Customers' Priority to Implement SSTs Using AHP Analysis

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Abstract—Self-service technologies (SSTs) make an important contribution to the daily life of people nowadays. However, the introduction of SST does not lead to its usage. Thereby, this paper was an attempt on discovery of the most preferred SST in the customers' point of view. To fulfill this aim, the Analytical Hierarchy Process (AHP) was applied based on Saaty's questionnaire which was administered to the customers of e-banking services located in Golestan providence, northern Iran. This study used qualitative factors in association with the intention of consumers' usage of SSTs to rank three SSTs: ATM, mobile banking and internet banking. The results showed that mobile banking get the highest weight in consumers' point of view. This research can be useful both for managers and service providers and also for customers who intend to use e-banking.

Keywords—Analytical Hierarchy Process, Decision-making, E-banking, Iran, Self-service technologies.

I. INTRODUCTION

ADVANCES in banking technology made a fundamental shift in banking delivery channels toward using self-service technologies (SSTs). These SSTs, which are defined as the automated delivery of new and traditional banking products and services directly to customers through electronic, interactive communication channels, enables customers to generate a service independent of direct service employee involvement such as ATMs, online banking, scanning purchases in supermarkets, and paying public transportation tickets by mobile phone as the most popular SSTs among consumers [1]. These technologies have been applied in the delivery of services, so that it serves several benefits for customers and banks alike in terms of money and time saving. In addition, better branding, better responsiveness to the market and also perfect opportunity for maximizing profits are the advantageous that banks can get from the SSTs [2]. In other words, an extensive appeal with using these technologies is made for banks, in such a way that they can reduce labor

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cost and expand the options for delivery [3]-[5]. On the other hand, banks can reduce their branch networks and downsized the number of service channels in that the customers don't need to take too much time and effort for getting the bank services [6]. Therefore, service providers introduce SSTs to increase productivity and efficiency [7], and to offer customers access to services via convenient channels [8].

It is evident that SSTs are now widespread across the world but little is known about why customers are willing to prefer using specific SSTs and also which SSTs are more widely accepted than the others. The current study, then, was aimed to deal with the underlying factors influencing usage of SSTs and to compare three SSTs comprising ATM, internet banking, and mobile banking based on variables making contribution to the acceptance of SSTs in banking industry. In the sections which follow, after introduction the variables affecting usage of SSTs would be reviewed and then in the third section, we present the method of Analytical Hierarchy Process (AHP) which used for ranking SSTs. Subsequently, in the fourth and fifth section, data and results demonstrated. Finally, conclusions demonstrated in section six.

II. CONCEPTUAL BACKGROUND

What causes people to accept or reject SSTs? Many variables that may influence on consumer preferences of using SSTs have been introduced in previous researches. Based on literature on this topic and especially the work of [9], four variables which affect the customers' choice for SSTs are used in this paper that is purpose, perceived risk, benefits and requirements. As mentioned by [9], the purpose of SST can be determined as fund transactions, service requests and availing information, so that fund transactions includes payment for some services like paying for bills, purchasing tickets for travel or mobile charge. Additionally, the authors distinguished between availing information and service request, so that information about banks' activities, procedures related to availing different services extended by banks and so on, take place under the term of availing information and, in turn, information about account balance, financial turnover, account payments and received details is contained in service requests.

The second factor considered in our analysis is perceived risk which is defined as the amount of risk perceived by a customer in a particular action [10]. In fact, individuals might expect some kinds of loss in the result of being aware of a risk [11]. Evaluation of risk in the context of consumers' behavior began in 1960 with the work of Bauer which has found that the behavior of customers is involved risk. In fact, the author

has showed that customers' actions may produce consequences which he cannot predict with certainty. Accordingly, based on the theory of consumers' perceived risk, individuals perceive risk because they face uncertainty and undesirable consequences as a result of using SSTs. Therefore, the more risk they perceive, the less likely they will use the systems. Perceived risk can be identified in five classifications as follows:

Financial risk: Perceived financial risk is sometimes economic risk which is representation of the probability of monetary loss arising from payment process without the money being transferred [11].

Performance risk: Perceived performance risk is the probability that the instruments and software do not work properly or crash in the middle of payment process.

Time risk: Perceived time risk is the probability of losing time for correcting the mistake generated in once steps of transfer or payments.

Security risk: Perceived Security risk is the possibility that personal information such as national number, account number and account pin number getting hacked and used without owner's permission.

Psychological and social risk: Perceived Psychological and social risk is concerned with individuals' perception of other people, potential loss of status in one's social group and also mental stress because of unsuccessful actions as e-mail attachments.

It is evident that one of the variables which may affect on the preferences of customers can be the relative advantage that customers discern they get from using an SST. Time saved, money saved, less physical efforts and round the clock banking are such benefits received by customers which differs among SSTs in customers' perspective. As mentioned in introduction, time saving and money saving are the most important benefits customers receive. The concept of the first variable is the least time taking from starting up to ending of transfer or payment process, in addition the second one is defined as the lowest fees that bank asked as a charge of transferring money or payment.

Besides the variables mentioned above, it is crucial to consider appropriate instrument for applying SSTs and also required knowledge and skills for using them. Additionally, customers' experiences can be one of the determining factors affecting the preferences of bank customers, in such a way that respondents with less SST experience may be more likely to blame themselves for a failure or less likely to complain about a failure.

Of course when consumers decide to whether use these SSTs or not, they will weigh these criteria. As the implementation and management of technology-based service delivery systems are so expensive, it is important to understand how consumers arrive at such a decision. With the method presented in the next section, consumers rank the most important factors toward using SSTs.

III. ANALYTICAL HIERARCHY PROCESS (SSTs)

The analytical hierarchy process (AHP) developed by [12], is a structured technique for organizing and analyzing complex decisions [13]. This technique is used to quantify the qualitative factors, thereby ranking the decision alternatives based on pairwise comparison among the decision criteria as well as the alternatives. The methodology of AHP has four steps to the final result as follows:

The hierarchical structure: The first step to select the best alternative is stratifying the framework of the decision-making which includes decomposition of the decision problem into elements according to their common characteristics [14]. Fig. 1 demonstrates the hierarchical structure for evaluation of self service technologies based on criteria and subcriteria mentioned in section 2. This model, which has four levels divided into goal, criteria, subcriteria and alternatives, captures the customer preference based on these criteria and subcriteria.

This step includes comparative judgments or pairwise comparisons among criteria at the same level to measure the contribution of the each criterion in relative to goal, based on 9-point scale of [12] as given in Table I. In other words, a comparison matrix is made by comparing pairs of all criteria and alternatives.

TABLE I
9-POINT SCALE OF PAIRWISE COMPARISON IN A MULTICRITERIA DECISION MAKING

Intensity of Importance	Definition
1	Equal importance
3	Moderate importance
5	Strong importance
7	Very strong importance
9	Extreme importance
2,4,6,8	Intermediate values between the two adjacent judgments
Reciprocals of above	If activity i has one of the above numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i.

Suppose that there are n criteria and their relative priorities $w_1, w_2, ..., w_n$. Therefore, A is an $n \times n$ matrix of pairwise comparison whose elements are a_{ij} which may be regarded as an estimate of the ratio $w_1, w_2, ..., w_n$. The matrix A is expressed as (1) [9]:

$$A = \begin{bmatrix} a_{ij} \end{bmatrix} = \begin{bmatrix} w_1/w_1 & w_1/w_2 & \cdots & w_1/w_n \\ w_2/w_1 & w_2/w_2 & \cdots & w_2/w_n \\ \vdots & \vdots & & \vdots \\ w_n/w_1 & w_n/w_2 & \cdots & w_n/w_n \end{bmatrix} \quad (1)$$

where,

$$a_{ij} = w_i/w_j, a_{ij} = 1/a_{ij}, w = \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{bmatrix}, i, j = 1, 2, ..., n \quad (2)$$
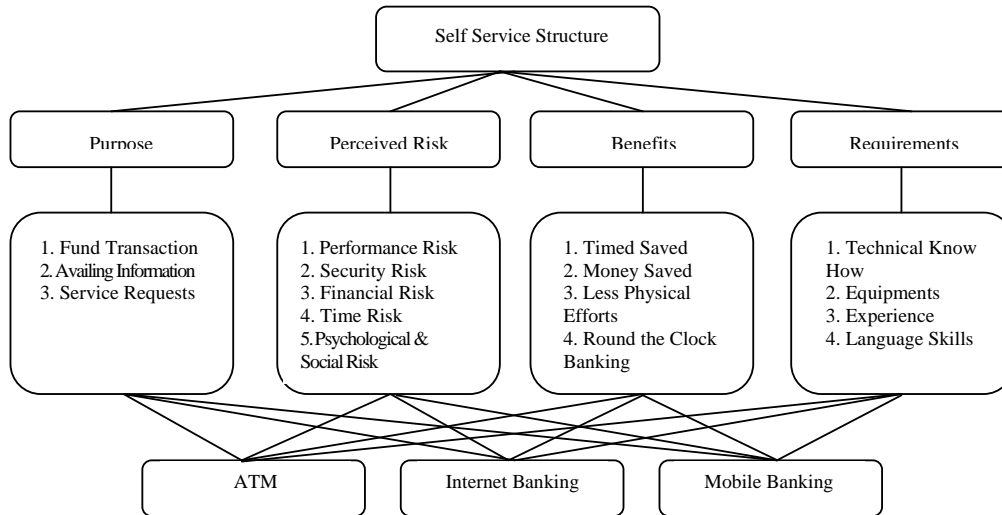
Fig. 1 Hierarchical structure of the problem

Consistency index (CI): Following identifying preferences through the comparison matrix as outlined in step 2, transitivity principle, and CI should be checked. Transitivity principle declares that if for example A outperforms B and B outperforms C, to be consistent A should outperform C. Rejection of this principle leads to inconsistency between the pairwise values. So a consistency check which is formulated as (3) is required for the pairwise comparison matrices. When the transitivity principle holds, the maximum eigenvalue of the matrix, λ_{max}, is equal to n.

$$\lambda_{max} = \sum_{j=1}^{n} a_{ij} \frac{W_j}{W_i} = n \qquad (3)$$

Unfortunately, the estimate of λ_{max}, λ'_{max}, is not equal to n in most cases. Therefore, we calculated the CI to determine if the law of transitivity is violated [15]. The formula of the CI is

$$CI = \frac{\lambda'_{max} - n}{n - 1} \qquad (4)$$

Accordingly, the consistency ratio (CR) might be calculated by using (5):

$$CR = \frac{CI}{RI} \qquad (5)$$

The value of RI which is related to the dimension of the matrix is tabulated (Table II).

TABLE II
THE VALUE OF RI

Dimension	1	2	3	4	5	6	7	8	9
RI	0	0	0.52	0.89	1.12	1.26	1.36	1.41	1.46

If the result of CR is less than 0.1, the consistency of the pairwise comparison matrix M is acceptable.

Aggregation of weights: The last step is to compute the composite weight of each alternative through the comparison matrix to identify the best alternative. Accordingly, the ultimate weight of each alternative can be computed using (6), if we assume that A_i is one of the alternatives and C_j is the criterion of the model.

$$A_i = \sum_{j=1}^{n} \left[\begin{pmatrix} \text{Local weight of A}_i \text{ with} \\ \text{respect of criterion C}_j \end{pmatrix} \times \begin{pmatrix} \text{Local weight of} \\ \text{criterion C}_j \end{pmatrix} \right] \qquad (6)$$

IV. DATA COLLECTION

The individuals contributed to fill the questionnaire were, at most, highly-educated with managerial experiences. The study was conducted in Golestan province, northern Iran. On the basis of Saaty's questionnaire layout, the interviewees measure the degree of preferences to which each SSTs correspond to the sub-factors on a five ordinal scale (as explained in Table I).

V. RESULTS

Large Based on the initial step of the AHP procedure, the activity entailed the formulation of a hierarchy pattern of the AHP model (Fig. 1) containing a goal and a pair of levels of elements (criteria and sub-criteria), to identify the best SST which provides the most satisfaction. All of the pairwise comparisons performed to work out the priority weights among the criteria and sub-criteria are presented in Table III. The results indicated that purpose of the usage of SSTs, which have an overall weight of 39 percent, play a crucial role in customers' choice of SSTs. Furthermore, the criteria perceived risk, requirements and benefits which constitute only 24, 19, and 17 percent respectively, rank the place second to fourth. In other words, purpose is the more significant factor affecting employment of SSTs by customers than the other factors. Yet, percentage weight among the sub-criteria shows that fund

transaction with 17 percent weight is the major concern followed by service request (11.3%), availing information (10.5%) and round the clock banking (8.5%).

TABLE III
PRIORITY WEIGHTS AMONG CRITERIA AND SUBCRITERIA

criteria	Percentage weight between the criteria	Percentage weight within the criteria	Percentage weight among the sub-criteria
Purpose	**0.394 (1)**		
Fund transaction		0.447 (1)	0.176 (1)
Availing information		0.266 (3)	0.105 (3)
Service requests		0.287 (2)	0.113 (2)
Perceived risk	**0.240 (2)**		
Performance risk		0.122 (4)	0.029 (12)
Security risk		0.266 (2)	0.064 (7)
Financial risk		0.333 (1)	0.080 (5)
Time risk		0.157 (3)	0.038 (9)
Psychological & Social risk		0.122 (4)	0.029 (12)
Benefits	**0.172 (4)**		
Time saved		0.156 (4)	0.027 (14)
Money saved		0.163 (3)	0.028 (13)
Less physical efforts		0.188 (2)	0.032 (11)
Round the clock banking		0.493 (1)	0.085 (4)
Requirements	**0.195 (3)**		
Technical know how		0.187 (4)	0.036 (10)
Equipments		0.243 (2)	0.047 (8)
Experience		0.372 (1)	0.072 (6)
Language skill		0.198 (3)	0.038 (9)

In accordance with the local weights of criteria in different levels which are shown in Table III, the final weights of the alternative computed using (6) by multiplying its local weights with the corresponding weight along the hierarchy. Table IV shows the weight of the three SSTs including ATM, internet banking and mobile banking. Also, synthesis result of the factors using Expert Choice is outlined in Fig. 2. The priority weight associated with ATM, vide, is computed as follows:

$$\text{Final weight of ATM} = (0.394 \times 0.332) + (0.240 \times 0.339) + (0.172 \times 0.146) + (0.195 \times 0.347) = 0.305$$
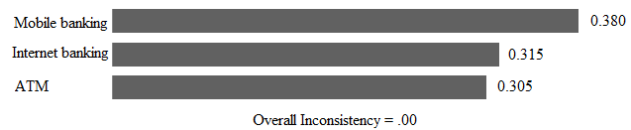

Fig. 2 Synthesis with respect to choice of SSTs

TABLE IV
IMPORTANCE WEIGHT OF ALTERNATIVES

Factors	ATM	Internet banking	Mobile banking
Purpose	**0.332 (2)**	**0.308 (3)**	**0.360 (1)**
Fund transaction	0.417	0.188	0.395
Availing information	0.209	0.450	0.341
Service requests	0.314	0.362	0.325
Perceived risk	**0.339 (2)**	**0.320 (3)**	**0.341 (1)**
Performance risk	0.471	0.251	0.278
Security risk	0.394	0.259	0.347
Financial risk	0.294	0.360	0.346
Time risk	0.362	0.373	0.265
Psychological & Social risk	0.180	0.343	0.477
Benefits	**0.146 (3)**	**0.355 (2)**	**0.500 (1)**
Time saved	0.214	0.348	0.438
Money saved	0.185	0.377	0.438
Less physical efforts	0.086	0.408	0.506
Round the clock banking	0.134	0.329	0.537
Requirements	**0.347 (2)**	**0.289 (3)**	**0.364 (1)**
Technical know how	0.387	0.284	0.329
Equipments	0.251	0.240	0.509
Experience	0.410	0.308	0.282
Language skill	0.308	0.316	0.376
Overall priority	**0.305 (3)**	**0.315 (2)**	**0.380 (1)**

According to the final weight which is shown in Table IV and Fig. 2, mobile banking with the global priority equal to 0.380 is the most preferred SST followed by internet banking (0.315) and ATM (0.305). Therefore, mobile banking is the superior e-banking service technology as it performs satisfactorily in all aspects and obtains the rank one in all criteria comprising purpose, perceived risk, benefits and requirements. By contrast, ATM has the third level gaining the score of 0.305. Although ATM perform better in terms of purpose, perceived risk and requirements than internet banking, but the more benefits can be obtain from internet banking in customers' point of view. We note that in spite of mobile banking which is scored the highest in the result, the scores of internet banking and ATM are close and a slight change in the importance of the criteria could alter the order.

VI. Conclusion

This paper provided empirical evidences on the customers' preferences of using SSTs in association with four criteria namely purpose, perceived risk, benefits and requirements. To do so, highly-educated individuals with managerial experiences were asked to fill out a questionnaire and weight some criteria over the other. An AHP analysis was performed to rank the three SSTs: ATM, mobile banking and Internet banking. Collating the findings, it is concluded that mobile banking is more popular SST than ATM and internet banking. In addition, ATM got the least preferred channel as it has less benefit than the two others. It is considerable that the Iranian educated people accept new technologies such as mobile banking and attempt to adopt themselves with today's development in technologies as same as developed countries. So, in the light of the considerable gap among these SSTs, creating more mobile facilities along with technology development and investment in mobile banking such as software, infrastructure and etc is highly recommended.

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