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Multi-Criteria Decision Making Approach For Selecting Efficient Electronic Banking Institution

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Abstract: In today's digital era, electronic banking has become an integral part of daily life. With a plethora of electronic banking institutions available, selecting the most efficient one can be a daunting task. This study provides a comprehensive overview of the Multi-Criteria Decision Making (MCDM) approach and its application in evaluating and selecting the most suitable electronic banking institution. In particular, this study used Analytic Hierarchy Process (AHP) to evaluate the decision making framework. The evaluation process involves identifying and analyzing key criteria and sub-criteria that are essential for assessing electronic banking institutions. The obtained result showed that the weight of Technological capability was (0.44) followed by Security measures (0.28), Customer service quality (0.16), Cost Effectiveness (0.16) then finally Accessibility (0.05). By using the AHP approach, this study shows that organizations and individuals can make informed decisions and choose the electronic banking institution that best satisfies their requirements, thereby contributing to a more efficient and effective electronic banking experience for customers.

INTRODUCTION

In this information age of the 21st century, where decision-making is fundamentally complex and multifaceted, many factors and forces operating in the business environment continue to exert significant influence on the decision maker and its environment (Haag, and Cummings, 2016). Multi-criteria analysis is then more needful than before by decision-maker/government agencies to be able to choose the best decision that gives optimum and satisfying results for the benefits of the stakeholders (Akinnagbe, and Adeyemo, 2017). In most countries, commercial banks (CBs) are one of the most important financial institutions. It can attract financial flows, offer offering credit and various financial services (Eze, and Egoro, 2016). These activities have a vital impact on national economic development. Therefore, CBs should be evaluated and analyzed by the modern and accurate techniques to rank CBs in the banking system and improve their performances.

The increasingly competitive environment in the financial service market has resulted in pressure to develop and utilize alternative delivery channels. The most recently delivery channel introduced is online banking (Eze, and Egoro, S. 2016). E-banking is defined as "the automated delivery of new and traditional banking products and services directly to customers through electronic, interactive communication channels." Online or electronic banking systems give everybody the opportunity for easy access to banking activities, thus promoting financial inclusion (Khatibinia, Barzegar, and Zandi, 2018). These banking activities may include retrieving an account balance, electronic money transfers and retrieving an account history electronically. Electronic banking (E-banking) has gradually become an indispensable part of modern day banking services. All over the world, banking industry is one of the industries that have adopted technology which helped in rendering better and quality services to customers (Khatibinia, Barzegar, and Zandi, 2018). The quality of services is enhanced using technological innovations.

Technological innovations have continued to engender speed of transactions and prompt service delivery in banks, thus promoting customers' convenience and satisfaction (Suh, and Han, 2003). The financial system of any country provides the catalyst through financial intermediation for productive activities to ensure economic growth and development. With numerous banking institutions offering electronic banking services, customers are faced with the challenge of selecting the most efficient and reliable option (Hammoud, Bizri, and El Baba, 2018). This decision requires careful consideration of various criteria, ranging from service quality and security to convenience and customer support. It considers the preferences and priorities of various stakeholders, including customers, regulators, and financial experts. Consequently, selecting efficient electronic banking institutions in Nigeria, MCDM can be a valuable tool for evaluating the performance of different banks based on various criteria. Thus, a structured multi-criteria decision-making approach that can effectively evaluate and compare electronic banking institutions based on various factors such as technological capabilities, customer service quality, security measures, accessibility, and cost-effectiveness is a challenge. This challenge hinders the efficient utilization of electronic banking services, potentially resulting in service inefficiencies, security vulnerabilities, and suboptimal customer experiences. Therefore, developing a comprehensive multi-criteria decision-making methodology specifically tailored for selecting efficient electronic banking institutions in Taraba State is essential to empower individuals and businesses in making informed decisions and fostering a competing ecosystem. To address this multifaceted issue, this study leverages the Analytic Hierarchy Process (AHP), a robust decision-making framework, as a lens through which to examines how to use a multi-criteria decision-making approach to select the most efficient electronic banking institution. This study makes four objectives contributions to the knowledge. First, identify the key criteria for evaluating banking institutions from customers. Second, compare and prioritize criteria or factors of selecting efficient and effective banking institutions. Thirdly, prioritize and rank the alternatives banking institution based on the identified criteria. Lastly, propose decision making framework for the selection of efficient and effective banking system.

RESEARCH GAP AND MOTIVATION

The studies have shown that more research on MCDM methods is needed to assess the effectiveness of the technique in promoting sustainability and effectiveness of the MCDM method (Belton and Stewart, 2002). This study aims to develop a systematic approach for decision makers to select the most suitable banking institution based on multiple criteria such as accessibility, customer service quality, cost effectiveness, security measures and technological capabilities. However, the question remains as what is the most efficient electronic banking institution based on multi-criterial decision-making approach. Therefore, this study examines how to use a multi-criteria decision-making approach to select the most efficient electronic banking institution.

PAPER ORGANIZATION

The study is organized as follows: section 2 discussed the literature review, section 3 discussed the methodology and hypothesis, section 4 discussed the research methodology, section 5 presented the results of the study, section 6 discussed the findings of the study that comprises research implications and limitations, and section 7 conclude the study.

RELATED STUDIES

This literature review provides an overview of the multi-criteria decision making (MCDM) approach in the context of selecting electronic banking institutions, highlighting relevant studies and methodologies. (Beheshtinia and Omidi, 2017), the hybrid MCDM technique identifies six criteria and 25 sub-criteria for evaluating banks, highlighting the importance of return on investment, debt ratio, and lower energy consumption. (Shao, Han, Sun, Xiao, Zhang, and Zhao, 2020), Multi-criteria decision making methods are commonly used in renewable energy site selection, with literature surveys and expert opinions being key

selection methods. (Sitorus, Cilliers, and Brito-Parada, 2019) Multi-criteria decision making (MCDM) methods have significantly increased in mining and mineral processing, with the Analytical Hierarchy Process (AHP) being the most used method. (Hashemi, Dowlatshahi, and Nezamabadi-pour, 2020) The MFS-MCDM method outperforms other methods in multi-label feature selection by assigning scores to features based on their relationship with multiple labels. (Álvarez, Ishizaka, and Martínez, 2021) review reveals that multi-criteria decision-making sorting methods are in a growth phase, with 16 application areas and a growing understanding of their trends and application. (Taherdoost, and Madanchian, 2023) Multi-criteria decision-making (MCDM) is a decision-making method that considers multiple criteria in various fields, enabling optimal choices in various decision-making processes. (Dotoli, Epicoco, and Falagario, 2020) This paper compares various multi-criteria decision making techniques for public procurement tenders, identifying the best method for transparency, objectivity, and non-discrimination. (Karsak, and Ahiska, 2005) proposed MCDM methodology improves technology selection by enabling further ranking of efficient decision-making units and saving computations compared to cross-efficiency analysis. (Wang, Tsai, Ho, Nguyen, and Huang, 2020) The MCDM model effectively evaluates and selects optimal suppliers in the oil industry, identifying DMU_01, DMU_04, and DMU_10 as the best suppliers. (George, and Kumar, 2014) Internet banking customer satisfaction is influenced by reliability, responsiveness, fulfillment, efficiency, and privacy and security, except for efficiency and website attributes. (Lee, and Lee, 2020) VIP customers value usefulness, ease of use, system trust, responsiveness, and empathy more than general customers in Internet banking. (Li, Lu, Hou, Cui, and Darbandi, 2021) Cloud services, security, e-learning, and service quality significantly influence customer satisfaction in using Internet banking services. (Ma, 2012) Serviceability and reliability significantly impact internet banking customer satisfaction in China, with convenience, comfort, empathy, privacy, security, and assurance being key factors. (Hammoud, Bizri, and El Baba, 2018) Reliability is the most important factor in e-banking service quality, with efficiency, ease of use, responsiveness, and security being key to customer satisfaction in the Lebanese banking sector. (Indrasari, Nadjmie, and Endri, 2022) E-banking service quality, reliability, and design positively influence user satisfaction and loyalty during the COVID-19 pandemic, while privacy and security only affect loyalty, and customer service and assistance have no effect. (Suh, and Han, 2003) customer trust in e-commerce security, including nonrepudiation, privacy protection, and data integrity, significantly impacts e-commerce acceptance. (M. Amin, 2016) Internet banking service quality, consisting of personal need, site organization, user friendliness, and efficiency of website, positively impacts e-customer satisfaction and e-customer loyalty.

RESEARCH METHODOLOGY

The primary objective of this study is to propose a decision making framework grounded in Multi-Criteria Decision Making, MCDM, utilizing the AHP, for the selecting efficient electronic banking institution. The framework is logical for comparing alternatives, and support decision-makers in selecting the best solution based on the defined criteria and objectives. To accomplish this goal, it is a systematic approach used to analyze and solve decision-making problems (Bukar et al, 2023). The methodology typically involves several steps. First, the decision problem is defined, and the criteria and alternatives are identified. The criteria represent the various dimensions or attributes that need to be considered in the decision-making process, while alternatives are the different options available (Belton and Stewart, 2002). Next, the criteria are weighted to reflect their relative importance or priority. This can be done through various techniques such as pairwise comparison, direct weightage assignment, or data-driven approaches. Once the criteria are weighted, the performance or effectiveness of each alternative is evaluated against these criteria. Various techniques and tools can be used, including numerical methods, mathematical models, statistical analysis, or expert opinions (Brans and Jean Pierre, 2005). MCDM methods also allow for trade-offs between criteria and alternatives, considering the potential conflicts or synergies among them (Ceballos, Teresa, and David, 2016). The goal is to find the optimal or preferred solution that best satisfies the decision-maker's preferences and objectives. The final step involves

synthesizing the results and presenting the findings in a meaningful and comprehensible manner. This can include ranking and prioritizing alternatives, sensitivity analysis, visualizations, or decision support tools. MCDM research methodology offers a systematic and rigorous approach to address decision problems involving multiple criteria and alternatives (Ceballos, Teresa, and David, 2016). It helps decision-makers in identifying the best possible solutions, considering different perspectives, and supporting transparent and informed decision-making processes. Figure 1 illustrates the hierarchical structure of multi-criteria decision making, which are discuss accordingly in the proceeding sections.

FRAMEWORK

The study framework consists of several key components that guide the research process. It is a systematic approach used to analyze and solve decision-making problems (Bukar et al, 2023). It emerged to address the complexity and subjectivity associated with decision-making processes by providing a structured methodology to evaluate and rank alternatives against multiple objectives. These techniques help structure the decision-making process, provide a logical framework for comparing alternatives, and support decision-makers in selecting the best solution based on the defined criteria and objectives. These includes:

- **Identify criteria:** Determine the criteria that are important for evaluating the efficiency of electronic banking institutions. These criteria can include factors such as service quality, transaction security, and technological infrastructure, ease of use, customer satisfaction, profitability, and regulatory compliance.
- **Weight the criteria:** Assign weights to each criterion based on their relative significance or importance in the context of electronic banking. The weights can be derived through expert opinions, surveys, or statistical analysis techniques such as Analytic Hierarchy Process (AHP) or Analytic Network Process (ANP).
- **Data collection:** Gather data related to the identified criteria for each electronic banking institution in Nigeria. This data can be obtained from financial reports, customer surveys, official reports, or other relevant sources.
- **Normalize the data:** Normalize the collected data to ensure that the criteria are measured on a consistent scale. This can involve transforming the data into relative scores or percentages.
- **Calculate scores and ranks:** Calculate scores or utility values for each electronic banking institution based on the evaluation results. Rank the institutions based on their overall
- **Performance Decision-making:** Based on the rankings and sensitivity, analysis, make an informed decision regarding the selection of efficient electronic banking institution in Nigeria.

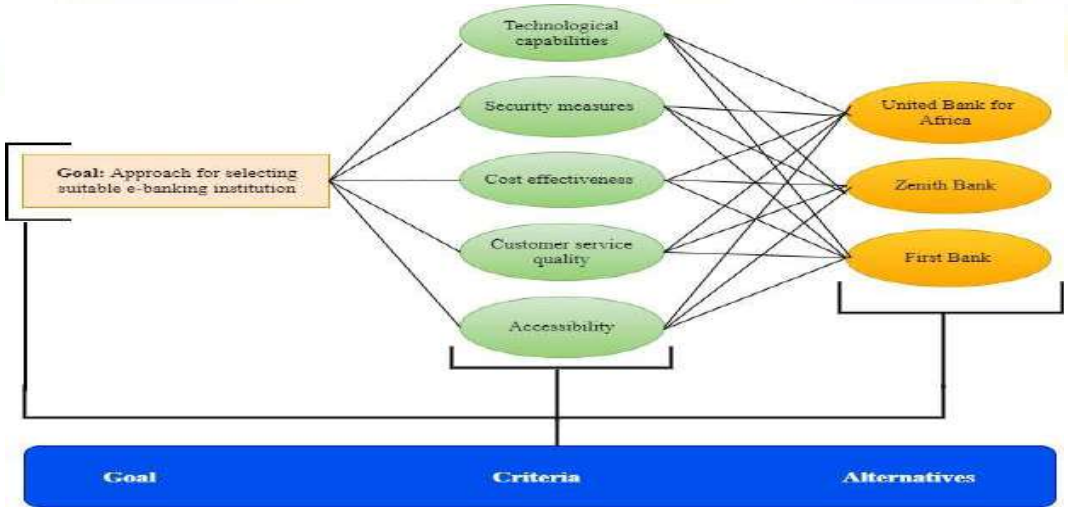

Figure 1: Hierarchical Structure of Multi-Criteria Decision Making

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INSTRUMENT

The study instrument has used based on Analytical Hierarchy Process (AHP). It is one of the most common instrument used in research studies (Sitorus, Cilliers, and Brito-Parada, 2019). It will be administered in a paper-based format (questionnaire) and The survey will include questions that captures pairwise comparisons between different elements in the hierarchy. The responding experts will be given the opportunity to provide their judgments and each judgment will be interpreted accordingly because each responses will be assigned numerical values ratios, indicating the relative importance or preference of one element over another (Sengupta, and Ray, 2016). The conceptual model will be derived from the literature to guide the survey questionnaire design presumptions.

ANALYTIC HIERARCHY PROCESS

Analytic Hierarchy Process (AHP) is developed by Saaty (1980) and then it is used widely as an efficient multi-criteria decision making (MCDM) method for ranking alternatives (Sitorus, Cilliers, and Brito-Parada, 2019). AHP is based on three principles: structure of the model; comparative judgment of the alternatives and the criteria; synthesis of the priorities. One of the main advantages of this method is the relative ease with which it handles multiple criteria (Sengupta, and Ray, 2016). In addition to this, AHP is easier to understand and it can effectively handle both qualitative and quantitative data. The use of AHP does not involve cumbersome mathematics. Because of these reasons AHP has been applied many areas such as personal, social, manufacturing sector, political, engineering, education, industry, government and others which include sports, management, etc. (Saaty et al, 1980). AHP can efficiently be integrated with other methods like mathematical programming, quality function deployment, meta-heuristics, SWOT analysis and data envelopment analysis (Saaty et al, 1980). The main steps of AHP are given as follows directly involving Saaty's scale.

SAATY'S SCALE

Saaty's scale, also known as the Analytic Hierarchy Process (AHP) scale, was developed by Thomas Saaty, as presented in Table 2. It is a measurement scale used to assess a person's relative preferences or priorities for different criteria or alternatives in decision-making processes. The scale is based on pairwise comparisons, where individuals assess the relative importance of criteria or alternatives using numerical values assigned to their importance or preference (Sengupta, & Ray, 2016). The scale typically ranges from 1 to 9, with 1 representing equal importance and 9 representing extreme importance or preference. Intermediate values are used to indicate gradations between the extremes. The AHP scale is widely used in fields such as business, engineering, and social sciences to structure complex decision problems and facilitate decision-making (Saaty et al, 1980).

Intensity of importance	Definition
1	Equal importance
3	Moderate importance
5	Strong Importance
7	Very Strong Importance
9	Extreme Importance
2,4,6,8	Intermediate values

Table 1: Rank for importance of values

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Step 1: First of all, criteria and alternatives of the problem are defined. Then problem is organized hierarchically. The overall goal of this decision making problem is at the highest level and the alternatives are at the lowest level. Criteria and sub-criteria are placed between them. The hierarchical structure is presented in Figure 1.

Step 2: A pairwise comparison of relative importance between the n criteria is defined. In each level, the criteria are compared pairwise according to their levels of influence and based on the specified criteria in the higher level Saaty's 1-to-9 scale shown in Table 1. The comparison matrix is given by 'A' in the following expression

$$A = [aij] \ldots\ldots\ldots\ldots \quad 1$$

where aij = 1/aij

Step 3: Local weights (priorities), priorities of elements in the same level from judgment matrices are calculated. This results in a weight vector shown as

$$eT = (1,1,\ldots 1)$$

where 'e' is the Eigenvector technique

$$w = \lim k \rightarrow \infty \frac{A^k . e}{e^T . A^k . e} \ldots\ldots\ldots\ldots 2$$

which is the normalized principal eigenvector of matrix A. For simplicity the elements of the weight vector are computed as the average value of the rows in the normalized pairwise comparison matrix A.

Step 4: The consistency ratio (CR) is measured by the help of the following formula

$$CR = \frac{CI}{RI} \ldots\ldots\ldots\ldots 3$$

where CI is the consistency Index expressed as

$$CI = \frac{\lambda max - n}{n-1} \ldots\ldots\ldots\ldots 4$$

And

λmax is the largest eigenvalue of A. RI is the average value of CI one would obtain were the entries in A chosen at random, subject that all diagonal entries must equal 1. RI values can be obtained from table 2 for different n values.

N	1	2	3	4	5	6	7	8	9	10	11	12
RI	0	0	0.59	0.89	1.12	1.25	1.35	1.40	1.45	1.49	1.51	1.54

Step 5: A matrix of pairwise comparison between alternatives is then built for each criterion, following the procedure of Step (2). This allows expressing a judgment about how well any alternative compares to the others respect to the considered criterion.

Step 6: A normalized relative rating bij is computed for each ith alternative respect to any judgment criterion CI in comparison with the other alternatives. The normalized relative rankings are obtained by applying the same procedure of Steps (2) and (3) to the pairwise alternatives comparison matrices built at Step (5) The final step is obtaining global priorities (including global weights and global scores) by aggregating all local priorities with the application of a simple weighted sum.

POPULATION

The study population is the total group of a given item in specified environment. It is a fundamental concept in various fields, including ecology, biology, and sociology, and is often used to analyze and understand the characteristics and dynamics of a group. The term can be applied to human populations, animal populations, or plant populations. In this research, our study population is Taraba State.

SAMPLING

Sampling means small group of items taken out of a larger group for study purpose. It is a widely used technique in various fields such as statistics, social sciences, market research, and quality control. The goal of sampling is to gather information about the population by studying a smaller, more manageable subset, which can then be generalized to the larger population. In this study, Jalingo city is the sample scope.

RESULTS AND DISCUSSIONS

AHP is a decision making technique and hence requires a very small sample size for its analysis. In this light, 20 experts responded to our survey and only 11 met consistency requirement. As expressed below, work done was based on the 11 respondents.

THEORETICAL IMPLICATION

This topic has several theoretical implications for selecting an efficient electronic banking institution:

- **Objectivity:** MCDM helps in ensuring objectivity in decision-making by considering multiple criteria simultaneously. This helps in avoiding bias and subjectivity in the selection process.
- **Comprehensive evaluation:** MCDM allows for a comprehensive evaluation of electronic banking institutions based on multiple criteria such as service quality, convenience, security, and costs. This helps in selecting an institution that best meets the needs and preferences of customers.
- **Trade-offs:** MCDM helps in identifying trade-offs between different criteria and options. For example, a customer may have to sacrifice convenience for better security features. By using MCDM, customers can make informed decisions based on their priorities.
- **Transparency:** MCDM provides a transparent decision-making process by clearly outlining the criteria used and how each institution performs on these criteria. This transparency helps in building trust and confidence in the selection process.
- **Flexibility:** MCDM allows for flexibility in decision-making by enabling customers to customize the criteria based on their preferences. This allows for a personalized and tailored selection process. Overall, the MCDM approach can help customers in selecting an efficient electronic banking institution by providing a systematic and structured framework for decision-making. It ensures that all important criteria are considered, trade-offs are identified, and decisions are made transparently and objectively.

PRACTICAL IMPLICATION (TRANSFER THIS SECTION AFTER RESULT)

The MCDM approach can be applied in selecting an efficient electronic banking institution by considering various factors that are important in making a decision. Some practical implications of using the MCDM approach include:

- **Identifying the criteria:** The first step in using the MCDM approach is to identify the criteria that are relevant for selecting an electronic banking institution. These criteria may include cost, convenience, security, customer service, and technological capabilities.
- **Weighting the criteria:** Once the criteria have been identified, they should be weighted based on their importance to the decision-making process. This weighting can be done through consultation with stakeholders or using a structured approach such as the Analytic Hierarchy Process (AHP).
- **Evaluating alternatives:** The MCDM approach involves evaluating different alternatives based on the criteria and weights assigned to them. This may involve collecting data on the performance of different electronic banking institutions and comparing them using a decision-making tool such as the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS).
- **Selecting the best alternative:** Based on the evaluation of the alternatives, the MCDM approach helps in identifying the best electronic banking institution that meets the criteria and objectives of the decision-maker. This can help in making an informed decision that considers all important factors.
- **Continuous monitoring and improvement:** The MCDM approach can also be used for continuous monitoring and improvement of the selected electronic banking institution. By regularly evaluating performance and customer feedback, decision-makers can ensure that the selected institution remains efficient and meets the evolving needs of customers.

Overall, the MCDM approach can provide a systematic and structured way of selecting an efficient electronic banking institution by considering multiple criteria and alternatives. This can help in enhancing the decision-making process and improving the overall efficiency of electronic banking services.

CONSISTENCY CHECK

In AHP, decision-makers compare alternatives based on multiple criteria and assign numerical values to each criterion. Consistency check ensures that the decision-makers pairwise comparisons are logical and do not contain inconsistencies. During the pairwise comparisons, decision-makers are asked to determine the importance of one criterion relative to another. The consistency check evaluates whether the decision-maker's judgments are coherent and free from contradictions. If inconsistencies are found, the decision-maker may need to revise their judgments to ensure the validity and reliability of the decision-making process.

$$\text{Consistency Index (CI)} = \frac{\lambda - n}{n-1},$$

where the n value is the number of rows in the table. Random index (RI) is obtained from a normal table 3.2 above as 1.12 for our n-value being 5.

$$\text{Consistency Ratio (CR) is} = \frac{CI}{RI}. \quad \ldots\ldots\ldots\ldots 5$$

Consistency in pairwise comparisons is essential for achieving accurate and reliable results in MCDM. By verifying the consistency of judgments, decision-makers can enhance the quality of their decisions and promote clearer and more rational decision-making processes.

WEIGHTS

The AHP method calculates the weights of criteria based on the consistency of the pairwise comparisons provided by decision-makers. The consistency ratio is used to assess the reliability and coherence of the judgments made during the pairwise comparisons. If the consistency ratio exceeds a predetermined threshold, decision-makers may need to revise their judgments to ensure more reliable results. The weights derived from the AHP process represent the relative importance of each criterion in the decision-making process. These weights are used to combine the performance scores or evaluations of alternatives across different criteria to calculate an overall score or ranking. By assigning weights through the AHP method, decision-makers can make more informed and structured decisions based on a systematic analysis of criteria importance. The weights are calculated by taking the averages of each row of the normalized matrix able. AW is simply the product of our weights (W) and corresponding elements in our comparison matrix (A) as (A x W). Lambda (λ) in Multi-Criteria Decision Making (MCDM) refers to a weighting factor that is used to assign priorities or importance to different criteria in the decision-making process. Lambda helps decision-makers account for the relative importance of each criterion when evaluating alternatives and making decisions. Lambda Max (λMax) is a specific value of λ that represents the maximum weight that can be assigned to the criteria without changing the preference order of the alternatives. In other words, λMax is the threshold value beyond which the relative importance of the criteria cannot be altered. It is used to check the consistency of decision matrices and ensure the validity of the decision-making process in MCDM.

$$\text{Lamda (} \lambda \text{)} = \frac{AW}{W} \quad \ldots\ldots\ldots\ldots 6$$

Lamda max (λmax) = I the average of all Lamda values in the Lamda column.

AGGREGATE

Aggregate score is calculated by combining the performance evaluations or scores of alternatives across different criteria using the weights assigned to each criterion. The aggregate score represents the overall evaluation of each alternative in relation to all criteria considered in the decision-making process. To calculate the aggregate score in AHP, the following steps are required.

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Assign weights to criteria: Use the AHP method to determine the relative importance of each criterion by conducting pairwise comparisons and deriving the weights for each criterion.

- **Evaluate alternatives:** Assess each alternative with respect to each criterion by assigning performance scores or ratings. These scores can be numerical values, rankings, or ratings based on the decision criteria.
- **Multiply performance scores by weights:** Multiply the performance scores of each alternative by the corresponding weights assigned to each criterion. This step accounts for the importance of each criterion in the decision-making process.
- **Sum the weighted scores:** Add up the products of the performance scores and weights for each criterion to calculate the weighted score for each alternative.
- **Calculate the aggregate score:** The aggregate score for each alternative is obtained by summing up the weighted scores across all criteria. This final score represents the overall evaluation of the alternative based on the criteria and their importance in the decision-making process. By calculating the aggregate score in AHP, decision-makers can compare and prioritize alternatives based on a systematic evaluation of their performance across multiple criteria.

The AHP method provides a structured and quantitative approach to decision-making that considers both the subjective judgments of decision-makers and the objective evaluations of alternatives.

Table 3: Aggregate Criteria Data for (A) from 1 to 11

	Acc	**CSQ**	**CE**	**SM**	**TC**
Acc	1	1/3	1/4	1/5	1/5
CSQ	3	1	2/5	3/7	2/9
CE	3 2/3	2 2/5	1	1/2	1/4
SM	5	2 1/3	2 1/5	1	3/5
TC	5 2/5	4 2/5	3 4/5	1 2/3	1
	18.09	10.46	7.70	3.78	2.27

PRIORITY MATRIX

Priority matrix is a table that express the weights of each alternative against the criteria

Table 4: Alternatives against criteria

Table 4.4.1: Alternatives against criteria

	ACC	**CSQ**	**CE**	**SM**	**TC**
ZB	0.33	0.6374034	0.2556067	0.24856331	0.335966
FB	0.28	0.273035	0.4068479	0.45688882	0.301245
UBA	0.35	0.3680043	0.1832654	0.14047542	0.314335

CRITERIA WEIGHT

Criteria weight is a numerical value that indicates the importance or relevance of a specific criterion in a decision-making process or evaluation. It is used to prioritize different factors or criteria based on their relative significance in achieving a particular goal or outcome. The criteria weight is typically assigned as a percentage or a point value to each criterion to reflect its relative importance compared to

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other criteria. By assigning weights to criteria, decision-makers can make more informed and objective decisions by giving more consideration to the most important aspects of a problem or situation.

Table 5: Criteria weights

Criteria	Weights	Rank
Technological Capabilities	0.44	1
Security Measures	0.28	2
Customer service quality	0.16	3
Cost effectiveness	0.16	4
Accessibility	0.05	5

ALTERNATIVE WEIGHT

Alternative weight refers to the relative importance or value assigned to different alternative options in a decision-making process. This weight represents how much each alternative contributes to the overall objective or goal, and helps in comparing and evaluating different alternatives based on their significance and impact. When considering multiple alternatives, decision-makers can assign weights to each alternative to reflect their relative importance or priority in achieving the desired outcome. By assigning alternative weights, decision-makers can make more informed and rational decisions by considering not only the different options available but also their respective importance in relation to the objective. Alternative weightings are often used in decision analysis, risk assessment, and other decision-making frameworks to help evaluate and compare different options based on their overall impact and importance. It is obtained by;

Alternative Weights = priority matrix x criteria weights.

Table 6: Alternative weights

Alternatives	Weights	Rank
First bank	0.38333	1
Zenith bank	0.37672	2
United bank for Africa	0.28355	3

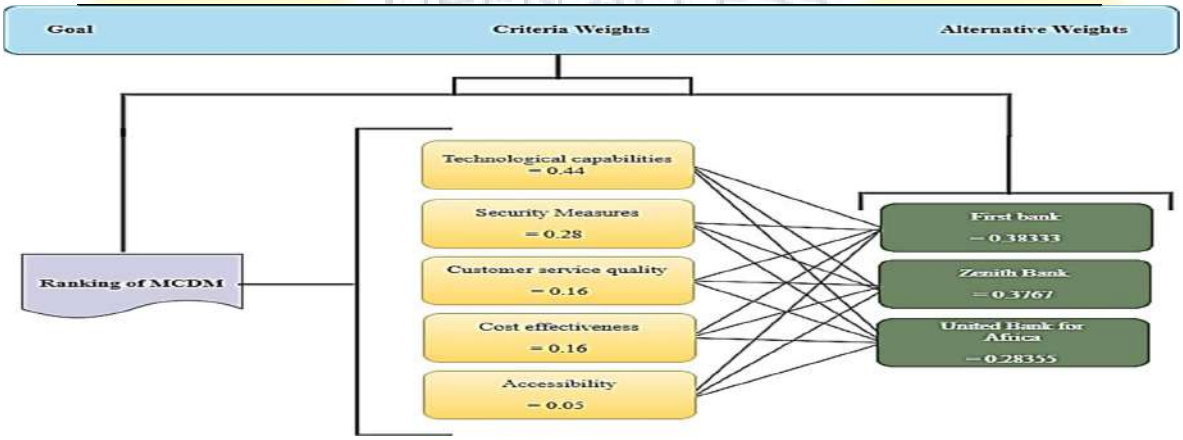

Figure 2: Decision making framework for selecting banking system

DISCUSSION

From the above calculations, the consistency ratio (CR) is 0.0676 which indicates an acceptable level of consistency the pairwise comparison made during the decision making process. It has shown that Technological Capabilities (TC) has the highest weight, followed by Security measures (SM) while Accessibility is the lowest in the decision making process. Additionally, when comparing the alternatives, First Bank and Zenith Bank appeared to be the most favorable options for an efficient electronic banking institution. This research used MCDM approach to assess and rank the efficiency of First Bank, Zenith bank and UBA in providing electronic banking services in Taraba state. The focus was on accessibility, customer service quality, cost effectiveness, security measures and technological capabilities using analytic hierarchy process (AHP) methods. The evaluation revealed that First Bank outperformed Zenith Bank, scoring highest in technological capabilities and security measures while UBA was least. First Bank emerged as the most efficient electronic banking institution in Taraba, excelling in technological capabilities and security measures. Zenith Bank also performed well but was slightly behind First Bank. Customers in Taraba have access to efficient electronic banking services through both banks. The technological capabilities and security measures offered meet customer needs.

SUMMARY, CONCLUSION AND RECOMMENDATION

This study presents the findings from evaluating the efficiency of electronic banking institutions in Taraba state, focusing on First Bank, Zenith Bank and UBA. The results are discussed, and their implications are examined. This research aims to develop a systematic approach for decision makers to select the most suitable banking institution based on multiple criteria such as accessibility, customer service quality, cost effectiveness, security measures and technological capabilities This topic has several theoretical implications for selecting an efficient electronic banking institution. Overall, the MCDM approach can help customers in selecting an efficient electronic banking institution by providing a systematic and structured framework for decision-making. It ensures that important criteria are considered, trade-offs are identified, and decisions are made transparently and objectively. The MCDM approach can be applied in selecting an efficient electronic banking institution by considering various factors that are important in making a decision.

RECOMMENDATION

Both First Bank and Zenith Bank should continue to prioritize and invest in technological capabilities and security measures to maintain their competitive edge and meet evolving customer demands.

CONTRIBUTION TO KNOWLEDGE

Multi-Criteria Decision Making (MCDM) is a way to help people choose the best electronic bank among many options. When picking an electronic bank, there are different things to consider like how happy customers are, how safe it is, how easy it is to use, how much it costs, and how innovative it is and so on. MCDM techniques like AHP help by making a structured method to decide which electronic bank is the best. These techniques give weights to each consideration to show how important it is. This helps in ranking and choosing the electronic bank that best fits what the decision-maker wants. By looking at the importance of each factor, MCDM helps make decisions based on a thorough assessment of all the available choices. Involving people like customers, regulators, and other key players also makes it harder to choose an electronic bank. MCDM helps by bringing in different views and preferences, making sure that all the important things to stakeholders are considered. By including the thoughts and ideas of these people, decision-makers can come to an agreement that includes everyone's interests and priorities.

MCDM also helps in dealing with risks and uncertainties that come with making decisions. In the fast-paced financial world, unexpected events and changes can happen. Using tools like probabilistic models and sensitivity analyses, decision-makers can understand what could happen in different situations and reduce risks when choosing an electronic bank.

As the world of digital banking keeps changing, it's important for decision-makers to keep up with the latest trends and innovations. MCDM is a flexible tool that can adapt to new customer needs, market

changes, and advances in electronic banking technology. By taking these factors into account, decision-makers can pick an electronic bank that is efficient, caters to customer needs, and stays competitive in the ever-changing financial environment.

In summary, using MCDM to choose an electronic bank helps decision-makers make a smart and thorough decision. By looking at many factors, involving stakeholders, and managing risks, MCDM helps make choices that meet customer needs and keep the chosen electronic bank competitive. Further research in this area can explore different MCDM techniques and create tailored decision-making strategies that stay up-to-date with the changing digital banking world.

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