

The Impact of Energy Efficiency in the Design of a Convention Center in Port Harcourt

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ABSTRACT-The impact of energy efficiency in the design of convention center. The convention center is a place or a building designed for the purposes of convention, seminars, lectures, conferencing etc. The center brings delegates from different part of the country and the world at large to share common interest and ideas towards development, therefore, there is need to design a convention center that will be energy efficient. To achieve this objectives the author or researcher will explore the objectives such as the occupant health; using energy, water, and other resources more efficiently, and reducing the overall impact to the environment. In Rivers state, Nigeria today, most centers are constructed in the conventional ways, thereby using more energy which contributes to the greenhouse gas. The building sector alone represents about 35% energy consumption. Realizing the situation, the need of the day is to adopt sustainable green building design approach which is the ultimate solution to reduce the energy demand of the building. Over usage of conventional building materials not only cause global warming but also affects the natural resources. Green or sustainable building use key resources like energy, water, materials, and land more efficiently than buildings that are just built conventionally. A study has been undertaken for the newly constructed and existing buildings in order to assess its potential and capacity to save energy. This thesis report, thus deals with the various energy saving concepts which can be incorporated at the time of planning, designing, construction and execution stage to have energy efficiency in the convention center, keeping in mind the cost perspective. In this thesis report, the author or researcher will be exploring environment friendly innovative technologies like energy efficient materials, intelligent gadgets, energy efficient doors and windows, solar water heating and generating power, rain water harvesting, reflect sol glass for windows openings in the auditoriums, multipurpose hall to enhance indoor air quality and temperatures, use of colored lime plaster; to enhance a sustainable appearance on the walls of the building, eco-friendly tile on the floor of the auditorium and other parts the convention center and the use of solar water pump etc. consequently, all these parameters or measures will create a conducive and comfortable eco-friendly environment for delegates and visitors that are national and international. This research utilized combined techniques in a critical thinking approach. For data collection, combined methods were used. This involved a review of architectural antecedents which included review of documented projects and actual site visits to existing related projects. Qualitative methods which involved literature reviews. Secondly, the collected data was analyzed against recommended and recognized architectural design standards established by the Neuferts' Architectural Data and Time Savers Standards. Case studies were conducted that helped broaden the knowledge on convention center design. Accessibility, flexibility, and aesthetics are common themes in all case studies. Experimental design methods were also used in achieving research recommendations.

Index Terms - Convention, Center, Energy Efficiency, impact, design

1.0 INTRODUCTION

A convention Centre is a large building that is designed to hold a convention, where individuals and groups gather to promote and share common interests. Convention centers typically offer sufficient floor area to accommodate several thousand attendees. Very large venues, suitable for major trade shows, they are sometimes known as exhibition centers. (Cambridge Dictionaries, 2015)

Convention centers typically have at least one auditorium and may also contain bon

Concert halls, lecture halls, meeting rooms, and conference rooms. Some large resort area hotels include a convention center. (Cambridge Dictionaries, 2015)

Convention is bringing together, for the purpose of discussion and sometimes decision, of representatives of sovereign states or of delegates of all sorts of bodies and societies (Lawson, 1981) . Convention are sometimes classified political or bargaining and non-political;

legislative diplomatic and technical; and periodic and ad hoc. Non-political convention is subdivided into administrative, economic, humanitarian, social, communications, scientific, educational, and cultural. Legislative, if they result in the development of Law, and diplomatic/technical depending on whether attended by diplomats/technical experts. Such classifications are of relative value as some conferences, notably peace conferences, embrace a wide range of objectives and include diplomatic along with technical representatives. (Lawson, 1981)

A convention center is a building or group of buildings designed, in most cases, for the purpose of conducting meetings, rallies, or seminars. It may also be adapted for specific events, such as appearances by well-known speakers or musicians. In some cases, meetings or other events take place in centers or buildings not specifically designed for conventions, but large enough to accommodate attendees. (Bhandari, 2005)

1.1 Aim And Objectives Of The Study

This research aim is to explore the impact of energy efficiency in the design of a convention center, in as much as employing the application of sustainable materials that are energy saving to create a comfortable and conducive atmosphere, therefore placing Port Harcourt favorably to enjoy the benefits of MICE tourism by improving its capacity to hold medium to large-Scale international

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meetings, conferences, exhibitions. This ultimately will involve creating a landmark through unique architectural design that will attract people to visit from different cities and countries to attend meetings, conferences, exhibitions and events in Port Harcourt, Rivers State. To achieve the above aim, below are the specific objectives of the project;

- To create a place for social and cultural gathering.
- To create a venue for exhibition and interaction.
- To create interactive spaces and landscaping to generate public interest.
- To create a landmark through contemporary architectural features.
- To explore how it proves beneficial for urban growth.

2.0 LITERATURE REVIEW

2.1 Convention Center Facilities; an Overview

Convention centers and Exhibition spaces evolved from the open-air amphitheaters of the Greek Agoras and Roman Forums, which were initially intended for large commercial fair. The first convention centers can be traced back to mid-19th century Britain. Commonly known as exhibition halls, the centers were designed to bring together people to discuss and explore their mutual interest of a subject. These imposing Victorian buildings often covered several acres and were multi-functional incorporating lecture halls, libraries, galleries, theatres and exhibition areas

2.2 Evolution of the Convention Industry

For centuries, people have been meeting in cities and states with defined spaces for gathering people for such meetings. In ancient Rome, meetings were held in the Forum, usually located in the center of the city for public discussions, judicial issues and other matters. The Rostra was known for hosting public debates and historical speeches while, the Comitias was the meeting place for the Senate in Rome. However, just recently have the Convention industry been established. The most famous examples of ancient meeting places still found today include the Agora of Athens (5th Century BC), the Roman Forum (7th century BC) and the Coliseum. During the Industrial Revolution and advancement in technology, these spaces were replaced as meeting places to indoor spaces as a means of showcasing the improved technology. At this point, the city/town halls were used as convention centers. During the 1950s -1970s, the meeting industry grew larger and the whole idea of the indoor meeting places was replaced with fairgrounds, stadia, Expo hall and then convention centers.

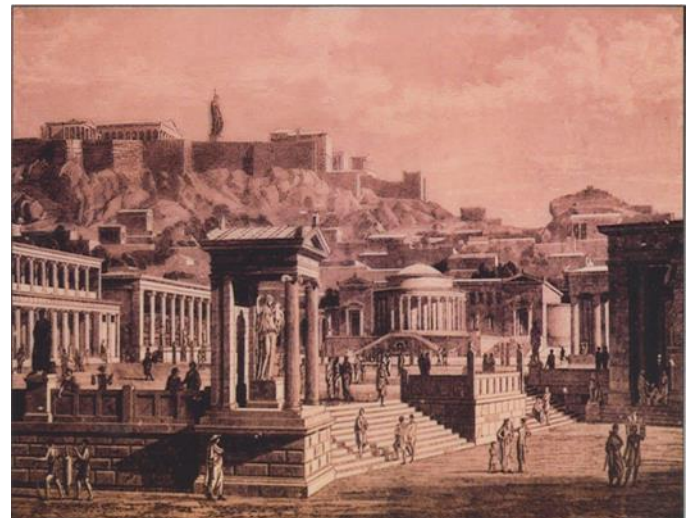


FIGURE 2.1 Drawing of the Agora with the Acropolis in the background

Source: My Architectural Moleskin, 2011

Advancement in technology has resulted in changes in the way meetings/conventions are held and how these centers function. Since these technologies are evolving, convention centers will always change.

2.3 Why a convention center and for whom

The predominant factor that contributes to the increase demand for meeting and meeting places is the need for people to communicate through physical reading to exchange views, ideas and thoughts on matters usually by problem solving and innovative individuals.

The convention industry is one that's dynamic in nature and growing at a fast rate. The fact that it's a young industry means that it lacks some characteristics of well-developed industries, including well defined terminologies, adequate training process, adequate market intelligence and the likes.

The main functions of a convention center include:

1. Conduct organization's business
2. Pass information to delegates
3. Train; and
4. Solve problems

2.4 Benefits of a Convention Center

Convention is a unique form of tourism. There is usually an intrusion reaction response from the host city due to the encapsulation/confinement of conventioners especially when the convention reaches the magnitude of a mega event.

The major benefit of such conventions is the impact made on the city's tourism and economic sector. The convention industry is the one part of the tourism sector which yields the highest per capita expenditure from conventioners than from tourists. This helps to sustain the economy during this period. It is noteworthy that this sector of

tourism is quite stable; marketing and organization are quite simple relative to the other sectors of tourism.

There are also secondary benefits in having a convention center in any city. Some of these benefits include;

- Creation of businesses and job owing to hosting of conventions and exhibitions.
- A successful convention held in any state increases the chances of that region being a holiday destination.
- Convention centers are multifunctional facilities at such can be used for any gathering whatsoever; concerts, film festivals, weddings etc.

2.5 What is Energy Efficiency?

Green building also known as green construction or sustainable building. It is a way of enhancing the environment. It benefits humans, the community, and the environment in order to reduce resource consumption while enhancing quality of life. This ultimately results in reduction of greenhouse gases which will help to reduce greenhouse effect. (Gurav, 2018)

This research work presents an overview of application of modern green infrastructure construction technology which makes a significant impact on conservation/proper utilization of resources like land, water, energy, air, material thereby reducing the overall cost of construction as well as adverse impacts of climate change. (Gurav, 2018)

Energy efficient building is best way to reduce in some extent of these damages although new technologies are constantly being developed to complement current practice in eco-friendly structure; the common objective of green built environment on human health and the natural environment.

A green building, also known as a sustainable building, is a structure that is designed, built, renovated, operated, or reused in an ecological and resource-efficient manner. Green buildings are designed to meet certain objectives such as protecting occupant health; improving employee productivity; using energy, water, and other resources more efficiently; and reducing the overall impact to the environment (Gurav, 2018)

Green Building practices promote construction of buildings that are healthier for the occupants and healthier for the environment Sustainable or "green" building practices can reduce the tremendous impact that building design, construction and maintenance has on both people and nature Energy and material consumption in buildings can contribute significantly to global climate change. (Gurav, 2018)

2.6 Benefits of Green Building

Various benefits from green buildings are discussed below;

2.61 Environmental Benefits

Protect bio diversity and eco systems, improve air and water quality, reduce waste streams, conserve natural resources.

2.62 Economic Benefits

Reduce operating cost, create, expand, and shape markets for green product and services, improve occupant productivity. Building is to reduce the overall impact of the

2.63 Social Benefits

Enhance occupant comfort and health, heighten aesthetic qualities, and minimize strain on local infrastructure overall quality life.

2.64 Benefits for Building Owners

1. Potential higher occupancy rates.
2. Higher future capital value.
3. Less need for refurbishment in the future.
4. Reduced risk of obsolescence.
5. Ability to command higher lease rates.
6. Higher demand from institutional investors.
7. Mandatory for government tenants.
8. Lower tenant turnover.

2.65 Objectives of Green Building:-

Green Buildings are designed to reduce the overall impact on human health and the natural environment by the following ways using energy, water and other resources efficiently. By reducing waste, pollution, and environmental degradation. (Gurav, 2018)

- i. Identify the design technique for energy efficient building.
- ii. Modify the structure and reduce the cost and make it environment friendly.
- iii. Improve occupant health and comfort.
- iv. Improve air and water quality.
- v. Conserve the natural resources.
- vi. Improve occupant productivity.

2.66. Green Building Product and Materials:-

Green building materials are composed of renewable, rather than nonrenewable resources. Green materials are environmentally responsible because impacts are considered over the life of the product. Depending upon project-specific goals, an assessment of green materials may involve an evaluation of one or more of the criteria listed below.

1. Resource efficiency
2. Indoor air quality
3. Energy efficiency
4. Water conservation
5. Affordability

As the energy required for manufacturing of cement and other construction material is more so it is major contributor to the consumption of our total energy source. Using such materials described below with their benefits towards environment.

1. Sand Lime Bricks: - The main constituents of sand lime bricks are sand, lime, fly ash, water. Using sand we can achieve the adhesiveness to hold the particles together. Its brittleness helps us to recycled it and reuse in other works.

2. Eco-Friendly Tiles: An Eco-friendly tile replaces the conventional flooring and uses less energy in their production. This tile improves performance of indoor environment quality.

3. Colored Lime Plaster:

Though low VOC (Volatile Organic Compounds) paints are available but by using colored lime plaster as paint it reduces the painting for whole structural life. It is maintenance free, washable and water proof. Its shine and glossiness increases as the time passes. It gives better aesthetics look than conventional painting work.

4. Reflectasol Glass:

Reflectasol glass gives better indoor quality than the normal clear glass. It keeps the inner temperature cool in hotter summers which reduce the energy consumption.

5. Rainwater Harvesting:

Rainwater harvesting system we are collect rainwater from roof and then storing it is storing it in a tank. The collected water can then be used for other purposes such as toilet and sprinkler system. The rain barrels are one of the most common methods of Rainwater harvesting is being frequently used this day.

6. Solar System:

Solar energy is clean and renewable source energy. Solar panels are an emerging and hot technology for peoples who want to utilize the natural power all around us. Solar power brings down the energy consumption and supply excess energy to your utility company.

7. Solar Roof Top System:-

Industrial, institutional and house hold needs continuous and regular access to power for various needs, solar roof top system are designed to provide electricity to office homes with intermittent or no greed electricity.

8. Use Solar Water Heater:-

A solar water heater is a device that uses heat energy of the sun to provide hot water for various applications. In homes, it is useful for bathing, washing, cleaning, and other chores

Comparison of Conventional and energy efficient building

Conventional Building	Energy Efficient Building
<ul style="list-style-type: none"> • In Conventional Building, there will be different room conditions depending on the changes in the environmental conditions. • The cost of construction of Conventional Building is comparatively lower than energy efficient building. • But in case of Conventional Building, a building service engineer and an architect is enough. • Energy Consumption is more as compared to energy efficient Building. • Salvage value is less. 	<ul style="list-style-type: none"> • Energy efficient Building adjusts the inside functional aspects such as lighting, ventilation, air conditioning, etc. automatically with the changes in environmental conditions controlled by computer. • In an energy efficient building the security system, communication system, etc. are coordinated and automatically controlled by computer work station whereas in Conventional Building there is no work station. • While planning Energy efficient Building a building service engineer, an architect and hardware engineer is required. • Salvage value is more as many of the electronic devices are reusable

3. RESEARCH METHODOLOGY

This outlines the data collection process for this research onto compilation and categorization.

3.1 Research Design

This research work was carried out using mixed methods in a problem-solving approach. The research drew largely on qualitative research techniques. Cross-sectional survey design was used for this study, and this method was chosen because the study centered on human factors.

3.2 Research Population

According to International Association of Professional Congress Organizers (IAPCO) in the journal, planning a Conference Center, the minimum seating capacity for the auditorium is 3500 delegates. The target population of this project is 5000 delegates. This includes 3500 seating arrangement for the main hall and 1500 for other events that can take place simultaneously.

3.3 Sources of Data

The relevant data for the study was collected from both primary and secondary sources. Descriptive analysis was used to analyze the data which was collected.

3.4 Primary Data Collection

Case Studies

This involved personal visits made to related sites and similar establishments of interest to gather first-hand information on existing infrastructure. A survey of the existing infrastructure and proposed project site was also undertaken with the purpose of identifying the unique concerns as well as location dependent issues. Sourcing of layout plans, templates and proposed site information was done.

3.5 Secondary Data Collection

Literature reviews and case studies

An extensive review of books, journals and other recorded research related to the study was undertaken. Government regulations, institutional guidelines and professional architectural standards as concerned with convention centers and exhibitions were also drawn upon. A good portion of the literature was sourced electronically and duly referenced. Similar facilities in foreign countries were also reviewed and adopted as case studies for this work.

3.6 Research Challenges

Access to literature on Convention facilities in Nigeria posed a major challenge as there is a very limited amount of existing literature on the subject. Greater knowledge thus had to be drawn from research considerations from other

developed and developing countries which were dutifully recorded

4. FINDINGS AND DISCUSSION

New conference centers are being designed and constructed all over the world under the supervision of Professional Congress Organizers (PCOs) in order to avoid the problems that have arisen in the past.

Proper considerations and implementation should be given to anthropometric and technical data when designing a conference center. This ensures efficiency and optimization of spaces. In this research comfort is achieved with regards to ventilation and lighting irrespective of the space.

4.1 Categorization of Spaces

It is important that a standard convention center should have at least a convention hall, an exhibition hall, a restaurant and parking facility. The details of some of these spaces are given below:

Main foyer: This allows for circulation through the building and connects different functions and entrances to meeting rooms and exhibition.

Convention hall: This space should have audio visuals, conferencing equipment, a facility of high fidelity recording video projection/ video graphs and skilled manpower at various levels. The capacity is a minimum of 3500 delegates.

Meeting Hall: These are equally important in convention centers as meetings and seminars are held here.

Exhibition: This is another important feature. Delegates and trade promoters usually use this medium to promote new products. This should have the capacity to accommodate at least 20 booths with a minimum dimension of 3x3m excluding passages in between the booths.

Plenary: This is the space where delegates are seated for presentations. This is a space that can be configured. For this space, an auditorium space can be configured in a classroom or theatre arrangement.

Ballroom: Cocktail parties and dinners hold here. To get this space, an auditorium space can be configured for different events. Smaller meeting rooms, boardrooms and multi-functional spaces support the ballroom.

Restaurants: These are usually designed based on the regulations set by the management of the facility.

Breakout spaces: these are areas where delegates break away from the main event.

4.2 Spatial Impact and Determination

Considerations should first be given to the physical impact of the building to make sure that building fits to the site and support different activities. Some of the limitations to this design

Include:

Ability to handle a large influx of people, vehicles, deliveries and services

Ability to build a convention center that fits the site and is open for expansion.

4.2.2 Spatial Relationship

Some spaces are linked by a common space. Most times, two spaces can be dependent on an intermediate space for their relationship. This relationship allows for common spaces to be used as gathering spaces thereby promoting interaction between people.

The design of these spaces is, therefore, crucial towards having a meaningful gathering space.

4.3 Lighting

Lighting is an integral part of design. This determines the utilitarian and aesthetic environment of the design. Therefore, requires thoughtful planning. Lighting may be analysed and its relative importance changed depending upon time, the building's function and its location (Ham, Roderick 1998).

Lighting can be seen as letting in light into a space to aid vision. Observation shows that lighting is used for decorative and functional purposes. The pattern of lighting and intensity determines the 'mood' of the interior (Ham, Roderick 1998).

The function of the building determines the intensity of light required. Different building types and different areas in a building require different intensity of light, while some require daylight, others require artificial lighting. This means there are two sources of lighting a building- natural and artificial lighting.

4.3.1 Natural Lighting

This is lighting from the sun. It is an important aspect to consider when designing a building with lighting in mind. This involves determining the amount of daylight, the variation in the position of the sun, site orientation, exterior obstruction, climate, adverse effect of glare and means to cope with it. Window design (types, sizes and orientation) is the basics of daylighting in any building design. Daylight when applied skilfully gives the architect the most effective modes of aesthetic architectural expression (Lawson F.R 1981).

Provision of support facilities like; waste disposal, electricity, water, security and safety services.

4.2.1 Spatial Organization

Linear spatial organization is appropriate in the design of a convention center as it allows for spatial continuity especially due to the size of the structure and in most cases its length. This organization allows for circulation and provide for ample space for break out of people to gather between functions

Roof Lighting

This means provides the greatest introduction of light to a building. This method of daylight is not suitable for convention designs.

Lateral Light

This involves admitting light through normal or high-level windows. This method allows for natural lighting and natural ventilation. It promotes a flow space between interior and exterior spaces and further screens off infra-red rays from the sun.

Total Glaring

In this method, the entire wall is glazed thereby admitting sunlight from all sides of the wall. This style is not appropriate for the hot weather condition in the tropics.

Daylighting is not appropriate in designing a convention centre as its disadvantages of variation in levels and directional characteristics, greater heat loss and air-conditioning loading on services add to insulations difficulties, design limitations and flexibility (Lawson F.R 1981, pg. 194).

However, it is important to note that meeting rooms need sufficient daylighting through windows for contrast and relief from the formal situation.

4.3.2 Artificial Lighting

Artificially lighting is widely used today. This is so because, although natural lighting allows for some of control in certain areas, artificial lighting is totally the architect's doing since it allows for control in the areas of illumination in a building space.

Artificial lighting can be classified into: Exterior lighting and Interior lighting

4.3.3 Exterior lighting

The importance of exterior lighting cannot be over emphasized, some of them include:

- Promote awareness and interest in the convention center.
- Demonstrates the architectural character and form of the building.
- Reduces the occurrence of accidents.
- Facilitates security by illuminating carparks and access roads.

Applications

- Upwards illumination to create emphasis on vertical features thus giving them form and shape.
- Concealed illumination under arches in window recesses and penetrating spaces.
- Floodlighting of external facades
- Trees, monuments and other features are also floodlit usually in contrast to that of the building
- Down lighting below canopies and entrance lobbies to distinguish entrances.

4.3.4 Interior Lighting

The intensity of the light and the pattern it flows determines the 'mood' of the interior space, varying the intensity of the light, places emphasis on architectural features (Lawson F.R 1981).

For receptions, foyers and circulation areas, the quality of lighting will be judged by the manner which human faces are revealed and the brightness of vertical surfaces.

For exhibition and display, directional lighting is appropriate.

For auditoria, the following considerations should be made:

- Spatial illumination must be at sufficient level to avoid strong contrasts. Illumination should be such that it can be dimmed or increased whenever.
- There should be a balance between brightness of surface and color harmonization.
- There should be provision for special stage light to accommodate the multi-purpose function of the auditorium.

4.4 Acoustics

Convention centers and auditoria need to be given special attention when it comes to acoustics. In designing a convention centre, acoustic considerations are mostly given

to the design of the convention halls, auditorium and seminar and meeting rooms. But necessary considerations must be given to other parts of the facility like gallery, lobbies and restaurants.

The first set of minimum acoustic requirement is that the direct sound be loud enough meaning it replicates conversation sound level.

Hall acoustics should be free from echoes and other types of reflections (Noxon A. 2002). Noise from the hall should be fairly quiet.

4.5 Ventilation

Constant ventilation of air is necessary for a comfortable working space in the building. Ventilation involves exchange of air. It also involves maintaining and regulating the temperature of the environment.

Proper ventilation reduces the level of indoor air pollution by circulating fresh air continually. Just like lighting, ventilation can be done in two ways:

Natural and Artificial

Natural Ventilation; this involves making use of the advantages of air movement in nature. The designer/architect takes advantage of the prevailing wind over the site through the positioning of windows and other air inlets and then released through provided outlets.

In order to achieve this, the building orientation is done taking into cognizance the prevailing Northeast and Southwest trade wind.

Since the site is located in the tropics, ventilation cannot be compromised. The desired effect of ventilation can be achieved when other determining factors like size, type and position of window openings are manipulated.

Artificial Ventilation

In this case, mechanical devices like air-conditioners, exhaust and ceiling fans, etc are used for the removal or exchange of air within a space. Most times, these are used to achieve what the natural ventilation could not achieve.

The architect should provide sufficient ventilation for any space. In order to minimize cost, the design should apply more of natural ventilation which could be complemented by artificial ventilation.

4.6 Convention Centre Planning

Convention centers aim at satisfying the need of the organizers as these needs are peculiar to each event. These needs are in terms of layout, size and flexibility of the spaces. The convention typology is becoming widespread and this is so as it allows for different activities to be hosted

within one facility or under one roof. The concept of this typology has been adopted by almost all convention centers.

This concept requires flexibility. So, each space is not designed for any particular activity but for all activities that could be required. Thus, the space becomes an open space that be configured in different ways.

5. CONCLUSION AND RECOMMENDATIONS

Architectural design; green technologies and intelligence in combination may be a pragmatic approach towards the sustainability aspect. Intelligent buildings have been a positive impact there is still a wide scope for enhancement. (Gurav, 2018)

Through a thorough investigation and understanding of the proposed site, the issues that were found showed the need for a convention center in the state. A project of this kind is necessary to solve the problems and achieve the aims and objectives earlier stated.

A convention center of this kind is needed in creating a meaningful space that supports a cultural and social order of interaction. The absence of a space that connects social and cultural interaction has imposed some urban issues on the city and its waterfront environment. The need for this reconnection presents a backbone for this research where this facility is structured towards the development of a new paradigm for convention centers as well as a well-integrated public gathering space.

In designing a convention center, three integral parts are considered; administration area, convention area and ancillary facilities.

- The administrative area is the center of the facility. It is located around the entrance of the facility for accessibility and controlling of activities in the facility.
- The convention area is the hub of the facility and is shielded from the noisy area. It is accessible from the entrance. Some activities or spaces are accessible without going through the center. The convention area is made of different independent spaces that allows for different events to be held simultaneously and independently.
- Support and ancillary spaces include the exhibition with galleries. This earns revenue to the facility and state at large.

The design is open with green areas to achieve comfort within the center and promote interaction between various users. The centrality of the design emphasizes on the concept used.

Conferencing and MICE tourism is a growing industry and the demand for it will always increase. This is so as the

search for national and world peace will continue to exist, which in turn promotes dialogue and meetings. The design of the convention center in Rivers State thereby makes the State an international convention city and destination.

There is the need for a convention center in Rivers State. This center should meet the international standard for designing a convention center.

It is recommended that:

1. To reduce the scale of the convention center, the building should be broken into series of parts composed of the main spaces of the building. This space; being introverted spaces rather than larger ones will be connected by circulation areas and waiting areas.
2. By reducing the building into parts rather than a large one, the megalithic quality of the building will be reduced and respond better to human scale.
3. There should be a connection between the recreational areas with similar activities. This could be done using a path of movement across the site.

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