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Developing a Framework for Exploring Factors Affecting on Trust in M-Commerce using Analytic Hierarchy Process

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Abstract

Mobile Commerce is a developing and maturing area of electronic Commerce, where customers and vendors can interact via the service providers through a wireless network and mobile devices for information retrieval and transaction processing. In mobile transactions trust is an essential constituent in mobile commerce transactions .This study aims to clarify the factors that affect on trust in mobile commerce, and then evaluate and asses these factors by AHP method. This paper provides a theory based framework that helps to customers to make a right decision while they would like to shop via mobile facilities in mobile browsers. For this purpose the contribution of different scientific approaches is examined. By combining these approaches a framework for the classification is derived for trust model.
Keywords: AHP method, Mobile Commerce, Trust, Security.

1. Introduction

The rapid evolution of mobile technology has intensified the enlargement of the mobile Internet as a foundation for mobile commerce (m-commerce). M-commerce refers to "e-commerce activities via mobile devices, such as mobile phones and Personal Digital Assistants (PDA's)" [4].

Mobile Commerce is distributing at a remarkable speed. Along with mobile commerce popularity the issues regarding the trust on mobile commerce is raising which it is a major issue for customers and seller of mobile commerce. As general, many users usually do not browse an m-commerce portal, which results in customer distrust, doubt and suspiciousness. Additionally, even experienced users face immune problems. In the following sections we will briefly discuss the rapid development of m-commerce and the trust problems of m-commerce. At this point, two definitions of mobile business would be useful:

- Mobile Business or Mobile Commerce is any transaction with a monetary value that is conducted via a mobile telecommunications. [1]
- Mobile Business or Mobile Commerce is the purchase and the sale of goods and services using wireless mobile devices, such as mobile phones and personal digital assistants (PDAs) [2].

Mobile Commerce is also known as mobile electronic commerce or wireless E-commerce. It is conclude to be the next gold scurry after electronic commerce. Business companies of different industries are scurrying to stake a claim [3]. However, m-commerce is many things to many people. Some people deduce m-commerce as an extension of e-commerce to mobile devices. Some people believe it is another new channel after the Internet. Generally, m-commerce refers to any business deal with a fiscal value that is managed through a mobile telecommunications network. According to this definition, m-commerce represents a subset of all e- commerce, including both B2C and B2B. M- Commerce uses the internet for purchasing goods and services as well as sending and receiving messages using hand- held wireless devices. Wireless web applications will enable users with Internet enabled cell- phones.

Mobile phones are stabilized to significantly influence the way people shop. Looking ahead to 2014, Gartner appraises that three billion adults around the world will be equipped to conduct transactions via mobile or Internet technology. And mobile phones will overtake PCs as the most common web access device worldwide by 20131.As consumers become increasingly connected – to each other and to brands - it is critical that retailers develop a seamless cross-platform communication strategy and shopping experience. They should leverage the mobile strengths of convenience and portability to build brand loyalty and ultimately, drive sales [17].

During the last decades mobile networks and devices have been facing many developments. These progress and maturities facilitate e-commerce conducted from a wired network to a wireless network [19, 20] with the increasing developments in the wireless and mobile networks technologies more and more applications are offered to the customers. Table 1 shows Mobile Communication Technologies Eras.

According to Nicholson, Compeau and Senthi [5], trust is a crucial concept in multiple system areas. According to Morgan and Hunt, [6] and O'Malley and Tynan [5], trust is defined as a certainty between the parties that the other party is trustworthy and that the parties will act with a level of trustfulness when dealing with each other. Heffernan [7] summarized that within the realm of relationship marketing; trust has been identified as an significant variable for the success of relationships in the supplier literature [8], the channel literature [9], end consumer relationships literature [10] and lateral relationships literature [11]. In the works of McKnight and Chervany [12], it is stated that trust opinions must exist from the consumers' side in order for a transaction to transpire thereafter. Based on the opinions of McKnight and Chervany, [12] and Poong, Eze and Talha [13], trust is when "one believes that the other party has one or more characteristics beneficial to oneself" while trusting intention means "one is willing to depend on, or intends to depend on, the other party even though one cannot control that party". However, one of the most intimidates challenges to guarantee wide distribution of mobile commerce concerns trust in mobile commerce. Lack of consumer trust is the most significant long-term barrier for e-commerce [21], as well as for mobile commerce. Although mobile devices are more serviceable for "anytime shopping", it has some

exceptional features and characteristics that prevent the development of consumer trust. Mobile commerce must overcome the problem of user distrust to become a viable means of performing business. An in-depth understanding of the factors that constitute and can bring about consumer trust in mobile commerce is necessary.

Indeed trust is significant challenge in the mobile commerce environment. Customers are concerned and involved about the level of security when providing sensitive information online [14]. Also, they expect that personal information will be secured from external access; there are two alterative security and privacy. There are potential advantages in storing data, including personal and financial information, on mobile devices for use in mobile commerce applications [15].

Trust plays a critical role in commercial relationships [22].Trust has been studied in various disciplines ranging from social psychology to decision making. Recently, trust has been studied widely in the e-commerce context [23].Table 1 provides some of frameworks and models regarding trust in e-commerce and m-commerce.

In this study, we endeavor to highlight the potential factors that can improve the trust on mobile commerce services based on experts' viewpoints.

2. The rationale of AHP

Thomas L.Saaty in the 1970s developed analytic hierarchy process (AHP) method depending on mathematics and psychology, it is a decision making technique of fragmenting the elements related to the decision into goal, criteria and alternatives, and then making both qualitative and quantitative analysis. AHP is also a widely used technique to help decision-makers choose the best suited one among various alternatives [16].Figure.1 shows a primary of AHP structure.

There are mainly four steps that AHP does for working on models:

- Define the decision object.
- Group the factors which influence the decision, and build a multi-level structure: the top level is the goal of this decision, the mediatory levels are criteria and sub-criteria of comparing distinct alternatives, and the lowest level is alternatives;
- Make comparisons between each criterion in an upper level and the same criterion in its below level in terms of relative importance, that is, make a set of pair wise comparison matrix. In addition, in order to make a contrast that how much a criterion is more important than another one; a scale of numbers is settled .Table 3 shows the essential scale of absolute numbers.
- Examining the matrix consistency through calculation, adjust it if necessary so that to obtain an acceptable consistency; In line with the premise of the consistency test, calculate the eigenvector corresponding to the maximum eigenvalue of the pair wise comparison matrix, define the weight between each criterion and that in its upper level; figure out the overall ranking weight between each criterion and the goal, and finally make the decision.

The consistency test process is:

- Calculate CI which stands for the consistency index λ_{max} is the maximum eigenvalue of the pair wise comparison matrix, n is the size of matrix;

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

- Find the corresponding RI which stands for the random index from the existing average consistencies of random matrices;

$$RI = \frac{\lambda_{max} - n}{n - 1}$$

Table 4. The average consistencies of random matrices (The Random Index-RI-Values)

Size	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49

- Calculate CR which stands for the consistency ratio.

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

If CR< 0.10, the consistency of matrix is tolerant, otherwise the matrix should be modified.

AHP processes provides a set of methodical analysis method and provides scientific management and decision with a persuasive basis;

Furthermore, AHP method is a simple approximation to help make decisions concerning rather complicated and obscure problems, since it could aggregate various opinions from many experts and even those in different groups[18]; Particularly it is suitable for those problems which are not easy to make absolute quantitative analysis, since AHP combines quantitative and qualitative elements together; Furthermore, all the stakeholders' feelings and opinions could be converted into a numerical scale, especially for laymen's feeling, this method plays a vital role in taking unstructured feelings into consideration[16];And checking the consistency ratio is extreme and critical when it comes to make assessments and decisions, AHP provides feasibility and flexibility to modify the judgment if it turns out to be incompatible.

3. Research Objectives

The primary objective of this research is to develop a valid framework for the comparison trust factors on mobile commerce. The framework was based primarily on subjective trust factors assessments using questionnaires.

4. Overall Theoretical Framework

For presenting a research framework of trust on mobile commerce for users a conceptual framework was created that employs the factors obtained of prior researches. Figure 2 presents a diagrammatic representation of our proposed framework along with the grouped factors.

5. Evaluation of trust factors through AHP

An online questionnaire was constructed using the method of pairwise comparison in which respondents constantly had to choose between three statements in order to get a priority list. In this study ten different experts for Judging were selected. The questionnaire was sent to a random sample of the mobile commerce service providers, academic experts and professional executives of about 100 contacts and 80 respondents completed the questionnaire, a response rate of 80%.

The most of respondents aged between 35-50 years old, while 82.1% of the respondents were male. The respondents of the study also indicated that they were employed in many different businesses. 69.7% of the respondents had a job related to the specialist, technical, and related occupations, and about 20.9% had a job related to executive and managerial occupations, as well as administrative support occupations.

5.1. Pair-wise comparison

By comparing the trust factors in each groups, affecting weight of all factors were determined. Quantitative qualitative judgments, obtain the scale ratio of every factors, namely Comparison Matrix. Generally, comparison matrix is obtained through filling in a questionnaire form by 80 numbers of experts and managers in the field and results processing. The comparison Matrix form is shown in table 5.

mij is a numerical representation of relative importance that factor Mi to Mj that at the same layer for one element at the upper layer. When mij> 1, factor i is more important than factor j to the expressed goal. The number size means degree of relative importance. While mji = (1/mij) <1, factor j is less important than factor i , the number size means relative less important. The form of Comparative judgment matrix of support is shown in Table 6. Similarly A1, A2, A3 can be of similar structure.

5.2. Reorganization of main criteria affecting on trust in mobile commerce

After forming the model in Expert Choice Software and entering the matrix of pair wise comparison, weight of dimensions, criteria and sub-criteria was calculated as shown below. Figure 3 shows prioritization main factors affecting on trust in mobile commerce with Expert Choice Software. As shown in Figure 3, priorities of main factors are 0.396, 0.264, 0.194 and 0.146 respectively .Inconsistency rate of the pairwise comparison is 0.03 which is acceptable; because it is lower than 0.10.

5.3. Calculation of relative weight of criteria regarding each of the main factors

In this research, referring to the literature review and expert views, 4 main factors and 29 sub-criteria was recognized. For prioritization of sub-criteria expert choice was used for all Pairwise Comparison matrixes.

Figure 4 shows Relative Weight of all sub-criteria of customer desires factor.

According to the results of the software, security criterion is of the most importance, weighted 0.285 and so it is in the top priority. Privacy policy and reputatione are in the second and third priority weighted 0.180 and 0.176. Inconsistency rate of pairwise comparison is equal to 0.03 which is acceptable; because it is lower than 0.10.

Figure 5 show Relative Weight of all sub-criteria of mobile and wireless technology factor.

As shown in Figure 5, wireless connection speed of criteria is of the most importance, weighted 0.176 and so it is in the top priority. Accessibility of wireless and encryption of wireless transaction data criteria are in the second priority (weighted 0.161),third(weighted 0.152) and wireless coverage area are in the fourth priority (weighted 0.136). Inconsistency rate of pairwise comparison is 0.04 and since it is lower than 0.10 these comparisons is acceptable.

6. Conclusion

In this study a framework for trust in mobile commerce was developed and AHP method was applied to identify factors influencing trust in mobile commerce although some of the trust factors identified in this study have been presented in the e-commerce literature, our framework identifies new antecedents that are unique to trust in mobile commerce. Results of the survey show that among factors affecting trust in mobile commerce, customer desires is the most important factor and it is considered as the significant factor for trust a customers to mobile commerce.

In summary, we believe that M-Commerce has enormous potential. However, to achieve this potential, the trust issue needs to be more fully comprehended and directly addressed by vendors and providers of M-commerce technologies and services. The framework of trust in mobile commerce developed in this research is an important step in this direction and future research should make several extensions of the current study.

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Table 1. Mobile Communication Technologies Eras

No.	Generation	Decade	Features
1	1st Generation	80-Mid 90s	➢ Simplest communication networks ➢ Voice service only ➢ Analog frequency ➢ Inconsistent ➢ Loss of signal ➢ Limited customer base
2	2nd Generation	Mid 90s-2000s	➢ Digital frequency ➢ High quality and secure mobile voice ➢ Fax and messaging services ➢ Worldwide roaming service
3	2.5 Generation	Early 2000s	➢ Include GPRS & EDGE Services ➢ Visual & multimedia messaging ➢ Location based services ➢ Colored internet browsing ➢ High Speed Circuit Switched Date (28.8 kbps speed)
4	3rd Generation	Early 2000s	➢ Extortionate fees ➢ Will be a stepping-stone towards global mobile convergence ➢ Bases and IP-Core network infrastructure
	3.5 Generation	Expected around 2010	➢ Promises high rate data transfer (about 10 Mbps and higher) ➢ Will be the basis for 4th generation
5	4th Generation	Expected 2010-2015	➢ Voice data integration ➢ Support for mobile and fixed networking ➢ Enhanced services through the use of simple networks ➢ with intelligent terminal devices ➢ Flexible method of payment for network connectivity
6	Mobile Satellite Networks	Launch is not mentioned yet	➢ Ubiquitous access to voice and data services anywhere in the world ➢ Accurate positioning information used to provide ➢ location sensitive information ➢ Access to IP-based networks including internet and corporate data networks

Table 2.Some of Trust Frameworks and Models

Decade	Features
Siau and Shen (2003)	➢ Trust in mobile commerce can be differentiated into two categories: trust in mobile technology and trust in mobile vendors.
Shankar, Urban and Sultan(2002)	➢ Website characteristics (e.g., navigation and user friendliness, advice, error free) ➢ User characteristics (e.g., Internet savvy, past Internet shopping behavior, feeling of control) ➢ Other characteristics (e.g., online medium, trustworthiness of firm, perceived size of firm)
Pavlou and Ba (2000)	➢ Seller's reputation Appropriate feedback ➢ mechanisms
Nah and Davis (2002)	➢ Content of website ➢ Design of website ➢ External certifications and references
McKnight, Choudhury and Kacmar (2002b)	➢ Disposition to trust (faith in humanity, trusting stance) ➢ Institution-based trust (situational normality: general, competence, integrity and benevolence, structural assurance) ➢ Trusting beliefs (competence beliefs, benevolence beliefs, and integrity beliefs) ➢ Trusting intentions (willingness to depend, subjective probability of depending)
McKnight, Choudhury and Kacmar (2002a)	➢ Perceived vendor reputation ➢ Perceived site quality ➢ Structural assurance of the web
Lee and Turban (2001)	➢ Trustworthiness of Internet merchant (ability, integrity, benevolence) ➢ Trustworthiness of Internet shopping medium (technical competence, reliability, medium understanding) ➢ Contextual factors (effectiveness of third party certification, effectiveness of security infrastructure) ➢ Individual trust propensity ➢ Other factors
Gefen, Karahanna and Straub (2003)	➢ Calculative-based ➢ Institution-based structural assurance ➢ Institution-based situational normality ➢ Knowledge-based familiarity ➢ Perceived ease of use

Table 3. Scale of preference between two attributes

Preference weights/level of importance	Definition	Explanation
1	Equally preferred	Two activities contribute equally to the objective
3	Moderately	Experience and judgment slightly favour one activity over another
5	Strongly	Experience and judgment strongly or essentially favour one activity over another
7	Very strongly	An activity is strongly favoured over another and its dominance demonstrated in practice
9	Extremely	The evidence favouring one activity over another is of the highest degree possible of affirmation
2, 4, 6, 8	Intermediate values	Used to represent compromise between the Preferences listed above
Reciprocals	Reciprocals for inverse comparison	

Table 5 .Comparison Matrix M

	M_1	M_2	...	M_n
M_1	m_{11}	m_{12}	...	m_{1n}
M_2	m_{21}	m_{22}	...	m_{2n}
...	...	...	...	...
M_n	m_{n1}	m_{n2}	...	m_{nn}

Table 6. Comparative Judgments Matrix of Support

A4	S24	S25	S26	S27	S28	S29
S24	m11	m12	m13	m14	m15	m16
S25	m21	m22	m23	m24	m25	m26
S26	m31	m32	m33	m34	m35	m36
S27	m41	m42	m43	m44	m45	m46
S28	m51	m52	m53	m54	m55	m56
S29	m61	m62	m63	m64	m56	m66

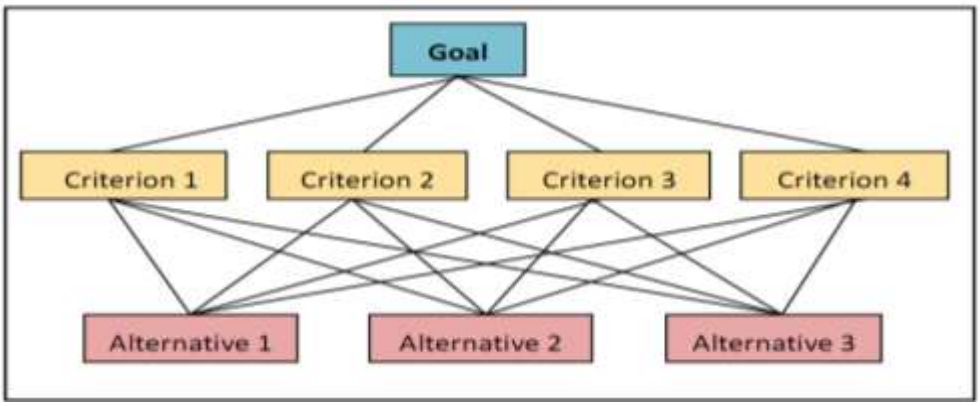

Figure 1. A primary structure of AHP

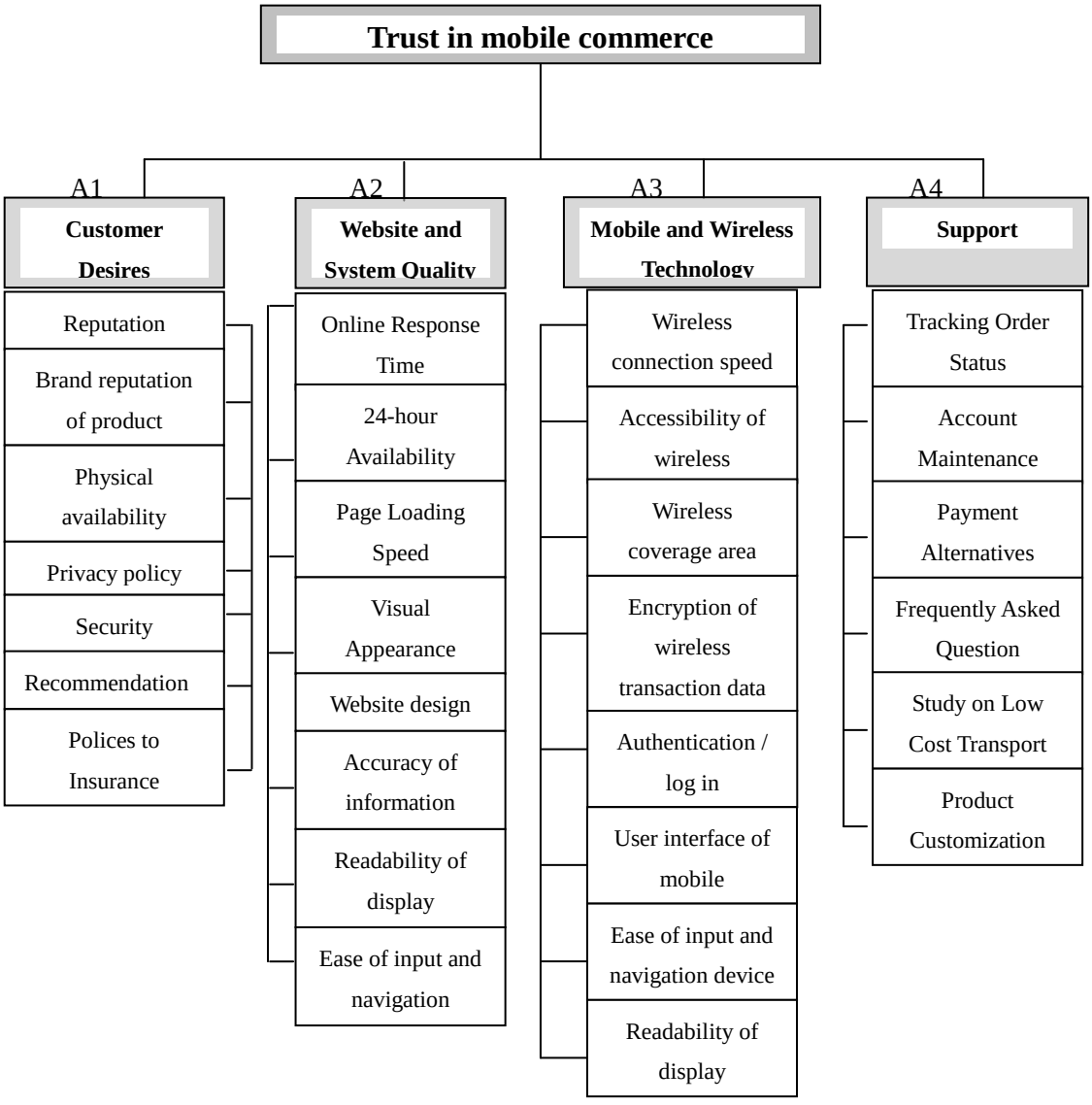

Figure 2 . Proposed Framework for Trust in M- Commerce

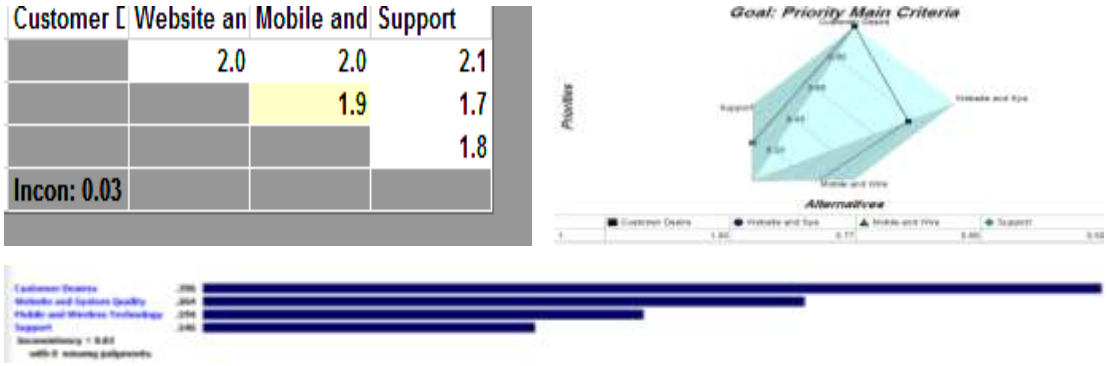

Figure 3. Prioritization of main factors affecting on trust in M-commerce Using Expert Choice Software

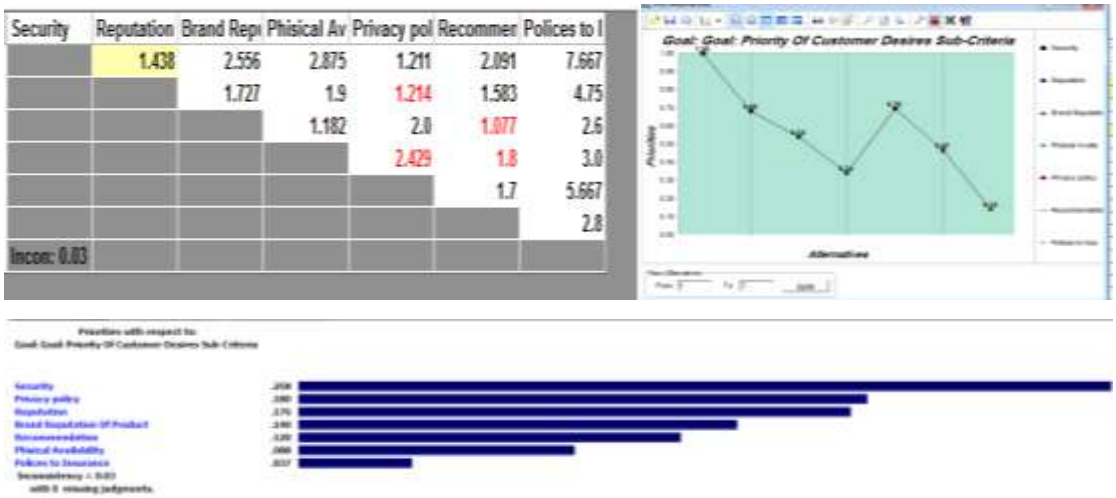

Figure 4. Prioritization of sub-criteria of customer desires Using Expert Choice software

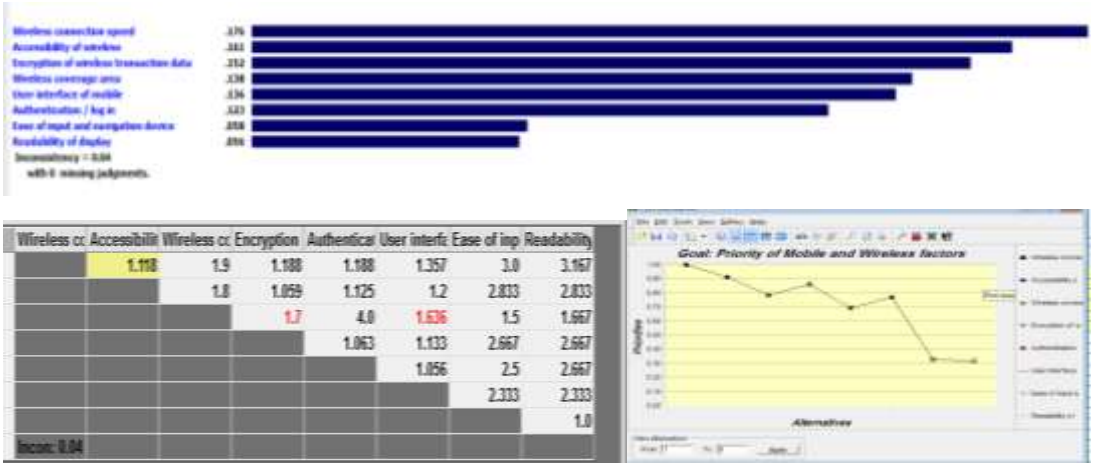

Figure 5. Prioritization of sub-criteria of mobile and wireless technology using Expert Choice software