A Hybrid Model AHP and PROMETHEE for Evaluation of E-Banking Services

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Abstract

Nowadays, customers are using more self-service options in Egyptian banking sector such as Automated Teller Machines (ATMs), Telephone Banking, and Internet Banking, which are more convenient to use. Taking into consideration the huge investments made by banks in Internet infrastructure, customer satisfaction and retention are turning into the crucial factors for success in order to generate positive customer value. In order for banks to retain their e-customers, they should have better understanding of how customers perceive and evaluate the quality of the electronically offered services. This paper proposes a structured model for evaluating the performance of the three electronic banking services; ATMs, Telephone Banking, and Internet Banking using the Preference Ranking Organization Method For Enrichment Evaluation (PROMETHEE) in conjunction with Analytical Hierarchy Process (AHP) based on the E-service quality dimensions. AHP is used to determine the relative importance of service quality multi-criteria dimensions from bank customers’ point of view, and PROMETHEE method is applied for ranking the performance of different electronic banking services.

Keywords

1. Introduction

With the rapid development in information technology, the financial services industry have experienced significant changes brought about by the interaction between competitive pressure, customer needs, and technological innovation. Customers move toward technology-based self-service as an alternative to the traditional inter-personal service encounter. This provides benefits to both the bank, as it decreases the cost per transaction, and the customer, who is offered, increased convenience. As a result, today’s banking takes place increasingly through electronic channels such as automated teller machines (ATMs), telephone banking, Internet banking and mobile banking.

Nowadays, most of Egyptian banks provide ATM, Telephone banking and Internet banking services. In April 2013, only one Egyptian bank “HSBC” is about to offer m-banking system. The Ministry of Communications and Information Technology was reluctant to introduce the mobile banking service for many reasons, most importantly the lack of security that Egypt has been suffering from since the 25 January Revolution [1].

ATMs, Telephone banking and Internet banking services offer common services such as Checking accounts, obtain account summary, money transfer between accounts, pay bills and other services. In order for banks to retain their e-customers, they should have better understanding of how customers perceive and evaluate the quality of the electronically offered services. Therefore, delivering high quality services of these automated services is a prerequisite for achieving customer satisfaction and only through customer satisfaction can the company gain loyal customers. During the last two decades, the Egyptian financial system has developed rapidly in terms of size,
Recognizing the criteria that customers use to judge the quality of bank services is a prerequisite to design the most effective and efficient service. Criteria envisaged to measure automated and electronic service quality are derived from traditional service quality and e-service quality literature. Nine criteria have been selected to define e-banking services. User-friendly, Security/Privacy, Efficiency, Fulfillment, Reliability/Availability, Responsiveness, Compensation/Incentive, Assurance/Trust and finally Empathy are those nine criteria that will be adopted in the present work. Analytical Hierarchy Process (AHP) is a structured technique applied to analyze complex decision problems using pairwise comparisons [2]. Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE) is an outranking multiple criteria technique [3].

The present work is concerned with the application of a hybrid model of both AHP and PROMETHEE to rank and evaluate the performance of the three above-mentioned electronic banking channels based on the above-mentioned nine e-service quality criteria. The role of AHP is to prioritize the nine service quality criteria and to find their relative weights of importance. These weights, in turn, are used by the PROMETHEE to outrank the most desirable e-banking service. The structure of this paper is as follows: section 2 literature review about e-banking services, service quality dimensions, AHP and PROMETHEE; section 3 methodology used; section 4, data collection and analysis, section 5 summary of achievement and remarks and section 6 future work.

2. Literature Review

2.1 SERVQUAL and E-SERVQUAL
With an increasing competition, service quality has become a popular area of academic investigation, and has been recognized as a key factor in keeping competitive advantage and sustaining satisfying relationships with customers. Service quality is generally recognized as an essential prerequisite and determinant of competitiveness for creating and sustaining satisfying relationships with customers. Many studies found that there is a positive and significant relationship between service quality and business performance [4]. The SERVQUAL model [5] is the most outstanding model that consists of five dimensions: tangibles, responsiveness, reliability, assurance and empathy. It has been used and tested in several contexts such as hospital, banking and public services. Parasuraman et al. (2005) introduced the E-SQUAL scale that contains four dimensions: efficiency, fulfillment, system availability, and privacy and E-RecS-QUAL scales with three dimensions: responsiveness, compensation, and contact [6].

2.2 E-banking Service Quality
The challenging business environment of banking sector resulted more pressure on banks to develop and utilize alternative delivery services with a view to attract more customers and encourage loyalty. In Egypt, public and private banks realized the potential of investing in retail banking. Due to the small number of bank branches compared to the high population in Egypt, banks expanded their networks and offered a variety of delivery channels such as automated teller machines (ATMs), telephone banking and Internet banking. Thus, good understanding of the attributes that customers use to judge service quality is necessary as banks will be able to monitor and enhance its service performance and improve its overall service quality.

Automated and electronic service quality is defined by Santos (2003) [7] as “the consumers’ overall evaluation and judgment of the excellence and quality of e-service offerings in the virtual marketplace”. As customers ranked ATMs to be the most important delivery channel, ATM usage turned to be the most common and convenient mode of transactions among customers [8]. All Banks particularly in Egypt are aggressively adopting this mode. The advantages of using ATM have given new motivation in dimensions of service quality and banks are offering new choices to customers. Investment opportunities, reduction in costs, satisfaction of customers and competitiveness regard as the main motives to install and add new ATM to the existing network. Different dimensions of ATM service could be considered; security, convenience of location, adequate number, user-friendly system, functionality of ATM, reasonable cost, minimum errors, high uptime, cash backup, availability and accuracy are considered important dimensions that influence customers’ satisfaction [9].

On the other hand, Internet banking service involves a customer connecting to bank computer systems via the Internet to access banking services [10]. In this context, the majority of interactions between the bank and the
customer are conducted digitally [10]. Five online service quality dimensions (responsiveness, reliability, competence, access and security) and their relationships with the customer satisfaction were identified [11]. Reliability and fulfillment are the strongest predictors for customer satisfaction [12]. Other study found six dimensions of e-banking service quality such as convenience and accuracy, feedback and complaint management, efficiency, queue management, accessibility and customization [13]. Khan and Mahapatra (2009) [14] tested seven quality dimensions (reliability, accessibility, user friendliness, privacy/security, efficiency, responsiveness and fulfillment) and show that customers are satisfied with quality of service on four dimensions such as reliability, accessibility, privacy/security, responsiveness and fulfillment, but least satisfied with the ‘user-friendliness’ dimension. Moreover, Hussien and Abd El Aziz, (2013) [15] studied nine Internet banking quality dimensions that affect customer satisfaction from the consumer and provider perspectives and found that incentive and empathy are the least dimensions that affect customer satisfaction.

Telephone banking customers retrieved many bank services such as account balances, check last transactions, instruction to issue bank cheques, account payments/transfers, open new account, update personal data and know latest bank offers. The items pertaining to telephone banking were generated from a study, which focused upon evaluating the impact of technology on service delivery such as easy to use, short waiting time, clear instructions, availability, reliability, telephone banking options and others [16].

Service quality is increasingly recognized as being of key strategic value by service-oriented industries such as banks. The major benefits of offering high quality self-services is to retain and attract new customers, increase sales and market shares, enhance corporate image, and reduce costs. The present paper uses nine service quality dimensions namely: User-friendly, Security and Privacy, Efficiency, Reliability and Availability, Responsiveness, Compensation and Incentive, Fulfillment, Trust and Assurance, and Empathy adapted from Elbadrawy, 2013[17].

2.3 AHP Method

Analytic Hierarchy Process (AHP) method allows us to prioritize things that are difficult to measure, such as opinions, feelings, behaviors, and beliefs. AHP is a very popular approach to multi-criteria decision-making (MCDM). It transforms qualitative factors into quantitative variables. It orders the decision criteria in a hierarchical structure and using a series of pairwise comparisons among the decision criteria and among the alternatives. The methodology of AHP is based on pairwise comparisons of the following type 'How important is criterion A relative to criterion B?' [18]. The pair wise comparison is based on a 9-point scale as given in Table1.

<table>
<thead>
<tr>
<th>Weight Definition</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equal importance</td>
</tr>
<tr>
<td>3</td>
<td>Weak importance of one over another</td>
</tr>
<tr>
<td>5</td>
<td>Essential or strong importance</td>
</tr>
<tr>
<td>7</td>
<td>Very strong importance</td>
</tr>
<tr>
<td>9</td>
<td>Absolute importance</td>
</tr>
<tr>
<td>2.4.6.8</td>
<td>Intermediate values between the two adjacent judgments</td>
</tr>
</tbody>
</table>

If the judgment is that criterion B is more important than criterion A, then the reciprocal of the relevant index value is assigned. The next step is the calculation of a list of the relative weights of importance of the factors. When the number of attributes (or criteria) in the hierarchy increases, more comparisons between the attributes need to be made. The number of pair wise comparisons is N (N-1)/2, where N is the number of criteria to be ranked. As N increases the chance to be consistent in judgments decreases. If for example you judge that A outperforms B and B outperforms C, to be consistent A should outperforms C. Any other entry will lead to inconsistency. So a consistency check is required for the pair-wise comparison matrices. Inconsistency Index (ICI) for matrices with size N is given as follows:

\[ ICI = \frac{\lambda_{max}N - N}{N-1} \]  

Where, \( \lambda_{max} \) is the maximum Eigen value of the reciprocal matrix of size N. In order to assess the consistency of
the judgments entered in any of the reciprocal matrices, the ICI is related to the inconsistency index of a reciprocal matrix of the same size N, but with normalized random entries RI. Thus we get what is called Inconsistency Ratio ICR.

\[
ICR = \frac{ICI}{RI}
\]  \hfill (2)

Values of Random Index RI for different reciprocal matrix sizes are given in table 2.

<table>
<thead>
<tr>
<th>N</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI</td>
<td>0</td>
<td>0.58</td>
<td>0.9</td>
<td>1.12</td>
<td>1.24</td>
<td>1.32</td>
<td>1.41</td>
<td>1.45</td>
<td>1.49</td>
</tr>
</tbody>
</table>

An upper limit should be indicated for the ratio ICR. This is to be done mainly in case of having group decision makers that necessitate discarding inconsistent matrices. In case of having reasonable number of alternatives (less or equal 5), 0.1 was suggested in literatures as an upper limit. However, in case of scarcity of respondents and/or increased number of alternatives (criteria), this upper limit could be relaxed. In the present work, an upper limit of ICR is taken as 0.3. Responses that have ICR greater than 0.3 are discarded.

The resultant weight of importance of each alternative (criteria), in case of group decision making, is obtained as the geometric mean of all consistent questionnaires.

AHP has been widely applied in engineering, government, industry, management, manufacturing, personal, political, social, and sports. Due to its wide applicability and ease of use, the Analytic Hierarchy Process (AHP) has been studied extensively for the last 30 years especially in the fields of ecommerce and m-commerce. For instance, AHP has been used to evaluate the success factors of ecommerce website and a comprehensive evaluation of the website had been taken [19]. Recently, it has been observed that focus has been confined to the applications of the integrated AHPs rather than the stand-alone AHP [20].

2.4 PROMETHEE method

The Preference ranking organization method for enrichment evaluation (PROMETHEE) is a multi-criteria analysis method that uses concepts introduced by Brans J.P. [21]. PROMETHEE, which deals with ranking of many alternatives according to multiple conflicting criteria, have been successfully applied to various fields such as banking, industrial location, medicine, ethics, health care, investments, etc. [3]. PROMETHEE is based also on pair wise comparisons of alternatives as regards to specified criteria. The comparisons in this case are represented by differences \( d_j(a, b) \) of two numerals \( g_j(a) \) and \( g_j(b) \) expressing levels of the two alternatives \( a \) and \( b \) for \( j \)th criterion. A preference function \( P_j(a, b) \) which is a function of differences \( d_j(a, b) \) is to be selected. Six basic types of preference functions have been proposed: (1) Usual, (2) U-shape, (3) V-shape, (4) levelled, (5) V-shape with indifference and (6) Gaussian. For each criterion, the value of a minimum difference threshold \( q \), the value of a strict preference threshold \( p \), or the value of \( s \) an intermediate value between \( p \) and \( q \)  have to be fixed [3]. The first step for implementation of PROMETHEE is to the determination of deviations based on pair-wise comparisons.

\[
d_j(a, b) = g_j(a) - g_j(b) \quad i, j = 1, 2, ..., N \tag{3}
\]

Where \( d_j(a, b) \) denotes the difference between the evaluations of alternatives \( a \) and \( b \) on each criterion, and \( N \) is the number of involved criteria in the decision problem. Next, the second step is the application of the preference function.

\[
P_j(a, b) = f \left( d_j(a, b) \right) \tag{4}
\]

The relevant preference function, selected out of the above mentioned six functions, translates the differences \( d_j(a, b) \) into a degree of preference \( P_j(a, b) \). Summing up on all criteria, the total degree of preference of alternative \( a \) as compared to alternative \( b \) as regards to all criteria \( \pi(a, b) \)is determined as follow

\[
\pi(a, b) = \sum_{j=1}^{N} p_j(a, b)w_j \quad \forall \ a, b \in A \tag{5}
\]
A is the set of all alternatives under consideration. \( w_j \) is the weight of importance of criterion \( j \) as already obtained from the module of AHP. Having determined the degree of preference \( \pi(a, b) \) for all combinations of the alternatives and their reciprocals \( \pi(b, a) \) the outranking flows \( \varnothing(a) \) for each alternative \( a \) can be readily obtained as follows:

\[
\varnothing(a) = \varnothing^+(a) - \varnothing^-(a)
\]

(6)

\[
\varnothing^+(a) = \frac{1}{N-1} \sum_{x \in A} \pi(a, x)
\]

(7)

\[
\varnothing^-(a) = \frac{1}{N-1} \sum_{x \in A} \pi(x, a)
\]

(8)

Where \( \varnothing^+(a) \) and \( \varnothing^-(a) \) denote the positive outranking flow and the negative outranking flow. \( \varnothing(a) \) is the net outranking flow for each alternative. The Alternative \( a \) is preferred to Alternative \( b \) when \( \varnothing(a) > \varnothing(b) \), and \( a \) and \( b \) are indifferent when \( \varnothing(a) = \varnothing(b) \).

3. Problem statement & solution methodology

The purpose of the study is to evaluate the performance of three automated banking services (ATMs, Internet Banking, and telephone banking). Having defined the goal of the decision model and selected the objective functions, the construction of the hierarchy is structured using the nine service quality dimensions that were extracted from the literature review (chapter 2) namely (1) user friendly, (2) efficiency, (3) Security and Privacy, (4) Reliability and availability, (5) responsiveness, (6) incentive and compensation, (7) fulfillment, (8) Trust and Assurance and finally, (9) Empathy.

The hybrid model AHP/PROMETHEE is proposed to be applied to rank e-banking services namely ATM, Internet Banking and Telephone banking. The AHP is used to determine weights of relative importance of the service quality criteria, and PROMETHEE method is used to obtain final outranking of three different technologies as judged by customers.

Bank customers made pair wise comparisons in order to obtain the service quality dimensions weights. Questionnaires designed for the purpose and contained items for customer satisfaction and demographic variables. The questionnaires were administered both electronically and in person in order to increase the diversity of the respondents, increase the number of returned questionnaires, and increase the geographical accessibility.

In order to evaluate the performance of the three Automated-banking services from bank’s customers’ point of view using PROMETHEE method, a questionnaire has been developed to obtain values for each dimension for the three automated services from customers ‘point of view. The aim of the questionnaire was to evaluate the performance of the automated banking services as a whole. The feedback gained is quite crucial so as to understand how the performance of these automated banking channels was perceived from bank customers.

4. Data collection and analysis

4.1 Sample description of AHP questionnaire

The respondents were asked to consider a series of paired comparisons to state their preferences. 100 questionnaires were distributed over the targeted bank customers from Alexandria in Egypt. Yet only 50 completed questionnaires were returned. The inconsistency values of the 50 completed questionnaires were calculated. In case of having reasonable number of alternatives (less or equal 5), 0.1 was suggested in literatures as an upper limit. However, in case of scarcity of respondents and/or increased number of alternatives (criteria), this upper limit could be relaxed. In the present work, an upper limit of ICR is taken as 0.3. Responses that have ICR greater than 0.3 were discarded. Therefore, the number of consistent questionnaires was 23 questionnaires.

All the population of the study have already bank account and used different electronic services from which 100% of the sample used ATM service, 46% used telephone-banking service and 64% used Internet banking service. The
sample was equally distributed between male and female. 16% of the sample was below 25 years old, while 60% were in the 25 - 40 age group, 18% were in the 41-55 age group and 6% were over 55 years old. Population studied comprised postgraduate and graduate, with frequency distributions of 64% and 34%, respectively. The majority group of respondents was with monthly income within the range of EGP 5000 -15,000 (48%) followed by those with a monthly income EGP 2000 to 5000 (34%). Most of the sample was salaried employees (78%).

Demographic information revealed that most of respondents were highly experienced in using automated banking services, well-educated with high income and worked as employee so he doesn’t have the time to go to traditional branch to do banking transactions.

4.2 Weights of Criteria applying AHP and check of the consistency
The questionnaire was designed under the requirements of AHP. The respondents were asked to consider a series of paired comparisons to state their preferences. The consistency of pairwise comparisons has been checked for each respondent. They used the scale represented in Table 1. Results of processing the consistent questionnaires are shown in Table 3.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Definition</th>
<th>Weights</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>User-friendly system</td>
<td>System is simple to use, and structured properly.</td>
<td>0.051</td>
<td>8</td>
</tr>
<tr>
<td>Efficiency</td>
<td>Requires a minimum of information to be input by the customer and cost efficient.</td>
<td>0.1</td>
<td>5</td>
</tr>
<tr>
<td>Security/privacy</td>
<td>Degree to which the customer believes the system is safe from intrusion and personal information is protected.</td>
<td>0.227</td>
<td>1</td>
</tr>
<tr>
<td>Reliability and availability</td>
<td>Correct technical functioning of the system, the accuracy of service promises and available anytime.</td>
<td>0.128</td>
<td>3</td>
</tr>
<tr>
<td>Responsiveness</td>
<td>Quick response and the ability to get help if there is a problem or question</td>
<td>0.112</td>
<td>4</td>
</tr>
<tr>
<td>Compensation and Incentive</td>
<td>The degree to which the system compensates customers for problems, encouraging customers to use electronic channels and rewarding them.</td>
<td>0.055</td>
<td>7</td>
</tr>
<tr>
<td>Fulfillment</td>
<td>The extent to which the system’s promises about transaction/transfer made is fulfilled.</td>
<td>0.086</td>
<td>6</td>
</tr>
<tr>
<td>Assurance/trust</td>
<td>Confidence the customer feels in dealing with the system and is due to the reputation of bank and services as well as clear and truthful information presented.</td>
<td>0.203</td>
<td>2</td>
</tr>
<tr>
<td>Empathy</td>
<td>Refers to the caring and individualized attention the firm provides to its customer</td>
<td>0.038</td>
<td>9</td>
</tr>
</tbody>
</table>

4.3 Performance Evaluation of competing channels applying PROMETHEE
PROMETHEE has been used for the prioritization of different automated banking services as regards to the nine criteria. Some of the evaluation values are to be minimized (reliability and Availability) and the rest are maximized. Preference functions were selected according to the nature and the scale of measurement of each criterion as shown in Table 4.

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Type</th>
<th>Units of measurements</th>
<th>Optimality</th>
<th>Preference function</th>
</tr>
</thead>
<tbody>
<tr>
<td>User-friendly system</td>
<td>Qualitative</td>
<td>5 point scale (Very good, good, average, bad, very bad)</td>
<td>Maximize</td>
<td>Usual</td>
</tr>
<tr>
<td>Efficiency</td>
<td>Qualitative</td>
<td>5 point scale</td>
<td>Maximize</td>
<td>Usual</td>
</tr>
<tr>
<td>Security/privacy</td>
<td>Qualitative</td>
<td>5 point scale</td>
<td>Maximize</td>
<td>Usual</td>
</tr>
<tr>
<td>Reliability and Availability</td>
<td>Quantitative</td>
<td>Failure rate of the system / year</td>
<td>Minimize</td>
<td>V-shape</td>
</tr>
<tr>
<td>Responsiveness</td>
<td>Qualitative</td>
<td>5 point scale</td>
<td>Maximize</td>
<td>Usual</td>
</tr>
</tbody>
</table>
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6. Compensation and Incentive
   Qualitative 5 point scale  Maximize Usual
7. Fulfillment  Qualitative 5 point scale  Minimize Usual
8. Assurance/trust Qualitative 5 point scale  Maximize Usual
9. Empathy  Qualitative 5 point scale  Maximize Usual

4.4 Sample description of PROMETHEE questionnaire
In order to evaluate the performance of the three Automated-banking services from bank’s customers’ point of view, a questionnaire has been developed to obtain values for each dimension for the three automated services from customers’ point of view. The aim of the questionnaire was to evaluate the performance of the automated banking services as a whole. The feedback gained is quite crucial so as to understand how the performance of these automated banking channels was perceived from bank customers.

The questionnaire was divided into three main parts for the three automated banking services; each part of the questionnaire contains items measuring the nine service quality dimensions for each service. These items were derived from prior Internet and mobile banking studies. A five-level Likert scale ranging from very good (1) to totally disagree (5) was used in all dimensions except Reliability and Availability dimension, whereas we asked about the failure rate per year of the service. The questionnaire also includes questions relating to socio-demographics (gender, age, income, and education). Most of the questions in the questionnaire were adapted from previous research. However, a number of questions were self-developed solely for the purpose of this research to address important concepts, which were not addressed in previous studies.

The survey was administered both electronically and in person in order to increase the diversity of the respondents, increase the number of returned questionnaires, and increase the geographical accessibility. The sampling method chose in this survey was quota sampling [22], as respondents should use at least one of the automated banking services. 150 questionnaires were distributed over respondents from Alexandria. Yet only 55 valid questionnaires were returned of whom 55 respondents (100 per cent) use ATM service, 27 respondents (48.2 per cent) use telephone banking service and 32 respondents (57.1 per cent) use Internet banking service.

The number of male respondents was 23 males (41.8%) while the number of female respondents was 32 females (58.2%) in this survey. The majority of the respondents were in the 26-40 age group (52.7%). The population studied comprised postgraduate students with 60 per cent and graduated students with frequency distributions 40 %. 85% of the sample was salaried employees, while 7% of the sample was business owners. Respondents that get a monthly income from EGP 5000 to 15000 were the highest group (45 %) followed by those with a monthly income within the range of EGP 2000 to 5000 (42 %).

4.5 Outranking of the alternatives
After collecting the valid questionnaires, the mean average of all values for the nine dimensions of each automated banking service were calculated using SPSS Software and Microsoft Excel. The average values of reliability dimensions were calculated to obtain the average failure rate of the service per year. A summary of the values was illustrated in table 5.

Table 5: Evaluation values of automated banking service channels

<table>
<thead>
<tr>
<th></th>
<th>User friendly</th>
<th>Efficiency</th>
<th>Security</th>
<th>Reliability/ year</th>
<th>Responsiveness</th>
<th>Compensaton</th>
<th>Fulfillment</th>
<th>Trust</th>
<th>Empathy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min/Max</td>
<td>Max</td>
<td>Max</td>
<td>Max</td>
<td>Min</td>
<td>Max</td>
<td>Max</td>
<td>Max</td>
<td>Max</td>
<td>Max</td>
</tr>
<tr>
<td>ATM</td>
<td>Very good</td>
<td>Good</td>
<td>Good</td>
<td>11.64</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Telephone</td>
<td>Good</td>
<td>Average</td>
<td>Average</td>
<td>15.84</td>
<td>Average</td>
<td>Average</td>
<td>Average</td>
<td>Average Good</td>
<td></td>
</tr>
<tr>
<td>Internet</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>20.04</td>
<td>Good</td>
<td>Average</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
</tr>
</tbody>
</table>

Then, the values were entered in visual PROMETHEE software and the leaving flow ∅ +, entering flow ∅ − and net flow ∅ are deduced as shown in Table 6.

Table 6: leaving flow, entering flow and net flow of three competing automated banking service channels
From bank customers’ point of view, ATM and Internet banking got almost the same values in all dimensions except the highest p

SMS banking in Iran using Analytic Hierarchy Process (AHP) model and reported that ATM banking has the five electronic banking methods comprising ATM banking, Phone banking, Internet banking, Mobile banking and lowest value for (performance channel)

The results of PROMETHEE outranking approach revealed that the service of ATM ranked as the highest performance channel $\Phi = 0.3900$ followed by Internet banking ($\Phi=0.3135$) while the telephone banking got the lowest value for ($\Phi = -0.7035$). This results is consistent with Rasolizjad, (2009) [27] in her study aimed to rank five electronic banking methods comprising ATM banking, Phone banking, Internet banking, Mobile banking and SMS banking in Iran using Analytic Hierarchy Process (AHP) model and reported that ATM banking has the highest performance in Iran among other electronic channels.

From bank customers’ point of view, ATM and Internet banking got almost the same values in all dimensions except

<table>
<thead>
<tr>
<th>E-services Channels</th>
<th>$\Phi+$</th>
<th>$\Phi-$</th>
<th>$\Phi$</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telephone banking</td>
<td>0.0000</td>
<td>-0.7035</td>
<td>-0.7035</td>
<td>3</td>
</tr>
<tr>
<td>ATM</td>
<td>0.3900</td>
<td>0.0000</td>
<td>0.3900</td>
<td>1</td>
</tr>
<tr>
<td>Internet Banking</td>
<td>0.3390</td>
<td>0.0255</td>
<td>0.3135</td>
<td>2</td>
</tr>
</tbody>
</table>

On the basis of the net flows as shown in table 6, the ATM banking service is ranked as the best performance among all other channels followed by Internet banking. The telephone-banking channel got the lowest net flow value.

5. CONCLUSION

One of the ways for achieving high customer satisfaction and gaining the loyalty of customers is for banks to offer high quality services. This research presents a proposal for applying a decision model to evaluate the performance of three different e-services channels namely: ATM, Telephone banking and Internet banking. This model uses two multiple criteria decision aid techniques (AHP and PROMETHEE), with nine Service quality dimensions (user-friendly, Cost efficiency, security and privacy, reliability and availability, Responsiveness, Compensation and incentives, fulfillment, Assurance and trust, Empathy). The usage of AHP/PROMETHEE methods was powerful tools to evaluate the performance of E-banking services and to analyze the relations between criteria. Our approach allows dealing with several conflicting performance of criteria (qualitative and quantitative). The proposed decision model can help bank Stakeholders choose and analyze factors and attributes easily.

From results of AHP computations, respondents reported that both criteria that had greater concern to customers are Security/Privacy (0.227) and Assurance/ Trust factor (0.203) followed by Reliability and Availability (0.128), Responsiveness (0.112), Efficiency (0.10) and fulfillment (0.082). Surprisingly, a respondent considered that compensation/ incentive (0.055), User-friendly (0.055) and Empathy (0.051) were almost the least important among other criteria.

Security/ Privacy and Assurance/Trust got the highest score which is well matched with the findings of Amirzadeh et al., (2011) [23] who used Fuzzy TOPSIS approach to rank the E-service quality of ATM which indicates that security and privacy is the most important factor from customers ‘views. Moreover, Kheng et al. (2010) [24] who used the Regression Analysis to rank the E-service quality dimensions, Assurance got the highest score among other factors. Furthermore, Khan et al., (2009) [14] reported that customers are satisfied with quality of service on four dimensions such as reliability, accessibility, privacy/security, responsiveness and fulfillment, but least satisfied with the ‘user-friendliness' dimension.

Two other works supports the output from AHP, Golmohammadi and Jahandideh, (2010) [25] used the artificial neural network approach and reports that “Reliability” is the most important criteria in Iran’s banking sector. Moreover, Ooni et al., (2010) [26] found also that reliability have the highest influence among other factors on the customers’ satisfaction while Empathy and user-friendly have little positive influence on customers’ satisfaction, which is consistent with the research findings.

Accordingly, banks must provide more sophisticated authentication systems to protect users, to ensure that the service is secured and mention explicitly the security techniques used. Safety issues in particular should be well addressed and targeted marketing actions should be taken in order to encourage customers to use automated banking services and feel that these services are trustable to use it. Banks could also offer an explicit guarantee, which ensures to replace funds a customer did not authorize to be withdrawn, transferred, or paid from an account. The use the AHP method rank only the service quality dimensions and find the relative weights of service quality dimensions for automated banking service is are important and would help the service managers to efficiently allocate resources.

The results of PROMETHEE outranking approach revealed that the service of ATM ranked as the highest performance channel $\Phi = 0.3900$ followed by Internet banking ($\Phi=0.3135$) while the telephone banking got the lowest value for ($\Phi = -0.7035$). This results is consistent with Rasolizjad, (2009) [27] in her study aimed to rank five electronic banking methods comprising ATM banking, Phone banking, Internet banking, Mobile banking and SMS banking in Iran using Analytic Hierarchy Process (AHP) model and reported that ATM banking has the highest performance in Iran among other electronic channels.
the failure rate (Reliability and Availability) of ATM is the least (11.64/year) comparing to internet banking (20.4/year). Moreover, Compensation and incentive for ATM is higher (good) than Internet banking (average). Also, customers found that ATM system is more user-friendly than Internet banking system. On the other hand, for results customers stated that Telephone banking service is less secured, less trustable, less efficient, and less responsive than other channels. Accordingly, decision makers in the banking industry should pay more attention to the telephone banking service by providing more customer service employees in order to let customer connect immediately with no waiting time. Additionally, banks should provide voice directions for users that are easy to understand and should offer more wide services to increase the efficiency of the telephone banking system. Finally, in general, the Performance of automated banking services should be monitored on a regular basis to ensure that their service quality is up to customers’ expectations and increase customers’ satisfaction.

To summarize, this research proposed an evaluation of the performance of E-banking channels by using AHP and PROMETHEE. MCDM methods such as AHP and especially PROMETHEE has not yet been used in evaluating the e-banking services based on Service Quality dimensions. Additionally, this study has not been applied before in Egypt. In this paper, the proposed model is proved to be suitable and can be used widely in the area of quality service evaluation of E-banking service by banking stakeholders. They can add more criteria, provides more and accurate data to evaluate the performance of E-banking channels, identify its weakness and successful points. This procedure can help decision makers make better decisions and obtain efficient and significant results.

6. FURTHER WORK
The sample of the study is based on the samples selected from non-random method as the same is taken in only Alexandria, Egypt, which is considered a limitation. Therefore, the results should be interpreted with caution, with respect to the generalization of research findings to Egyptian customers as whole. A more convenient sample that targets more respondents from all Egyptian cities would give a better analysis than that carried only Alexandria.

Future research studies need to employ random sampling method to verify the findings of the current study. Moreover, by adding more criteria and providing more and accurate data from banks records to evaluate the performance of automated banking channels, this could help decision makers make better decisions and obtain efficient and significant results. Moreover, this hybrid model could also be useful and could be implemented in other fields such as airlines, hotels, hospitals… etc.

References

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