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FUZZY ANP-BASED ANALYSIS OF CUSTOMER EXPECTATIONS IN THE E7 BANKING INDUSTRY

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Abstract

This study aims to analyze the customer expectations in E7 banking industry. For this purpose, 8 different criteria are selected and weighted by using fuzzy ANP approach. The results show that pricing policies ease of access and security are important factors that affect customer satisfaction in banking industry. Therefore, it is strongly recommended that banks should charge affordable prices because the customers give significance to the cost in banking activities. Another important point is that banks should open enough branches and ATMs in critical locations since the ease of access is an essential issue for the customers. Finally, these banks should invest in IT development so that there should not be any risk about the security. By considering these issues, it can be much easier for the banks to meet the expectations of the customers.

Keywords: Customer Expectation; Banking Industry; Fuzzy ANP

JEL Classification: *D81, G10, G11*

E7 BANKACILIK SEKTÖRÜNDE MÜŞTERİ BEKLENTİLERİNİN BULANIK ANP TABANLI ANALİZİ

Öz

Bu çalışma, E7 bankacılık sektöründeki müşteri beklentilerini analiz etmeyi amaçlamaktadır. Bu amaçla, bulanık ANP yaklaşımı kullanılarak 8 farklı kriter seçilmiş ve ağırlıklandırılmıştır. Sonuçlar, fiyatlandırma politikalarının erişim kolaylığı ve güvenliğinin bankacılık sektöründe müşteri memnuniyetini etkileyen önemli faktörler olduğunu göstermektedir. Bu nedenle, müşteriler bankacılık faaliyetlerinde maliyeti önemsedikleri için bankaların uygun fiyatlar talep etmeleri şiddetle tavsiye edilmektedir. Bir diğer önemli nokta ise, müşteriler açısından erişim kolaylığı önemli bir konu olduğundan, bankaların kritik lokasyonlarda yeterli sayıda şube ve ATM açması gerektiğidir. Son olarak, bu bankalar, güvenlik konusunda herhangi bir risk olmaması için BT geliştirmeye yatırım yapmalıdır. Bu konular göz önünde bulundurularak bankaların müşterilerin beklentilerini karşılaması çok daha kolay olabilecektir.

Anahtar Kelimeler: Müşteri Beklentisi; Bankacılık Sektörü; Bulanık ANP

JEL Sınıflandırması: *D81, G10, G11*

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1. Introduction

Especially in recent years, large-scale international banks have started to operate in different countries of the world. This has led to an increase in the competition in the banking sectors in these countries. Increasing competition is highly preferred for customers. The main reason for this is that this situation will lower the prices of banks (Leroy and Lucotte, 2015; Dinçer et al., 2019c). Therefore, customers will have the opportunity to use loans at cheaper prices. In other words, as a result of the fact that large banks are active in different countries, it has become quite reasonable to use loans from banks.

In spite of these positive aspects, it is possible to mention some negative situations of this competition in the banking sector. The biggest negative impact of this increasing competition was on small-scale local banks. These banks had to compete with the aforementioned large banks. This situation caused small-scale banks to have problems. Large-scale banks have been able to offer more attractive products for customers by using their capital and technology power. Other banks, which do not have the same power, cannot be preferred by customers (Amin, 2016; Dinçer et al., 2018; Ayo et al., 2016). This has resulted in the inability of many banks to continue their operations. On the other hand, some banks had to merge with other big banks.

As can be understood from these issues, banks need to take some measures to survive in this competitive environment. Within this framework, customer satisfaction is the most prominent issue. Obviously, customers must be satisfied with the products and services of these banks before they can choose their products. Therefore, banks should first determine the expectations and complaints of their customers (Yüksel et al., 2018). The main reason for this is that it is not possible to meet these expectations without understanding what the expectations are.

Another important issue in this regard is that it is very difficult for banks to determine customer expectations. The main reason for this is that the bank customers are quite heterogeneous. In other words, both low-income people and high-income people are each customers of banks and their expectations from banks are quite different. In this context, it is important that banks conduct a comprehensive survey with their customers and identify these different expectations (Zameer et al., 2015). This will make it easier for banks to focus on their customers' expectations.

This situation is also important for developing countries. These countries are slightly behind developed countries in terms of economic performance. In parallel to this, the quality of life in this country is also lower than in other countries. Therefore, high performance of banks in these countries is very important for the growth of their economies. On the other hand, this competitive environment has made the work of local banks in these countries quite difficult. It has become essential for these banks to increase their competitiveness by taking certain actions.

In this study, it is aimed to analyze customer expectations in the banking sector. In this study, banking sectors belonging to E7 countries are included in the scope of the study. At the beginning of the analysis process, a wide literature review was made and the factors that could affect the expectations of the bank customers were listed. On the other hand, in the second stage of the study, these criteria are listed according to their importance. In this process, fuzzy ANP method was utilized. Based on the results of the analysis, it will be possible to provide suggestions for the more active functioning of the banking sector in E7 countries.

This study is thought to contribute to the literature in many respects. First of all, in this study, a wide literature review has been made and the main issues affecting the expectations of the bank customers have been determined. These factors provide guidance for all banking sectors, regardless of country type. In addition, these factors were weighted by the fuzzy ANP method for E7 countries in this study. E7 countries are the 7 developing countries with the largest

economy. These countries are trying to grow their economies in order to reach the level of developed countries. Therefore, the banking sector has an important role to play in achieving this goal. Therefore, it will be possible to identify priority actions in order to make the banking sector more successful in E7 countries with the help of these weighted criteria.

2. Customer Needs in Banking Industry

There are many studies in the literature that analyze customer expectations in the banking sector. These studies highlighted different aspects of customer expectations. In this part of the study, studies that emphasize similar issues among the factors affecting customer expectations will be presented in groups. In this way, it will be easier to analyze the literature on customer expectations in the banking sector.

According to many researchers, the most important aspect of customer expectations in banking is ease of access to products and services in banking. Customers want to easily access the products and services of banks (Liébana-Cabanillas et al., 2016; Paul et al., 2016). Therefore, banks should ensure that products and services are easily accessible in order to meet these expectations of customers (Machogu and Okiko, 2015). In this context, banks are required to open branches in important places in the country (Mwatsika, 2016; Simon and Thomas, 2016; Masoud and AbuTaqa, 2017). Especially in places where population density is high, it is important that banks place ATMs. In this way, customers will have easy access to banks' products and services. In this framework, Wang et al. (2017) and Sikdar et al. (2015) made a study related to the expectations of the customers in the banking industry. They underlined that the products and services should be easy to use by the customers for this purpose. Al-Hawary and Al-Smeran (2016), Pereira et al. (2017) and Yousuf and Wahab (2017) also focused on this issue.

In some studies, it was stated that the physical conditions of the bank building had an impact on customer satisfaction. In this context, it is considered that customers attach particular importance to the physical conditions of the bank branches (Al-Azzam, 2015; Leong et al., 2015). In order to meet these customer expectations, banks should pay attention to branch design. Therefore, it is important to position the tables within the branch in a suitable place and thus make the branch even more spacious (Lone et al., 2017; Selvakumar, 2016). In parallel, the screen color and menus of ATMs and the internet banking system are also important for customer satisfaction. In this context, Kaura et al. (2015), Chanana and Gupta (2016) and Yilmaz et al. (2018) aimed to evaluate what affects customer satisfaction in the banking industry. They reached a conclusion that banks should mainly give importance to the physical conditions of the bank buildings in order to increase customer satisfaction. Similarly, Ali et al. (2018), Felix (2017), Bakar et al. (2017) and Long and Vy (2016) also identified that attractive physical conditions of the bank building are the most important issues for this purpose.

Pricing policies are also considered as factors that affect the satisfaction of bank customers in many studies. The main consideration emphasized in these studies is that although all other factors are important, customers first consider cost (Zameer et al., 2015; Iberahim et al., 2016; Kaura et al., 2015). Within this framework, banks are required to present a competitive pricing policy. However, banks need to reduce their costs in order to bring their prices to competitive levels (Rahi et al., 2017; Andaleeb et al., 2016). In this way, customers will be able to extend loans with lower interest rates (Tesfaye et al., 2019). Since this situation will increase the customer satisfaction, banks will be preferable. Bapat (2017) and Long et al. (2017) also identified that customer satisfaction can be increased in the banking sector mainly with the help of competitive prices. Parallel to these studies, Parameswar et al. (2017), Navimipour and Soltani (2016) and Felix (2017) also analyzed this situation for different regions, such as India and Rwanda and reached the similar conclusion.

Many researchers also underlined the importance of security in this regard. In these studies, it is stated that customers attach the greatest importance to security in banking transactions (Belás et al., 2016; Ling et al., 2016). Since they entrust their customers' money to the bank, they want not to worry about the security of these moneys (Amin, 2016). Information security is the most important issue in this regard (Raza et al., 2015; Sampaio et al., 2017). Especially because of the increasing internet fraud problem in recent years, customers prefer to feel safe when dealing with the bank. Within this framework, Tham et al. (2017), Firdous and Farooqi (2017), Mahmud et al. (2016) and Lone et al. (2017) focused on the banking industries of different countries like Saudi Arabia and Malaysia. They mainly stated that IT security plays a key role on the eyes of the customers while making banking transactions. Additionally, Long et al. (2017), Avo et al. (2016) and Kuo et al. (2016) also defined that customers mainly give importance to the security issue in order to select the banks to work.

Finally, a group of researchers stated that banks should attach great importance to technological development in order to meet customer expectations. Within this framework, banks should develop their products by making technological investments (Iberahim et al., 2016; Navimipour and Soltani, 2016; Ghani et al., 2017). For example, all products and services should be available to customers through the internet and mobile banking applications produced by banks (Wang et al., 2017; Amin, 2016; Paul et al., 2016). Similarly, in order to withdraw money from a customer account, it must be able to do it without going to a branch, with the help of the mobile application and ATM (Zameer et al., 2015; Ahmed et al., 2017; Barua et al., 2018; Kaura et al., 2015). In order for these opportunities to be offered to customers, banks must make a serious technology investment (Ngo and Nguyen, 2016).

As a result of these studies in the literature, it is tried to determine what kind of expectations the bank customers have. In these studies, many different regions have been examined. In this context, collecting the group of developing countries in a new study will contribute to the literature. In addition, a new method will increase the authenticity of this study. In this way, it will be possible to make a comparative analysis between the results in different studies.

3. Fuzzy Analytic Network Process

Analytic network process (ANP) is introduced by Saaty in 1996 to construct a tool for the complex decision-making problems under the interaction (Saaty, 1996). The method assumes that there could be interdependency among the criteria with non-hierarcial relations. Thus, this method provides more accurate results by considering the interdependency assumption (Gao and Hailu, 2012; Yu et al., 2011). Nowadays, fuzzy method is widely used for the multi-criteria decision making problems of items under the uncertainty. Thus, fuzzy-based evaluations could be defined by considering the inter-dependence assumptions of criteria for analytic network process as well (Ma et al. 2010).

Fuzzy analytic network process is defined in the fuzzy pairwise comparison matrices. For that, linguistic evaluations are initially selected by the experts and the evaluations are adopted to the fuzzy numbers. In this study, triangular fuzzy numbers are defined to weight the criteria respectively. Chang's method is applied for the calculation process of fuzzy analytic network process (Chang, 1996). First, the values S_i are calculated by the formula (1).

$$S_i = \sum_{j=1}^{m} M_{gi}^{j} \otimes \left[\sum_{j=1}^{n} \sum_{j=1}^{m} M_{gi}^{j} \right]^{-1} \quad (1)$$

Furthermore, $\sum_{j=1}^{m} M_{gi}^{j}$ is the fuzzy addition operation of m extent analysis and detailed as the formula (2).

$$\sum_{j=1}^{m} M_{gi}^{j} = \left(\sum_{j=1}^{m} l_j, \sum_{j=1}^{m} m_j, \sum_{j=1}^{m} u_j\right) \quad (2)$$

Additionally, $\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1}$ is constructed by performing the fuzzy addition operation $M_{gi}^{j}(j = 1,2,\dots m)$ of values as in the formula (3).

$$\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j} = \left(\sum_{j=1}^{m} l_i, \sum_{j=1}^{m} m_i, \sum_{j=1}^{m} u_i\right) \quad (3)$$

After that, the inverse values of vector are computed with the formula (4).

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} l_i}\right) \quad (4)$$

Following step is to define the degree of the possibility of $M_2 = (l_2, m_2, u_2) \geq M_1 = (l_1, m_1, u_1)$ as in the formulas (5) and (6).

$$V(M_2 \geq M_1) = sup\left[min(\mu_{M_1}(x), \mu_{M_2}(y))\right] \quad (5)$$

$$V(M_2 \geq M_1) = hgt(M_1 \cap M_2) = \mu_{M_2}(d) = \begin{cases} 1, & if \quad m_2 \geq m_1, \\ 0, & if \quad l_1 \geq u_2, \\ \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)} & otherwise \end{cases} \quad (6)$$

In this process, *d* is the ordinate of the highest intersection point *D* between μ_{M_1} and μ_{M_2} to compare M_1 and M_2, the values of $V(M_1 \geq M_2)$ and $V(M_2 \geq M_1)$ are needed. Another step is to define the degree possibility for a convex fuzzy number to be greater than *k* convex fuzzy numbers $M_i(i = 1,2,\dots,k)$ as in the formulas (7) and (8).

$$V(M \geq M_1, M_2, \dots M_k) = V[(M \geq M_1) and (M \geq M_2) and \dots and (M \geq M_k)] = min\, V\,(M \geq M_i) \quad (7)$$

$$d'(A_i) = min\, V\,(S_i \geq S_k) \quad (8)$$

Then, the weight vector is given by the formula (9).

$$W' = (d'(A_1), d'(A_2), \dots, d'(A_n))^T \quad (9)$$

Final step is to normalize weight vectors which are given in the formula (10). In this case, *W* represents a nonfuzzy number.

$$W' = \left(d(A_1), d(A_2), \dots, d(A_n)\right)^T \quad (10)$$

In the literature, fuzzy ANP method was considered for different purposes. Dinçer et al. (2016a,b) used this approach for banking industry whereas Dinçer et al. (2017) made an analysis related to global financial crisis. Uygun et al. (2015), Tang and Hsu (2018) and Chatterjee and Kar (2018) used this approach to make evaluation in communication industry. On the other side, Ramkumar et al. (2016), Dinçer et al. (2019) and Perçin (2019) evaluated financial services performance with this methodology.

4. Analysis Results

In this study, the customer expectations in E7 banking industry are defined and then measured with fuzzy analytic network process. For this aim, a set of criteria is determined based on supported literature and then applied for the customer expectations in banking industry. Initially, an expert team is selected for collecting the linguistic evaluations for the criteria of

customer expectations in banking industry. Linguistic evaluations are obtained by use of linguistic scales illustrated in Table 1.

Table 1: The fuzzy scale of the pair-wise comparison

Definition	Triangular Fuzzy Numbers		
Equally important (EI)	0.5	1	1.5
Weakly more important (WI)	1	1.5	2
Strongly more important (SI)	1.5	2	2.5
Very strongly more important (VI)	2	2.5	3
Absolutely more important (AI)	2.5	3	3.5

Source: Chang, 1996; Bozbura et al. 2007; Dincer et al. 2016

Linguistic choices are used for the evaluation of selected factor of customer expectations for the service industry. The selected criteria are defined in Table 2.

Table 2: Selected factors of customer expectations for the service industry

Criteria	Definition	Supported Literature
Ease of access (criterion 1)	Availability of multidimensional channels	Calisir and Gumussoy, 2008; Gu et al. 2009; Dincer et al. 2019a
Operational conditions (criterion 2)	Facilities in use of services	Raj et al. 2014; Dincer and Hacioglu, 2013; Athukorala and Sen, 2004
Pricing policies (criterion 3)	Providing competitive prices for services	Dincer et al. 2019a; Dincer, 2018; Coccorese and Pellecchia, 2013
Customer support (criterion 4)	7/24 access to the personnel in case of customer requests	Lee et al. 2018; Dincer et al. 2019b; Dauda and Lee, 2015
Security (criterion 5)	Constructing the infrastructure for customer data and physical security	Dincer et al. 2019a; Dominguez, 2017; Lee et al. 2013
Innovation (criterion 6)	Presenting the incremental and radical service developments	Apak et al. 2012; Huang, 2018; Morgan et al. 1995
Quality (criterion 7)	Steady quality improvement based on market conditions	Dincer and Hacioglu, 2013; Lin, 2013; Fragoso and Espinoza, 2017
Loyalty (criterion 8)	Presenting the services that cause to the customer loyalty	Dincer et al. 2019a; Lee et al. 2018; Mohammadi, 2015

In Table 2, there are 8 criteria of customer expectations in the service industry with the supported literature. First criterion is defined as ease of access indicating the availability of multidimensional channels in the service providing process. Second factor is entitled operational conditions that define the facilities in use of services and user friendly operations by the professional assistance services. Another item is the criterion of pricing policies present the competitive prices in the fierce market conditions. The fourth factor is customer support that ease to reach the technical support in case of difficulties and demands from the customers. Security is the fifth criterion that provides the appropriate infrastructure for protecting the data and physical security of each customer. Innovation is defined as sixth criterion presents the all shapes of service developments including the incremental and radical innovations. Quality functions are also one of the most important expectations for the banking customers against the

steady market changes. Loyalty is recommended as another criterion of customer needs for the banking services.

Linguistic choices are obtained by generating several rounds of conversation for the relationship between criteria. At the final round of discussions on the choices, the decisions are collected with consensus of all experts. Linguistic priorities of each criterion are presented with the pair-wise comparison matrices including the inner dependency assumptions and obtained evaluations are illustrated in the appendix, Table A1-A9 consecutively. Additionally, linguistic evaluation matrices are converted into the triangular fuzzy numbers by using the scales in table 1. The fuzzy matrices are given in appendix, Table A10-A18 respectively.

After the construction of fuzzy matrices for analytic network process, interdependent weights and all criteria degrees are computed to generate the overall weights of customer expectations criteria. Table 3 shows the weighting results of each criterion.

Table 3: Weighting results of the criteria

Criteria	**Interdependent weights of the criteria**								**Local weights**	**Global Weights**
Ease of access (criterion 1)	1.000	0.199	0.170	0.162	0.166	0.146	0.159	0.239	0.151	0.147
Operational conditions (criterion 2)	0.163	1.000	0.152	0.155	0.160	0.168	0.159	0.136	0.149	0.142
Pricing policies (criterion 3)	0.157	0.133	1.000	0.164	0.166	0.156	0.152	0.239	0.176	0.152
Customer support (criterion 4)	0.132	0.228	0.137	1.000	0.147	0.127	0.142	0.110	0.111	0.123
Security (criterion 5)	0.187	0.126	0.186	0.143	1.000	0.137	0.143	0.143	0.162	0.146
Innovation (criterion 6)	0.187	0.172	0.155	0.138	0.124	1.000	0.137	0.098	0.158	0.144
Quality (criterion 7)	0.114	0.090	0.117	0.132	0.122	0.132	1.000	0.035	0.084	0.095
Loyalty (criterion 8)	0.059	0.053	0.082	0.107	0.116	0.134	0.108	1.000	0.009	0.051

According to the weighting results, the importance of criteria is listed as pricing policies (criterion 3), security (criterion 5), innovation (criterion 6), ease of access (criterion 1), operational conditions (criterion 2), customer support (criterion 4), quality (criterion 7), loyalty (criterion 8) respectively. The analysis results demonstrate that outcomes are coherent in the limitations of hierarchical relation and interdependency among the criteria. Accordingly, pricing policies (criterion 3) is the most prominent factor for the customer expectations in the banking services of E7 countries. In addition to this issue, ease of access (criterion 1) is another important factor to meet the expectations of the customers. However, the criterion of loyalty has the weakest importance between the criteria set. Parallel to this issue, quality (criterion 7) and customer support (criterion 4) are other indicators that have a lower importance in comparison with others.

5. Conclusion

The customer expectations in the banking sector are evaluated in this study. For this purpose, E7 economies are taken into consideration. In the analysis process, first of all, related literature is evaluated. In this framework, the studies, which were published after 2015, were analyzed

and 8 different criteria are selected which may affect customer satisfaction in banking sector. After that, these criteria are weighted for E7 economies in order to understand which ones are more important in comparison with others. In this process, fuzzy ANP approach is used.

It is concluded that pricing policies is the most prominent factor for the customer expectations in the banking services of E7 countries. Parallel to this situation, it is also defined that ease of access and security are the other important factors for customer satisfaction in the banking industry for these economies. On the other side, customer support and quality play a less important role for this purpose. In addition to them, it is identified that the criterion of loyalty has the weakest importance between the criteria set.

It is determined that pricing policies, ease of access and security are the most important factors for customer satisfaction in the banking industry in E7 economies. Hence, it is recommended that banks should charge affordable prices to the customers. In other words, they should mainly focus on pricing policies because it is seen that most of the customers in these countries give very much importance to the cost in banking activities. On the other side, since the ease of access is an essential issue for the customers in banking activities, these banks should open enough branches and ATMs in critical locations. In addition to them, it is also understood that bank customers demand to have themselves in a secured condition in banking operations. Therefore, these banks should invest in IT development so that there should not be any risk about the security.

This study focused on E7 economies in order to understand what affects customer satisfaction in banking activities. In a new study, another evaluation can be made for G7 economies. Therefore, it can be possible to compare the results for different economies. Furthermore, fuzzy ANP approach is used in the analysis process of this study. In the future studies, different methodologies may be implemented in the evaluation.

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APPENDIX

Table A1: Linguistic priorities for the pairwise comparison matrix

Criteria	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6	Criterion 7	Criterion 8
Ease of access (criterion 1)		VI	EI	EI	EI	EI	EI	VI
Operational conditions (criterion 2)			EI	VI	EI	EI	EI	AI
Pricing policies (criterion 3)				AI	EI	AI	WI	WI
Customer support (criterion 4)					WI	EI	WI	WI
Security (criterion 5)						EI	AI	AI
Innovation (criterion 6)							AI	AI
Quality (criterion 7)								WI
Loyalty (criterion 8)								

Table A2: Linguistic priorities with the respect to criterion 1

Criteria	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6	Criterion 7	Criterion 8
Operational conditions (criterion 2)		WI	WI	EI	EI	WI	WI
Pricing policies (criterion 3)			WI	EI	WI	WI	WI
Customer support (criterion 4)				EI	SI	EI	EI
Security (criterion 5)					WI	VI	VI
Innovation (criterion 6)						AI	AI
Quality (criterion 7)							VI
Loyalty (criterion 8)							

Table A3: Linguistic priorities with the respect to criterion 2

Criteria	Criterion 1	Criterion 3	Criterion 4	Criterion 5	Criterion 6	Criterion 7	Criterion 8
Ease of access (criterion 1)		VI	WI	WI	WI	WI	WI
Pricing policies (criterion 3)			EI	VI	EI	EI	EI
Customer support (criterion 4)				AI	AI	EI	AI
Security (criterion 5)					WI	WI	VI
Innovation (criterion 6)						AI	AI
Quality (criterion 7)							EI
Loyalty (criterion 8)							

Table A4: Linguistic priorities with the respect to criterion 3

Criteria	Criterion 1	Criterion 2	Criterion 4	Criterion 5	Criterion 6	Criterion 7	Criterion 8
Ease of access (criterion 1)		SI	SI	EI	EI	EI	WI
Operational conditions (criterion 2)			EI	SI	WI	WI	EI
Customer support (criterion 4)				EI	SI	EI	EI
Security (criterion 5)					SI	AI	SI
Innovation (criterion 6)						SI	AI
Quality (criterion 7)							SI
Loyalty (criterion 8)							

Table A5: Linguistic priorities with the respect to criterion 4

Criteria	Criterion 1	Criterion 2	Criterion 3	Criterion 5	Criterion 6	Criterion 7	Criterion 8
Ease of access (criterion 1)		EI	WI	EI	WI	EI	WI
Operational conditions (criterion 2)			EI	EI	WI	WI	VI
Pricing policies (criterion 3)				WI	WI	WI	WI
Security (criterion 5)					EI	EI	WI
Innovation (criterion 6)						WI	WI
Quality (criterion 7)							WI
Loyalty (criterion 8)							

Table A6: Linguistic priorities with the respect to criterion 5

Criteria	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 6	Criterion 7	Criterion 8
Ease of access (criterion 1)		EI	WI	WI	WI	EI	WI
Operational conditions (criterion 2)			WI	EI	WI	WI	EI
Pricing policies (criterion 3)				SI	WI	WI	WI
Customer support (criterion 4)					SI	WI	EI
Innovation (criterion 6)						WI	WI
Quality (criterion 7)							WI
Loyalty (criterion 8)							

Table A7: Linguistic priorities with the respect to criterion 6

Criteria	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 7	Criterion 8
Ease of access (criterion 1)		EI	EI	EI	EI	EI	WI
Operational conditions (criterion 2)			WI	WI	WI	WI	EI
Pricing policies (criterion 3)				WI	EI	WI	WI
Customer support (criterion 4)					EI	EI	EI
Security (criterion 5)						EI	EI
Quality (criterion 7)							EI
Loyalty (criterion 8)							

Table A8: Linguistic priorities with the respect to criterion 7

Criteria	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6	Criterion 8
Ease of access (criterion 1)		WI	EI	WI	EI	EI	WI
Operational conditions (criterion 2)			WI	EI	WI	WI	EI
Pricing policies (criterion 3)				WI	EI	EI	WI
Customer support (criterion 4)					WI	EI	WI
Security (criterion 5)						WI	WI
Innovation (criterion 6)							WI
Loyalty (criterion 8)							

Table A9: Linguistic priorities with the respect to criterion 8

Criteria	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6	Criterion 7
Ease of access (criterion 1)		VI	VI	VI	WI	WI	WI
Operational conditions (criterion 2)			EI	EI	WI	WI	WI
Pricing policies (criterion 3)				WI	WI	WI	WI
Customer support (criterion 4)					EI	EI	WI
Security (criterion 5)						WI	VI
Innovation (criterion 6)							WI
Quality (criterion 7)							

Table A10: Fuzzy pair-wise comparison matrix

Criteria	**Ease of access (criterion 1)**			**Operational conditions (criterion 2)**			**Pricing policies (criterion 3)**			**Customer support (criterion 4)**		
Ease of access (criterion 1)	1.00	1.00	1.00	2.00	2.50	3.00	0.50	1.00	1.50	0.50	1.00	1.50
Operational conditions (criterion 2)	0.33	0.40	0.50	1.00	1.00	1.00	0.50	1.00	1.50	2.00	2.50	3.00
Pricing policies (criterion 3)	0.67	1.00	2.00	0.67	1.00	2.00	1.00	1.00	1.00	2.50	3.00	3.50
Customer support (criterion 4)	0.67	1.00	2.00	0.33	0.40	0.50	0.29	0.33	0.40	1.00	1.00	1.00
Security (criterion 5)	0.67	1.00	2.00	0.67	1.00	2.00	0.67	1.00	2.00	0.50	0.67	1.00
Innovation (criterion 6)	0.67	1.00	2.00	0.67	1.00	2.00	0.29	0.33	0.40	0.67	1.00	2.00
Quality (criterion 7)	0.67	1.00	2.00	0.67	1.00	2.00	0.50	0.67	1.00	0.50	0.67	1.00
Loyalty (criterion 8)	0.33	0.40	0.50	0.29	0.33	0.40	0.50	0.67	1.00	0.50	0.67	1.00
Criteria	Security (criterion 5)			Innovation (criterion 6)			Quality (criterion 7)			Loyalty (criterion 8)		
Ease of access (criterion 1)	0.50	1.00	1.50	0.50	1.00	1.50	0.50	1.00	1.50	2.00	2.50	3.00
Operational conditions (criterion 2)	0.50	1.00	1.50	0.50	1.00	1.50	0.50	1.00	1.50	2.50	3.00	3.50
Pricing policies (criterion 3)	0.50	1.00	1.50	2.50	3.00	3.50	1.00	1.50	2.00	1.00	1.50	2.00
Customer support (criterion 4)	1.00	1.50	2.00	0.50	1.00	1.50	1.00	1.50	2.00	1.00	1.50	2.00
Security (criterion 5)	1.00	1.00	1.00	0.50	1.00	1.50	2.50	3.00	3.50	2.50	3.00	3.50
Innovation (criterion 6)	0.67	1.00	2.00	1.00	1.00	1.00	2.50	3.00	3.50	2.50	3.00	3.50
Quality (criterion 7)	0.29	0.33	0.40	0.29	0.33	0.40	1.00	1.00	1.00	1.00	1.50	2.00
Loyalty (criterion 8)	0.29	0.33	0.40	0.29	0.33	0.40	0.50	0.67	1.00	1.00	1.00	1.00

Table A11: Inner dependence fuzzy matrix with the respect to criterion 1

Criteria	**Operational conditions (criterion 2)**			**Pricing policies (criterion 3)**			**Customer support (criterion 4)**			**Security (criterion 5)**		
Operational conditions (criterion 2)	1.00	1.00	1.00	1.00	1.50	2.00	1.00	1.50	2.00	0.50	1.00	1.50
Pricing policies (criterion 3)	0.50	0.67	1.00	1.00	1.00	1.00	1.00	1.50	2.00	0.50	1.00	1.50
Customer support (criterion 4)	0.50	0.67	1.00	0.50	0.67	1.00	1.00	1.00	1.00	0.50	1.00	1.50
Security (criterion 5)	0.67	1.00	2.00	0.67	1.00	2.00	0.67	1.00	2.00	1.00	1.00	1.00
Innovation (criterion 6)	0.67	1.00	2.00	0.50	0.67	1.00	0.40	0.50	0.67	0.50	0.67	1.00
Quality (criterion 7)	0.50	0.67	1.00	0.50	0.67	1.00	0.67	1.00	2.00	0.33	0.40	0.50
Loyalty (criterion 8)	0.50	0.67	1.00	0.50	0.67	1.00	0.67	1.00	2.00	0.33	0.40	0.50
Criteria	Innovation (criterion 6)			Quality (criterion 7)			Loyalty (criterion 8)					
Operational conditions (criterion 2)	0.50	1.00	1.50	1.00	1.50	2.00	1.00	1.50	2.00			
Pricing policies (criterion 3)	1.00	1.50	2.00	1.00	1.50	2.00	1.00	1.50	2.00			
Customer support (criterion 4)	1.50	2.00	2.50	0.50	1.00	1.50	0.50	1.00	1.50			
Security (criterion 5)	1.00	1.50	2.00	2.00	2.50	3.00	2.00	2.50	3.00			
Innovation (criterion 6)	1.00	1.00	1.00	2.50	3.00	3.50	2.50	3.00	3.50			
Quality (criterion 7)	0.29	0.33	0.40	1.00	1.00	1.00	2.00	2.50	3.00			
Loyalty (criterion 8)	0.29	0.33	0.40	0.33	0.40	0.50	1.00	1.00	1.00			

Table A12: Inner dependence fuzzy matrix with the respect to criterion 2

Criteria	**Ease of access (criterion 1)**			**Pricing policies (criterion 3)**			**Customer support (criterion 4)**			**Security (criterion 5)**		
Ease of access (criterion 1)	1.00	1.00	1.00	2.00	2.50	3.00	1.00	1.50	2.00	1.00	1.50	2.00
Pricing policies (criterion 3)	0.33	0.40	0.50	1.00	1.00	1.00	0.50	1.00	1.50	2.00	2.50	3.00
Customer support (criterion 4)	0.50	0.67	1.00	0.67	1.00	2.00	1.00	1.00	1.00	2.50	3.00	3.50
Security (criterion 5)	0.50	0.67	1.00	0.33	0.40	0.50	0.29	0.33	0.40	1.00	1.00	1.00
Innovation (criterion 6)	0.50	0.67	1.00	0.67	1.00	2.00	0.29	0.33	0.40	0.50	0.67	1.00
Quality (criterion 7)	0.50	0.67	1.00	0.67	1.00	2.00	0.67	1.00	2.00	0.50	0.67	1.00
Loyalty (criterion 8)	0.50	0.67	1.00	0.67	1.00	2.00	0.29	0.33	0.40	0.33	0.40	0.50
Criteria	**Innovation (criterion 6)**			**Quality (criterion 7)**			**Loyalty (criterion 8)**					
Ease of access (criterion 1)	1.00	1.50	2.00	1.00	1.50	2.00	1.00	1.50	2.00			
Pricing policies (criterion 3)	0.50	1.00	1.50	0.50	1.00	1.50	0.50	1.00	1.50			
Customer support (criterion 4)	2.50	3.00	3.50	0.50	1.00	1.50	2.50	3.00	3.50			
Security (criterion 5)	1.00	1.50	2.00	1.00	1.50	2.00	2.00	2.50	3.00			
Innovation (criterion 6)	1.00	1.00	1.00	2.50	3.00	3.50	2.50	3.00	3.50			
Quality (criterion 7)	0.29	0.33	0.40	1.00	1.00	1.00	0.50	1.00	1.50			
Loyalty (criterion 8)	0.29	0.33	0.40	0.67	1.00	2.00	1.00	1.00	1.00			

Table A13: Inner dependence fuzzy matrix with the respect to criterion 3

Criteria	**Ease of access (criterion 1)**			**Operational conditions (criterion 2)**			**Customer support (criterion 4)**			**Security (criterion 5)**		
Ease of access (criterion 1)	1.00	1.00	1.00	1.50	2.00	2.50	1.50	2.00	2.50	0.50	1.00	1.50
Operational conditions (criterion 2)	0.40	0.50	0.67	1.00	1.00	1.00	0.50	1.00	1.50	1.50	2.00	2.50
Customer support (criterion 4)	0.40	0.50	0.67	0.67	1.00	2.00	1.00	1.00	1.00	0.50	1.00	1.50
Security (criterion 5)	0.67	1.00	2.00	0.40	0.50	0.67	0.67	1.00	2.00	1.00	1.00	1.00
Innovation (criterion 6)	0.67	1.00	2.00	0.50	0.67	1.00	0.40	0.50	0.67	0.40	0.50	0.67
Quality (criterion 7)	0.67	1.00	2.00	0.50	0.67	1.00	0.67	1.00	2.00	0.29	0.33	0.40
Loyalty (criterion 8)	0.50	0.67	1.00	0.67	1.00	2.00	0.67	1.00	2.00	0.40	0.50	0.67
Criteria	**Innovation (criterion 6)**			**Quality (criterion 7)**			**Loyalty (criterion 8)**					
Ease of access (criterion 1)	0.50	1.00	1.50	0.50	1.00	1.50	1.00	1.50	2.00			
Operational conditions (criterion 2)	1.00	1.50	2.00	1.00	1.50	2.00	0.50	1.00	1.50			
Customer support (criterion 4)	1.50	2.00	2.50	0.50	1.00	1.50	0.50	1.00	1.50			
Security (criterion 5)	1.50	2.00	2.50	2.50	3.00	3.50	1.50	2.00	2.50			
Innovation (criterion 6)	1.00	1.00	1.00	1.50	2.00	2.50	2.50	3.00	3.50			
Quality (criterion 7)	0.40	0.50	0.67	1.00	1.00	1.00	1.50	2.00	2.50			
Loyalty (criterion 8)	0.29	0.33	0.40	0.40	0.50	0.67	1.00	1.00	1.00			

Table A14: Inner dependence fuzzy matrix with the respect to criterion 4

Criteria	**Ease of access (criterion 1)**			**Operational conditions (criterion 2)**			**Pricing policies (criterion 3)**			**Security (criterion 5)**		
Ease of access (criterion 1)	1.00	1.00	1.00	0.50	1.00	1.50	1.00	1.50	2.00	0.50	1.00	1.50
Operational conditions (criterion 2)	0.67	1.00	2.00	1.00	1.00	1.00	0.50	1.00	1.50	0.50	1.00	1.50
Pricing policies (criterion 3)	0.50	0.67	1.00	0.67	1.00	2.00	1.00	1.00	1.00	1.00	1.50	2.00
Security (criterion 5)	0.67	1.00	2.00	0.67	1.00	2.00	0.50	0.67	1.00	1.00	1.00	1.00
Innovation (criterion 6)	0.50	0.67	1.00	0.50	0.67	1.00	0.50	0.67	1.00	0.67	1.00	2.00
Quality (criterion 7)	0.67	1.00	2.00	0.50	0.67	1.00	0.50	0.67	1.00	0.67	1.00	2.00
Loyalty (criterion 8)	0.50	0.67	1.00	0.67	1.00	2.00	0.50	0.67	1.00	0.50	0.67	1.00
Criteria	**Innovation (criterion 6)**			**Quality (criterion 7)**			**Loyalty (criterion 8)**					
Ease of access (criterion 1)	1.00	1.50	2.00	0.50	1.00	1.50	1.00	1.50	2.00			
Operational conditions (criterion 2)	1.00	1.50	2.00	1.00	1.50	2.00	0.50	1.00	1.50			
Pricing policies (criterion 3)	1.00	1.50	2.00	1.00	1.50	2.00	1.00	1.50	2.00			
Security (criterion 5)	0.50	1.00	1.50	0.50	1.00	1.50	1.00	1.50	2.00			
Innovation (criterion 6)	1.00	1.00	1.00	1.00	1.50	2.00	1.00	1.50	2.00			
Quality (criterion 7)	0.50	0.67	1.00	1.00	1.00	1.00	1.00	1.50	2.00			
Loyalty (criterion 8)	0.50	0.67	1.00	0.50	0.67	1.00	1.00	1.00	1.00			

Table A15: Inner dependence fuzzy matrix with the respect to criterion 5

Criteria	**Ease of access (criterion 1)**			**Operational conditions (criterion 2)**			**Pricing policies (criterion 3)**			**Customer support (criterion 4)**		
Ease of access (criterion 1)	1.00	1.00	1.00	0.50	1.00	1.50	1.00	1.50	2.00	1.00	1.50	2.00
Operational conditions (criterion 2)	0.67	1.00	2.00	1.00	1.00	1.00	1.00	1.50	2.00	0.50	1.00	1.50
Pricing policies (criterion 3)	0.50	0.67	1.00	0.50	0.67	1.00	1.00	1.00	1.00	1.50	2.00	2.50
Customer support (criterion 4)	0.50	0.67	1.00	0.67	1.00	2.00	0.40	0.50	0.67	1.00	1.00	1.00
Innovation (criterion 6)	0.50	0.67	1.00	0.50	0.67	1.00	0.50	0.67	1.00	0.40	0.50	0.67
Quality (criterion 7)	0.67	1.00	2.00	0.50	0.67	1.00	0.50	0.67	1.00	0.50	0.67	1.00
Loyalty (criterion 8)	0.50	0.67	1.00	0.67	1.00	2.00	0.50	0.67	1.00	0.67	1.00	2.00
Criteria	Innovation (criterion 6)			Quality (criterion 7)			Loyalty (criterion 8)					
Ease of access (criterion 1)	1.00	1.50	2.00	0.50	1.00	1.50	1.00	1.50	2.00			
Operational conditions (criterion 2)	1.00	1.50	2.00	1.00	1.50	2.00	0.50	1.00	1.50			
Pricing policies (criterion 3)	1.00	1.50	2.00	1.00	1.50	2.00	1.00	1.50	2.00			
Customer support (criterion 4)	1.50	2.00	2.50	1.00	1.50	2.00	0.50	1.00	1.50			
Innovation (criterion 6)	1.00	1.00	1.00	1.00	1.50	2.00	1.00	1.50	2.00			
Quality (criterion 7)	0.50	0.67	1.00	1.00	1.00	1.00	1.00	1.50	2.00			
Loyalty (criterion 8)	0.50	0.67	1.00	0.50	0.67	1.00	1.00	1.00	1.00			

Table A16: Inner dependence fuzzy matrix with the respect to criterion 6

Criteria	**Ease of access (criterion 1)**			**Operational conditions (criterion 2)**			**Pricing policies (criterion 3)**			**Customer support (criterion 4)**		
Ease of access (criterion 1)	1.00	1.00	1.00	0.50	1.00	1.50	0.50	1.00	1.50	0.50	1.00	1.50
Operational conditions (criterion 2)	0.67	1.00	2.00	1.00	1.00	1.00	1.00	1.50	2.00	1.00	1.50	2.00
Pricing policies (criterion 3)	0.67	1.00	2.00	0.50	0.67	1.00	1.00	1.00	1.00	1.00	1.50	2.00
Customer support (criterion 4)	0.67	1.00	2.00	0.50	0.67	1.00	0.50	0.67	1.00	1.00	1.00	1.00
Security (criterion 5)	0.67	1.00	2.00	0.50	0.67	1.00	0.67	1.00	2.00	0.67	1.00	2.00
Quality (criterion 7)	0.67	1.00	2.00	0.50	0.67	1.00	0.50	0.67	1.00	0.67	1.00	2.00
Loyalty (criterion 8)	0.50	0.67	1.00	0.67	1.00	2.00	0.50	0.67	1.00	0.67	1.00	2.00
Criteria	**Security (criterion 5)**			**Quality (criterion 7)**			**Loyalty (criterion 8)**					
Ease of access (criterion 1)	0.50	1.00	1.50	0.50	1.00	1.50	1.00	1.50	2.00			
Operational conditions (criterion 2)	1.00	1.50	2.00	1.00	1.50	2.00	0.50	1.00	1.50			
Pricing policies (criterion 3)	0.50	1.00	1.50	1.00	1.50	2.00	1.00	1.50	2.00			
Customer support (criterion 4)	0.50	1.00	1.50	0.50	1.00	1.50	0.50	1.00	1.50			
Security (criterion 5)	1.00	1.00	1.00	0.50	1.00	1.50	0.50	1.00	1.50			
Quality (criterion 7)	0.67	1.00	2.00	1.00	1.00	1.00	0.50	1.00	1.50			
Loyalty (criterion 8)	0.67	1.00	2.00	0.67	1.00	2.00	1.00	1.00	1.00			

Table A17: Inner dependence fuzzy matrix with the respect to criterion 7

Criteria	**Ease of access (criterion 1)**			**Operational conditions (criterion 2)**			**Pricing policies (criterion 3)**			**Customer support (criterion 4)**		
Ease of access (criterion 1)	1.00	1.00	1.00	1.00	1.50	2.00	0.50	1.00	1.50	1.00	1.50	2.00
Operational conditions (criterion 2)	0.50	0.67	1.00	1.00	1.00	1.00	1.00	1.50	2.00	0.50	1.00	1.50
Pricing policies (criterion 3)	0.67	1.00	2.00	0.50	0.67	1.00	1.00	1.00	1.00	1.00	1.50	2.00
Customer support (criterion 4)	0.50	0.67	1.00	0.67	1.00	2.00	0.50	0.67	1.00	1.00	1.00	1.00
Security (criterion 5)	0.67	1.00	2.00	0.50	0.67	1.00	0.67	1.00	2.00	0.50	0.67	1.00
Innovation (criterion 6)	0.67	1.00	2.00	0.50	0.67	1.00	0.67	1.00	2.00	0.67	1.00	2.00
Loyalty (criterion 8)	0.50	0.67	1.00	0.67	1.00	2.00	0.50	0.67	1.00	0.50	0.67	1.00
Criteria	**Security (criterion 5)**			**Innovation (criterion 6)**			**Loyalty (criterion 8)**					
Ease of access (criterion 1)	0.50	1.00	1.50	0.50	1.00	1.50	1.00	1.50	2.00			
Operational conditions (criterion 2)	1.00	1.50	2.00	1.00	1.50	2.00	0.50	1.00	1.50			
Pricing policies (criterion 3)	0.50	1.00	1.50	0.50	1.00	1.50	1.00	1.50	2.00			
Customer support (criterion 4)	1.00	1.50	2.00	0.50	1.00	1.50	1.00	1.50	2.00			
Security (criterion 5)	1.00	1.00	1.00	1.00	1.50	2.00	1.00	1.50	2.00			
Innovation (criterion 6)	0.50	0.67	1.00	1.00	1.00	1.00	1.00	1.50	2.00			
Loyalty (criterion 8)	0.50	0.67	1.00	0.50	0.67	1.00	1.00	1.00	1.00			

Table A18: Inner dependence fuzzy matrix with the respect to criterion 8

Criteria	**Ease of access (criterion 1)**			**Operational conditions (criterion 2)**			**Pricing policies (criterion 3)**			**Customer support (criterion 4)**		
Ease of access (criterion 1)	1.00	1.00	1.00	2.00	2.50	3.00	2.00	2.50	3.00	2.00	2.50	3.00
Operational conditions (criterion 2)	0.33	0.40	0.50	1.00	1.00	1.00	0.50	1.00	1.50	0.50	1.00	1.50
Pricing policies (criterion 3)	0.33	0.40	0.50	0.67	1.00	2.00	1.00	1.00	1.00	1.00	1.50	2.00
Customer support (criterion 4)	0.33	0.40	0.50	0.67	1.00	2.00	0.50	0.67	1.00	1.00	1.00	1.00
Security (criterion 5)	0.50	0.67	1.00	0.50	0.67	1.00	0.50	0.67	1.00	0.67	1.00	2.00
Innovation (criterion 6)	0.50	0.67	1.00	0.50	0.67	1.00	0.50	0.67	1.00	0.67	1.00	2.00
Quality (criterion 7)	0.50	0.67	1.00	0.50	0.67	1.00	0.50	0.67	1.00	0.50	0.67	1.00
Criteria	**Security (criterion 5)**			**Innovation (criterion 6)**			**Quality (criterion 7)**					
Ease of access (criterion 1)	1.00	1.50	2.00	1.00	1.50	2.00	1.00	1.50	2.00			
Operational conditions (criterion 2)	1.00	1.50	2.00	1.00	1.50	2.00	1.00	1.50	2.00			
Pricing policies (criterion 3)	1.00	1.50	2.00	1.00	1.50	2.00	1.00	1.50	2.00			
Customer support (criterion 4)	0.50	1.00	1.50	0.50	1.00	1.50	1.00	1.50	2.00			
Security (criterion 5)	1.00	1.00	1.00	1.00	1.50	2.00	2.00	2.50	3.00			
Innovation (criterion 6)	0.50	0.67	1.00	1.00	1.00	1.00	1.00	1.50	2.00			
Quality (criterion 7)	0.33	0.40	0.50	0.50	0.67	1.00	1.00	1.00	1.00			