

Estimation of Users Satisfaction in Electronic Banking: Neural Network Approach

Stefan Zdravković¹, Jelena Peković², Aleksandar Jovanović³

1. Faculty of Economics, University of Kragujevac, Djure Pucara Starog 3, 34000, Kragujevac, Serbia,

szdravkovic034@yahoo.com

2. Faculty of Economics, University of Kragujevac, Djure Pucara Starog 3, 34000 Kragujevac, Serbia,

jelenapekovic@gmail.com

3. Faculty of Engineering, University of Kragujevac, Sestre Janjic 6, 34000, Kragujevac, Serbia,

a.jovanovic@kg.ac.rs

Abstract

The rapid progress of information technologies has resulted in the development of e-banking. The significant range in consumer demands and lifestyles have imposed the need for banks to use new technologies to communicate with clients. The main advantage of e-banking is the ability to conduct transactions at any time and anywhere. For banks, as providers of e-banking services, it is important to identify factors that influence customer satisfaction. In this paper, we deal with users attitudes that were examined using a pre-prepared survey, which is composed of relevant issues taken from the literature in order to assess the user's satisfaction. The results thus obtained relate to the subjective level of satisfaction of each user. Four parameters were selected that can affect users, and for each of them, the degree of influence on the ultimate customer satisfaction was examined. After then we develop a neural network that approximates the function of an objective level of user satisfaction, taking into account the views of all previous users and matching them. For the last 5 users, who completed the survey, both subjective and objective level of satisfaction was presented. This method for estimating the objective level of customer satisfaction can serve banks as a parameter in estimating the effects of the applied e-banking system. Data processing was performed using SPSS statistical software. Neural network was developed using MATLAB statistical software.

Keywords: E-banking, Users satisfaction, Neural network.

1. Introduction

With the development of technology, the Internet has become the best channel for providing banking services. Banks now consider the Internet to be part of their strategic plan. The Internet is revolutionizing the way we do business, complete in the market and gain competitive advantage (Alsajjan et al., 2006). Customers are now demanding new levels of comfort and flexibility, as well as simple financial management tools that traditional banking cannot offer. With the change in people's lifestyles, banks have recognized the possibility of introducing e-banking into their business (Yiu et al., 2007). As a result, the quality of e-banking services is catching the attention of researchers and bank managers because of its strong impact on business performance, costs, customer satisfaction and loyalty, as well as profitability (Seth *et al.*, 2004).

There are numerous models in the literature that aim to explain what affects service quality. This paper starts from the SERVQUAL model, in which responsibility and security are distinguished as determinants of service quality (Parasuraman et al., 1988). Responsibility refers to the perception of clients that employees are ready to assist the client at all times and provide him with all necessary advice and information (Gasevic et al., 2016). Security is about protecting clients while using e-banking services (Yang, 2009).

The main advantage of electronic banking is the ability to transact at any time and place. However, a number of clients have a risk aversion and are slower to adopt new technologies. For this reason, a modified Technology Acceptance Model (TAM) is used in this research, where ease of use and website content can be identified as significant determinants of e-banking (Davis 1989). Ease of use refers to the effort that an individual will have to make to perform a technical task (Revels et al. 2010). The content of the website refers to the opinion of the respondents whether the bank's website is clear and understandable to use, as well as whether it provides all necessary information to the clients (Gasevic et al., 2016).

Each bank strives to provide the best possible service to its clients, in order to achieve a certain degree of satisfaction. The concept of customer satisfaction is the subject of special attention in marketing, as it is justifiably believed that satisfaction influences clients' intentions and future behavior. Satisfaction is defined as the clients' understanding of the extent to which his or her requirements are fulfilled.

The subject of this research is to examine the impact of key determinants of e-banking (responsibility, security, ease of use, website content) on customer satisfaction. This is an important research activity, which can have practical implications for service providers in the banking sector. The main objective of

the paper is to determine whether the determinants of e-banking (responsibility, security, ease of use, website content) have an impact on customer satisfaction. In particular, using a neural network, customer satisfaction was assessed when taking into account the experiences of all clients previously examined.

The paper consists of 5 parts. After introducing and reviewing the literature in the first part, the second part presents the problem setting for analyzing the impact of e-banking determinants on customer satisfaction. In this section, research hypotheses are formulated. This third part presents the sample structure and research methodology. The fourth part contains the results of the research, while the fifth part gives conclusions and contribution of the work, points out the limitations, as well as the directions of future research.

2. Problem Setting

This paper examines how the determinants of the SERVQUAL model (responsibility and security) and the determinants of the modified TAM model (ease of use and website content) impact on customer satisfaction.

Responsibility refers to the client's perception of whether employees show a willingness to assist the client at all times, to provide him with all the necessary information and advisory services. The results of a previous study (Gasevic et al., 2016) have shown that responsibility is the most important determinant of e-banking and has a positive impact on customer satisfaction. Accordingly, the first research hypothesis can be formulated in this paper:

H1: *Responsibility has a positive statistically significant impact on e-banking customer satisfaction.*

Security refers to protecting the privacy of clients while conducting banking transactions transakcija (Chung and Paynter, 2002). Previous studies (Eweoya et al., 2016) have shown that security has a positive impact on e-banking customer satisfaction. Shaikh & Sohail (2008) found a similar result in their research. Accordingly, the second research hypothesis can be formulated in this paper:

H2: *Security has a positive statistically significant impact on e-banking customer satisfaction.*

Ease of use refers to an individual's perception that using a particular system is free or simple (Taylor & Todd, 1995). Previous research (Eweoya et al. 2016) has shown that ease of use has a positive impact on customer satisfaction. The results of the study (Guardia, Leiva & Cabanillas, 2013) showed that ease of use has a crucial impact on customers to use e-banking services. Accordingly, the third research hypothesis can be formulated in this paper:

H3: *Ease of use has a positive statistically significant impact on e-banking customer satisfaction.*

Website content is about design, graphic style, photographs, animations and needs to be clear and

understandable to the client and provide him with all the necessary information (Hoque & Lohse, 1999). Gasevic et al. (2016) examined the impact of website content combined with ease of use on e-banking customer satisfaction. Accordingly, the fourth research hypothesis can be formulated in this paper:

H4: *Website content has a positive statistically significant impact on e-banking customer satisfaction.*

In this paper, the authors introduce two concepts related to customer satisfaction, which represents the output size of the model. Subjective customer satisfaction is an expression of one customer's satisfaction with the e-banking system, taking into account only his or her personal experience. Objective customer satisfaction is an expression of one customer's satisfaction with e-banking system, taking into account the experiences of all previous clients. The client's subjective satisfaction comes from the survey he completed, while the client's objective satisfaction is obtained through a developed neural network.

3. Research Methodology and Sample

Based on the research objects and objectives, as well as on the formulated research hypotheses, a conceptual model was constructed, which is shown in Figure 1.

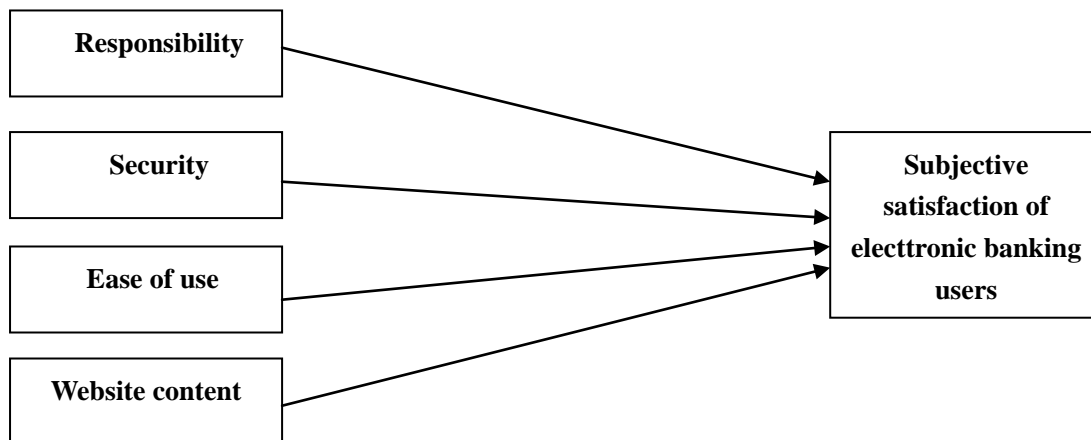


Figure 1: Conceptual model

The research was conducted on the territory of the Republic of Serbia from 15 April to 15 May 2019. The sample consists of 105 respondents, which are segmented by specific demographic characteristics. The research was conducted in person and electronically, using a survey method. Respondents provided answers via the **Likert scale** and expressed the degree of agreement with a particular statement with grades 1 to 7 (1- absolutely disagree; 7- absolutely agree). The condition that the respondents could participate in the survey was that they used electronic banking services. Data processing was performed using **SPSS statistical software**. Neural network was developed using **MATLAB statistical software**.

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The respondents were segmented according to the criteria gender, age, monthly income and education. In the sample of 105 respondents, there are 56 women and 49 man. The largest number of respondents is under 20 age (25,7 %). The largest number of respondents earns over 50, 000 dinars per month (34,3 %), while the highest number of respondents has higher education 46 (43,8 %).

An empirical study was conducted to examine the impact of key determinants of e-banking on customer satisfaction. A questionnaire was formulated containing 15 findings. The variables responsibility, security, ease of use, website content and consumer satisfaction were measured with 3 findings each. An overview of the findings by which these variables were measured is presented in Table 1.

Table 1: Research variables and their corresponding statements

Variables	Statements	Source
Responsibility	1. Employees always have time to answer customer questions. 2. Employees are ready to assist the client at any time. 3. Employees have the necessary knowledge and competencies to answer each client's question.	Adapted to: Gasevic, Vranjes & Drinic, 2016
Security	4. Electronic banking implements measures to protect customers. 5. Electronic banking offers the possibility to confirm the identity of clients for their security. 6. I would feel safe about the electronic payment system in mobile banking.	Adapted to: Koufaris & Hampton-Sosa, 2004
Ease of use	7. The way of using electronic banking is clear and understandable. 8. The use of e-banking services does not require too much effort. 9. I find it easy to use e-banking services.	Adapted to: Choi, 2018
Website content	10. The content of information on the e-banking site meets my needs. 11. The content of the website is clear and understandable. 12. The website provides enough information.	Adapted to: Gasevic, Vranjes & Drinic, 2016
Customer satisfaction	13. I find that my choice to use e-banking services is a good one. 14. The experience I have gained using e-banking is positive. 15. In general, I am pleased with the benefits of e-banking.	Adapted to: Ha, Chang & Susanto, 2016

4. Research results

Descriptive statistical analysis was applied in the study. Table 2 shows the values of arithmetic means and standard deviations for the statements.

Table 2: Result of arithmetic means and standard deviations for statements

Statements	Arithmetic means	Standard deviations
1. Employees always have time to answer customer questions.	5,32	1,22
2. Employess are ready to assist the client at any time.	5,33	1,26
3. Employess have the necessary knowledge and competencies to answer each client's question.	5,24	1,12
4. Electronic banking implements measures to protect customers.	5,26	1,38
5. Electronic banking offers the possibility to confirm the identity of clients for their security.	5,19	1,14
6. I would feel safe about the electronic payment system in mobile banking.	5,62	1,15
7. The way of using electronic banking is clear and understandable.	4,50	1,71
8. The use of e-banking services does not require to much effort.	5,02	1,20
9. I find it easy to use e-banking services.	4,94	1,29
10. The content of information on the e-banking site meets my needs.	4,75	1,60
11. The content of the website is clear and understandable.	4,44	1,86
12. The website provides enough information.	4,39	1,37
13. I find that my choice to use e-banking services is a good one.	5,17	1,45
14. The experience I have gained using e-banking is positive.	4,53	1,67
15. In general, I am pleased with the benefits of e-banking.	4,58	1,73

Respondents expressed the most favorable views on the basis of the statment *I would feel safe about the electronic payment system in mobile banking* (the highest value of arithmetic mean 5,62). Respondents expressed the most unfavorable views on the basis of the statment *The website provides enough*

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information (the lowest value of the arithmetic mean 4,39).

Respondent's attitudes are the most homogeneous based on the statement *Employeess have the necessary knowledge and competencies to answer each client's question* (the lowest standard deviation value 1,12). Respondent's attitudes are the least homogeneous based on the statement *The content of the website is clear and understandable* (the highest standard deviation value 1.86).

The study used reliability analysis to determine whether the findings by which certain variables are mesasured are internally consistent. Table 3 presents the results.

Table 3: Reliability analysis

Variables	The value of Cronbach's alpha coefficient
Responsibility	0.875
Security	0.729
Ease of use	0.809
Website content	0.827
Customer satisfaction	0.876

Reliability analysis is usually used by looking at Cronbach's alpha coefficient values. For a given variable to have an appropriate degree of reliability, it is necessary that the value of this coefficient be higher than 0.70 (Nunnally, 1978). In the case of all five variables, adequate results were obtained.

A correlation analysis was used to determine whether there was a statistically significant relationship between the variables. Table 4 shows the results.

Table 4: Correlation matrix

	Responsibility	Security	Ease of use	Website content	Customer satisfaction
Responsibility	1	0,461*	0,496*	0,319*	0,535*
Security	0,461*	1	0,515*	0,178*	0,476*
Ease of use	0,496*	0,515*	1	0,496*	0,570*
Website content	0,319*	0,178*	0,496*	1	0,292*
Customer satisfaction	0,535*	0,476*	0,570*	0,292*	1

Note: * The coefficients are statistically significant at the level 0.05

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Based on the results of the correlation analysis, we can conclude that all Pearson coefficient values are statistically significant. The highest degree of linear correlation is present between ease of use and customer satisfaction (the highest coefficient value of 0,570). The lowest degree of linear correlation is present between security and website content (the lowest coefficient value is 0,178).

The study applied multiple regression analysis, which measured the impact of e-banking determinants (responsibility, security, ease of use, website content) on customer satisfaction. The results are shown in Table 5. Based on the results of multiple regression analysis a decision is made to confirm or reject the research hypotheses.

Table 5: Results of multiple regression analyzes (dependent variable: customer satisfaction)

Variables	coefficient β	Sig value	VIF
Responsibility	0,342*	0,000	1,461
Security	0,331*	0,001	1,882
Ease of use	0,217*	0,014	1,364
Website content	-0,072	0,428	1,500

Note: * The coefficients are statistically significant at the level 0.05 $R^2=0.451$

The coefficient of determination of R^2 is 0.451, which means that 45.1% of the variability of customer satisfaction is explained by this regression model. The problem of manifesting multicollinearity was tested by analysis of the variance growth factor VIF, whose value for all variables was significantly lower than the threshold 5. This confirms that multicollinearity is present to a low degree in a given research model and that the calculated values of the standardized coefficients are accurate and stable. The coefficient β shows the strength of the influence of the independent variable on the dependent one. For a variable to have a statistically significant impact, it is necessary that the Sig value be lower than 0.05. Based on the results, we can conclude that the variable responsibility, security and ease of use have a positive statistically significant impact on customer satisfaction, while the website content variable does not have a statistically significant impact on customer satisfaction. Variable responsibility has the greatest impact on customer satisfaction (the highest value of coefficient β is 0.342). **Based on the above, we conclude that hypotheses H1, H2, H3 are confirmed, and hypothesis H4 is not confirmed.**

Based on the outputs from the previous analysis, that is the confirmed hypotheses, the neural network shown in Figure 2 was formed. Input sizes represent responsibility, security and ease of use, while output size is the objective satisfaction of the customer. The hidden layer consists of 10 neurons. The input group

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for neural network training was taken from the first 100 clients, while the least 5 clients were used for testing. The neural network is developing it in MATLAB software.

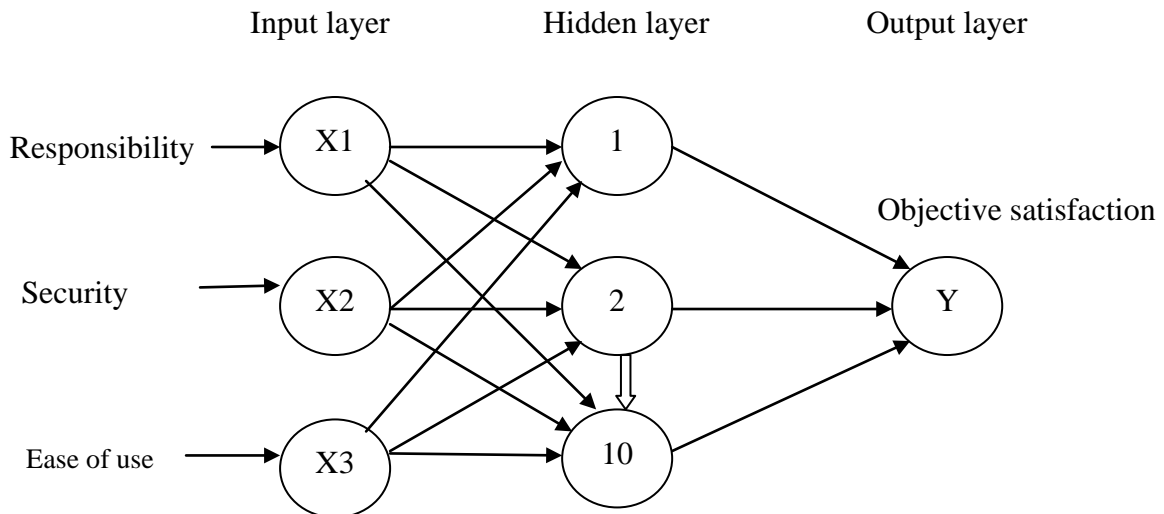


Figure 2: A neural network developed to solve a set problem

Table 6 shows the test results. The difference, which represents the last column on the table, is obtained when the objective satisfaction of the client is subtracted from the subjective. Being positive means that the client's subjective satisfaction is greater than the experience of all other clients indicates in his answers. On the contrary, if this difference is negative, it tells us that the subjective assessment of client satisfaction is less than the experience inherited from other clients. If this difference is close to zero, it tells us that the client through the stated views on responsibility, security and ease of use has evaluated in accordance with the previous experiences that are the result of all the estimated satisfaction of all previous clients covered by this research.

Table 6: Subjective and objective satisfaction of customer who used to test the model

Customer	Responsibility	Security	Ease of use	Subjective satisfaction	Objective satisfaction	Difference
101	4	5,67	5,67	4,67	4,72	-0,05
102	6,67	7	7	7	6,18	0,82
103	6	6,67	4,67	4,33	4,36	-0,03
104	5,33	3,33	4,67	6,67	4,42	2,25
105	4,67	3,67	3,67	2,33	3,11	-0,78

Except in the case of customer 104, significant discrepancies in subjective and objective satisfaction ratings were not accepted. It can be said that this customer rated his satisfaction higher than his views expressed in the survey and when considering all other customer's estimates.

5. Conclusion

In the conditions of increased competition, banking institutions are imperative to apply an adequate model for analyzing business performance as well as to focus on providing quality services in order to achieve a certain degree of customer satisfaction. In the Republic of Serbia, in recent years, there has been a tendency for an increase in the number of bank clients using electronic banking services. Some of the most significant benefits of e-banking are time saving, better pricing, fast transaction execution. The theoretical implications of the paper are reflected in the extension of scientific knowledge about the impact of e-banking determinants on customer satisfaction. The managerial implications of the work are reflected in helping the banking service providers look at the factors that affect customer satisfaction. The contribution of the paper is reflected in the connection of two concepts related to the subjective and objective satisfaction of clients. The paper uses a neural network to evaluate the objective satisfaction of clients, based on the experience of previous clients. The main limitation of the paper is the sample size, which included only 105 subjects. Future research should increase the sample and include some more determinants of e-banking in the conceptual model.

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