British Journal of Mathematics & Computer Science
16(3): 1-22, 2016, Article no.BJMCS.25359
ISSN: 2231-0851

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Integrating AHP-TOPSIS Approach on Prioritizing Self-Service Technology (SST) Decision Making in Financial Institution (TOGO)

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

Article Information

DOI: 10.9734/BJMCS/2016/25359
Editor(s):
(1) Radko Mesiar, Head, Department of Mathematics, Faculty of Civil Engineering, Slovak University of Technology Bratislava, Slovakia.
Reviewers:
(1) R. Praveen Sam, Jawaharlal Nehru Technological University, Anantapur, India.
(2) Baofeng Shi, Northwest A&F University, China.
(3) Fang Xiang, University of International Business and Economics, China.
Complete Peer review History: http://sciencedomain.org/review-history/14363

Original Research Article

Received: 29th February 2016
Accepted: 16th April 2016
Published: 27th April 2016

Abstract

Aims: Expansions of new technological innovations in networks, Self-Service Technologies (SSTs), are increasingly shifting the way customers interact with firms to create service. However, lots of service innovations have been unsuccessful to generate revenue due to lagging adoption issues. This research is to assess some of the critical variables that affect consumer choice of SST and to determine the best one given the most consumers' satisfactions for the criteria identified through the integrated AHP-TOPSIS framework that is a MCDM approach.
Study Design/Methodology: This paper used Analytical Hierarchy Process (AHP) to compute the weighting values and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) to evaluate the SST's ratings through the helps of five experts in the fields.
Place and Duration of Study: Togo, one of the developing countries in West Africa has been chosen for the duration of two weeks in December 2015.
Results: It revealed that Purpose criteria (59.1%) with Fund Transaction sub-criteria (37.20%) to be the utmost significant factor that could aid banking customers in the choice of SST; Moreover, ATM was identified as the best alternatives behind Online Banking (O-B) and Mobile Banking (M-B) respectively.
Conclusion: The main contribution concludes to the fact of how lower adoption rate is M-B in Togo.

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Both Financial Risk and Transaction Cost reducing policies should therefore be promoted strongly. In addition, Banks operating M-B services compared to prevailing competitors services in a related area such as O-B, should bring innovative services by increasing the Perceived Benefit of SST. These diversities strategies can also be achieved through adding more benefit factor that create incentive for SST users to opt for mobile banking in the near future. Furthermore, the outcomes show that, with slight modifications, the benchmarking structure AHP-TOPSIS proposed can be useful guidance to most of financial institutions in their selection's decision-making.

Keywords: Self-Service Technology (SST); Banking Industry; Multi-Criteria Decision Making (MCDM); Analytical Hierarchy Process (AHP); Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS).

1 Introduction

As the number of PCs, Mobile Phones and Internet users is increasing, the need for the financial institution predominantly the banking industry to follow the trend of Information Technology in order to gain competitive advantage on the field for their potential customer has also increased. According to Internet Live Stats (elaboration of data by International Telecommunication Union (ITU) and United Nations Population Division), approximately 40% of the world population has an internet connection facility today. In 1995, it was less than 1% and this figure has boosted tenfold from 1999 to 2013. The first billion was reached in 2005, the second billion in 2010 and the third billion in 2014. Convergence of technologies has made the delivery of services more suitable than ever before. A report from Wall Street financial stipulated that, if online stock trading were the foremost, the online insurance trading the second wave of revolution in the industry of financial services, then it appears that online banking is the third internet revolution wave in this business. As a result, banks are putting efforts in e-banking services more than before and investigating further to provide high quality services that accurately satisfy customer's requirements and expectations.

However, the banking technology services put in place for the benefit of its customers lagging of full acceptance and usage. The growth in this technological adoption rate is still sluggish and become a tremendous challenge for the banking industry. This particularly occurred with the technology that is planned to be used by the customer without the aid of the provider [1]. Allowing for this type of technology, SST (Self-Service Technology) is part of the technology which has been applied in the delivery of many services as a support to the front-line worker who interacts with the consumer [2]. Additionally, it is generally more challenging to persuade customers to used new technology in service than an employee to use it.

Previous extend researches have been conducted to explore the features and dynamics of interpersonal interactions between service providers and customers [3,4,5], nevertheless much less researches was done on the issues of customer interactions with technological interfaces [6,7]. Since the main idea toward the establishing of any business is to gain profit and successfully increase competitive marketplace at the end, integrating new technology may be a significant drain on resources in the case the consumers have the reticence or not widely accepted it. In the field of banking sector, the most used SST technology is ATM, Online Banking, and Mobile Banking. Therefore customers will gradually be confronted with the need to evaluate the different opportunities against threats based on the available SST settle by banks. Previous studies conducted have been for the selection of SST by their consumers in general and more concentrated in the developed Countries.

The purpose of this research is to help , the bank managers to get insight to the evaluation of the Self-Service Technology offer to their consumers in order to access the best quality of its and create the best environment for the entirely consumer acceptance. Reducing the labor cost, and expands the options for delivery is the extensive request by the bank which integrates these technologies [8,9].

Definitely, SST implementation and its usage differ across contexts and cultures. Thus, consumers in developing nation or less developed countries facing political conflict, terrorism and war situations which is refer as high-risk, might appreciate SST usage quiet differently as compared to the developed countries. Togo, one of the developing countries in West Africa, is selected for this study as it has been proved for low technology penetration rate. Furthermore, to the best our knowledge, no multi-criteria decision making (MCDM) techniques has been used to assess self-service technology of any financial company in the country. Mostly, financial institutions in Togo evaluate the technology service on the managerial scale. Due to the existence of qualitative, quantitative and multiple criteria that demand consideration in the decision process, the SST choice can be model as a complex MDCM process.

The contributions of this study are to assess some of the critical variables that affect consumer selection of SST, essentially using AHP-TOPIS conceptual framework to weigh against each indicator or criteria and sub-criteria in order to select the best alternative among ATM, Online Banking, and Mobile banking. Thus, to recommend different strategies that can better fit the selected SST getting the lower preference among. These overall outcomes can be a useful help for both Financial Institutions management and SST's users. To recommend the benchmarking structure AHP-TOPSIS model if possible with the slight modification.

The rest of this paper is organized as follows: Section 2 describes the Related Works, Section 3 Research Methodology, Section 4 Numerical Application of the Proposed Method and finally Section 5 with Discussions and Conclusion.

2 Related Works

Service encounters are proved to be one of the major incentives for consumers in the process of gaining satisfaction about their needs and wants principally when they are dealing with their financial institution. As far as the monetary issue is concerned, banking consumers would like to get the clear picture concerning their update information related to the financial state. Certainly, for most of the customers, their first experiences with service firms are interpersonal contact with frontline employees. Previous studies investigated on service encounters found that, the interpersonal aspect has played a critical role in the determinations of customer experience. Some researchers showed that, interaction between a customer and a frontline employee influence positively service quality [6], customer satisfaction [10], word of mouth [11], customer loyalty [12].

Although Service encounter has positive impact on the image of the company and create the good behavioral intention, eventually, today's business environment are hastening the pace of information revolution by reshuffling tasks in exploit online potential. This revolution in technology innovation definitively will not arise in the financial sector without affecting the way the business is running. Ever since the field of technology is increasing, the researchers started to explore the factors that might inspire the consumer to embrace or unwillingness to adopt technology, mainly innovation offers by financial institution to the consumer in terms of service delivery. One of the innovation technology challenging the personal interact service with the customer is the SST (Self-Service Technology). SST is defined as "technological interfaces that enable customers to produce a service independent of direct service-employee involvement" [1]. It is acknowledged as being the channel transforming business process over the past decade [7,13]. Service firms are speedily integrating various SSTs to persuade consumers to perform services themselves. Nowadays, there is no doubt that the use of SSTs has altered business processes over the past decade and continues to be. A lot of researchers have extensively investigated customer experience with SST service encounters in a variety of contexts such as personal banking [14,15], hotels [16,17], retailing [18,19] and libraries [20]. Mostly, these researches turn to focus on the behavioral intentions to use SST and attitudes toward usage, with the major goal being to scrutinize the determinants of those attitudes and intentions. A meta-analysis of the findings demonstrates that attitude toward usage of SST is determined by the person intention then split into two categories of antecedents: SST characteristic and individual difference variables [21]. So far, the most important SST characteristics are consist of perceived usefulness [22,23]; fun/enjoyment [9,24]; risk [25,9], ease of use [26]; technology readiness [27];

technology anxiety [28,29] and control [30]. In short, findings point out that a person is more likely to hold a favorable attitude toward an SST if it is perceived to be useful, easy to use, enjoyable, not risky, and controllable, less anxious and more ready to embrace new technology.

Although there is a great contribution from the previous research which impact deeply on the understanding of why people use SSTs, few important matters have been largely unnoticed in the literature. Furthermore, service companies did not intend introducing self-service certainly to swap entirely the traditional personal service, conversely to offer a choice and a sense of control, and thereby enriching the overall customer experience and Benefit [31].

Among the factors influencing the usage and selection of SST, the role of purpose and the system requirements on the choice of SST in multiple choice environments have been investigated in the recent research [32]. The role of purpose was distinguished as fund transaction, service request and availing information while the system requirement are the technical know-how, equipment, experience and language skills. Perceived risk and its facet were also found to be a factor that may affect the adoption of the e-service [33], Internet banking [34], and mobile banking [35]. Other factors involve cost savings, greater reduced waiting time, control over the service delivery, [36] also have been notified as vital. Despite the broad research toward SST adoption and evaluation choice based on the different antecedent (Purpose, Benefit, Requirement) affecting the acceptance issues, little has been done to shed light on the sacrifice factors which comprising of perceived risk and perceived cost.

Considering the number of conflicting criteria and alternatives which are increasing speedily in the banking self- technology industry, robust assessment prototypes are vital in order to integrate various adjustments' criteria meritoriously. Moreover, the existence of qualitative and quantitative variables that demand attention in the decision process, the SST choice can be seen as a complex MDCM process. To assess the SST selection process, diverse MCDM techniques have been widely used in the previous literature: AHP was used [37] to ranked five electronic banking techniques encompassing ATM Banking, Phone Banking, Internet Banking, Mobile banking and SMS banking; Thamaraiselvan [32] applied AHP to prioritize ATM, Internet Banking, Mobile Banking; AHP and PROMETHEE [38] was combined to evaluate the performance of three electronics banking service ATMs, Telephone Banking, and Internet Banking; Amiri [39] investigated and explained effective factors for improving e-banking by using Fuzzy TOPSIS in Persian bank. The recent applications of Hybrid-MCDM or MCDM approach for various problems and issues considered are presented in brief and listed in Table 1.

Based on the past works related to this current study, there is hardly any literature which joint AHP-TOPSIS approach in assessing SST in developing country.

Hence, this research brings to the existing literature how sacrifice factor, as an undeniable relevance to the topic of technology adoption, combine with purpose, benefit and requirement may affect the choice of the multi-channel SST in the developing country environment applying a benchmarking framework AHP-TOPSIS approach.

2.1 Sacrifice factors

Sacrifice factors refers to the expectation of the customer to part with or forego, in exchange for obtaining the service. Perceived Sacrifice denotes both the material or physical costs and the mental effort consumers face when using a given product or service, which costs and efforts necessitate consideration when appraising service or products [53,54]. Perceived sacrifice can also reveal the total monetary and non-monetary costs associated with the product or service procurement [55,56]. As noted earlier on, the perceived sacrifice consists of perceived cost and perceived risk. Technology users are exposed to the costs and risks related to use a particular service. Cost is one of the main factors that consumers evaluate in their decisions process, thus lower costs are expected to attract more customers contrast to higher costs. According to [57], perceived cost is the extent to which "a person believes that using M-Banking will cost money" then using SST will definitively cost money per the same view. Perceived cost involves equipment

cost, access cost, transactions fees. Past literatures about the perceived cost have clarified that perceived financial cost and perceived risk affect negatively the users' behavioral intention to adopt technology service mostly mobile banking technology [58,59]. In the same view, Perceived Risk characteristic has been extensively debated from the psychological aspect of the past research and Bauer (1960) [60] was amongst the first author revealed the meaning of the subjective risk (perceived risk) associated with consumer behavior. He stipulated that consumer behavior may derive from unsure outcome which cannot be foreseen by consumers themselves and this result mostly may be unpleasant one. The perceived risk is different from the real risk. For the importance of this ongoing research, the perceived risk may be simultaneous used as real risk, and lastly identified in the field of technology adoption [33] as follow: Financial Risk, Performance Risk, Time Risk, Security Risk, and Psychological &Social Risk.

Based on the survey of the related work one part, and secondly, the experts view and the existing customers experience, we can draw the SST selection process and proposed the different methods for its evaluations.

Table 1. Recent applications of hybrid AHP-TOPSIS or MCDM (AHP, TOPSIS) on topic of individual activities

Considered Issues and Problems	Applied methods	Publication author (S) publishing year
An integrated multi attribute decision model for energy efficiency processes in petrochemical industry applying fuzzy set theory.	An integrated Fuzzy AHP and fuzzy TOPSIS	Osman et al. (2016) [40]
Application of a multiple-criteria decision making approach for selecting non-perennial reservoirs for culture -based fishery development: Case study from Sri Lanka.	AHP	W. Kelum et al. (2016) [41]
Wind farm siting using a spatial Analytic Hierarchy Process approach: A case study of the Städte region Aachen.	AHP	Tim Höfer et al. (2016) [42]
Machine Selection by AHP and TOPSIS Methods.	AHP and TOPSIS	Karim et al. (2016) [43]
Selecting construction method for urban storm water collection system.	Fuzzy AHP, CP	Ebrahimian et al. (2015) [44]
Detecting and prioritizing failure of marine diesel engine.	Fuzzy AHP, fuzzy VIKOR	Balin et al. (2015) [45]
Selecting supplier with emphasis on sustainability issues; an example of packaging in food industry.	fuzzy AHP, multi-objective mathematical programming	Azadnia et al. (2015) [46]
Measuring small and medium sized enterprises readiness for institutionalization.	Fuzzy DEMATEL, Fuzzy ANP, TOPSIS	Uygun et al. (2015) [47]
Selecting programs for nonprofit TV projects.	Fuzzy DELPHI, ANP, TOPSIS	Chang, (2015) [48]
Developing novel product in competitive market environment.	Fuzzy ANP, fuzzy Kano method, fuzzy DEMATEL, TOPSIS, GRA	Chyu et al. (2014) [49]
Gas well-drilling projects are analyzed, 77 tasks studied and 31 models prioritized.	Neuro-fuzzy network, TOPSIS	Ahari et al. (2014) [50]
Selecting the best plastic recycling method.	Fuzzy AHP-TOPSIS	Vinodh et al. (2014) [51]
Evaluation of clustering algorithms for financial risk analysis using MCDM methods.	TOPSIS, DEA, VIKOR	Gang et al. (2014) [52]

3 Research Methodology

This section describes the proposed approach that this paper used to evaluate the different indicator of SST. The major components of this approach are elucidated in the sequence.

3.1 Application of AHP to analyze priorities

Analytical Hierarchy Process (AHP) was developed by Thomas Saaty in the 1970s as one of the Multi-Criteria Decision Making (MCDM) methodology. It is a technique for solving problems with complex multiple criteria and is called hierarchical analysis method [61], mostly applied to help decision-makers for prioritizing alternatives in order to determine the optimal alternative using pairwise comparison judgments [62,63]. AHP techniques, sub-divides a complex decision making problem into easily understandable hierarchy elements and makes decisions based on the elements which convert qualitative factors into quantitative variables. AHP method has two characteristics, firstly to divide the issue into category based on the property of the subject and the final objectives; secondly, to construct a hierarchical structure model by which the causalities among the factors, sub-factors and alternatives are made [64]. Allowing decision makers or the participants made up of multiple experts having the task to weigh the criteria, eliminate the bias decision making and provides impartiality [65]. The selection process of AHP is based on the different steps as follow [64,66]

Step1: Definition of the problem and deciding on the criteria. Factors and related sub-factors should be correlated [51]

Step2: Structure the problem into hierarchy considering the objective of the decision, while the data are collected from experts or decision-makers corresponding to the structure

Step3: Construction of set containing all judgments in a square comparison matrix which set of elements is compared with itself (size $n \times n$) by using the fundamental scale of pairwise comparison revealed in assign the reciprocal value in the corresponding position in the matrix. Using $n(n-1)/2$ comparisons help to establish the full set of pair-wise judgments for n criteria [67].

Table 2. The fundamental scale for pairwise comparisons

Intensity of the Importance	Definition	Explanation
1	Equal importance	Element x and y contribute equally to the objective
3	Moderate importance of one over another	Slightly favor element a over b
5	Essential importance	Strongly favor element x over y
7	Demonstrated importance	Element a is favored very strongly over b
9	Absolute importance	The evidence favoring element x over y is of the highest possible order of importance
2, 4, 6, 8	Intermediate values between the two adjacent judgments	When compromise is needed. For example, 4 can be used for the intermediate value between 3 & 5
1/3, 1/4 , 1/5, 1/6, 1/7, 1/8, 1/9	These values represent the opposite of the reciprocal whole numbers. For example, if "9" means that x is much more important than y, "1/9" means that x is much less important than y	

Note: Element x & y are any two of the criteria

Step 4: The principal eigenvalue and the associated normalized right eigenvector of the comparison matrix provide the relative importance of the various criteria being compared. The elements corresponding to the normalized eigenvector become weights with respect to the criteria or sub-criteria and ratings with respect to the alternatives.

Step 5: Calculation of the Consistency Index (CI) and Consistency Ratio (C R) of the matrix of order n.

$$Aw = \begin{bmatrix} 1 & w_1/w_2 & . & w_1/w_n \\ w_2/w_1 & 1 & . & w_2/w_n \\ . & . & . & . \\ w_n/w_1 & w_n/w_2 & . & 1 \end{bmatrix} \begin{bmatrix} w_1 \\ . \\ . \\ w_n \end{bmatrix} = nw \quad (1)$$

$$a_{ij=} w_i/w_j \qquad i, j=1,2,\ldots..n \qquad Aw = \lambda_{max}\ w \quad (2)$$

The computation of the consistency index (CI) adopts the value

$$CI = (\lambda max - n)/(n-1) \quad (3)$$

It is compared with the average RI obtained from associated random matrices of order n to measure the error due to inconsistency (Saaty, 1990).

The computation of the consistency ratio (CR) adopts the value:

$$CR = CI/RI \quad (4)$$

A consistency ratio (CR) value of 10% or less is considered acceptable; otherwise the pairwise comparisons should be revised. After calculation is made in the way presented above, the relative weights of decision-making are summed to prioritize alternatives to be evaluated. The general importance is expressed as $C[1,k] = \prod_{i=1}^{n} Bi \times C[1,k]$ means the general weight of k^{th} hierarchy element in the 1^{st} hierarchy, and Bi means $n_{i-1} \times a_i$ matrix that contains the row forming the estimated w vector. In Brief, maximized eigenvalue, CI and CR are found to obtain the weights of each criterion [67]. Experts are asked to compare the criteria on a pairwise basis to determine their relative importance

Table 3. Average RI value

N	1	2	3	4	5	6	7	8	9	10
(Random index) RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

(Remark: n is the number of factors)

Step 6: Maximized eigenvalue, CI and CR are established to get the weights of each criteria [67]. The rating of each alternative is multiplied by the weights of the sub-criteria and aggregated to get local ratings with respect to each criterion. The local ratings are then multiplied by the weights of the criteria and aggregated to get global ratings.

Briefly, for this present study, AHP method is used to determine the weight of the selection criteria and sub-criteria in order to rank the SST alternatives using TOPSIS method. Four criteria i.e. Purpose, Perceived Benefit, Requirements and Perceived Sacrifice, have been identified with their corresponding sub-criteria.

3.2 Application of TOPSIS to rank the alternatives

Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) method is presented in [68], referencing to [69,70] as an expended TOPSIS. Recall: Yoon was first presented TOPSIS [69], for solving multiple criteria decision making (MCDM) problems based upon the basic principle that the chosen alternative should have the shortest Euclidian distance from the Positive Ideal Solution (PIS) and the farthest from the Negative Ideal Solution (NIS). While, PIS maximizes the benefit and minimizes the cost, the NIS maximizes the cost and minimizes the benefit. The assumption is that, each criterion needs to be maximized or minimized. TOPSIS is a simple and useful technique for ranking a number of possible

alternatives according to closeness to the ideal solution. One the advantage of the TOPSIS is to eliminate the pairwise comparison procedure.

The procedure of TOPSIS method is conducted as follows [71]

Step 1: The first step of the TOPSIS involves the construction of decision matrix for the ranking. TOPSIS applies all outcomes (x_{ij}) in a decision matrix to develop a compromise rank. The feasible alternatives of the decision process are A1, A2…..An. The structure of the decision matrix denoted by $X = (x_{ij})n \times m$ can be expressed as follows:

$$X = \begin{matrix} & \overbrace{\quad\quad\quad\quad\quad\quad}^{m\ Criteria} \\ & C_1 \quad C_2 \quad \cdots \quad C_J \quad \cdots \quad C_m \end{matrix}$$
$$\begin{matrix} \\ A_1 \\ A_2 \\ \vdots \\ A_i \\ \vdots \\ A_n \end{matrix} \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1j} & \cdots & x_{1m} \\ x_{21} & x_2 & \cdots & x_{2j} & \cdots & x_{2m} \\ \vdots & \vdots & \cdots & \vdots & \cdots & \vdots \\ x_{i1} & x_{i2} & \cdots & x_{ij} & \cdots & x_{im} \\ \vdots & \vdots & \cdots & \vdots & \cdots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nj} & \cdots & x_{nm} \end{bmatrix} \} n\ Alternatives \quad (5)$$

Table 4. Transformation of linguistic scale into quantitative values

Linguistic scale	**Quantitative value**	
	Benefit-max	**Cost-min**
Very high	9	1
High	7	3
Average	5	5
Low	3	7
Very low	1	9
Intermediate values between the Two adjacent judgments: (2,4,6,8)		

The outcome x_{ij} represents i^{th} alternative with respect to j^{th} criteria. $W = (w_1, w_2 \quad w_j \quad w_m)$ is the relative weight vector about the criteria, and W_j represents the weight of the j^{th} attribute and

$$\sum_{j=1}^{m} W_j = 1 \quad (6)$$

Step 2: The matrix $(x_{ij})n \times m$ is then normalized to create the matrix $R = (r_{ij})n \times m$ using the normalization method

$$r_{ij} = \frac{w_{ij}}{\sqrt{\sum_{i=1}^{n} w_{ij}^2}}, \qquad i = 1,2,\ldots\ldots,n, \qquad j = 1,2,\ldots..m \quad (7)$$

Step 3: Calculate the weighted normalized decision matrix by multiplying the normalized decision matrix with its associated weights as follows:

$$v_{ij} = w_j r_{ij} \qquad i = 1,2,3,\ldots\ldots,n \qquad j = 1,2,3,\ldots\ldots,m \quad (8)$$

Step 4: Determination of the Positive ideal Solution (PIS) and Negative Ideal Solution (NIS) as follows:

$$\text{PIS} = A^{+} = \{v_1^{+}, v_2^{+}, \dots\dots, v_m^{+}\} = \{(\max_i v_{ij} | j \in \omega_b), (\min_i v_{ij} | j \in \omega_c)\} \quad (9)$$

$$\text{NIS} = A^{-} = \{v_1^{-}\ v_2^{-}, \dots\dots, v_m^{-}\} = \{(\min_i v_{ij} | j \in \omega_b), (\max_i v_{ij} | j \in \omega_c)\} \quad (10)$$

ω_c is related to the benefit criteria while ω_b to the cost criteria

Step 5: Calculation of the Euclidean distance between the target alternative *i* from the ideal positive and negative-ideal solution respectively as follows:

$$d_i^{+} = \sqrt{\sum_{j=1}^{m} \left(v_{ij} - v_j^{+}\right)^2}, \quad i = 1,2,3 \dots\dots., n \quad (11)$$

$$d_i^{-} = \sqrt{\sum_{j=1}^{m} \left(v_{ij} - v_j^{-}\right)^2}, \quad i = 1,2,3 \dots\dots., n \quad (12)$$

Step 6: Measure the relative closeness of the i^{th} alternative to ideal solution is computed as follows:

$$RC_i = \frac{d_i^{-}}{d_i^{+} + d_i^{-}}, \ i = 1,2,3, \dots\dots, n \qquad 0 \le RC_i \le 1 \quad (13)$$

Step 7: Ranking the preference order which is to determine the rank of the alternative by comparing RC_i values. The greater the value of the relative closeness, the higher the ranking orders and hence, the better the performance i.e. rank the alternatives by maximizing the ratio RC_i. The alternatives rank start from the values that closest to 1 and in decreasing order.

4 The Numerical Application of the Proposed Method

The questionnaires conducted during 2 weeks of December 2015, were filled by highly-educated respondents with some managerial experiences, associated with expertise. 5 experts in the banking field were asked to evaluate by comparing the criteria and sub-criteria at a given level on a pairwise basis to identify their relative preference, then in the basis of TOPSIS. When subjectivity matter arises, AHP is an effective decision making method and it is very suitable to solve problems where the decision criteria can be structured in a hierarchical way into sub-criteria. With the aid of the existing literature, the ranking for the attribute in terms of importance or weights are defined by each expert. On the basis of the Saaty's questionnaire layout, each expert was asked to fill the questionnaire measuring the degree of preferences to which each criterion corresponds to the sub-factors. The AHP allows group decision making, and one of the main benefit of that is the simple structure. The Judgements of the expect are arranged into the matrixes and presented in (Tables 5, 6, 7, 8, 9) and the relative normalized weigh w_j of each criteria j is found by formulae (1) with the geometric means value of the total weigh of the experts, Table 10.

4.1 Integrating AHP -TOPSIS method to determine the rank of alternatives

In the data scrutinizing process, Analytical Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) approaches are used for the outranking of the Self-Service Technology (SST) alternatives. Fig. 1 illustrates the different steps of the proposed methods.

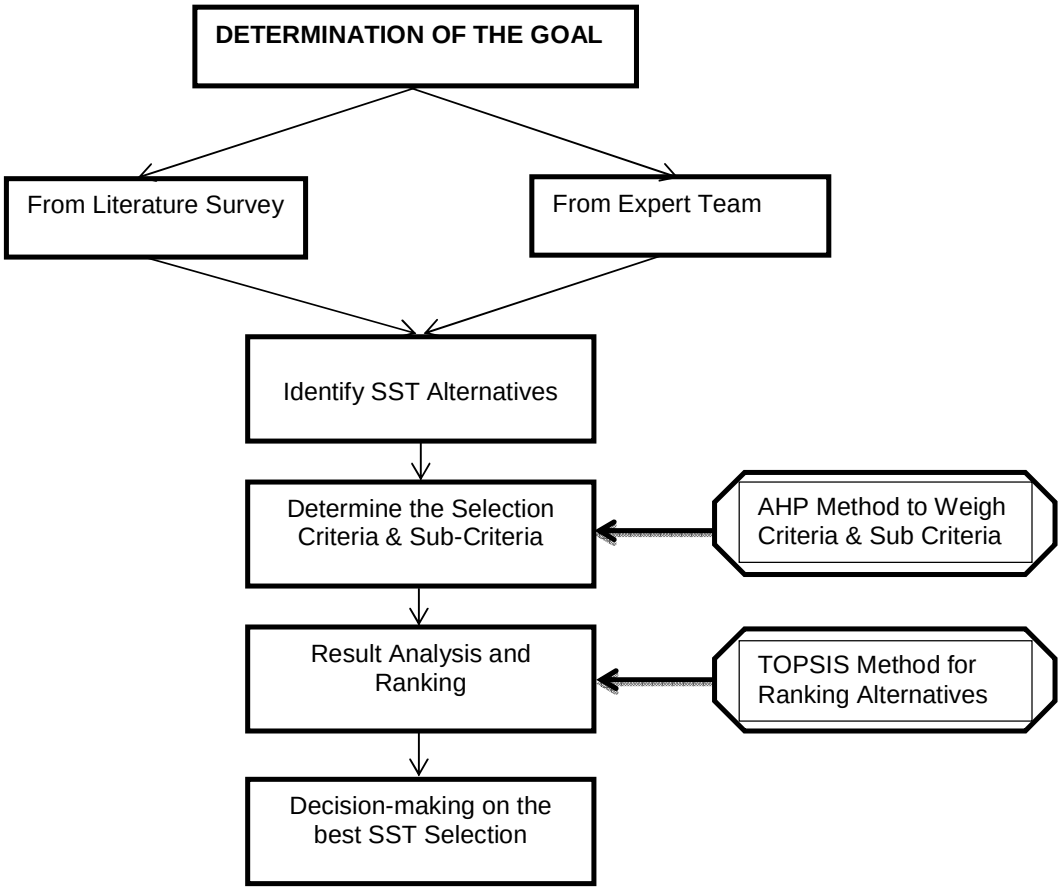

Fig. 1. Steps of proposed integrated AHP-TOPSIS methods

Finally this study used only 4 criteria, 2 sub-criteria level 1, and 19 sub-criteria level 2 in evaluation process which leads to the establishment of the decision hierarchy structured with the determined alternative SST (Fig. 2).

There are 5 levels in the decision hierarchy structured for SST selection problem. The overall objective of the decision problem is ‘‘the selection of the best Self-Service Technology for Banking services” on the first level of the hierarchy. Second level is the criteria; third level (Sub-criteria1), fourth level (Sub-criteria 2) and alternatives SST are on the last level of the hierarchy. Once the decision hierarchy for the problem is made, the weights of the criteria and sub-criteria to be used in assessment process are calculated by using AHP method (Tables 5, 6, 7, 8, 9, 10). At this stage, a task has been assigned to the experts in the team to form individual pairwise comparison matrix by using the Saaty’s 1-9 scale (Table 2).

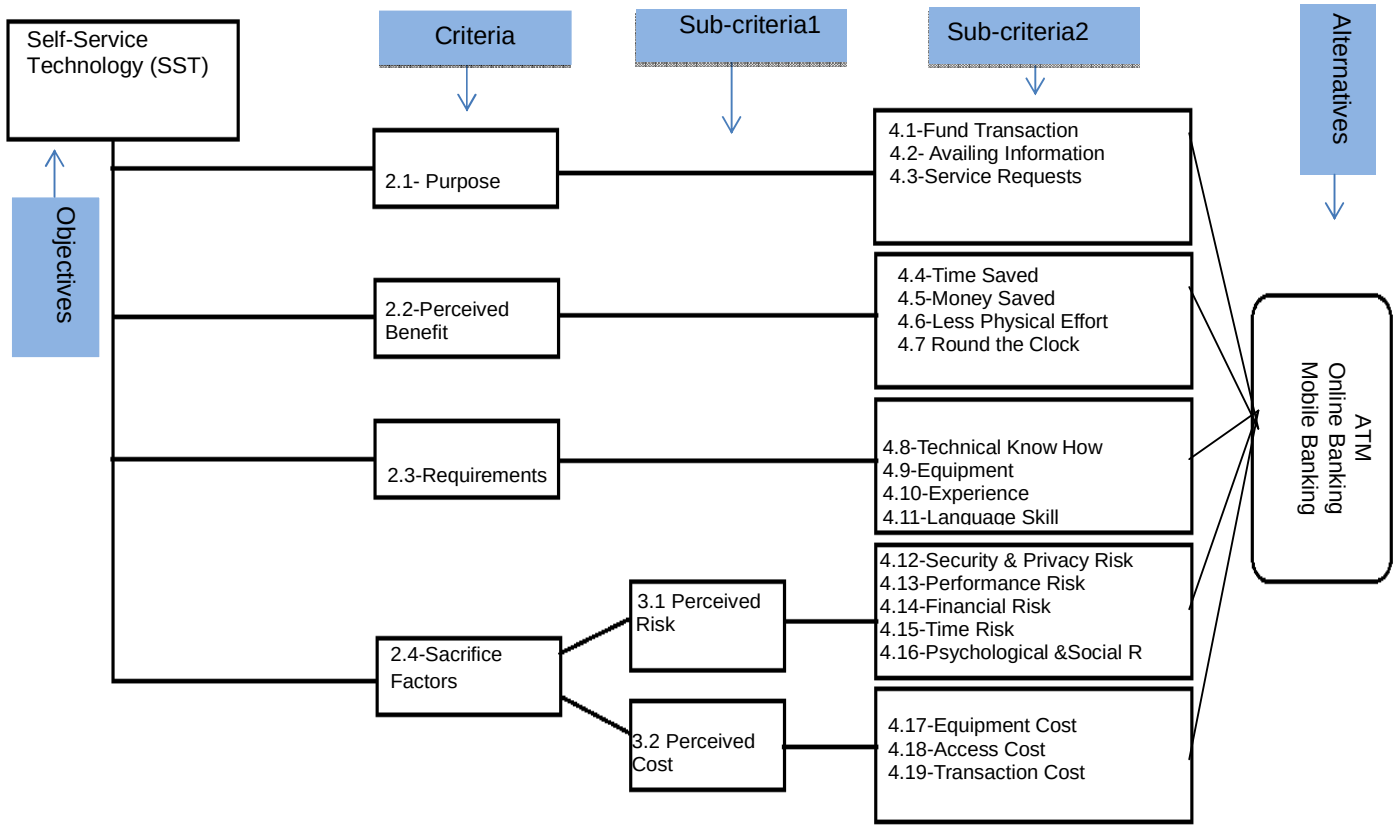

Fig. 2. Extended hierarchical structure of self-service technology (SST) selection

Table 5. Comparison of Sub-criteria with respect to purpose: Expert 1

Priority	4.1 (Fund transaction)	4.2 (Availing information)	4.3 (Service requests)	Priority	Consistency ratio, λ_{max}
4.1 (Fund transaction)	1	3.00	8.00	65.3%	CR = 7.7%,
4.2 (Availing information)	0.33	1	6.00	28.5%	λ_{max} = 3.074
4.3 (Service requests)	0.12	0.17	1	6.2%	

Table 6. Comparison of sub-criteria with respect to purpose: Expert 2

Criteria	4.1	4.2	4.3	Priority	CR, λ_{max}
4.1	1	2.00	7.00	61.5%	CR = 0.3%,
4.2	0.50	1	3.00	29.2%	λ_{max} = 3.003
4.3	0.14	0.33	1	9.3%	

Table 7. Comparison of sub-criteria with respect to purpose: Expert 3

Criteria	4.1	4.2	4.3	Priority	CR, λ_{max}
4.1	1	3.00	7.00	68.2%	CR = 0.3%,
4.2	0.33	1	2.00	21.6%	λ_{max} = 3.003
4.3	0.14	0.50	1	10.3%	

Table 8. Comparison of sub-criteria with respect to purpose: Expert 4

Criteria	4.1	4.2	4.3	Priority	CR, λ_{max}
4.1	1	2.00	7.00	60.3%	CR = 0.2%,
4.2	0.50	1	4.00	31.5%	λ_{max} = 3.002
4.3	0.14	0.25	1	8.2%	

Table 9. Comparison of sub-criteria with respect to purpose: Expert 5

Criteria	4.1	4.2	4.3	Priority	CR, λ_{max}
4.1	1	2.00	8.00	59.5%	**CR = 1.9%,**
4.2	0.50	1	6.00	34.0%	**λ_{max} = 3.018**
4.3	0.12	0.17	1	6.5%	

Table 10. Summary of the pairwise comparison for the criteria purpose

Criteria	Expert 1 Weights (w)	Expert 2 Weights (w)	Expert 3 Weights (w)	Expert 4 Weights (w)	Expert 5 Weights (w)	Geometric mean Weights (w)
4.1 (Fund transaction)	65.3%	61.5%	68.2%	60.3%	59.5%	62.96%
4.2 (Availing information)	28.5%	29.2%	21.6%	31.5%	34.0%	28.96%
4.3 (Service requests)	6.2%	9.3%	10.3%	8.2%	6.5%	8.1%

Table 11. Summarizing the criteria and sub-criteria weighted results under AHP method

Criteria, Sub-criteria1, sub-criteria2	% weight between the criteria	% weight between the sub-criteria 1	% weight within the step of sub-criteria 2	% weight among the sub-criteria 1	% weight among the sub-criteria 2
2.1-Purpose	59.1% (1)				
4.1-Fund transaction			62.96% (1)		37.20% (1)
4.2- Availing information			28.96% (2)		17.12% (2)
4.3-Service requests			8.1% (3)		4.79% (6)
2.2-Perceived Benefit	20.2% (2)				
4.4-Time saved			7.0% (4)		1.414% (14)
4.5-Money saved			15.1% (3)		3.05% (9)
4.6-Less physical efforts			29.1% (2)		5.88% (5)
4.7- Round the clock banking			48.9% (1)		9.88 % (3)
2.3-Requirements	6.4% (4)				
4.8-Technical know-how			24.9% (2)		1.593% (12)
4.9-Equipment			11.8% (3)		7.552% (4)
4.10-Experience			58.5% (1)		3.744% (8)
4.11-Language skill			4.8% (4)		0.3072% (19)
2.4-Sacrifice Factors	14.3% (3)				
3.1-Perceived Risk		66.7% (1)		9.5381%	
4.12-Security & privacy risk			25.7% (2)		2.4512% (11)
4.13-Performance risk			15.6% (3)		1.4879% (13)
4.14- Financial risk			48.5% (1)		4.6259% (7)
4.15-Time risk			6.4% (4)		0.6104% (16)
4.16- Psychological & social risk			3.7% (5)		0.3529% (18)
3.2-Perceived cost		33.3% (2)		4.7619%	
4.17-Equipment cost			10.5% (3)		0.4999% (17)
4.18-Access cost			25.8% (2)		1.2285% (15)
4.19-Transaction cost			63.7% (1)		3.0333% (10)

% Weight among the subcriteria1 for perceived risk: (14.3%) (66.7%) = (9.5381%)
% Weight among the Sub-criteria2 for fund transaction: (59.1%) (62.96)=37.20%
% Weight among the Sub-criteria2 for security & privacy risk: (9.5381%) (25.7%) = 2.4512

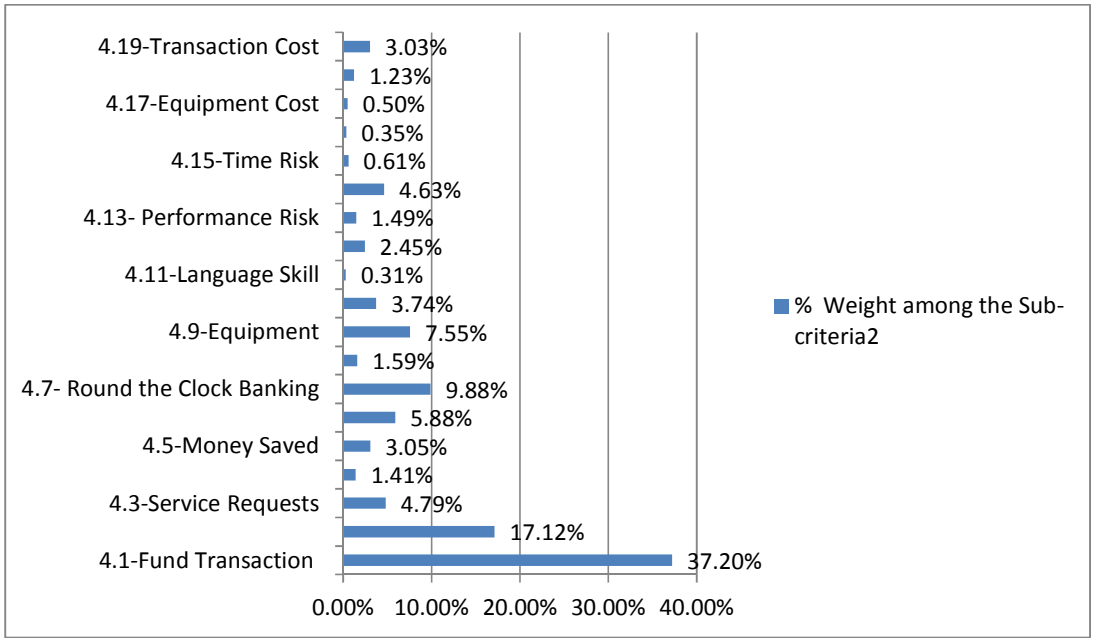

Fig. 3. Final sub-criteria 2 weight obtained via AHP

Table 12. Sub-criteria + & -

Sub-criteria2 (W)	**.348**	**.160**	**.044**	**.013**	**.028**	**.055**	**.092**	**.014**	**.070**	**.035**	**.009**
Sub-criteria2	(4.1)	(4.2)	(4.3)	(4.4)	(4.5)	(4.6)	(4.7)	(4.8)	(4.9)	(4.10)	(4.11)
ATM	7	8	5	5	5	4	8	7	7	5	7
Online Banking	8	8	8	6	6	7	8	4	4	2	6
Mobile Banking	6	8	8	8	7	8	8	5	5	4	6

Sub-criteria2 (W)	**.022**	**.013**	**.043**	**.005**	**.003**	**.004**	**.011**	**.028**
Sub-criteria2	(4.12)	(4.13)	(4.14)	(4.15)	(4.16)	(4.17)	(4.18)	(4.19)
ATM	7	6	7	8	6	5	6	4
Online Banking	6	8	6	5	7	8	8	6
Mobile Banking	8	7	8	4	6	6	8	8

N.B: Normalized weight of fund transaction (.348) = 37.20/ sum (sub-criteria 2), i.e.: 37.20/10.81
(4.1) represents fund transaction; (4.2) represents availing information….

To rank the alternatives of SST, the TOPSIS method is used. The priority weights of alternative SST with respect to sub-criteria 2, calculated by AHP method (Table 11) can be applied as input of TOPSIS (Table 12) using the (Table 4) measurement scale. The weighted normalized decision matrix is computed using the equation (7) can be seen from Table 13.

Using TOPSIS method through the help of Matlab technical computing tool, the ranking of the alternative SST is calculated (Table 14), (Fig. 4).

Table 13. Weighted normalized matrix

Sub-criteria2(W)	.348	.160	.044	.013	.028	.055	.092	.014	.070	.035	.009
Sub-criteria2	**(4.1)**	**(4.2)**	**(4.3)**	**(4.4)**	**(4.5)**	**(4.6)**	**(4.7)**	**(4.8)**	**(4.9)**	**(4.10)**	**(4.11)**
ATM	.573	.577	.404	.447	.476	.352	.577	.737	.737	.745	.636
Online Banking	.655	.577	.646	.536	.572	.616	.577	.421	.421	.298	.545
Mobile Banking	.491	.577	.646	.715	.667	.704	.577	.527	.527	.596	.545

Sub-criteria2(W)	.022	.013	.043	.005	.003	.004	.011	.028
Sub-criteria2	**(4.12)**	**(4.13)**	**(4.14)**	**(4.15)**	**(4.16)**	**(4.17)**	**(4.18)**	**(4.19)**
ATM	.573	.491	.573	.780	.545	.447	.468	.371
Online Banking	.491	.655	.491	.487	.636	.715	.624	.557
Mobile Banking	.655	.573	.655	.390	.545	.536	.624	.742

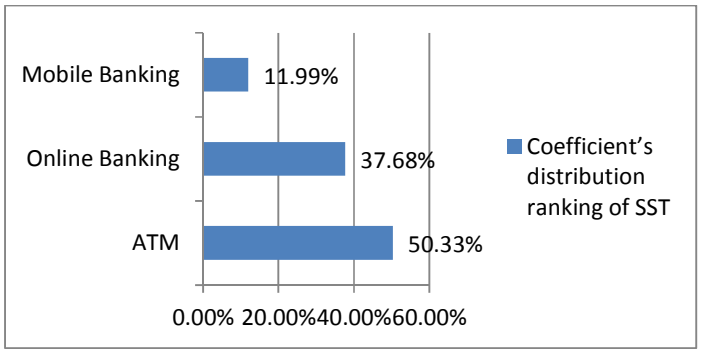

Fig. 4. Coefficient's distribution ranking of SST

Table 14. Rank of the SST alternatives

	RC_i	**Choice order**	**Distribution of coefficients**
ATM	0.7533	1	50.33%
Online banking	0.5640	2	37.68%
Mobile banking	0.1793	3	11.99%

5 Discussion and Conclusion

With the objectives to increase allocate resources to reach productivity advantage, to quickly and efficiently satisfy consumer's needs and wants, it has become crucial for a service company to analyze the circumstances in which self-service option will be effectively useful and how the users will appraise it.

One of the fundamental motives for customers to embrace technology as a support to the front-line worker who interacts with the consumer is the notion of choice. Providing them with options can be tremendously effective in easing the financial transaction process. In previous years, it seems that a particular attention has been placed by researchers on the issues of Self-Service Technology (SST) selection mostly toward the developed countries. Definitely, SST adoption and selection differ across contexts and cultures, and therefore, users in developing nations might be ignored in past research.

This present study extracted influencing factors and alternatives of SST from banking services and evaluated them in order to select the best one in terms of preference, using AHP-TOPSIS integrated approach. These

factors were brought forward through literature reviews, users of SST services, expert views in accord with company's missions. Centered on the selected elements, assessment was made not for specific SST in a narrow sense but for common SST provide by banks in a broad sense. While factors are grouped by criteria, sub-criteria1 and sub-criteria2; the alternatives are consisted of ATM, Online Banking and Mobile Banking. The findings being discussed with those experts, revealed with the AHP technique that among the examined criteria identified, Purpose (59.1%) represents the utmost important criterion follows by, Perceived Benefit (20.2%), Sacrifice Factors (14.3%) and Requirements (6.4%) correspondingly (Table 11), (Fig. 3). Based on this result, it has been viewed that the purpose of using SST has played significant role in the decision to opt for it and the requirements of using SST could be seen flexible and are not largely contributing as a factor.

Within Sacrifice Factor, Perceived Risk has considerable effect weighs (66.7%) against Perceived Cost (33.3%), i.e. almost Perceived Risk evaluation to SST is 3 times the Perceived Cost associated with sacrifice to be made. Vis-à-vis to Perceived Risk factor, the results show that, consumers were more concerned with the Financial Risk (48.5.13%), followed by Security& Privacy Risk (25.7%), less more on Performance Risk (8.06%) and less emphasis was focused on Time Risk (5.78%) followed by Psychological & Social Risk (4.23%). Defining Financial Risk as "the potential monetary outlay associated with the initial purchase price as well as the subsequent maintenance cost of the product''[72], the present research extends the facet of Financial Risk to include potential monetary loss due to transaction errors or bank account misuses. The Security & Privacy Risk are the possible loss due to the hacker or fraud compromising the security of SST users and potential loss of control over personal information. The above outcome can be used to explain the facts that, the consumers always pay attention to their money matters and the security issues encompass in the application of SST

In the light of sub-criteria 2, which weigh helped in the ranking of alternatives, Fund Transaction with a score of 37.20% and the Language Skill with the score 0.3072% were respectively ranked at the first and last places. Availing Information with 17.12%, Round the Clock Banking with 9.88 etc. are respectively ranked 2nd, 3rd, through 17 sub-criteria. The results point out that the value-added services in banking positively impacts SST customer's demands in terms of criteria identified. Thereby, to satisfy the request of consumer's benefits, bank service operators should definitely incorporate the resources that may offer more opportunity to enjoy fund transaction with availing information at any time through the related equipment whereas making the language skill as flexible as possible.

The overall ranking of SST alternatives using TOPSIS technique is classified as follows: ATM, Online Banking, and Mobile Banking with 1^{st} (.7533), 2^{nd} (.5640) and lastly (.1793) respectively (Table 14) (Fig. 4). Though the fund transaction has been revealed as the most influential element in sub-criteria2, the choice among SST alternatives is not yet well balanced. Almost 50.33% customers would prefer using ATM. The reason might be that, customers do not need to own any equipment or device before using ATM. On the other hand, Online Banking and Mobile Banking require computer, smart mobile phone, and installation of software in the consumer's devices which should be provided by the banks.

Whereas a previous study [73] about internet diffusion across 143 nations in the macro-level, suggested political conflict (opposing regime transitions, political violence, insecurity and risk issues) would negatively influence internet usage, i.e. technology based on the internet usage, and recommended further research in the individual level; on the other hand, this present research has found that the Sacrifice Factor which embedded the Perceived Risk and Perceived Cost has less important influence on the choice of SST, particularly with the Online Banking and Mobile Banking. We can stipulate that, nevertheless a number of instability issues arise in Togo; these are not influencing individual's perception to embrace or not SST. The low adoption motive might reside in other factors. A report [74] has shown low mobile banking adoption rate in Togo as 1% while is 12% in the West Africa.

Unlike the earlier scholar on the SST studies, the proposed approach of methodology used in this research gives distinctive view since it acknowledges that the best allocation of resources or limited resource to build an effective business model is a Multi-Criteria Decision-Making (MCDM) problem. Though AHP-TOPSIS are not the only best approach for complex decision making problems-solving, it is proved as tool to provide

rational and realistic solution where the prioritizing matters arise and to select the designated elements according to the consumers' choice. This integrated approach combined with the expert's views offers a number of benefits. It assists as a guideline to the bank managers providing the self-service technology in bank industry. Moreover, it makes use of the hierarchical structural based on the pairwise comparison where the consistency ratio can be checked and adjusted throughout the assessment process. This confirms how easy, flexible and excellent tool it is, to handle the complex quantitative, qualitative, and multiple criteria in the decision making process compared to other MCDM or Mathematical tools such as Fuzzy Logic, ELECTRE and DEA.

To sum up, not only these suggestions can support SST providers to build more robust business models, it can empower and help consumers boost their confidence independently. The more these companies appreciate the degree of importance of any factor at a point; the more the aforementioned factors can assist them to develop a supplementary competitive model, taking with diligent the most influential criteria. Furthermore, adapt the proposed hierarchical framework with slight modification to fit any current situation of the market environment will also be an advantage for the companies.

Questions which remain to be addressed lead to the shortcoming of this research. Surely, there is an appeal for further research to increase our understanding on the impact of sacrifice and benefit factors in assessing M-Banking in Togo. The limitations of the research are first concentrated on the fact that, the present results are based on the experts' opinions which are not representing the entire population. Moreover, the efficiency of the model depends on the accuracy and the value of judgements given by the experts. Therefore, the findings can hardly be generalizable and claimed as valid for all the financial institutions dealing with SST. Future research may be focused using the representative expert populations through cluster analysis with Fuzzy AHP which truly and precisely reflect the human thinking style.

Yet AHP-TOPSIS is simple to implement, the reverse side will occur when during the process of analysis or after, there is a need to add or restructure any criterion. In that case, it will be complex task and time consuming due to the recalculation of the pairwise comparison matrix.

In addition, the criteria used in this research seem not to represent all the factors. Hence, searching for additional variables that can increase our ability to more accurately predict and evaluate consumer's intention to use or to prioritize SST will highly contribute to the current field.

Acknowledgements

In the first place, the author would like to express his profound gratitude to the Almighty God for his guidance and faithfulness. The author highly appreciates the unflinching assistance of Prof. PENG Yi.

He is also grateful to referees for their valuable comments and suggestions which were helpful in improving this research paper

Competing Interests

Author has declared that no competing interests exist.

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