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PRIORITISATION OF FERRY COMMUTERS' NEEDS IN LAGOS METROPOLIS: AN ANALYTICAL HIERARCHICAL PROCESS APPROACH

Summary. Understanding the needs of ferry service commuters cannot be overemphasis, considering the fact that the survival of any business largely depends on the volume of its customer base, and how well they are satisfied with the level of services received. More so, owing to the high population of Lagos state and usual traffic congestion across main roads during the peak periods, water transportation via ferries undoubtedly becomes a viable alternative to ensure stakeholders satisfaction in urban planning for a city majorly surrounded by water providers. Thus, this study employs the analytical hierarchy process (AHP) to prioritise the ferry services needs of commuters to make effective managerial decisions that will aid efficiency in their operations, thereby, increasing the market penetration, competitive edge and commuter satisfaction. A sample size of two hundred and four was computed through purposive sampling procedure. The data retrieved were analysed using pairwise comparison in line with AHP methodology. The study found out that among the criteria measured, comfort was perceived more important to commuters compared to its pairs. In addition,

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recreational facilities, ease of online payment, regular maintenance of waterways and seating with good legroom were ranked high by the commuters. Therefore, to ensure a sustainable competitive advantage over other modes of transportation, these indicators need to be effectively considered in water transportation policy.

Keywords: AHP, transportation, commuter, ferry service, jetty, Lagos

1. INTRODUCTION

Understanding the needs of commuters that use ferry services in a cosmopolitan city with high-level traffic congestion is one of the first steps in working out how best to ensure better inter-modal transport for efficient movement in a megacity. Furthermore, prioritising these commuters' needs and tackling them systematically will bring expansion and economic growth to the industry or sector and to the state and the nation at large.

Although commuter assessment of a service depends on the balance between sacrifices and benefits, both monetary and non-monetary. Sacrifices and benefits are moderated by the commuter's tastes and characteristics. The needs of individual commuters are important determinants of the level of satisfaction [16], the customer's experience [7] and of repurchase intentions [12].

Traffic congestion experienced in Lagos metropolis daily have advanced into so much delay and inconsistent journeyed times, extreme loss of energy and loss of bona fide man hour, hence, the need to fully harness the potentials of water transportation via ferries serving as a complement and substitute mode to road transportation has become compelling [14]. It is this convincing need that made the researchers embark on ascertaining and prioritising the need for commuters using ferry service. Although Lagos is blessed with rivers and lagoon that permeate deep into the mainland, water transportation is still grossly underutilised by the commuting public. A vast majority of the population still depend on road transport to carry out their daily activities, the consequence is that most times, a journey that would normally take 30 minutes, lasts for as much as 4 to 6 hours. The manpower loss in traffic is quite enormous with the economy of the individual at the receiving end.

However, some commuters still patronise local boats especially those living in the riverine areas of the city. These corporate passengers/commuters have four main operators that move passengers in and out of the island to the mainland on a daily basis. Comparatively, the capacity of ferries plying the routes is far less than the population of Lagos which has been estimated to be 20 million people [9] and projected to triple this figure by 2050.

This service is meant to meet the following needs among others;
- having accessible jetties and port for embarkation and debarkation of commuters in the metropolis,
- affordable fare comparable to other modes of transportation within the city,
- comfort and good ambience,
- safety and security,
- speed.

All these needs involve satisfying multiple objectives.

Prioritising them, a common approach to use is the analytic hierarchy process (AHP) technique developed by [18]. AHP uses a multi-level hierarchical structure of objectives, criteria, sub-criteria, and alternatives, where the goal is at the top of the hierarchy, followed by the criteria and sub-criteria (if required), and finally, the alternatives occupy the lowest

level. It uses pairwise comparison to determine the relative importance of each alternative in terms of each criterion. Using Saaty's scale of relative importance, the alternatives are compared in two's with respect to each criterion to generate a matrix of performance values known as judgement matrix for each criterion. Similar comparisons are made for the criteria with respect to the overall goal. Finally, priority vectors from each judgement matrix are combined to form the decision matrix from which the final priority vector is obtained. The final priority vector ranks the alternatives from the most suitable alternative to the least suitable one.

Many studies have been conducted on customer's satisfaction, the safety of commuters and boat, and the safe operating speed of the ferry, however, to the best of our knowledge, very little or no work has been done in the area of prioritising these needs. This study adds to the existing literature on this subject matter while exploring the peculiarities of the ferry operations as an alternative means of transportation. The intention is to adopt a systematic way of prioritising commuters' need and meeting them as well. Two major routes: Victoria Island to Ojo through Mile 2, Victoria Island to Ikorodu were selected for case studies.

A report by the Building Nigeria's Response to Climate Change [5], states that Lagos state has a significant accumulation of water and marshland of over 40% of its entire land area and extra 12% prone to regular submerging by a flood. The waterside areas comprise of lagoons, creeks and swamps segregated from the open sea by a strip of sandy land that varies in width from two to sixteen kilometres. Thus, the state consists of various islands (Victoria Island and the continuations, Ikoyi, Apapa and some parts of Amuwo-Odofin) which are linked by bridges to the mainland.

Despite this, a greater majority of the inhabitants do not subscribe to water transport as a substitute to road transportation. Moving from one part of the city to the other is habitually an unpleasant experience due to the high population of individuals resident in the state. A transition that usually should take 35 minutes takes as much as 4 to 6 hours on a rainy day. Therefore, it has become imperative to state that a city of this size cannot survive on only one major mode of transportation.

A lot of establishments at various times have ventured to solve this problem by investing enormously into medium size ferries, however, they could not continue with the business after some years and some were even liquidated. An understanding of the needs facing the ferry services commuters, as well as adequate prioritisation of these needs, will help investors and government agencies in Lagos fully grasp the situation and address them in a systematic manner. This necessitates this study.

The aim of this study is to ascertain and prioritise the needs of the ferry services commuters in the Lagos Metropolis using AHP to help stakeholders tackle these needs systematically. Therefore, the specific objectives are to:
(i)   ascertain the needs of ferry service commuters in the Lagos metropolis,
(ii) prioritise the commuters' needs of ferry services using AHP,
(iii) determine appropriate strategies towards meeting ferry commuters needs for improving patronage.

This study analyses the needs that affect the commuters in using ferries optimally, thereby, preferring it to road mode of transportation, it gives insight on how prioritising them using AHP will aid resolving means of these needs. Therefore, it strengthens our knowledge of driven existing research challenges in water transportation. Thus, opening a new scope in the study of the subject matter.

In addition, experts and practitioners such as river engineers stand to gain from the result of this study. This is because this study exposes how to engage them in the waterway, as they channelise and dredge the ferry route. Thereby, enhancing the safety of boats on different routes.

Finally, this study will be beneficial to the Lagos State Government, especially Lagos State Ferry Services Corporation (LFSC), Lagos State Waterways Authority (LASWA) and other firms who rely on water transportation to render their services. It is of utmost importance as it sheds light on the major needs of ferry service commuters, which are the main reasons for operating ferry services in a commercial city like Lagos. Many organisations today are interested in expanding their businesses into this area, therefore, knowing the needs of the commuters and the abundant untapped opportunities underneath will help them explore. Importantly, it will help in providing a solution to humanity's problem and expand the body of knowledge.

2. LITERATURE REVIEW

Review of the water transportation system in the Lagos Metropolis Water covers over 25% of the land space in Lagos state, as a result, the recognition of water transport is as an alternative way of transiting both human, goods and services from one location of the city to another dates back to centuries. Conventionally wooden boats driven by paddles made from wood and bamboo sticks are seen in the lagoon and rivers. Small outboards petrol engines (25 to 40Hp) is gradually phasing out the paddles and bamboo sticks in moving personnel and goods faster to their various places of embarkation and debarkation.

Though Lagos State Ferry Services started operations in 1925 [10], the patronage of this means of transport over time has not been encouraging especially when compared to the population growth in the city and movement of people within the city via road transportation. Water transportation is rather associated with a certain tribe (Ijaw), who by reason of place of birth are known to be at home with the water. At a young age, children from this tribe are taught how to swim and learn various survival techniques in water. Other tribes are indifferent to swimming, consequently developing a phobia for water, and subsequently, neglect this means of transportation.

When the civil war ended in 1970, lots of marketable centres came up inside the Lagos Island and the traffic situation between the island and mainland worsened, thus, Lagferry was established in 1983. This ferry services provided a shift from the old wooden boats to a more cooperate outfit targeting the middle class. The issue of safety and security was taken more seriously; life vest was mandatory for all commuters boarding the ferry at the point of embarkation. Coast guards also became visible in the lagoon and these became a confidence booster in this sector till date.

Ferry services

Ferry service connects two shores usually to meet the needs of the people. Therefore, ferry service involves the movement of people and goods from one shore location to another shore location by water. Hence, every ferry service is a market of demand and supply onto itself. There are peak and off-peak periods during the day. The peak periods are the rush hours of the morning and evening, while the off-peak period is between late morning and early afternoon (between hours of 1000 and 1500Hrs). At this period, workers and business/traders are in their offices and shops. Weekends are particularly off-peak periods.

Lagferry or Lagos State Ferry Services Corporation is the main ferry provider within the metropolis, her operation started in 1925 [8]. Although most of their fleet is either broken-down or laid-up, they are still visible in the water space. Lately, other operators are making a good incursion into this sector. They include:
- metro ferry,
- sea Coach Express,
- texas Connection.

These operators present good corporate brands that are attractive to the working class and other corporate business executives.

The following government agencies regulate operations in the sector:
- NIWA – National Inland Waterways Authority,
- NIMASA – Nigeria Maritime Administration and Safety Agency,
- LASWA – Lagos State Waterways Authority.

Actors and stakeholders

Actors and stakeholders play active roles, shape development and expansion and competition. They include the following:
  I.   government agencies,
 II.   operators,
III.   commuters and the general public.

Government agencies: Under the transport ministry, the government provides guidelines to regulate this sector. The ministry controls waterways and has the responsibility of dredging, wreck removal and clearing of the channels at regular intervals. They also build and manage ports/jetties and places of embarkation and debarkation.

These ministries conduct their businesses through the following agencies:
- National Inland Waterways Authority (NIWA): NIWA was created by decree No. 13 of 1997 to oversee the massive inland waterway asset in Nigeria. NIWA by this decree has the exclusive authority of overseeing, guiding and monitoring the whole waterways within the Nigerian territory. The act vested the following objectives among others to NIWA:
    (i)   to encourage and grow private sector venture and involvement in the running and control of the resources of the National Inland Waterways Authority;
    (ii) to plan for the safety and security guidelines of the National Inland Waterways;
    (iii) to plan a substitute means of carriage for the movement of commodities and people, and put in practice the National Transport rules as it concerns the National Inland Waterways in Nigeria.
- Nigeria Maritime Administration and Safety Agency (NIMASA): It was created to inspire local companies to boost maximum volume. The mandate of the agency is to confirm that vessels for shore and local trade be constructed in Nigeria, possessed by Nigerians, operated by Nigerians and be listed in Nigeria.
- Lagos State Waterways Authority (LASWA): They are mandated with the obligation of organising and overseeing improvements needed for the long-term development and expansion of water transportation in Lagos State, including the approval of ferry licenses and recognitions for the operations of ferry paths and terminus to individual owners.

Ferry service operators

Companies that operate ferries in Lagos metropolis [10]

S/N	Company	Incorporated	Number fleet	Routes/Service
01	Texas Connection Ferries Ltd	2001	Not known, company have different sizes of ferries.	Corporate charter services to companies and individuals to different destination across the lagoon from the Island
02	Metro Ferry (Private limited liability company)	2008	18	Metro Ferry plies Ebute-Ero to CMS down to Folomo under bridge and Addax jetty, VI to Mile 2
03	Sea Coach Express	2015	10	Sea Coach Express plies Ikorodu to outer Marina during the morning and evenings rush hoursand shuttles between CMS outer Marina and Apapa during the day
04	Lagos State Ferry Services (owned by the State government)	2008	Not known, between 10 and 20	Lagos State Ferry Services plies Ikorodu to outer Marina during the morning and evenings rush hours, and shuttles between CMS outer Marina and Apapa during the day

Commuters and the general public

With a population approximated at 20 million residents, the Lagos state government estimates that over 6 million commute every day. The strategy is to encourage approximately 2 million of these commuters to use waterways to decongest the road. For this research work, the focus is on the middle class because these strata are willing to pay a little more to have time provided safety and comfort guaranteed.

Analytic hierarchy process

"Reference [17]" human daily life is scheduled with numerous decisions making which most times possess multiple conflicting interests. Thus, the need for prioritisation is of high importance in every decision scenario. Moreover, life and business challenges requiring human judgment and perceptions and with long term effect calls for a rational technique to solving them. To solve such a problem, there is a need to juggle various factors which might require a reasonable amount of time and resources. In practice, the time allowed for decisionmakers in solving high risks and long-term effect decisions in today's dynamic and uncertain world is limited. There is a need for a better analytic technique for solving such challenges.

The Analytic hierarchy process, popularly known as AHP, is one of the most famous methods for making multi-criteria decisions. It was developed to assist with optimisation of decision making when faced with a number of quantitative and qualitative factors.

"Reference [4]", AHP was developed by T.L. Saaty, while directing research projects in the US Arms Control and Disarmament Agency. It was developed to help solve complex decision-making problems. The simplicity and power of the AHP have led to its use in business, government, research and development, defence, telecommunication, etc. [2].

AHP employs the verdict of decision makers to arrange a breakdown of problems into hierarchies. Problem complication is characterised by the number of stages in the hierarchy which syndicates with the decision-maker's model of the problem to be solved. The hierarchy is utilised to originate ratio-scaled measures for decision alternatives and the comparative value that alternatives have against the study goals prioritising the commuters needs and the criteria (Jetty facilities, Fare, Safety and security and Comfort). AHP practises the use of pairwise matrix comparison to categorise factors to attain a mathematically ideal result. AHP is a time-tested technique that has been utilised in billion-dollar decisions. AHP is used typically in the following applications:
- prioritising the factors and requirements that impact in software development and productivity,
- helps in making choices among several options for improving safety features in motor vehicle manufacturing,
- assist in establishing cost and options for scheduling material requirements planning (MRP),
- in the software industry, it is used for vendor management to select the right vendor for the right component.

There exist, three major concepts in AHP, they include:
- the analytic nature of AHP:
  AHP employs a logical and mathematical approach to decision making. It helps decision makers in placing the decision problem on a logical format, converting decision-makers' intuition and feelings into a numerical form which can be easily assessed and explained,
- the hierarchical structure of AHP:
  AHP decomposes complex problem into sub-problems. This assists decision makers to be able to solve the complex problem. Thus, to deal with enormous and complex decision-making problem, it is necessary to break it into levels called hierarchy,
- the process nature of AHP:
  AHP takes decision making in processes. Process-driven decision making takes into consideration, the evolution of the decision in a step by step approach.

Procedure for using AHP and its application
"Reference [10]" gave the following procedure for AHP.
Step 1: The first step in analysing AHP problems is to break the goal or objective, into hierarchical structure or grading, which comprises of criteria, sub-criteria (if any) and alternatives. In Fig. 1, the goal is to prioritise the ferry services needs of commuters in Lagos Metropolis, it sits on the top and defines clearly what the problem is. The criteria are available jetty facilities, affordable fare, safety/security and comfort. The sub-criteria are as shown directly under the criteria.

Step 2: Data collected from the questionnaire are subjected to pairwise comparison in matrix form of alternatives on a scale of degree of importance starting from 2 to 9. 1 is equally important between the two alternatives. While 2 is equally to moderately important and 9 is extremely important.

Step 3: The pairwise comparisons of several measure or criteria created at step 2 are arranged into a square matrix. The diagonal rudiments or components of the matrix are 1. The measure (criterion) in the i_{th} row is better than measure in the j_{th} column if the worth of the component (rudiment) (i, j) is more than 1; if not, the measure in the j_{th} column is better than that in the i_{th} row. The (j, i) component of the matrix is the reciprocal of the (i, j) component.

Step 4: The primary eigenvalue and the conforming normalised right eigenvector of the evaluation matrix gives the comparative importance of several measures or criteria being compared. The components of the normalised eigenvector are called weights with regard to the measure (criteria) or sub-criteria and ratings with regard to the alternatives.

Step 5: The uniformity of the matrix of order n is estimated. Judgments made by this method are subjective and the AHP tolerates inconsistency through the amount of redundancy in the approach. If this consistency index fails to range a required level then responses to evaluate may be re-examined. The consistency index (CI) is analysed as $CI = (\lambda max - n)/(n-1)$
where λmax is the maximum eigenvalue of the decision matrix. This CI can be compared with that of a random matrix (RI). The ratio obtained, CI/RI, is called the consistency ratio (CR). Saaty recommends the value of CR should be less than 10%.

Step 6: The grading of each alternative is multiplied by the weights of the sub-criteria and accumulated to obtain local ranking with respect to each measure (criterion). The local rankings are then multiplied by the weights of the measures (criteria) and accumulated to obtain comprehensive ranking.

The AHP generates weightiness of values for one-to-one alternative centred on the estimated ranking of one alternative over another with respect to a shared measure.
AHP has enjoyed application in several fields of human endeavour, amongst which are ranking, choice, prioritisation/evaluation, resource allocation, benchmarking, quality management, public policy, health care and strategic planning.

Research conceptual model – X-ray commuter needs
Lagos is a megacity with a population close to 20 million, which has an imperative need for an efficient means of moving people from one end of the metropolis to the other. Over the years, the only means of transportation is the road, which the government has invested heavily on as an infrastructure. After the Nigerian civil war, most people migrated from villages to urban centres to start life afresh. Lagos as the commercial nerve centre of Nigeria became one of the first points of such migration. Consequently, this stretched the available infrastructures to its limit. The road was badly hit as the traffic bottleneck (go slow as it is called in Lagos) became a normal feature on the roads.
Successive governments have always looked at ways to solve the traffic situation in Lagos, right from when Lagos was the capital of Nigeria. One of the ways is the use of waterways as a viable alternative to the road to commute people and goods from one end of

the city to the other. When this means is effectively utilised, it is expected that over 30% of the commuters would patronise the ferry services, thereby, decongesting the roads.

Maslow hierarchy of need was used as a tool to X-ray the needs of the commuters. The needs are broken down into the following sub-headings:
- availability of jetties with its facilities,
- reasonable fare,
- safety and security,
- comfort.

The aim of this study was to identify the reasons the majority of Lagosians do not patronise water transportation despite its economic potentials. Furthermore, what can be done better to make it attractive, thereby reducing the heavy traffic gridlock on Lagos roads which has brought so much loss in man-hour. The listings below provide clues to why the potential is untapped, we foresee more commuters being attracted to this mode of transportation when they are put in place or systematically implemented with an evident increment in the use of ferries.

Available jetties with its facilities

Jetties are places of embarkation and debarkation for passengers and goods for ferries. Lagos is blessed with rivers and a lagoon that penetrates right into the mainland, providing a good spread to make water transportation accessible to the populace. "Reference [3]" states that the Lagos lagoon covers a total area of about 426.0 km^2 with a coastline and inland waterways; it reaches an average depth of about 1.6 m throughout the year with negligible or insignificant variations, thus, making the rivers and lagoons navigable. On the west of the lagoon (south-west of the harbour), there are several creeks; Lighthouse creek, Ologe lagoon and Badagry creek, the main waterway leading to Badagry (Port Novo and Cotonou). Another creek joining the southern part of the main Lagos lagoon to the Atlantic Ocean through Victoria Island is called Five Cowries Creek. The North East of the lagoon is bounded by the Ikorodu local port that leads to Epe. In addition, at that region, there are several inlets from the Ogun River, Majidun River and Agboyi creek. A sub-lagoon of the Lagos lagoon lies to the east of the harbour bound, and the bar beach between the Atlantic Ocean and the lagoon is called the Kuramo waters.

However, Lagos can only boast of about 59 jetties (most unfunctional). Should the government keep their promises by completing the 8 additional jetties by the end of the administration that ends in 2019, the total number will increase to 67, which is still grossly inadequate compared to the size of the population.

To make water a viable alternative to road, jetties must be accessible to commuters and have facilities like car pack, restaurants, recreational facilities, ATMs and shopping centres. Furthermore, there is need for investment in the construction of over 50 additional jetties with modern facilities and 100 embarkation and debarkation points along the rivers and lagoons for ease of pick-ups and drop-offs along the waterway. The embarkation and debarkation points may not necessarily have the aforementioned facilities, rather they will serve as stops to commuters; as bus stops serve to road users [20].

Additionally, having more jetties in the creeks, lagoons and islands would make them easily accessible.

Reasonable fare

Commuters expect value for their money. Time is money, this is the main attraction water transport has over the road. Commuters can predict their transit time, unlike the road where a journey meant for 30 minutes can go for as long as 4 to 6 hours. As a result, commuters in most cases are ready to pay a premium to have this service.

Incentive theory of motivation posits that actions are induced by the desire towards gaining rewards. Operators, therefore, create incentives and reward systems for loyal customers. For instance, operators could announce the incentive of buy two tickets and get one free, buy bloc thick for a month and use the service for an uncountable number of times within the month at no additional charge.

In addition, online ticketing and cashless transaction is convenient to commuters and create the flexibility of allowing them to plan their journeys well in advance. All of these are not optimally employed within the current mode.

Safety and security

Self-survival is man's number one instinct. No normal person will put himself/herself in any kind of danger. Consequently, commuters will comfortably utilise this mode of transportation if there is some form of assurance that the waterways are safe and secured with supportive measures to support in case of natural disasters. Availability of the following could serve as confidence builders:
- availability of coast guards for rescue operations along the waterways,
- availability of adequate life vest for all passengers,
- good maintenance record by operators and availability of spares,
- adequate maintenance and dredging of the waterways,
- low incidence of avoidable accidents on the waterways.

Comfort

The targeted middle class and business executives are disposed to pay a little bit more provided the service is convenient and offers some level of comfort. This starts from access to the jetty, facilities available at the jetty, the ferry itself, considerable ambience, courteousness of the crews, tidiness and reception, onboard entertainment, and so on.

All these put together will attract and bond the commuters to water transport, thus, increase patronage and meet overall government objectives.

Empirical review

The procedure of deciding the relative importance, urgency or position of a thing(s) cannot be overemphasis in any organisation or sector. Hence, the prioritisation of factors and criteria to attract the patronage of commuters (consumers) have weighty effects globally.

Analytical hierarchy process (AHP) is one of the multi-criteria decision making methods originally developed by Prof Thomas Saaty that has proven effective in providing measures of judgement consistency and deriving priorities among criteria and alternatives. Moreover, it simplifies preference ratings among decision criteria using pairwise comparisons.

"Reference [6]" in their research work of prioritisation of human capital measurement indicators in Turkey employed the application of AHP and fuzzy logic known as Fuzzy AHP to improve the quality of human capital achieved by considering within the model, five main attributes; talent, strategical integration, cultural relevance, knowledge management, and leadership; their sub-attributes, and 20 indicators are defined. The result of the study conclusively indicated that 'creating subsequent results by using knowledge, employee skill

index, sharing and reporting knowledge and succession rate of training programs are the four most important. In addition, "Reference [11]" applied fuzzy multi-criteria decision making technique to assess the service quality of ferry services in Malaysia, and it was discovered that as satisfied as commuters are with ferry service performance, ferry personnel service performance ranks better compare to ferry service in handling delay. Thus, the delay handling process was highlighted for improvement. While, "Reference [8]" examined service performance of ferry in the Sabang zone, Indonesia, with the aid of Cartesian graph. It was found that irrespective of the pass mark ascribe to service delivery, the need for improvement in areas such as notification of delay, employees' technical know-how, employees' complaint management, on-time service performance, security, and reliability are of high importance. In the same vein, "Reference [15]" observed the indicators that influence commuters' selection process of ferry service operators in Greece and it was found that commuters' choice was heavily dependent on perceived service quality, price, and convenience. Whereas, among the selected service criteria measured by [13], it was found that travel speed, on-time performance, and service frequency sub-elements of core service attributes were of high importance and aid satisfaction to commuters compared to vehicle tidiness and safety on board.

"Reference [1]" used the analytical pairwise comparison procedure to rank the human capital indicator in Malaysia. AHP was employed to integrate the multi-facets preferences of the five criteria of human capital to determine the importance of the four identified. "Reference [1]" showed from their result that creating result by using knowledge is the most important measurement indicator, while employee skill index is the least important.

The Analytical hierarchy process was utilised in selecting and prioritising projects in a portfolio. "Reference [17]" in their work presented, discussed and applied the principles and techniques of AHP in the prioritisation and selection of projects in a portfolio by considering the projects under the two subheadings of possible definitions of low cost and possible definitions of high benefits, which forms part of the criteria for prioritisation and possible inconsistencies were determined too. Therefore, in this research work, the process of AHP was applied on a step by step basis to prioritise the ferry services needs of the commuter in the Lagos metropolis, which has four criteria: Jetty facilities, safety and security, fare and comfort with fifteen alternatives.

3. RESEARCH METHODS

This study considered two conscientious channels of focus for analysis. A correct mental comprehension of the influence of activities and operations in these locations presents a clear account of what transpires in other channels and locations. The two routes or channels of interest are Victoria Island to Ojo through Mile 2 and Victoria Island to Ikorodu. The rationale for their selection is because Victoria Island captures the major transaction areas commuters' move from, to the farthermost part of the city- transiting to the West and East (Ojo through Mile 2 and Ikorodu, respectively) of the metropolis. This study was conducted on randomly sampled ferry commuters within the Lagos metropolis and with the aid of AHP, data gathered were scientifically analysed to generate the relative importance of selected needs of ferry commuters within the Lagos axis. The questionnaires administered were structured in the AHP format to aid prioritisation of ferry commuters' needs with a response based on the fundamental ratio scale [6]. This is to help identify the preference level of needs

from the commuters' standpoints. Thus, overall, 240 copies questionnaires were deemed fit for analysis.

4. RESULTS AND DISCUSSION OF FINDINGS

A. To ease understanding of commuters' relative importance of ferry service within the Lagos metropolis, results were depicted based on the study's objectives in line with AHP procedure:

Step I: AHP model construction

The model was constructed in line with the basic hierarchical structure of 3 levels (goal level, criteria level, and alternatives level). The goal level contains the prioritisation of ferry commuters' service needs as the goal; the criteria level comprise of constructs such as available jetties facilities, fare (cost), safety/security, and comfort. While, the alternative level comprises of availability of parking space, availability of conducive waiting lounge, a good access road to the jetty, and recreational facility as sub-criteria to available jetty facilities; while, affordable fare, availability of incentive and fare discount, and ease to online payment as sub-criteria to cost/fare; and safety/security has regular maintenance of waterway, availability of coastguards for rescue operations, availability of life vest for passengers, and maintenance and spare available as its sub-criteria. Whereas, ambience, seat with good legroom, availability of onboard entertainment, and availability of onboard convenience serve as sub-criteria of comfort.

Step II: Pairwise Comparison

Afterwards, commuters were asked to respond to pairwise comparison questions representing one criterion against another with respect to a control criterion. This was done to actualise the relative importance of criterion within a sub-division of criteria and as determinants towards commuters' needs of ferry services. This comparison was completed using [18] fundamental scale of 1-9, and the model comprise of 5 pairwise matrices for commuters' responses (Tab. 2). The individuals that completed pairwise matrices were later grouped together through the computation of arithmetic mean across all matrices to derive a unified pairwise comparison matrix for analysis.

Tab. 2

Responses towards criteria with respect to goal

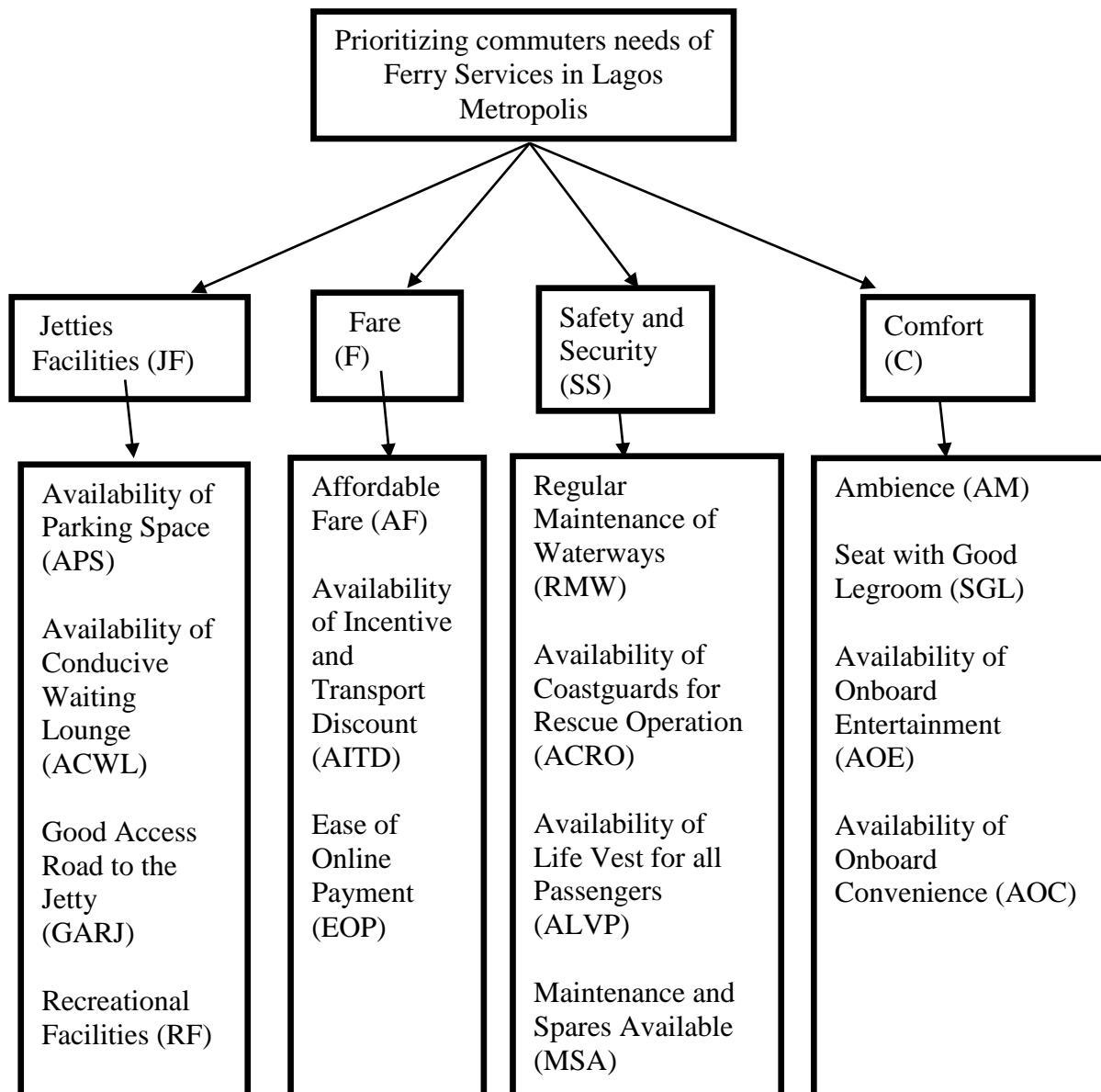| Commuters needs of ferry service	JF	F	SS	CM
JF	1	1	1/7	1/9
F	1	1	1/7	1/5
SS	7	7	1	1
CM	9	5	1	1
Column Sum	18	14	2 2/7	2 1/3

Fig. 1. AHP model for prioritising the ferry service commuters' needs in
the Lagos Metropolis

Step III: Consistency Measure

Finally, a Microsoft excel solver was utilised in computing the consistency of commuters' decision. Based on this, only a consistency ratio of less than or equal to 0.10 or 10% was acceptable as suggested by [14], however, if CR is greater than 10%, the need to revise the pair-wise comparisons either on the suggestion of the analysis tool or the researcher's intuition is introduced. Thus, to measure consistency, the pairwise matrix (Tab. 2) is first normalised (that is, each entry on the table is added up along each column, then the entry is further divided by the respective column sum). Then, the priority vector is calculated through the division of the summed value of each entry along each row by the number of the entries on the normalised table.

Further, the weighted sum matrix is generated through the multiplication of each entry along the row on the pairwise matrix with the respective priority vector. Thereafter, the weighted sum is divided by the respective priority vector. In addition to computing the consistency ratio, the result from the initial computation is then summed and divided by the number of the entries to derive the Lambda max. Then, the consistency index and consistency ratio are calculated based on the aforementioned formula in the research method. Hence, Tab. 3 depicts the results of the consistency measure for Tab. 2.

Tab. 3

Consistency measure

	Normalisation				TOTAL	WEIGHT	AW	AW/W	LAMDA MAX	RI	CI	CR
	JF	F	SS	CM								
JF	0.055556	0.071429	0.0625	0.048077	0.237561	0.05939	0.239202	4.027626	4.032779	0.9	0.010926	0.01214
F	0.055556	0.071429	0.0625	0.086538	0.276023	0.069006	0.277587	4.022671				
SS	0.388889	0.5	0.4375	0.432692	1.759081	0.43977	1.770375	4.025682				
CM	0.5	0.357143	0.4375	0.432692	1.727335	0.431834	1.751145	4.055136				
	1	1	1	1								

Tab. 3 depicts the normalisation generated value, priority vector (that is weights), the Lamda max of 4.032779, the consistency index of 0.010926 and the consistency ratio of 0.01214. Thus, based on the consistency ratio value which is less than 10%, the commuter's judgment can be said to be consistent. Therefore, this is continually done to the other pairwise matrix to generate the unified matrix to be tested for consistency.

Step IV: Synthesis
Lastly, based on the nature of the hierarchical structuring of the research decision problem, the global priority is derived through the multiplication of the local weight of both criteria and the alternative.

B. Findings on research objectives
After the unification of the pairwise matrices, the combined matrix is generated and final computation is actualised with weights generated (that is, the priority vector which dictates the direction of interpretation of results in relation to the objectives) and the consistency ratio also derived to determine whether commuters' judgment was consistent.

Findings on criteria in relation to goal
Below is the combined pairwise matrix with its final computations of results and priorities of criteria to the main goal of prioritisation of commuters' needs of ferry services.

Tab. 4

Combined final computation of weights and priority of criteria to goal

Commuters' needs of ferry services	JF	F	SS	CM	WEIGHT	AW	AW/W	LAMDA MAX	RI	CI	CR
Jetty Facilities (JF)	1	1 1/7	1	1	0.253529	1.078095	4.252348	4.25229	0.9	0.084097	0.093441
Fare (F)	1	1	1	7/8	0.218132	0.927774	4.253274				
Safety and Security (SS)	1 1/7	1 1/8	1	1	0.248362	1.057018	4.255964				
Comfort (CM)	1 ¼	1 1/3	1 2/9	1	0.279977	1.189224	4.247575				
Column Sum	4 1/3	4 5/8	4 1/4	4							

Tab. 4 depicts that among the criteria, the need for comfort was prioritised first by commuters to be of high importance with the weight of 0.279977, that is, 28%, followed by jetty facilities 25%, and the fare serving as the less important factor with a score of 22%. This result can be said to be in corroboration with [15] observation of convenience as one of the paramount indicators that influence passenger selection process of ferry services but, negatively skewed when compared with [11] results on the assessment of service quality of ferry services. However, the perception of commuters' towards fare as the less important factor neglects [15] observation of price as an important factor.

Findings on alternatives in relation to criteria

Respectively, the combined pairwise matrices for alternatives with respect to criteria were also computed and the final computations of weights and priority, and consistency ratio were generated as shown in Tab. 5.

Tab. 5

Combined final computations of weights and priority vectors of alternatives to criteria

Alternatives to Criteria											
Jetty facilities	APS	ACWL	GARJ	RF	WEIGHT	AW	AW/W	LAMDA MAX	RI	CI	CR
APS	1	1 1/9	8/9	1	0.231092	0.981368	4.246647	4.247409	0.9	0.08247	0.091633
ACWL	1 1/6	1	1	1	0.240615	1.021652	4.246005				
GARJ	1 2/9	1 1/8	1	1 1/7	0.264044	1.121468	4.247273				
RF	1 2/7	1 2/9	1	1	0.264248	1.12298	4.249712				
Column Sum	4 2/3	4 1/2	4	4							
Cost	AF	AITD	EOP	WEIGHT	AW	AW/W	LAMDA MAX	RI	CI	CR	

				WEIGHT	AW	AW/W	LAMDA MAX	RI	CI	CR
AF	1	1 1/5	1	0.34537	1.074907	3.112334	3.112945	0.58	0.056472	0.097366
AITD	1	1	1	0.305252	0.950301	3.113169				
EOP	1	1 1/5	1	0.349378	1.08773	3.113332				
Column Sum	3	3 2/5	3							

Safety/security	RMW	ACRO	ALVP	MSA	WEIGHT	AW	AW/W	LAMDA MAX	RI	CI	CR
RMW	1	1 1/3	1 1/9	1 1/3	0.277427	1.170199	4.218045	4.218873	0.9	0.072958	0.081064
ACRO	1	1	1	1	0.24032	1.013876	4.218862				
ALVP	1	1	1	1 1/7	0.249639	1.053622	4.220585				
MSA	8/9	1	1	1	0.232614	0.981168	4.217999				
Column Sum	3 5/6	4 1/3	4 1/5	4 5/9							

Comfort	AM	SGL	OEA	OCA	WEIGHT	AW	AW/W	LAMDA MAX	RI	CI	CR
AM	1	1	1 1/3	1 1/5	0.262663	1.116861	4.252072	4.254059	0.9	0.084686	0.094096
SGL	1 1/6	1	1 4/9	1	0.272399	1.159711	4.257405				
OEA	8/9	8/9	1	8/9	0.216297	0.919163	4.249537				
OCA	1	1	1 1/3	1	0.248641	1.058522	4.257222				
Column Sum	4	3 5/6	5 1/9	4 1/5							

Tab. 5 results depict that from the jetty facility criteria, availability of recreational facilities (RF) slightly edge over good access road to the jetty (GARJ) with 0.02% to attain the most important need of commuters from the angle of jetty facilities, while availability of parking space was prescribed the less important. However, the nature of the result shows the level of importance of all available needs.

Furthermore, observing the results of alternatives within the cost/fare criteria, it can be detected that ease of online payment (EOP) is ascribed more importance compared to other needs with a weight score of 34.94%. This means that the need for user-friendly online payment by an average commuter is of paramount need compared to other relevant needs of commuters, while, availability of incentives and transport discount serves as less important, which is 4% lesser than the most important need. However, previous study conducted by [13] portrays low ranking for ticket-selling network and price amid the observed criteria. This study's judgment is consistent at 0.09% and the slight gap within the needs depicts how tightly important those factors are. Likewise, under safety and security criteria, the commuters perceived regular maintenance of waterways (RMW) as the most important need among other needs with an ascribed weight of 27.74%. This is followed by availability of life vest for all

passengers (ALVP) and availability of coastguards for rescue operations (ACRO) with 24.96 and 24.03%, respectively, as presented in Tab. 4.

Finally, on the need for comfort, the commuters were of the opinion that seating with good legroom (SGL) is of essential importance compared to others perception of onboard entertainment as the last need from ferry service with a weight of 21.63%.

Findings of global priority

Subsequently, after derivation of local weights for both criteria and the alternatives, the final priority known also as the global priority, is computed through the multiplication of local priorities of both criteria and alternatives. Thus, Tab. 6 shows the result for the global priority.

Tab. 6

Computation of global priority

Criteria local priority	Alternative	Local weight	Global priority
Jetty facilities 0.253529291	APS	0.231092405	0.058589
	ACWL	0.24061486	0.061003
	GARJ	0.26404431	0.066943
	RF	0.264248425	0.066995
Fare/cost 0.21813181	AF	0.345370002	0.075336
	AITD	0.305251949	0.066585
	EOP	0.349378049	0.07621
Safety and security 0.248361669	RMW	0.27742687	0.068902
	ACRO	0.240319889	0.059686
	ALVP	0.249638752	0.062001
	MSA	0.23261449	0.057773
Comfort 0.279977231	AM	0.262662803	0.07354
	SGL	0.272398571	0.076265
	OEA	0.21629725	0.060558
	OCA	0.248641376	0.069614

From Tab. 6, the result presents evenly distributed relative weights of alternative. However, the commuters need for seating with good legroom and ease to online payment, a sub-element of comfort and cost/fare criteria ranks slightly higher compare to other criteria at 7.6%. Surprisingly, the need for parking space, and maintenance and spare parts ranked lesser in the mentioned order. Therefore, to an average operator of ferry service, essential consideration need to be assigned to the following; seating with good legroom, ease of online payment, affordable price, ambience, and onboard convenience of which three of the alternative is attached to the comfort criteria to provide itself with relevant strategies to outdo its competitors.

5. CONCLUSIONS

After the holistic execution of this study, these relevant conclusions were made:

i. As criteria measuring commuters' needs, availability of comfort aids satisfaction compared to its pairs.

ii. In addition, to facilitate commuters' needs based on the availability of jetty facilities, recreational facilities serve as the better need for the average commuter.

iii. On fare/cost alternatives, ease to online payment is of essential priority to commuters compared to its group of alternatives.

iv. While, on safety and the need for security, proper and regular maintenance of waterway was perceived as more important.

v. Being the most important need of commuters, comfort; availability of seating with good legroom was given more depth of importance amid its pairs.

vi. Finally, it can be inferred that to aid competitive sustainable advantage, ferry service operators need to enhance their depth of service provision towards these indicators; seating with good legroom, ease of online payment, affordable price, ambience, and onboard convenience.

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