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MULTIFACTOR INFLUENCES ON THE QUALITY OF EXPERIENCE SERVICE USERS OF TELECOMMUNICATION PROVIDERS IN THE REPUBLIC OF SRPSKA, BOSNIA AND HERZEGOVINA

Abstract: *The paper investigates multidisciplinary factors influencing the quality of experience (QoE) of service users of telecommunication provider as an open-structured stock-company of people who are creators of services and applications and/or proactive service users. The quality of user experience QoE is created and improved over time under multifactorial influences. The aim of this paper is to analyze legal-regulatory, socio-contextual, technological-process and stock-company ,factors as input independent variables and subjective-user factors as transition variables of influence on motivation, behavior and user satisfaction in the Model of influences factors (MIF). The output from MIF is dependent variable QoE. MIF was created on a perceptual and reference path with interactively related factors of all influences on QoE through subjective-user assessment. The quality of MIF was verified by statistical significance analysis among variables of paired factors influencing QoE using SPSS technology, regression analysis, and the Boosted Desedions Tree technique of machine learning method.*

Keywords: *Telecommunication service provider; Model of influences factors; Quality of experience of telecom service users; Legal norms and regulations; Network services and applications*

1. Introduction

The key words or constructs in the subject of research of this paper are *service* and *service user*, *experience,* and *quality of experience of service users* of telecommunication providers. In general, *service* can be defined as a "collective creation" of complex interactions in multimodal communication of service *organizations*, *technology*, the *environment* and *man* with connected thoughts, hopes, desires, beliefs, expectations, and competencies in open cooperation with thousands of different people (Pavlovic et al., 2020). The term *experience* and ways of determining its quality among users of various types of services is explained not just in numerous research studies. The basic, most frequently emphasized dimensions of the user experience are *perception* - the quality is conditioned by biological and environmental parameters; *understanding* - determined by cognitive and socio-psychological factors; *actions* - effects depend on physical factors of influence and applied knowledge; and *emotions* - conditioned by personal and

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social contexts. In essence, experience can mean the "integration of different types of acquired knowledge, developed skills, and formed attitudes and beliefs of a person with orientations that allow him to solve the same, similar, or analogous problem situations on the same, similar, or innovative way. The *service user* is a person who during the acquisition open structure of experience functions as, metaphorically speaking, a "dynamic information processor" on *cognitive*, *affective,* and *behavioral* communication platforms (Banjanin, 2008), with reliable engagement of *sensory*, *working*, and *long-term memory* in human cognitive architecture. The "practical expansion of multidisciplinary research" shows the possibility of replacing "the old experience with the new one of open structure". Exploring the "openness of structure" of experience, McGuinness, (2011) emphasized the importance of "experiencing something completely new that has not been verified in experience until then," but has the necessary significance of interactive influences "to explain some new scientific facts and realized scientific discoveries".Lukic R. (1995), in his research of action and interaction systems and social structures, emphasized the special importance of the "open structure of experience" in creating scientific knowledge in a way that "new experience corrects inaccuracies of old scientific knowledge based on narrow experience". While explaining the relationship between "open structure of experience" and "analysis of concepts method", Djuric (1962) points out that "a greater distance between concepts and experiential phenomena to which these concepts refer can lead to mis understanding", and thus "the problem of definition and more closely determining the experiential content of certain concepts occupies a central place in all phases of scientific activity."

Maricic (2020) emphasizes the need to understand the legal dimension of the concept of experience through a historical prism, concluding that the "stock company emerged and formed gradually", through experience "with the capacity of a legal entity by a legal transaction in order to create business capacity for common goals and interests".

This paper focuses on the services and application of telecommunications networks that are available to user according to their different requirements of the telecom provider. as a stock company, enables the arranging of life and gaining experience according to legally regulated and technological quality standards and good business practices harmonized with the modern dynamic density of the digital society.

The *quality of service users' experience* is very differently defined in the literature and can be seen as "the outcome of the process of comparing individual assessments" of variables and predictors that include positive and negative "impacts on perception, contemplation of conception, and narrative outcome". In addition to the perceptual way, the path of quality formation can be a reference one as well, since it reflects the temporal, systemic, and contextual aspects, in which human memory with stored "memories of former experience" has a significant impact. The reference path for forming the quality of experience defines the degree of satisfaction or anxiety of application users and services in a time series of events, experiences, actions, activities (Djordjevic Cegar, 2021), and processes in interactions with conversational, interactive, streaming, and background classes of communication traffic ETSI (2014).

The ITU-T recommendations (ITU-T, 2017) define quality of experience as "general acceptability of the application or service, as subjectively perceived by the end user in the context of communication services," "and he is influenced by content, network, device, application, user expectations and goals and context of use."

The importance of digital transformation in the dynamic density of society implies "the use of new digital technologies, such as e-services, social networks, mobile devices, analytics (Fitzgerald et al., 2014) and improving the business operations of companies must go in "the direction of improving user experience and creating new business models."

2. Materials and methods

The quality of experience of users of telecommunication service providers can be related to the constructs of models for assessing the quality of life experiences of people, which include an assessment of a person's physical, cognitive, emotional, and social functioning. The assessment can be based on subjective (self-reporting) and/or objective (independent sources of information) indicators. Therefore, the initial orientation in this research is the very familiar Technology Acceptance Model (TAM) in its extended versions, which, according to Ma and Liu (2004), is valid, robust, and powerful (Marangunić & Granić, 2014) for use in a wide range of experience quality research contexts. This wide range of contexts includes the application of models for different sexes and interval groups of biological age of service users (VS Lai & Li, 2005), for different levels of technological competence (Lu et al., 2009) of service users belonging to different social, political, and especially cultural systems (Hamutoglu, et all., 2020). TAM is useful for assessing the acceptance of ICT (Castiblanco Jimenez et al., 2021) because it implements the principles of Uses and Gratification Theory (U&G), whose main focus is on social, psychological, legal, technological, and content aspects of customer satisfaction (Boskovic, 2021).

The important constructs of the model are: *Motivation* to use services; *Behavior* of users before, during and after using services; and customer *Satisfaction* through acquired experience of usage with four important

dimensions of *social satisfaction* (as a result of various social influences - *historical, legal, sociological, cultural* and *organizational* relations and connections (Maricic, G. & Skoric, S. (2019); *technological satisfaction* (which arises during the use of different types of technologies - categories of life and business needs of users (Lolic, T. (2021); *content satisfaction* (which the user receives, perceives and cognitively processes as relevant data, information, messages, and knowledge gained in interactions with services and applications); and *satisfaction with the process* of telecom services (which characterize the availability of services, perception of the quality of content, reliability of network connection and its availability, interoperability and security of telecom processes and portfolio of services (software applications, network services and various digital services, not only those in certain classes of telecom traffic:conversation, interactive, background, video and audio streaming, ...), and based on this, to create a model for assessing the multifactorial impact on the QoE of users of telecom service providers.

The hypothetical setting of the research procedure in this paper was chosen that "quality of experiences of users of telecom and digital services in interactions with personal devices and network services, software applications and digital services of telecom providers determine the level of integration of subjective *cognitive, affective*, and *action communication competence* of users with the level of their personal curiosity, character, creativity, courage, communication, beliefs, charisma, competencies, use of common sense action and mobilization of the agile memory capacity of users in its cognitive architecture".

For the purpose of testing the hypothetical setting, in the paper created the Model of Multifactor Influences (MIF), in the open structure of *stock-company* (A), *legal-regulatory* (J), *socio-contextual* (S),

technological-process (T), and *subjective-user* (U) factors. MIF achieved through independent input and transition variables whose scaled values affect the output value of the dependent variable QoE. These variables are: (1) chronological age; (2) gender; (3) legal and regulatory affiliation of the stock-company; (4) the identity of one or more service providers with which the user has experience; (5) evaluation of user experience when using services and applications for four traffic classes (conversational, interactive, streaming, and contextual); (6) assessment of experience level related to technical parameters (A-availability of services, B-perceived quality of content, C-reliability, D-interoperability, E-safety) quality of network services quality (QoS) in certain traffic classes; (7) assessment of satisfaction with the price of service providers; (8) assessment of the legal safety of users in interactions with service providers in the field of contractual services and payment of bills according to the calculation of costs; (9) duration of experience of service users with an identified provider; (10) assessment of personal characteristics of service users (curiosity, creativity, communication, character, courage, beliefs, charisma, competence, common sense, and memory), which are the input variables for the transition variable general satisfaction, whose values affect the output dependent variable QoE. General satisfaction in QoE has two instances, namely *enthusiasm*, when the positive influence of characteristics is greatest, and (11) *anxiety,* when the greatest negative influence of certain types of rigidity as interpersonal, behavioral, structural-longing for structure and coping with lack of structure, prospective anxiety, inhibitory.

2.1. Explanation of MIF-model for QoE estimation using the Multi Impact Factors

In the creation MIF were used the principles of conceptually integrated theory, which is described as one that is "compatible with data and theory from other relevant fields." According to the evaluation criteria of the modeling process, MIF has its own structural integrity and is adaptable to changes of input, transition and output variables QoE. The research procedure was performed coherently because the results are verifiable and the assumptions are influenced by rational explanations (Lolic, T. et all. (2020).

The world literature often states that the type of model with paired influencing factors or components is the best for describing complex interactions between multifactors in order to predict, evaluate, and understand the value of process performance (Cohen, I. B. (1994).

The visual interpretability of the MIF is presented in a Table 1.

The above rational explanations of the paired influencing factors in the MIF are given in the following five points.

1. J "Legal and regulatory factors" of the telecommunications service provider that affect the QoE include standardized legal regulations in chronological order since the establishment procedure (legal form, registration, and status of legal entity) and during the operation of the company. Maričić (2020) emphasizes the importance of the ownership structure and types of business relations of status entities in determining the strength of the relationship in the forms of cooperative, coordinative and collaborative cooperation in the internal and external business environment. Models and competencies of individual and collective governing bodies, ways of changing the legal form and retaining identity, general and economic rights and responsibilities are regulated by law and other regulations. A special segment refers to the application of domestic and international standards in the formation of various normative acts, business procedures, protocols, and various types of standards on investment in company development (Maricic, 2016).

Table 1. The visual interpretability of the MIF

	Legal and regulatory factors (J)	Stock-Company factors (A)	Technological and process factors (T)	Socio-contextual factors (S)	Subjective--users factors (U)
Legal and regulatory factors (J)	-	J1) Standard-ization J2) Legal norms J3) QoS traffic class	J4) Specifications J5) Reports J6) Recommenda-tions	J7) Term definitions J8) Procedures	J9) Procedures for estimating QoE
Stock-Company-factors (A)	A1) Contracts A2) Warranties	-	A3) Level of technical assistance A4) Available resources A5) Scientific and professional approach	A6) Number of service users served by the company A7) Competitiv-eness A8) The cost of using the service	A9) QoS offered by the provider (Service provider's offerings of QoS - planned/targeted QoS)
Technological and process factors (T)	T1) End-to-end Service Quality of Service (ESQoS) T2) System Quality of Service (SQoS)	T3) Objective performance measurements and monitoring T4) Theoretical models for performance analysis	-	T5) Type of equipment/device T6) Quality of content T7) Service availability in terms of time T8) Service availability in terms of space	T9) QoS parameters - achieved QoS level
Socio-contextual factors (S)	S1) Inter-personal relationships S2) Socio-economic status	S3) Expectations S4) Collective attitudes related to QoE S5) QoS requirements	S6) Location and time S7) Previous experience	-	S8) Enthusiasm level S9) Anxiety level
Subjective-users factors (U)	J9) QoE estimation procedures	A9) QoS offered by the provider (Service provider's offerings of QoS - planned/targeted QoS)	T9) QoS parameters - achieved QoS level	S8) Level of user enthusiasm S9) Level of user anxiety	-

Telecomm-standards and norms of European anda International standardization bodies include: 3GPP-Third Generation Partnership Project, ETSI and ITU Standardization Sector ITU-T. The regulatory documents of these organizations are technical specifications, technical reports, and recommendations that establish the relationships between the quality of QoE user experience and the quality of the QoS network services for certain classes of network traffic. Contracts that service users sign as subscribers with the service provider, regulate mutual relations related to the provision/use of the service, which includes minimum levels of QoS that the operator should deliver to users and which ultimately affect the quality of the user experience. It is

legal practice that operators are responsible for the delivery of quality services, the installation and maintenance of terminal user equipment and network devices covered by manufacturer's guarantees, and overall control over equipment and data, but do not guarantee 100% reliability and availability of their services due to unforeseen external objective influences. Special provisions of the contract regulate the conditions for the provision of individual telecommunications services, such as prices, ranges, and specific user requirements.

2. A "Stock-Company factors" is a type of organization which, according to the famous sociologist Durkheim & Fauconnet (1982) is characterized by the importance of the "dynamic material density of society," which arises from the "increasing of interaction and competition between urban residents," and "increased dynamic density affects the change of mechanical with material solidarity". Modern organizational theories emphasize the term "*multicultural world of talents*" and these talents are people in a stock-company, who are constantly changing the modus operandi, the structure of goals, missions, and functions, the relationships between them, and the interactions in situational contexts (Innes, M. (2002). A company such as a telecommunications service provider can be defined as "a complex network of social connections created by people and to which they respond using the possibilities of technology." Zelenovic (2011) states that "in order to adapt a traditional company to the digital age, it is necessary that" the rate of knowledge acquisition is higher than the rate of environmental changes and discontinuous, unforeseen impacts" The research results in this paper indicate that the status and reputation of a telecommunication service operator and its position in the market are clear indicators of the quality of services it provides to users in the digital dynamics of society's density, and thus factors of that density affect the quality of QoE service users' experience.

3. S "Socio-contextual factors" – of influence on the quality of experience of service users are based on the sociological aspect (Compeau, D., Higgins, C. A., & Huff, S. (1999), of observing service users of a company as "people of the new age who are trained to work with knowledge and new orientations in responsive and strategic contexts, to operate in intelligent environments and communication in intelligent contexts. Today, creative users of network services and digital media are not just passive recipients of transferred content in technology and social networks, but are proactive participants in the dynamic density of the digital society who write blogs, create websites, and program applets, design applications and solve business problems. People of the new age (Katalinic, B. (2019), with new competencies are contributing to the improvement of the quality of life of society and communities in off-line, on-line, and in-line contexts. Therefore, in the structure of necessary competencies of service users for subjective assessment of the quality of user experience in MIF, "natural competencies" should be added as well, which include "senses and especially eyesight, language learning, perceiving a person as beautiful, reciprocity of service, fear of disease, falling in love, etc." which sociologist Skoric (2010) characterizes as "a huge heterogeneous complex computational machinery of human mind that supports and regulates these activities" (Skoric, 2010, dd, p. 358).

4. T "Technological and process factors" of impact on QoE in MIF contain a set of independent variables (type of user equipment/device, quality of content of the application or message, availability of services that can be viewed in terms of permanent availability over time and continuous availability in a particular geo-space) to which the realized, realistic level of quality of QoS network services delivered to the user belongs. The parameters measured on the user's side should be fully or highly consistent with what was specified and

offered by the telecommunication provider. The impact of QoS service quality is expressed by the degree of technical support provided by operators and is often crucial for customer perception of QoE service quality, which is also taken into account while structuring the MIF. QoS parameters such as baud rate, frame rate, content type, number of packets lost in transmission, resolution, codec, jitter, quantization level, device model/type, delay, packet error rate, spatial degradation, media distortion variation, bandwidth, frame size, display size, and compression level are systemic factors for evaluating the quality of service in MIF.

5. U "Subjective-user factors" of influences in MIF are related to the fact that modern business is increasingly turning to the individual, to his needs, creativity development, and also good relations between people, so that organizational climate and performance are optimal. The importance of the so-called concept of "well-being at work" has been recognized by many employers and, in its broadest form, includes mental and physical well-being, psycho-social factors, and the work environment. A service user of a telecommunication company is a person who builds experiences in changeable physical, mental, and discursive contexts. It works with *personal identity,* which is based on the data of a person acquired by birth; *biographical identity*, which is acquired over time with official documents and certificates that the individual receives from various organizations and associations; and *biometric identity*, which is based on unique physiological or behavioral characteristics of the individual (Paunovic & Starcevic, 2013).

With intelligent behavior, a service user learns from experience with understanding, perceives meaning from contradictory messages, quickly resonates and promptly reacts providing responses in a new situation, effectively orients himself in "confusing" situations, (Blumer, H. (1969), understands and concludes rationally, applies environmental management knowledge and

observes the relative importance of different elements in different situations (Maricic, G. & Skoric, S. (2019).

The quality of the created MIF was verified by statistical significance analysis among paired factors influencing QoE using SPSS technology, regression analysis, and the BDT technique of machine learning method.

2.2. Data collected

An integral part of the MIF for assessment of QoE is also the research Questionnaire on subjective assessments of multifactorial effects on the quality of experience of users of telecommunication providers (Table 2, Appendix) in the Republic of Srpska, Bosnia and Hercegovina. Statistical analysis of the research sample.

The structure of the formed research sample consisted of 167 surveyed users of TELEKOM services in the geo-area of the Republic of Srpska, BH. The list of providers with whom user have experience in using the services include the stock-company M:tel Banja Luka; Eronet-Mostar; BHTelecom Sarajevo and Others.

After filtering the collected data, i.e., removing missing values, the sample size for processing was reduced to 157 fully completed forms that were used for further analysis and processing. Male users were represented in their demographic profile with 52% and female users with 48%. 55% of service users are 30 - 45 years old, while 29% are 45 - 60 years old, 8% of users are 20 - 30 years old and older than 60 years, while only 0.006% of users are less than 20 years old. Business and professional roles are played by users of telecom services in educational and scientific institutions accounted for 53%, companies in the field of ICT(information and communication technologies) and media services accounted for 24%, state or local governments accounted for 16%, various types of agencies and associations like chamber of commerce, professional chamber, associations, small

entrepreneurial companies, banks, representative offices and the like accounted for 3%, from other types of organizations accounted for 3%, and the smallest number of users in the sample are students (1%). The longest duration of gaining experience in the use of telecom services is between 15 and 20 years, and 29.9% of users from the research sample have it. Users from other interval groups have significantly less experience, while only 2.5% of users have experience of between one and five years. The stated strata of the structure of the research sample show that the respondents meet the criteria of stratification Stratums - categories pattern of traits by which population members differ Random selection within each stratum.

At the beginning an overview of research sample statistics is given based on data collected through online surveys. Based on the same data, the second part of the section describes how to create (training and testing) two models for estimating QoE levels.

After the survey process is completed, the next step involves analyzing and processing the collected data. This means estimating the level of user experience based on respondents' answers (167 answers in total), filtering missing data and structuring the final set into input-output vectors in an Excel file (a final set of 157 completed questionnaires). Digital treatment of research data was performed with mathematical, statistical, and models based on artificial intelligence - decision trees. Performance assessment of model accuracy is performed by testing them on a special data set that is envisaged for that purpose.

3. Research results

The analysis of the results shows that, out of the total number of respondents, the average qualitative assessment of the level of user experience, i.e., perceived level of service quality (QoS) can be expressed as good. The corresponding quantitative score expressed over the Mean Opinion Score (MOS) is 2.97.

When it comes to customer satisfaction with the price of services, the realized value of MOS is 2.83%, which can be characterized as solid. Users rated legal certainty in interactions with the provider in the field of contract-based service provision and bill payment after calculating costs with an average score of 2.97 (solid). For the four defined traffic classes, based on the MOS values that represent the average ratings of the experience level, it can be concluded that the background traffic services have the highest rating of MOS = 3.87. On the other hand, real-time services, such as audio and video streaming, were rated with the lowest average score of MOS = 3.54.

The analysis includes 10 positive influences on the final assessment of service quality, which are defined by question No10. Statistics showed that *communication* is the best rated positive indicator with a score of MOS = 3.71, while the worst rated indicator is *courage*, whose average score is MOS = 2, 92. Negative effects on final QoE are expressed through five variables defined by question number 11, of which *behavioral rigidity* has the highest effect rated with MOS=2.88, and the least *prospective anxiety* whose value is MOS = 2.80.

Levels of QoE are assessed based on 10 independent-transitional variables of satisfaction at the level of *enthusiasm* and 5 independent-transient variables that affect the rigidity at the level of *anxiety* of network service users. Variables of satisfaction at the level of enthusiasm are defined by question No10 of the Questionnaire, and these are the factors influencing network services on the user: Curiosity (O_1), Creativity (O_2), Communication (O_3), Character (O_4), Courage (O_5), Beliefs (O_6), Charisma (O_7), Competence (O_8), Common Sense (O_9) and Memory (O_{10}). Each of these variables was assigned a weight value of 0.1. These variables affect the increase of total QoE level by multiplying their weights by the corresponding user rating. Question No 11 defines the variables of rigidity at the level of anxiety, as the connection of network

services with the following forms and measures of rigidity that services cause to users (Grahovac, B. (2021),: Interpersonal rigidity (R_1), Behavioral rigidity (R_2), Structural rigidity-longing for structure and coping with lack of structure (R_3), Prospective anxiety (R_4), and Inhibitory rigidity (R_5). These negative variables have weight values equal to 0.2 and affect the reduction of the previously calculated QoE level based on the positive variables of the influencing factor. This means that the weights of the variables (with a negative sign) are multiplied by the corresponding user rating. Based on the above, a mathematical formulation can be derived in order to estimate the QoE level:

$$QoE = 0.1 \cdot \sum_{i=1}^{10} Ip_i - 0.2 \cdot \sum_{j=1}^{5} In_j \quad (1)$$

where Ip_i marks user ratings of variables with positive multifactorial effects on user satisfaction to the level of *enthusiasm*, and In_j marks user ratings of negative variables with negative effects on user rigidity to the level of *anxiety*. Therefore, the total QoE level is determined on a scale of real numbers from 0 to 4, noting that negative QoE values are mapped to a value of 0.

3.1. The quantitative methods for estimating QoE

In this section, two models for estimating QoE level are presented, a linear regression method and a machine learning method based on the BDT technique. The aim is to model the quality of the user experience as assessed in the manner described above, depending on the factors defined in questions from No1 to No 9 of the research questionnaire. Thus, the inputs to the model represent the following independent variables or factors of influence: Age (X_1); Sex (X_2); Legal and regulatory affiliation of the stock-company (X_3); Provider(s) with which the user has experience (X_4); Qualitative level of experience-perceived level of QoS (X_5); Level of satisfaction with

the price of service providers (X_6); Assessment of the legal certainty of users in interactions with service providers in the field of contract-based service provision and bill payment according to the calculation of costs (X_7); User experience expressed through characteristics for four traffic classes (X_8); User experience expressed through levels of perceived quality of telecom service for four traffic classes (X_9); Time duration of experience formation service users with the chosen provider (X_{10}). Both models have one output, a dependent variable y that represents the estimated QoE level. The results of data processing from the questionnaire are structured in the Excel file into input/output vectors and are divided into two parts. 90% of the research sample, i.e., 141 vectors, is used to train (create) the model, and 10%, i.e., 16 vectors, is used to test the performance of the assessment accuracy.

3.2. Method of multiple linear regression

Linear regression method are one of the most statistical commonly used. The basic feature that allows them to have such a status is the simplicity of creation, but at the same time, they have numerous disadvantages, especially when it comes to application in large databases. In this case, the multiple linear regression model was created (Stojčić, 2021) in the statistical software *Minitab* and can be expressed by the following equation:

$$Y = 0.343 + 0.015X_1 + 0.104X_2 - 0.0438X_3 - 0.0081X_4 - 0.0133X_5 + 0.0271X_6 + 0.021X_7 + 0.0085X_8 - 0.0007X_9 + 0.0035X_{10} \quad (2)$$

As an indicator of the performance of the accuracy of the model when estimating the QoE level, the Mean Square Error (MSE) of the test is observed, which in this case has a value of MSE = 0.625. The coefficient of determination is $R^2 = 2.5\%$, which represents a very low accuracy of the model. The cause of poor accuracy performance can be

explained by the very nature of the data, i.e. weak linear correlation of dependent and independent variables.

3.3. BDT-Boosted Decision Tree tehnique

A Machine learning (ML) model based on the BDT technique was developed by implementing modified code in MATLAB software package under the paradigm of learning with a teacher (Stojcic, 2021). The test results show that MSE of the created model is 0.388, which is almost twice less error compared to the linear model. In addition, the analysis of the results concludes that user experience expressed by characteristics for four traffic classes and user experience expressed by satisfaction levels for four traffic classes, are the most important influence factors while assessing the overall QoE level. At the last place of factor influence are the years of biological life of service users.

If a decision tree is created, whose inputs are positive and negative indicators of user experience (15 inputs), the QoE estimation error is then MSE = 0.16. As a result of model training and testing, the MATLAB software package generates a graphical representation of the importance of the impact of each of these factors on the overall QoE level (Figure 1.a). Figure 1.b) shows the ranking of the influence of importance for the selected positive indicators, which in this case represent the inputs to the model. The error of estimating the quality of experience in that case has a value of MSE = 0.45. However, the smallest error is realized if only five negative indicators are observed as inputs, with an MSE = 0.09. Figure 1.c) graphically shows the importance of each. It can be concluded that the greatest influence on the overall level of QoE has the *assessment of the influence of service on customer charisma* (O_7), and among the negative indicators, the most significant is the *assessment of the association of the service with prospective anxiety* (R_4).
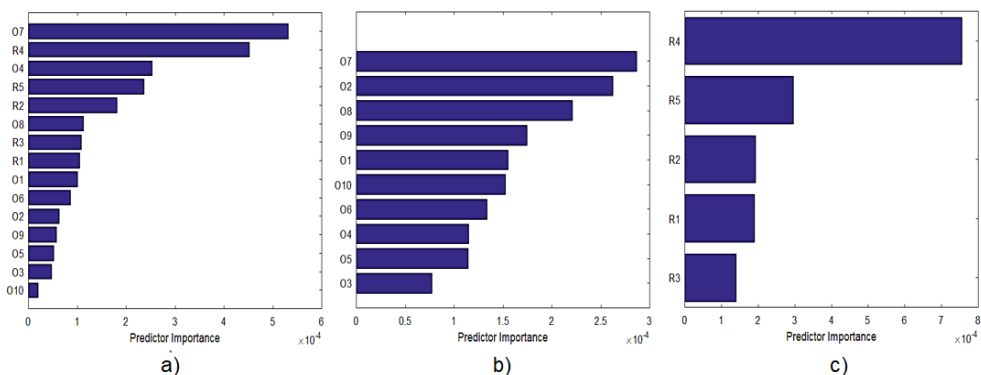

Figure 1. Importance of the influence of positive and negative indicators on the total level of QoE (Stojcic, 2021)

4. Discussion section

Correlation analysis of research results. Spearman's correlation coefficients make it possible to see the strength and direction of the interrelationships that exist between factors (X_1-X_7), transient (O, R), and dependent variable (y). The results of the correlation analysis given in Table 3 show that the legal-regulatory factors of influence (variable X_3) have a significant (negative) correlation with positive user factors at the error level of 0.05. Stock-company factors (variable X_4) also have only one significant correlation, with user rigidity factors.

Technological and process factors (variable X_5) at the level of significance of 0.01 have a significant connection with socio-contextual factors of influence (variable X_6). Socio-contextual factors, in addition to the relationship with variable X_5, have significant correlations with both positive and negative indicators of QoE. According to the above results, the highest (in absolute value) correlation coefficient is -0.555 and defines the relationship between negative indicators and the QoE value.

Table 3. Correlation analysis (Stojčić, 2021)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	O	R	y
X_1	1.000	-.154	.085	-.117	.248 **	-.003	-.044	.013	-.022	.358 **	-.072	-.001	-.012
X_2	-.154	1.000	-.031	.038	-.116	.078	.009	-.027	.025	-.132	-.017	-.049	.068
X_3	.085	-.031	1.000	.038	.101	-.111	-.086	-.097	.040	.153	-.171 *	.011	-.127
X_4	-.117	.038	.038	1.000	-.063	.038	-.027	.087	-.050	-.016	.010	.167 *	-.133
X_5	.248 **	-.116	.101	-.063	1.000	.316 **	.300 **	.074	.426 **	.379 **	.193 *	.294 **	-.028
X_6	-.003	.078	-.111	.038	.316 **	1.000	.631 **	.219 **	.350 **	-.174 *	.415 **	.333 **	.080
X_7	-.044	.009	-.086	-.027	.300 **	.631 **	1.000	.195 *	.380 **	-.129	.327 **	.248 **	.090
X_8	.013	-.027	-.097	.087	.074	.219 **	.195 *	1.000	.362 **	-.039	.199 *	.375 **	-.145
X_9	-.022	.025	.040	-.050	.426 **	.350 **	.380 **	.362 **	1.000	.172 *	.359 **	.334 **	-.009
X_{10}	.358 **	-.132	.153	-.016	.379 **	-.174 *	-.129	-.039	.172 *	1.000	-.139	-.025	-.060
O	-.072	-.017	-.171 *	.010	.193 *	.415 **	.327 **	.199 *	.359 **	-.139	1.000	.375 **	.414 **
R	-.001	-.049	.011	.167 *	.294 **	.333 **	.248 **	.375 **	.334 **	-.025	.375 **	1.000	-.555 **
y	-.012	.068	-.127	-.133	-.028	.080	.090	-.145	-.009	-.060	.414 **	-.555 **	1.000
** Significance at importance level 0.01; * Significance at importance level 0.05													

Analysis of significant statistical differences. Determining the existence of possible significant statistical differences in characteristics and levels of user experience in certain traffic classes was performed using the Friedman test, which represents a nonparametric alternative to analysis of the variance of repeated measurements. Realized statistics (Asymp. Sig.) of the test in SPSS technology, indicates that there are no significant statistical differences in user ratings due to multifactorial influences on the quality of the user experience for four traffic classes (0.185>0.05). On the other hand, when it comes to quantitative assessments of the quality of experience, the realized test statistics are less than the significance level (0.00<0.05), which means that these differences are statistically significant (Table 4).

Table 4. Friedman test results

	Characteristics by traffic classes (Question 8.a)	**Experience levels by traffic classes (Question 8.b)**
N	157	157
Chi-Square	4.831	33.018
df	3	3
Asymp. Sig.	.185	.000

5. Conclusion

From the analysis of research results in this Paper, it can be concluded that the quality of experience of service users in interactions with applications and services of telecommunication providers is determined by the level of integration of individual cognitive, affective, and action-behavioral communication platform of service user and it depends on the level of realization of subjective curiosity, productive creativity, effective total and business communication,

strong character, appropriate courage, proactive beliefs, inspiring charisma, multidimensional competencies for lifelong learning, action abilities of common sense and agile memory capacity.

Based on the generated indicators of the importance of interactive influences from individual paired components of the created model and significant connections between different input and transition variables, the quality of the QoE user experience was assessed as a dependent output variable of y model of paired multifactor influences. It was subjectively assessed that the greatest positive influence on the overall level of the QoE quality has *charisma* of user, as the ability to inspire people in modern society to content, proactive, interactive, irreversible, dynamic, and contextual effective communication and to motivate goodness in their desires, intentions, and actions in building cognitive skills, complementary ways of reasoning, language of interpretation, and intelligent behavior. At the same time, the strongest negative influence on the overall quality of experience of a service user, i.e., the output variable of the QoE model of paired multifactorial influences has behavioral user rigidity — which is a contrast to flexibility in interactions because it causes limited productivity and imagination, reduces orientation and ability to perceive complicated relationships, and constructive integration with intelligent behavior of an individual in the modern society.

The values of Spearman's correlation coefficients show that variables of legal-regulatory factors have a significant (negative) correlation with the positive user variables of the human influence factor, while stock-company factors have a significant correlation with the factors of user rigidity. Technological and process factors are significantly related to socio-contextual factors and a significant correlation with positive and negative indicators of human influences on the quality of user experience. Applied test statistics in SPSS technology for the studied traffic classes shows that there are no significant statistical differences in qualitative user assessments of the influence of certain technological and process factors on user experience, while in the case of quantitative assessments of the level of experience quality, the test statistics realized are lower than the reference level of significance. This suggests drawing a valid conclusion that these differences are statistically significant and, at the same time, that MIF for QoE assessment is well designed and structured with multifactorial influences on the assessment of the quality of experience of service users of telecommunication providers.

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Table 2. Questionnaire on subjective assessments of multifactorial effects on the quality of experience of users of telecommunication providers

		1	2	3	4	5
1	Indicate the time interval of your age? (1 = Less than 20; 2 = 20 to 30; 3 = 30 to 45; 4 = 45 up to 60; 5 = more than 60)					
2	Gender? (1 = Male; 2 = Female)		1		2	
3	Indicate the legal and regulatory affiliation of your organization/company in which you are employed in one of the following forms: 1 = company; 2 = state or local government body; 3 = Educational / scientific institution; 4 = agencies and associations-chambers, affiliations, entrepreneurs, banks, representative offices and the like; 5 = other organizational forms)	1	2	3	4	5
4	From the list provided, choose the name of one or more providers with whom you have experience in using the services (1=M:tel; 2=Eronet; 3= BHTelecom; 4 = Other)	1	2	3	4	
5	Indicate the qualitative level of EXPERIENCE you have as a service user of telecom provider service and service (Mark with: 1 (superficial); 2 (solid); 3 (good); 4 (very good.); 5 (excellent)	1	2	3	4	5
6	Based on experience, rate the level of satisfaction with the price of the provider's services on a scale of 1 to 5. (1 = poor; 2 = satisfactory; 3 = solid; 4 = good; 5 = excellent).	1	2	3	4	5
7	Based on your experience, evaluate the legal security of users in interactions with service providers in the field of contract-based service provision and bill payment (Mark (1= poor; 2 = satisfactory; 3 = solid; 4 = good; 5 = excellent).).	1	2	3	4	5

8	For certain traffic classes, rate the level of your experience according to the listed characteristics (A-Availability, B- Perception of content quality, C-Reliability, D-Interoperability, E-Safety) and experience levels (1 = unsatisfactory; 2 = poor; 3 = solid; 4 = good; 5 = excellent).	Indicate one or more of the characteristics represented					Satisfaction levels				
		A	B	C	D	E	1	2	3	4	5
	Conversational traffic (mobile telephony, Appl. Viber, Appl. Whatsapp, Skype)										
	Streaming traffic (e.g. YouTube, audio streaming, video streaming)										
	Interactive traffic (Internet search, social networks, video games...)										
	Background traffic (Messaging, SMS, e-mail, chat…)										
9	How long do you have EXPERIENCE as a user of telecommunication service providers (Mark 1,2,3,4 or 5)? 1 = (1-5 years); 2 = (5-10 years); 3 = (10-15 years); 4 = (15-20 years); 5 = (more than 20 years)	1					2	3	4		5
10	On a scale of 1 to 5 (1 = unsatisfactory; 2 = poor; 3 = solid; 4 = good; 5 = excellent), evaluate how, based on your overall EXPERIENCE, the service provider's network services affect the user's:	1					2	3	4		5
	Curiosity (implies that "No one should consider itself to be too smart to continue learning, i.e., everyone has a certain level of cognitive appetite," and understanding the stimuli that drive people to be better, more diligent, more correct, more efficient, more reliable, and more useful to themselves, their family, and society as a whole.)										
	Creativity (recognition and defining the problem in a different way than usual, reproductive, with thinking outside the box of the "black" or "gray" box and strengthening the repertoire of knowledge for predictive solutions)										
	Communication (continuous in space and permanent in time; the need of every person and organization that is satisfied with multidimensional activities according to the paradigm of the whole work in which man-organization-technology and the environment are interactively connected)										
	Nature (according to recognized criteria, this is a system of habits for accepting as valid what is assessed as such,)										
	Courage (consistency and reliability of what is said and what is done with the acceptance and proof of personal responsibility in all interactions and communication contexts.)										
	Conviction (a necessary value that indicates the desire and commitment to start and finish the work)										
	Charisma (the ability to transfer positive influences, motivations, and inspire people to goodness in their desires, intentions, actions, and behaviors.)										
	Competence (implies personal operational readiness and functional ability for "knowing how to solve a problem," demonstrating what is truly effective in business, and being fully accountable for your decisions.)										
	Common sense is the genetic capacity possessed by every human being, like the ability to perceive and notice, to reason, to understand, to present and interpret an event, phenomenon, or problem, to decide and to act reasonably and to understand the common sense of others with whom he interacts.)										
	Memory (In the human cognitive architecture, there is sensory, working, and long-term memory. Sensory memory refers to the amount, duration, and design of retained material from the cognitive content; working memory consists of a phonological loop that manipulates verbal material, a visual-spatial matrix that manipulates images, and a central executor that controls attention, allocates cognitive resources, and renews retained material in long-term memory.)										

11	On a scale of 1 to 5 (1 = weak; 2 = influential; 3 = very influential; 4 = strong; 5 = very strong), evaluate how, based on your overall experience, network services are related to the following forms and measures of rigidity that endanger the well-being of users. (Rigidity is defined as any repetition and established way of either thinking or experiencing oneself and the environment, or reacting to various stimuli from the external environment. The term **rigidity** (Grahovac, B. (2021)).has been used to describe mental sets, extreme attitudes, ethnocentrism, stereotypes, reduced flexibility, perseverance, authoritarianism, and the inability to change habits).	1	2	3	4	5
	Interpersonal rigidity (endangering the dimension of openness toward experience with individual behavior when activating different mental functions: perception, problem solving, emotional response, motor interactions)					
	Behavioral rigidity is in contrast to the flexibility in interactions that produces limited productivity and creativity, reduced resourcefulness, inability to perceive complicated relations, and constructive integration into intelligent behavior.					
	Structural rigidity - longing for structure and coping with lack of structure/It is typical of the lack of mental and cognitive structure, which is increasingly expressed by measures of intolerance of ambiguity, the need for cognitive clarity, and openness to experience with a tendency to heuristic information processing versus systemic, and heuristic processing is characteristic of people with low tolerance for insecurity, that is consequence of inconsistencies in understanding of space, time, and structure as the three essential elements on which every man-made system in which he operates is conceived.					
	Prospective anxiety - a **kind of rigidity** that basically means intolerance of uncertainty, is not a function of personality characteristics, but of environmental influences that produce fear of failure, uncertainty about the consequences of action, compulsive needs, inflexibility of goals, failures, frustrations, insecurities, and low expectations for success.					
	Inhibitory rigidity - manifests itself as mental inertia, attachment to the current performance of interactions in an inadequate manner with a lack of variability in responses, and resistance to change when the situation requires it, while maintaining old habits and showing the difficulty of change in the presence of new requirements.)					