, design efficiency, responsiveness and hoteliers' perception unveiled that they jointly influence hotel energy use profile by about 25.4 %.



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However, only design responsiveness demonstrates a significant causal effect on hotel energy use profile, while Hotel Energy management Strategies, service provision, hotelier's perception on barriers, importance and benefits of sustainable energy management were also found not to have a significant effect on hotel energy use profile.

Moreover, considering the significance of sustainable energy management in reducing energy costs, improved profitability and competitiveness of the hotels, as well as environmental friendliness, prompts assessing the effect of hotel energy management strategy, service provision, design responsiveness, energy use profile, appliances energy efficiency, and hoteliers' perception of sustainable energy management on hotel energy costs in the study area. This uncovers that they collectively influence hotel energy cost by about 59.1 %. However, they exhibit varying individual degrees of influence on hotel energy costs.

Although energy management strategies, hotel service provision, and hoteliers' perception of barriers to sustainable energy management proved to have a significant causal effect on hotel energy cost, the effects of appliances' energy efficiency, hoteliers' perception of the importance of sustainable energy management, and design responsiveness on hotel energy cost were found not to be significant.

### **CONCLUSION**

About the research findings, the study concludes that achieving sustainable development in the hotel industry requires efficient and objective energy management that considers the three sets of equally important (environmental, economic and social) conceptual pillars of sustainability. The study also elucidated the contextual hotel energy management in the study area and resolved the existence of energy leakages and wasteful consumption of energy evident in the established high energy intensities with attendant high operating costs. To overcome these challenges and encourage the accomplishment of the economic goal of sustainability, which encourages economic prosperity, the hotels need to redeploy effective energy management strategies proven to have cost-reducing effects.

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Moreover, the study also evidenced an inadequate combination of energy resources consumed, making up the hotel energy use profile in support of particularly environmental and economic realms of sustainability. This is apparent in the intense utilisation of diesel, a fossil fuel proven to be costly and environmentally unfriendly. Thus, the study emphasises the need for harnessing the endowed renewable resources to subdue the ills of fossil resources used and achieve the environmental goal of sustainability. Hotelier's perception is also concluded to influence design efficiency responsiveness, hotel features, appliances and energy use profile, thus seeking their enhancement to achieve environmental objectives and bring benefits in the form of savings, profits and a pollution-free environment while extensively imparts the growth of the local economy and accomplishes the social goal of sustainability.

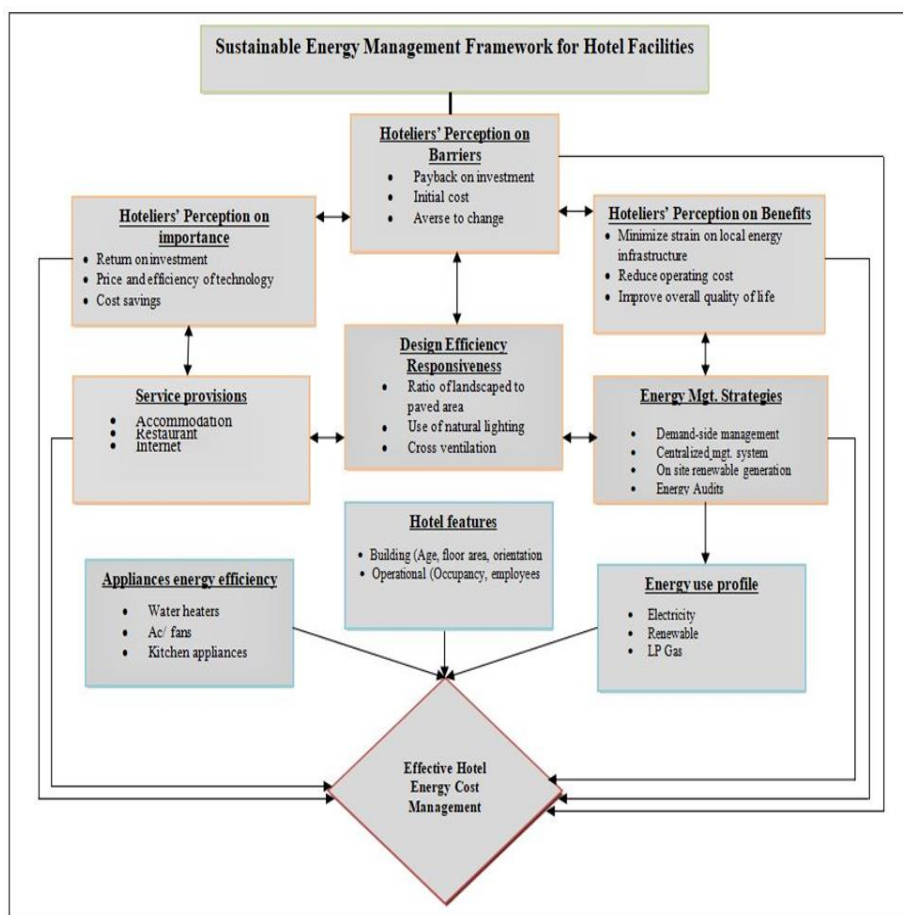
The study also resolved that a varying degree of relationship exists between hotel service provision, design efficiency, responsiveness, energy management strategies and hoteliers' perception of sustainable energy management. Furthermore, the study uncovers that hotel energy management strategy, design efficiency responsiveness, energy use profile, appliances energy efficiency, and hoteliers' perception of sustainable energy management collectively influence the hotel energy cost. This demonstrates the need for attaching the deserved significance to these factors, which assures not only attaining the tripartite goals of sustainability but also the benefits derivable from the mutual reinforcement of any two of the three-way pillars. This includes business ethics and fair trade from social and economic dimensions, prosperous green technology encouraged by subsidies and incentives from environmental and economic dimensions, as well as improved conservation policies and environmental justice from social and environmental dimensions.

The framework suggested the relevant indicators for achieving sustainable energy management in hotel facilities. The framework pointed out the existence of a relationship between hoteliers' perception of the importance of SEM, especially in areas such as return on investment, price and efficiency of technology and cost savings, with hoteliers' perception of barriers to SEM such as payback on investment, initial costs and aversion to change. Moreover, both hoteliers' perceptions of importance and barriers have a relationship with perception on benefits of SEM.

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## *Recommended Framework for Sustainable Energy Management in Hotel Facilities*

The main aim of this research work is to develop a framework for sustainable energy management of the hotel facilities in Abuja, Nigeria. The conceptualised framework of the study, as demonstrated in Figure 7, the assessment of the research construct, as well as the accompanying research findings, provides an insight into the hotel energy management situation in the study area. Based on the established research findings, a sustainable energy management framework was recommended.



**Figure 7.** Proposed Framework for Sustainable Energy Management in Hotel Facilities

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The major benefits to hoteliers include minimising strain on local energy infrastructure, reducing operating costs and improving overall quality of life. Nevertheless, the framework also suggests that hoteliers' perception collectively relates to design efficiency, responsiveness, service provision and energy management strategies of the hotels. This implies that hoteliers' perception of barriers, importance and benefits of SEM are related to design efficiency, responsiveness, service provision and energy management strategies in the hotels. Hence, improvement or change in hoteliers' perception on barriers, importance and benefits of SEM are vital for an improved energy management strategy, design efficiency, responsiveness and service provisions that ensure sustainable energy management in the hotel facilities.

In addition, the framework also explains the relevance of hoteliers' perception for effective hotel energy cost. The research findings detect that hoteliers' perception influences the effectiveness of hotel energy cost management. In the same vein, energy management strategies employed (such as demand-side management, centralised management system and energy audits), as well as a variety of services provided in the hotels (such as accommodation types and restaurant services), determine the effectiveness of hotel energy cost management. Therefore, advancing on such strategies and services can improve the energy cost effectiveness in the hotel industry. Moreover, the energy efficiency of appliances, hotel physical and operational features were also found to have a significant influence on the effectiveness of energy cost in the hotels. Therefore, it is imperative to make conscious decisions regarding hotel building plan form, orientation, and floor area from the design stage for their potential in eventually influencing the effectiveness of the hotel's energy costs. Nevertheless, frequency of renovations, occupancy rate and number of employees should also be well-monitored.

Furthermore, the proposed framework also suggests that emphasis should be placed on the combination of energy resources that make up the hotel energy use profile for effective energy costs and environmental friendliness. The suggestion is supported by the research findings, which indicate hotels' intense utilisation of diesel among the main sources of energy used, which is both costly and unsustainable.

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The framework further suggests harnessing the endowed renewable resources in supplementing the grid supply of electricity shortages, and utilising more sustainable cooking fuels (such as biofuels) for cost-effectiveness and sustainability.

Decisively, therefore, for hotels to achieve sustainable energy management, hoteliers' positive perception of the concept remains critical (in terms of its barriers, importance and benefits). This, in addition to securing effective energy management strategies, services, efficient responsive design and efficient appliances, as well as hotel features and energy use profile that ensures environmental friendliness and cost savings.

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ARCHITECTURE*

**REFERENCES**

- Ajayi, O. O. (2010). The Potential for Wind Energy in Nigeria. *Wind Engineering Journal*, 34(3), 303– 311. <https://doi.org/10.1260/0309-524X.34.3.303>
- Akindele O.A. & Adejumobi D.O. (2017). Domestic electric generator usage and residents' livability milieu in Ogbomosho. *Nigeria Environmental Management and Sustainable Development Journal*, 6(1), 91-104. <http://emsd.macrothink.org>
- Alexander, K. (2002). A strategy for facilities management. *Facilities*, 20(3/4), 63–74.
- Batagarawa Amina. (2013). Assessing the thermal performance of phase change materials in composite hot humid/hot dry climates: An examination of office buildings in Abuja, Nigeria. Unpublished PhD Thesis (Newcastle University) 1-353.
- Bodach, S., Lang, W. & Auer, T. (2016) Design Guidelines for energy- efficient hotels in Nepal. *International Journal of Sustainable Built Environment*. 5(2016) 411-434.
- Bohdanowicz, P. (2006). Responsible Resource Management in Hotels: Attitudes, Indicators, Tools and Strategies. Unpublished PhD Thesis, Royal Institute of Technology, Stockholm.
- Bohdanowicz, P., Churie-kallhauge, A., Martinac, I., & Rezachek, D. (2001). Energy-Efficiency and Conservation in Hotels – Towards Sustainable Tourism. In *Proceedings of 4th International Symposium on Asia Pacific Architecture*, University of Hawaii (Manoa), 1-12.
- Burkhard, B. J., & Kadakia, R. (2010). Energy Efficiency in Buildings. World Business Council for Sustainable Development, 1–38.
- Chan, W. (2012). International Journal of Hospitality Management Energy benchmarking in support of low-carbon hotels: Developments, challenges, and approaches in China. *International Journal of Hospitality Management*, 31(4), 1130–1142. <https://doi.org/10.1016/j.ijhm>.
- Chan, W. W., Wong, K. F., & Lo, J. J. (2003). Hotel energy consumption in Hong Kong. *International Journal of Contemporary Hospitality Management*, 15(6), 322–326.

## *SUSTAINABLE STRATEGIES IN THE BUILT ENVIRONMENT AND ARCHITECTURE*

- Chung, M., & Park, H. (2015). Comparison of building energy demand for hotels, hospitals, and offices in Korea. *Energy and Buildings*, 92, 383–393. <https://doi.org/10.1016/j.energy.2015.04.016>
- CIBSE Guide F. Energy efficiency in buildings. Chartered Institution of Building Services Engineers.
- Collaborative Labelling and Appliances Standards Programme (CLASP). General guides for achieving better energy efficiency in hotel buildings.
- Dascalaki, E., & Balaras, C. (2007). XENIOS—a methodology for assessing refurbishment scenarios and the potential of renewable energy sources and energy conservation in hotels. *Energy and Buildings*, 36(11), 1095–1105.
- Deng, S. (2005). Energy use and management in hotels.
- Deng, S., Burnett, J., 2002. Energy use and management in hotels in Hong Kong. *International. Journal of Hospitality Management*. 21, 371–380.
- Energy Consumption Guide 36. Energy efficiency in hotels.
- Federal Ministry of Power, W. and H. (2016). Building Energy Efficiency Guideline for Nigeria (No. 1). Abuja, Nigeria.
- Felix, C. (2014). The Relationship between Hotel Rating and Customer Outcomes: Customer Perceived Service Quality and Customer Satisfaction. *Greener Journal of Business and Management Studies*, 4 (4)146-152.
- Goldstein, K., & Primlani, R. V. (2012). Current trends and opportunities in hotel sustainability. HVS Sustainability Services, (February), 9 369, Willis Avenue Mineola, NY USA. Retrieved from <http://www.hvs.com/article/5655/current-trends-and-opportunities-in-hotel-sustainability/>.
- Good governance initiative (2014). Report on health hazards related to generator fumes and explosions in Nigeria.
- Hotel Energy Solutions. (2011). Best practices guide; Successful energy efficient technologies integration in SME hotels. Hotel Energy Solutions project publications.
- Hui, S. C. M., & Wan, M. C. W. (2013). Study of hotel energy performance using data envelopment analysis. 12th International Conference on Sustainable Energy Technologies (SET-2013), Hong Kong.

## *SUSTAINABLE STRATEGIES IN THE BUILT ENVIRONMENT AND ARCHITECTURE*

- IEA, & World Bank. (2015). Progress toward Sustainable Energy 2015: Global Tracking Framework Report. [https://doi.org/10.1596/978-1-4648 -0690-2](https://doi.org/10.1596/978-1-4648-0690-2)
- International Environment Initiative (1993). Good operational practices for better energy efficiency promoted by hotel professional's association.
- Järvensivu, J. (2014). Environmental Sustainability in Hotel Facilities a Case Study: Original Sokos Hotel Villa. Unpublished Thesis (JAMK University). Pp 1-49.
- Kapiki, S. T. (2012). Implementing Sustainable Practices in Greek Eco-friendly Hotels. *Journal of Environmental Protection and Ecology*, 13(2A), 1117–1123.
- Kasim, A. (2007). Towards a Wider Adoption of Environmental Responsibility in the Hotel Sector. *International Journal of Hospitality & Tourism Administration*, 8(2), 25–49.
- Kirk, D. (1995). Environmental Management in Hotels. *International Journal of Contemporary Hospitality Management*, 7(6), 3–8.
- Kirk, D. (2008). Environmental management in the hospitality industry.
- Lai, J. H. K. (2016). International Journal of Hospitality Management Energy use and maintenance costs of upmarket hotels. *International Journal of Hospitality Management*, 56, 33–43.
- Martinac, I., et al. (2008). Energy and water consumptions in European hotels.
- Melissen, F., Ginneken, R. Van, & Wood, R. C. (2016). International Journal of Hospitality Management Sustainability challenges and opportunities arising from the owner-operator split in hotels. *International Journal of Hospitality Management*, 54, 35–42.
- Mendes, J., & Santos, I. (2014). Energy Management in Four and Five-Star Hotels in Algarve (Portugal) *Turizam Journal*, 18(3), 95–112.
- Mensah, I. (2006). Environmental Management Practices among Hotels in the Greater Accra Region. *International Journal of Hospitality Management*, 25(3), 414–431.
- Michaelis Karagiorgas, Theocharis Tsoutsos, A. Moia-Pol (2007). A simulation of the energy consumption monitoring in Mediterranean hotels: application in Greece, *Energy Build.* 39 (4) 416–426.



## *SUSTAINABLE STRATEGIES IN THE BUILT ENVIRONMENT AND ARCHITECTURE*

- Moia, Cladera and Rossello (2010). Energy management in the hospitality industry.
- Mosgaard, M., et al. (2016). Studies on hotel energy management in developed and stabilized economies.
- Muazu, A. I. (2012) Scenario of office buildings energy consumption in Abuja. *International Journal of Science and Advanced Technology* (ISSN 2221-8386) Volume 2 (9), 32-41.
- Musango, J. K., & Brent, A. C. (2011). A conceptual framework for energy technology sustainability assessment.
- Nadabo (2010). Nigeria's economic vision 20:20:20 targets for clean development mechanism (CDM) status.
- Nasiru, et al. (2013). Impact of service quality on the popularity of Nigerian hotels..
- National Electricity Regulatory Commission (NERC) (2010). Estimate of annual expenditure on generator fuel in Nigeria.
- Neves, A. R., & Leal, V. (2010). Energy sustainability indicators for local energy planning: Review of current practices and derivation of a new framework. *Renewable and Sustainable Energy Reviews*, 14(9), 2723–2735. <https://doi.org/10.1016/j.rser.2010.07.067>
- Nižic, M. K., & Bracic, M. (2014). Effective Use of Resources in Tourist Facilities - Focus on Energy Efficiency. *Tourism and Hospitality Industry 2014, Congress proceedings Trend in Tourism and Hospitality Industry*, 39, 147–160.
- Oluloye, et al. (2012). Energy challenges in the Nigerian hospitality industry.
- Oluseyi, P. O., Babatunde, O. M., & Babatunde, O. A. (2016). Assessment of energy consumption and carbon footprint from the hotel sector within Lagos, Nigeria. *Energy & Buildings*, 118, 106–113. <https://doi.org/10.1016/j.enbuild.2016.02.046>
- Phillips, P. A. (1999). A multidimensional contingency framework of hotel performance.
- Priyadarsini, R., Xuchao, W., & Eang, L. S. (2009). A study on energy performance of hotel buildings in Singapore. *Energy and Buildings*, 41(10), 1093–1101.

## *SUSTAINABLE STRATEGIES IN THE BUILT ENVIRONMENT AND ARCHITECTURE*

- Shiming, D., & Burnett, J. (2002). Energy use and management in hotels in Hong Kong. *International Journal of Hospitality Management*, 21(2), 167–180.
- Sun, Z., & Liu, S. (2007). Sustainable energy management in developed economies.
- Swan, L. G., & Ugursal, V. I. (2008). Top-down and bottom-up modelling techniques for estimating regional or national residential energy consumption.
- Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics* (4th ed.). Needham Heights, MA: Allyn & Bacon.
- Ujoh, F., D. I., & Ifatimehin, O. O. (2010). Understanding urban sprawl in the Federal Capital City, Abuja: Towards sustainable urbanization in Nigeria, *Journal of Geography and Regional Planning* 3(5), 106-113.
- UNDP. (2015). Environmental and social benefits of energy efficiency | UNDP in Armenia. UNDP in Armenia. UNDP Project Publications.
- UNDP-GEF (2012). National energy efficiency program and demand-side management (DSM) initiative in Nigeria.
- Xu, P., Chan, E. H. W., Visscher, H. J., Zhang, X., & Wu, Z. (2015). Sustainable building energy efficiency retrofit for hotel buildings using EPC mechanism in China: analytic Network Process (ANP) approach. *Journal of Cleaner Production*, 107, 378–388.
- Zaiton, et al. (2012). Sustainable energy management as a tool for optimising performance.
- Zangeni, et al. (2014). Sustainability goals in the hospitality industry.
- Zengeni, N., Zengeni, D. M. F., & Muzambi, S. (2013). Hoteliers' perceptions of the impacts of green tourism on hotel operating costs in Zimbabwe: The case of selected Harare hotels. *Australian Journal of Business and Management Research*, 2(11), 64–73.



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