

## A Survey of Multi-Criteria Decision-Making in e- Banking Websites Quality Evaluation

### Tinjauan Terhadap Pembuatan Keputusan Berbilang Kriteria Dalam Penilaian Kualiti Laman Web Perbankan Elektronik

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#### ABSTRACT

Electronic banking grants users access to banking services virtually and offers convenience, ease of use, low cost, time saving, fast delivery and online bill payment. These services are mostly provided through websites; hence evaluation of its quality and services are very important. Website quality evaluation entails numerous dimensions and attributes and the processes which are critical as well as complex requires quality, accuracy and objectivity. This paper surveys the criteria and methodologies that have been used over years in e-banking websites quality as well as e-services quality evaluation. The survey covers articles within a five-year period from 2018 – 2022 which mostly focus on e-banking websites quality evaluation. Twenty-three articles which met the inclusion and exclusion criteria set by the authors are used for the study. Results show that the average number of criteria used in most studies are six with security, privacy and ease-of-use taking the lead as the mostly used criteria across different studies. Also, various types of multi-criteria decision-making model were used by different and there is none that is dominant among them. It was observed that fuzzy type of the various types of multi-criteria decision-making models are mostly used in many studies. In general, studies with focus on e-banking websites quality are not yet given much attention in the literature.

**Keywords:** Multi-Criteria Decision-Making, Fuzzy AHP, Website, Quality, E-banking.

#### ABSTRAK

Perbankan elektronik memberi pengguna akses kepada perkhidmatan perbankan secara maya dan menawarkan keselesaan, kemudahan penggunaan, kos yang rendah, penjimatan masa, penghantaran yang pantas, dan pembayaran bil dalam talian. Perkhidmatan ini kebanyakannya disediakan melalui laman web; oleh itu, penilaian kualiti dan perkhidmatannya adalah sangat penting. Penilaian kualiti laman web merangkumi banyak dimensi dan atribut, dan proses yang kritikal serta kompleks memerlukan kualiti, ketepatan, dan objektiviti. Kertas ini meninjau kriteria dan metodologi yang telah digunakan selama bertahun-tahun dalam penilaian kualiti laman web perbankan elektronik serta penilaian kualiti e-perkhidmatan. Tinjauan ini merangkumi artikel dalam tempoh lima tahun dari 2018 hingga 2022 yang kebanyakannya

memberi tumpuan kepada penilaian kualiti laman web perbankan elektronik. Dua puluh tiga artikel yang memenuhi kriteria penyertaan dan pengecualian yang ditetapkan oleh penulis digunakan untuk kajian ini. Keputusan menunjukkan bahawa bilangan purata kriteria yang digunakan dalam kebanyakan kajian adalah enam dengan keselamatan, privasi, dan kemudahan penggunaan mendahului sebagai kriteria yang paling banyak digunakan dalam pelbagai kajian. Selain itu, pelbagai jenis model pembuatan keputusan berbilang kriteria digunakan oleh pelbagai kajian dan tiada yang dominan di antara mereka. Didapati bahawa jenis kabur daripada pelbagai jenis model pembuatan keputusan berbilang kriteria paling banyak digunakan dalam banyak kajian. Secara umum, kajian yang memberi tumpuan kepada kualiti laman web perbankan elektronik masih belum diberikan perhatian yang banyak dalam literatur.

Kata kunci: Pembuatan Keputusan Berbilang Kriteria, Fuzzy AHP, Laman Web, Kualiti, Perbankan Elektronik.

## INTRODUCTION

The indispensability of the website in the daily lives of individuals globally has raised concerns about websites quality evaluations. This kind of evaluation attempt to measure the website by means of a set of quality requirements with the goal of fetching valuable feedback about necessary information needed to assist in the design and development of high quality and interactive websites. The term quality connotes the extent to which objects adhere to a collection of essential characteristics satisfies a set of requirements. These inherent characteristics refer to the available features found in an entity or object being evaluated to ensure that it attains the needs of users (Ahmad, et al, 2021). One of the intrinsic characteristics is quality, which embodies the behavioural characteristics of the object (or system). Therefore, these factors or characteristics establish the non-functional requirements utilized in judging the operations of websites operations best on perception of the expert evaluators, developers and users (Orhionkpaiyo & Momodu, 2021).

Accordingly, five key quality factors of websites common to financial websites in terms of degree of importance include: accuracy, timeliness, easy-to-navigate, multiple sources and up-to-date. In the educational domain, quality factors of websites include: ease-of-navigation, comprehensiveness, accuracy, search tool and layout. In the case of government websites, top quality factors include: accuracy easy-to-navigate, currency, availability of search tools, and layout. For e-commerce website, the most sought-after quality factors include: product/service concerns, search tools, appropriate explanatory text, security and ease of navigation. The health/medical website considers the following quality factors: accuracy, comprehensiveness, search tool, currency and easy-to-navigate. While in the entertainment domain, the renowned quality factors are multimedia, easy-to-navigate, visual design, responsiveness, and currency (Orhionkpaiyo & Momodu, 2021).

Today, websites play a very significant role in every organisation, and hence, a lot of tremendous efforts is needed to design websites that are of high quality, look and feel good, and usable. In the current dispensation, the banking sector have embraced modern day technological innovation drive by rendering their services online via websites. Hence, today e-banking websites can be navigated effortlessly and compared in terms of quality and service content it provides (Lin et al, 2020) One important task is how these websites can be evaluated in order to ensure users satisfaction with their usability and overall quality (Bacik et al., 2021). Though over the years several methods have been used to evaluate the quality and effectiveness of e-banking, yet there is debate over the usefulness of particular evaluation methods

(Chmielarz & Zborowski, 2018). Therefore, multi-criteria and complex decision-making processes which was developed by introducing some form of logical and scientific approach to decision making in multi-criteria settings such as website quality evaluation (Tseng et al., 2021) is examined in this study.

Based on the importance and tremendous growth of e-banking over the years, it is expected that the quality of services and interaction obtained from this important website genre is investigated. More so, the study is intended to know if the quantity of research in e-banking website quality has increased over the years in comparison to the abysmally low performance in the previous years (Adepoju, et al, 2020). Thus, the following are the research questions (RQ) which the study addresses.

RQ1: What are the studies which focus on e-banking website quality evaluation using the Multi-Criteria Decision Making (MCDM) and other approaches over the years?

RQ2: What are the criteria that are commonly used for e-banking website quality evaluation?

RQ3: What are the MCDM methods used in e-banking website quality evaluation?

To the best of the authors knowledge there is no research that has addressed survey in the domain of e-banking. The remaining parts of the paper are organized as follows: section two provides an overview of electronic banking, section three focuses on website quality evaluation, section four takes look at the review of related studies in e-banking quality evaluation, section five is on quality evaluation of e-banking criteria and sub-criteria, section six describes e-banking criteria methodologies, section seven gives an overview of survey findings and section eight is the conclusion.

## OVERVIEW OF ELECTRONIC BANKING

E-banking resulted from rapid growth in information technology systems which has given rise to globalization and competition. Over the years it has become a viable and dependable medium for bank customers. This is as a result of the ability of the banks to offer services and provide adequate information to the customers seamlessly through several state-of-the-art technology services such as the Internet and mobile phone (Chaimaa et al., 2020). Many organisation have adopted this new model because it enhances the quality of customer service and delivery. Also, it offers reduced costs and time as compared to the traditional approach. E-banking is also regarded as a less costly way of conducting banking business, information exchanged and buying and selling of goods or services from any place at any time is done. It also helps to retain current customers and attract new ones to the bank (Chaimaa et al., 2020).

Mobile banking (m-banking) has emerged as a form of innovative banking channel from the e-banking concept which provides for continuous real-time customer service (Roy & Shaw, 2022). At present, among the banks, e-banking is the common technology been used, that has enabled digital financial institutions and their consumers to conduct transactions through a personal computer's a web-browser linked to the websites of customer accounts. In the real sense, the banking sector has used digital and telecommunications networks to provide an extensive diverse type of products and services with value added. Customer Automated Teller Machines (ATM) or Cash Dispensers (CD), Phone-banking, Internet-banking, and Mobile-banking were deployed as modern distribution platforms or e-banking measures (Dhanya & Velmurugan, 2021).

E-Banking enables customers of banks to use their services without the need for direct contact with the bank officials, which is a kind of self service. However, in 1995, Rogers highlighted the assurance factor as a challenge faced by individuals operating new technologies. Education and understanding levels of customers are different that will assist banks in developing and tailoring their e-banking platforms to meet customers' needs, easy to use without complexities in operating e-banking services. Other service quality metrics include: innovation, security, accessibility, tangibility, usefulness, and trust. In particular, the concerns about security and privacy of e-banking products and services are due to reliance on Internet backbone through websites and software applications (Chhaya & Mittal, 2021).

Presently, almost no organizations do not have a web presentation (comparable to an ID card), which enables them to become visible on the Internet. Therefore, web presentations become a significant factor in order to keep up with other organizations, maintain competitive advantage and attract new customers. For a website to be effective, it should be a major source of information with provision for complete information on the available products and services. It must allow for quick and easy access to information with provision of tools like search engines. Customers must be able to interact with it seamlessly and easily and the website's name should be able to be recalled easily. Also, appropriate levels of service interaction like customer service should be provided by the websites. In addition to this, provision should be made for personalisation, and ease of contact in the events.

The processes of improving organizations' web presence require Multi-Criteria Decision Making (MCDM) which is an operational research approach for problems when a decision is made about selecting two or more possible alternative solutions. In this case, key evaluation criteria have been applied to evaluating websites for the purpose of revealing their quality and weaknesses in various areas of e-commerce and finance (Stanujkic et al, 2018). In evaluating the website quality, three key approaches were reported by (Abbasi et al. 2018): The first one involves using a machine that uses software to record the key features found in a website automatically. The process is completely automatic by the software and the opinions of visitors or users are not sought. The second approach involves experts as judge typically involving the researchers identifying a set of characteristics which are used to classify the sites. Thirdly, there is customer as judge approach in which customers and those who consume the information are used to evaluate the website.

#### MULTI-CRITERIA DECISION-MAKING CONCEPT

MCDM simply refers to decision-making involving multiple and usually conflicting criteria. MCDM methods are generally in problems which are complex in nature where conflicting criteria exist to assist in decision-making processes (Mahmut Bakır & Özlem Atalık, 2021) It revolves round evaluating a set of alternatives based on the number of criteria. MCDM entails decision making with multiple but usually conflicting criteria and the central problem is evaluating a set of alternatives in terms of a number of criteria It is also known as Multi Criteria Decision Analysis (MCDA) and is categorized into two; Multi-Objective Decision Making (MODM) and Multi-Attribute Decision making (MADM). MODM decision variable has values which is based on an integer or continuous domain. The value can be infinite or a large number of alternative choices. On the other hand, MADM methods handles problems with discrete decision spaces. The number of alternatives choices are predetermined or limited.

The common variants of MCDM are: Analytical Hierarchy Processing (AHP), Vlse Kriterijumska Optimizacija I Kompromisno Resenje (VIKOR) meaning Multicriteria

Optimization and Compromise Solution, Decision Making Trial and Evaluation Laboratory (DEMATEL), MultiAttribute Utility Theory (MAUT), Analytical Network Processing (ANP), ELimination Et Choix Traduisant la Réalité or Elimination and Choice Translating Reality (ELECTRE), Preference Ranking Organization METHod for Enrichment Evaluations (PROMETHEE), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). Decision makers complex problems may be in form of, selection, prioritisation, evaluation which covers website quality hence MCDM approach can be applied to it one or more of these methods have been applied over the years to evaluate different genres of websites (Bakır & Atalık ,2021; Gong et al., 2021; Pamucar et al, 2018; Adepoju et al,2020,)

The principle of MCDM is to simplify a complex decision problem through hierarchical structure representation composed of criteria and sub-criteria. The alternatives are then evaluated with a pairwise comparison against the criteria (Tseng, et al., 2021).

### WEBSITE QUALITY EVALUATION

Website quality evaluation on the part of the users attempts to determine that features of a website satisfy their needs, which depicts the overall superiority of a website. In this case, the success of websites relies on whether the design is tailored towards the needs of consumers. Diverse criteria and sub-criteria have been developed to enable the website quality evaluation achievable (Chang & Chen, 2008; Akincilar & Dagdeviren, 2014) including customer oriented (fulfilment, personalization, playfulness, customer retention, responsiveness, feedback, and contact information), other factors (visual appearance, site content , interactivity multimedia, site design, site management, and technological integration), security oriented (privacy and trust and security), marketing oriented (online transaction, promotion, order confirmation, customer and service advertising), and technology-oriented (information quality, accessibility, navigability and usability).

Essentially, the quality of the website is made of a set of criteria that is used to determine the level of fineness of a website. Quality attributes are imperative in predicting the quality of a website. It is specifically critical that instrument designed for measuring the consumer's perception of website quality is developed using various quality attributes including: Loading Time, Total Size, Social Media, Broken Links, Communication, , Compatibility, Overall Theme, Relevance, Global Audience, Resolution, Connectivity Typography and Font, Colour Scheme, and Keyword matching or Page Rank (Kumar & Arora, 2019).

Other criteria for website quality evaluation have been developed over the years from different perspectives such as online banking content, special content quality, appearance quality, technical quality and general content quality (Bacik et al., 2021). The degree of satisfaction of consumers with online service platforms depends on the website quality. The process of evaluating the quality of a website accounts for its usability, which is a module of website quality. Therefore, it is essential to measure the quality of a website as a development strategy for improving service, and raising agent satisfaction such as WebQual 4.0 evaluation method (Sari & Pangaribuan, 2019).

### REVIEW OF RELATED STUDIES ON E-BANKING QUALITY EVALUATION

Al Shammari and Mili (2019) developed a Fuzzy AHP (FAHP) MCDM model to select of commercial banks customers. The study involves the use of six criteria with five retails commercial banks in Bahrainia as alternatives A three-level hierarchical structure was used in

the decision problem formulation. Thereafter, relative weights of the criteria used for the evaluation were calculated by using FAHP. The results indicate that, most banks focus more on pricing strategy at the expense of bank facilities. Furthermore, credits and deposits interest rate and transaction costs were the main factors that attract customers. This support decision makers in developing the appropriate strategies towards their preferences of customers. Bacik et al. (2021) studied the impact of website quality on the usage and performance of e-banking. The model was based on the theory of Unified Theory of Acceptance and Use of Technology (UTAUT) and use of technology. The study identified some websites features and how they have impact internet banking usage by tourists in their destinations. The results indicate that quality of websites have indirect on the behaviour of users. This is based on the internet banking usage frequency.

Emam et al. (2021) developed a theoretical framework to examine the impact gamification has on website features. The criteria used are webpage characteristics, website design, ease-of-use and website information using e-banking in Washington DC. Data were collected from a hundred customers who had prior interaction with e-banking websites which used gamification so that their financial transactions can be monitored. The instrument of data collection was online questionnaire and it was found out that gamification significantly all those criteria used in the study. Butt (2021) study was conducted in Pakistan to analyse customers' behaviour intentions to use online-banking. It considered mediating influence of customers' trust on association of e-banking service quality (E-BSQ) and their behaviour intention (BI) as users of service. The author utilised e-service quality criteria such as security / privacy, fulfilment/system, reliability, efficiency, trust, customer behaviour intentions, responsiveness/communication, e-banking service quality.

Sari and Pangaribuan (2019) study focus on websites quality and agent satisfaction. The WebQual 4.0 method was adopted for analysing thirty sample from registered agent. The criteria used in the study include: usability of website and satisfaction of customers, while the sub-criteria include: product quality, price, service quality, emotional, and cost. The study revealed that the usability of the payment website can be used to enhance agent satisfaction. This implies that the more usable the usability of online payment websites the better the agent satisfaction. Das and Ravi (2021) in their study assessed the service quality dimensions and then measure the impact of each factor like website design, responsiveness/communication, security/privacy and reliability on satisfaction of customers. The data was gathered through an online questionnaire from one hundred and forty-nine respondents. The data was analysed using correlation, Regression and weighted average tests. The outcomes can assist banks in planning service quality improvements of e-banking service in order to attain customer satisfaction. Gill et al. (2021) used customers involved in the usage of online banking services from top five commercial private banks in Pakistan to serve as population of their study. By using structural equation modelling (SEM), it was observed that there is significant impact of security, web design and reliability on customer trust which in turn lead to higher loyalty based on cognitive, motivational relational theory.

Hammouri et al. (2021) developed a theoretical framework for examining the association between trust and security in online banking. Seven variables were collected in relation to the security issues in internet banking including: privacy, authorization, confidentiality, availability, authentication, non-repudiation and integrity. Thereafter, a research model was proposed for e-banking services. Reddy and Megharaja (2021) in their study focused on the relationship between customers satisfaction and the e-banking service quality dimensions. They intended to know which dimensions can possibly have the strongest impact on customer

satisfaction. Data were obtained from Lebanese bank customers through a survey instrument. By using SEM, the result reveals that, service quality and reliability are strong predictors of customer satisfaction. Chhaya & Mittal (2021) also attempted to identify factors mostly influencing the quality of service in adopting e-banking services. The primary survey method was used to gather data from bank customers in Indian private and nationalized banks. Results obtained by using SEM shows that service quality factors have great impact on the service quality of e-banking service such as ease of use and perceived security. Also, the e-banking service quality remained one of the unavoidable components of the banking sector for increasing profits, reputation, and competitive edge through raising customer satisfaction levels.

Agrawal et al (2020) combined three MCDM models of AHP–TOPSIS–DEMATEL to evaluate the quality of e-service quality of four banks in India. Criteria used in the study are responsiveness, efficiency, reliability, personalization, website aesthetic, security and trust, contact, ease of use and fulfillment. The study concludes that reliability and ease of use are the most important influencing factors of e-service quality in banks. Chaimaa et al. (2020) highlighted on e-banking concept, challenges and security risks connected with the use of technology. The study proposed security solutions in order to compare it with the user requirements for e-banking. It was discovered that most of e-banking security model systems are susceptible to attacks, complex to use and expensive. Therefore, the solutions proposed did not satisfy customer requirements for the internet banking system. Ullah (2021) focused on the impact e-banking service quality (EBSQ) dimensions have on the customer loyalty along with the mediation role of customer trust. The study was conducted in Malaysia with data obtained from two hundred and twenty respondents in five commercial banks. Support, website design, reliability and customer service were found to be statistically significant; while security and privacy have negative influence on customer loyalty. It was further discovered that there is significant impact of mediation role of customer trust in determining relationship between customer loyalty and dimensions of EBSQ

Orhionkpaiyo & Momodu (2021) considered five different website domains (e-health, education, e-commerce, e-banking and hospitality/tourism) to detect the critical quality characteristics. The quality characteristics in each domain were highlighted using conceptual content analysis of available literature. The outcomes showed that academics highly ranked e-banking website quality criteria to include: accessibility, privacy, availability, efficiency, and usability. On the other hand, developers ranked security, reliability and privacy as topmost characteristics.

Kimiagari & Baei (2021) investigated new decision factors that influence the behaviour of user's intention and real usage towards e-banking. The Technology, Organisation and Environment (TOE) framework and TAM theory were used to formulate evaluation model for Iranian banks. Partial Least Squares (PLS) was used to explain the inter-correlations within model constructs such as social influence, behavioural intention, initial trust, bank reputation, structural assurance, task-technology and task characteristics. Results shows that perceived bank size or geographical spread and social media campaigns of banks can increase users' e-banking actual usage. Fuzzy best–worst method (Fuzzy-BWM) and fuzzy TOPSIS were combined in modelling the m-banking applications choice in (Roy and Shaw, 2022). It was found that, application performance expectancy, convenience and functionality were important factors in choosing an m-banking application followed by compatibility, security and performance quality. This enables the complex decisions and ambiguity of identifying potential

factors for choosing m-banking applications available by customers using fuzzy set theory approach.

The evaluation of e-banking website quality for twenty-seven Poland banks were carried out using own conversion, Promethee II, PROSA and TOPSIS methods was conducted by (Chmielarz & Zborowski, 2022). The obtained results showed superiority of automated evaluation approaches against others for MCDM problems undertaken. The essence of website quality in promoting online purchases was considered by the study in (Wicaksono & Ishak, 2022). Several other factors such as electronic word of mouth, customer satisfaction, receiver perspective, and brand image as influence online purchases. These criteria were measured by means of different sub-criteria. After analysing with SEM and AMOS 24 software, the outcomes revealed that website quality have larger importance on customer satisfaction, brand image, and online purchase intentions. But online shopping became possible because of e-banking applications, which make the argument plausible.

## RESEARCH METHODOLOGY

The study is carried out in order to see the trend in the use of MCDM and other approaches for e-banking website quality evaluation using a survey of literature-based methodology. The survey steps involve first planning of the review process which aims at identifying the need for the review, formulating of research questions and selection of search criteria. The next stage is carrying out of the review via survey of literature. The final stage is dissemination of review report.

The strategies used in searching for related material in the study involved identifying both journal and conference articles in computer science and related fields from digital library databases like Science direct, Inderscience, IEEEExplore, Taylor and Francis, ACM among others. Only papers published from 2018 to 2022 were included in the study and only articles published in english were considered.

The search terms used are:

“e-banking website quality AND “multi-criteria decision analysis”

“e-banking website quality” AND “multi-criteria decision-making.”

“online banking website quality AND “multi-criteria decision analysis”

“online banking website quality” AND “multi-criteria decision-making.”

Articles retrieved were analysed mainly based on various methods in evaluating e-banking website quality and the number of criteria/sub-criteria used in the studies. A total of twenty articles were used for the study after eliminating unrelated articles.

## ANALYSIS AND RESULTS

This section discusses the results of survey classification based on criteria used and the number and the various MCDM methods as well as other allied methods used in e-banking website quality and service evaluation studies.

### ANALYSIS OF E-BANKING WEBSITE QUALITY EVALUATION BASED ON CRITERIA

The evaluation criteria are required to measure e-banking website quality which account for core features that good quality websites possess according to (Abbasi et al. 2018). MCDM approach works by taking into consideration different criteria and in some cases sub-criteria of the alternatives to be evaluated, ranked or selected. Due to fact that some studies mainly focus



on criteria used in formulating the MCDM models, the results presented here is only limited to various criteria used. This is a very important analysis based on the fact that criteria are very important in the formulation of MCDM methods. This is presented in Table 1.

TABLE 1. Criteria and Sub-Criteria Of E-Banking Websites Quality Evaluation.

S/N	Author(s)	Criteria/Number
1.	Roy & Shaw (2022)	convenience, simplicity, compatibility, expectancy, performance quality, functionality, responsiveness, security, trust, reliability (9)
2.	Chmielarz & Zborowski (2022)	Security, visualization, navigation, readability & ease-of-use, functionality, anti-crisis measure (18)
3	Lotko(2022)	Efficiency, fulfilment, system availability, privacy (4)
4	Angusamy et al., (2022)	Ease-of-use, security and privacy, reliability, responsiveness (4)
5	Mwiya et al (2022)	security, responsiveness, website attribute, reliability, efficiency, privacy, fulfilment (7)
6.	Bacik <i>et al.</i> (2021)	Helpful, Completeness, Clarity, Current, Descriptive, Accurate (5)
7.	Butt (2021)	Reliability, responsiveness & communication, system & fulfilment, efficiency, privacy & security, Trust (6)
8.	Das & Ravi (2021)	Reliability, security and privacy, website design, responsiveness and communication, service quality, length of usage (6)
9.	Gill <i>et al.</i> (2021)	Trust, reliability, website design, security (4)
10.	Reddy & Megharaja (2021)	Reliability, responsiveness, assurance, tangibles, empathy (5)
11.	Chhaya & Mittal (2021)	Security, trust, accessibility, Tangibility, usefulness Ease of use (6)
12	Mahajana et al., (2021)	efficiency, fulfilment, security, quick responses, easiness (5)
13.	Lin et al, (2020)	Perceived usefulness, ease of use, risk, trust, satisfaction (5)
14.	Kimiagari & Baei (2021)	Social influence, Behavioural intention, Initial trust, Bank reputation, Structural assurance, task technology fit, task characteristics. (7)
15	Agrawal et al (2020)	responsiveness, efficiency, reliability, personalization, website aesthetic, security and trust, contact, ease of use and fulfilment (9)
16	Özdemir & Turna (2020)	Load time, page speed, mark up, speed index, visitors, page view
17	Mujinga (2020)	Efficiency, system availability, privacy, fulfilment (4)
18	Singh (2019)	Responsiveness, Perceived credibility, Efficiency (3)
19	Shankar & Jebarajakirthy (2019)	privacy & security, reliability, customer service & support, website design (4)
20.	Al-Shammari & Mili (2019)	Interest rates on loans, Interest rates on deposit, fees & commission, branches and ATMs; transactions delays and staff recommendation (6)
21.	Liang <i>et al</i> (2019)	Product quality, ease of use, security, responsiveness and privacy. (4)
22	Halvadia & Halvadia (2018)	information quality, website design, ease of use, reliability, security & privacy, interactive interrogation, personalization/customization, basic service quality, other financial products' service quality & added values (10)
23	Hammoud (2018)	reliability, ease of use, efficiency, responsiveness & communication, security & privacy (5)

From the results presented in Table 1, total number of criteria used varies from across different studies. However, the most common frequency is six which implies that most studies used about six criteria. This is slightly closed to study by Adepoju et al., (2020) who reported that the number of criteria mostly used by authors in website usability and quality evaluation many genres of websites was five. MCDM being a decision-making methodology does not give room for much complexity in decision making to avoid too much cognitive load in information

processing by the human actor which can cause fatigues and error. Another observation from the Table 1 is that, criteria like security, privacy, ease-of-use are common across all the studies. This shows the importance of these criteria in e-banking. This further support research by Yoti & Kesharwani (2020) which identified ease-of- use and security among other criteria popular among the users of internet banking

## ANALYSIS OF E-BANKING WEBSITES QUALITY BASED ON MCDM AND OTHER METHODS

Many MCDM approaches are used to evaluate quality of e-banking websites which is often based on criteria, dimensions or factors. Results obtained from the papers review are presented in Table 2.

TABLE 2. Websites Quality Evaluation Methodologies

S/N	Author(s)	Methodology
1.	Roy & Shaw (2022)	Fuzzy-BWM and fuzzy-TOPSIS
2.	Chmielarz & Zborowski (2022)	Conversion method, TOPSIS, Promethee, PROSA.
3	Lotko (2022)	SEM
4	Angusamy et al., (2022)	SERVQUA, TAM
5	Mwiya et al (2022)	E-SERVQUA
6.	Bacik <i>et al.</i> (2021)	UTAUT
7.	Butt (2021)	E-SQUAL
8.	Das & Ravi (2021)	Correlation, Regression, ANOVA.
9.	Gill <i>et al.</i> (2021)	PLS-SEM)
10.	Reddy & Megharaja (2021)	SEM
11.	Chhaya & Mittal (2021)	SEM
12	Mahajana et al., (2021)	SEM
13	Agrawal et al (2020)	AHP TOPSIS DEMATEL
14	Mujinga (2020)	ESQUAL
15	Lin et al, (2020)	DEMATEL-ANP-SEM
16	Özdemir & Turna (2020)	AHP, TOPSIS, VIKOR
17	Kimiagari & Baei (2021)	TAM
18	Singh (2019)	SEM
19	Shankar & Jebarajakirthy (2019)	SEM
20	Al-Shammari & Mili (2019)	FAHP
21	Liang <i>et al</i> (2019)	TODIM, Pythagorean Fuzzy VIKOR.
22	Halvadia & Halvadia (2018)	Content analysis
23	Hammoud (2018)	CB-SEM

Table 2 shows that different variants of MCDM have been used to evaluate e-bank website quality. However, it could also be seen from Table 2 that Structural equation modelling (SEM) are also widely used as well though the focus is service quality which is obtained through the websites.

## FINDINGS

The paper identified that MCDM models have been considered in e-banking websites evaluation problems. Accordingly, three dimensions of solutions are obtainable with MCDM

techniques including: reaching decision of choosing the best options from pool of alternatives; ranking through the arrangement of various alternatives in acceptable order of preferences; and classification by sorting decision alternatives according to specified order of categories (Chmielarz & Zborowski, 2022).

Fuzzy analytical hierarchy process (FAHP) (Al Shammari & Mili, 2019), fuzzy TOPSIS, TODIM and VIKOR (Liang et al. 2019) were among most adopted methods of e-banking website quality evaluations. Again, in most papers the criteria and sub-criteria were constructed inline with products, users and services expectations while some others leave out the subcriteria. There is no preference for any technique but the foundation of every MCDM problem is AHP which is based on Saaty's scale and featured in most papers (Kumar et al. 2021).

Other methods identified in the studies are SEM, SERVQUAL and e-SERVEQUAL. Although, these are used mostly in studies involving e-service quality from customers' perspective. However, the result here agrees with the study of Deraz & Iddris (2019) which equally identified SERVQUAL & e-SERVEQUAL as the main theoretical framework used in knowing customers satisfaction with internet banking services.

## CONCLUSION

This paper discussed the subject of e-banking quality evaluation by highlighting on the concepts, criteria, MCDM methodologies and state of e-banking websites quality evaluation research. It was found that different criteria as well as criteria are required for e-banking website quality evaluation as reported in the literatures. Largely, the fuzzy integrated with many MCDM model was identified as capable of improving the decision-making process into somewhat hierarchical structure of criteria and sub-criteria, which are used to determine the best combinations for evaluating e-banking websites quality. The number of studies available in literature which focus on e-banking website quality are still not enough considering the importance of e-banking websites in this dispensation. Future studies can focus on review of e-banking websites usability evaluation and efficiency evaluation. Another area is to focus on e-banking service quality evaluation especially from the perspectives of diverse customers.

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