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ELECTRONIC COMMERCE SYSTEMS' QUALITY ASSESSMENT

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General characteristics of the dissertation

Topicality of the problem

Specialists working in business development realized that the internet becomes a more and more powerful tool in stimulating business and economics. The number of internet users exceeded the threshold of 1 billion in 2005 *(Augey, 2006)*; in 2010 it reached the level of 2 billions (*by InternetWorldStats.com*). The expenses of retail e-commerce users increase rapidly (according to US Commerce Department and Forrester Research). This gives a reason to believe that the importance of e-commerce in economy of each country is increasing as well. With the penetration of the internet in everyday life a new business area emerged, where the businessmen can compete, offer and buy goods and services. Thus, now we have the electronic market which develops rapidly and tends to impact economy more and more. As far back as 1997 the European Commission has emphasized that a rapid implementation of e-commerce presents an urgent challenge for commerce, industry and government in Europe, as e-commerce allows low-cost trading across regional and national frontiers *(European Commission, 1997)*. Lithuania is a society open to the global processes linked with the development of knowledge economy and electronic business. With the view to enhance the competitive ability and geographical limits of Lithuanian business, there is a need to give more attention to e-business, especially to its constituent electronic commerce (hereinafter e-commerce). Information technologies, such as e-commerce systems, help to reduce the impact of distance factors, to optimize the information exchange process, and become an indispensable tool for international business and marketing. The e-commerce systems, like every internet solution, are specific and develop very fast, so it is difficult to choose an appropriate method of e-commerce systems' quality assessment, which would be flexible and readjusted quickly to the dynamic environment. The performance of such a task is laden by the unstable environment and the newness of requirements and technical solutions. Nevertheless, such an assessment tool is necessary because the quality of the e-commerce system determines the competitive abilities of business on the global market and influences economy considerably.

Scientific problem

Analysis of scientific publications on e-commerce and quality management issues has shown that there is no consensus on the content of the e-commerce system and on how to choose the method of assessing e-commerce systems' quality. Thus, there is a need to define this object on the basis of quality management theory and to develop the appropriate research methods.

Nowadays, when advanced technologies are widely used in business, the demand for e-commerce systems increases. Thus, the lack of a clear definition of this object and the absence of an adapted quality assessment methodology can be considered as a significant and actual problem.

The e-commerce systems' quality assessment is important to business participants:

– to e-commerce systems' developers, as the prospects of their business depend on the quality of developed products;

– to the e-commerce system's owner, as this system is the marketing tool that impacts the efficiency of activities, corporative image, and the return of investment;

– to the e-customer, as the success of the purchase depends on the quality of the e-commerce system used.

The problem analyzed in this work can be defined as follows: the lack of the literature on the e-commerce systems' quality assessment does not allow to percept and colligate the structure of this object, the methods and criteria of its quality assessment; therefore, there is a need to define the content of e-commerce systems and to develop a methodology for a quality assessment of this object, adaptable to the market requirements.

Aim and tasks of the work

The object of analysis – e-commerce systems' quality.

The aim of the work – to consolidate the theoretical aspects of e-commerce systems and criteria of their quality assessment as well as to propose a model of e-commerce systems' quality assessment, which would be flexible and adaptable to the dynamic market changes.

The tasks of the work:

1. Upon analysing the literature, to present a conception of an e-commerce system appropriate for the quality assessment.

2. To analyze the existing models of e-solutions' quality assessment.

3. To designate the indicators of e-commerce systems' quality basing on:

   3.1. analysis of the literature;

   3.2. analysis of e-commerce experts' opinions;

   3.3. analysis of e-commerce users' opinions.

4. To compile a model of e-commerce systems' quality assessment.

5. Employ the proposed e-commerce systems' quality assessment model and assess it by comparison with alternative methods of quality assessment.

Methodology of research

The object of research is analysed from several perspectives. The main research methods used are: a review and systemic analysis of scientific literature, the conceptual content analysis of scientific works and practice describing the existing models and criteria of e-commerce assessment, the opinion poll and testing for initial data collection, a comparison of results, grouping, ranking, and classification methods used for modelling. The research data were processed employing the software of statistical analysis (*StatGraphics, SPSS*) and *Microsoft Office Excel* 2003. Methods of descriptive statistics (analysis of means, correlations, dispersion) were used for data analysis. The methodology of the work consisted of several stages:

1) the theoretical and empirical scientific works linked with e-commerce quality and its assessment criteria were selected after reviewing the corresponding publications. On the grounds of literature analysis, the theoretical e-commerce system's interpretation based on e-commerce processes was developed. During the conceptual content analysis, the aspects of e-commerce that had been mentioned by authors as quality characteristics were selected. Such characteristics were ranked by reference frequency. A list of the ranked characteristics allowed identifying the most important ones, which could serve as e-commerce systems' quality criteria;

2) considering the fact that the analytical basis covers the sources of a long period, the actual most relevant e-commerce quality criteria should be reviewed nowadays. Thus, the reconnaissance experts' survey was performed to refine the actual

quality criteria. This survey has shown that the criteria mentioned in the literature are actual but insufficient. The list of considered quality criteria was complemented by criteria for delivery and post-purchase services indicated by experts.

3) the e-customer's opinion survey allows identifying the e-commerce characteristics most important for the final e-purchaser as well as its acceptable ranges;

4) e-commerce systems' quality criteria were selected by comparing the e-commerce aspects accentuated in the literature, by the experts and customers. The selected criteria were grouped by their topics and organized in an hierarchical structure. The principles of fuzzy classification were invoked for constructing the model;

5) the validation of the model was conducted by testing six e-commerce systems.

Defended propositions

• The e-commerce system is defined as a complex product which allows to exercise the processes of goods and services ordering, payment, delivery, and providing the post-purchase services when at least one of the mentioned processes is performed online.

• Based on the analysis of the literature, surveys of expert and customer opinions, the most important e-commerce quality criteria were identified and grouped by topics as follows:

– criteria of sales organization quality: usability of e-shop navigation, technical quality, the content and localization of e-offer, possibilities to socialize through e-shop;

– criteria of payment organization quality: safety of the payment system, a number of offered payment alternatives, clearness of the payment system;

– criteria of delivery organization quality: term of delivery, price of delivery, modes of delivery, online support during delivery;

– criteria of post-purchase services quality: term of warranty, term of money recovery, term of product return, customer support.

• An e-commerce systems' quality assessment model was created as a tool for a flexible quality assessment. The model is based on the principles of fuzzy classification, thematic and hierarchical organization of data regarding the nature, relations, importance and acceptable ranges of involved criteria. The proposed model can be described by the following characteristics: flexibility, possibility to use assessment expressed in natural language, comparability of results, transparency of interpretation, an easier identification of quality refinement directions, the possibility to automate the quality assessment process.

• The fuzzy logic principles bring advantages to the assessment of e-commerce systems' quality in comparison with alternative methods. The advantages are: control of sensibility to data variation, better adaptation to market requirements, approximation of the results to the reality, better interpretation abilities.

Scientific novelty, theoretical and practical value

In Lithuania, the e-commerce systems quality assessment methods have not been explored from the theoretical point of view. There is a lack of theoretical provisions and methodologies that allow to examine e-commerce systems in the light of technology developments and the growth of customers' needs. Abroad, the theoretical examination of e-commerce systems' quality is also carried out only if it can be useful in practice. Provident entrepreneurs seek to make a full use of the possibilities provided by advanced technologies and the internet. Therefore, with a view to expand advertising, customers' information and sales channels, businessmen decide to build a website or an e-shop.

However, the majority of them has no idea what is the content of the system they have ordered, what exactly they are ready to buy, how to assess the quality of such virtual product, and how to foresee its evolution in the context of emerging technologies.

The e-commerce systems, in comparison with conventional sales systems used for decennaries, have specific features and develop faster. Therefore, it is difficult to find the method of system's assessment that would be exact but flexible and adaptable to market changes.

In practice, there are two types of e-commerce systems' quality assessment ways: based only on (1) compliance with the specifications or on (2) subjective users' opinions. However, there is no (published in the literature or widely used in practice) flexible model of quality assessment, which would bring together the objective and subjective assessments so that assessments of different objects could be compared. The formation of such a quality assessment model is revealed in this dissertation by examining the systems through the e-commerce processes.

Practical significance of the work: a model of e-commerce systems' quality assessment has been formed; a system of assessment criteria and the algorithm of the final quality rate calculation are presented. They allow:

– a flexible assessment of e-commerce systems' quality;
– a comparison of separate indicators of e-commerce system's quality;
– a rating of e-commerce systems by quality;
– identification of the areas and priorities of quality improvement.

Such assessment of e-commerce system's quality is useful to:

– a developer of e-commerce systems (to assess the created systems – which of them fits more the priorities of business, what are their weaknesses and advantages);
– a businessman in choosing an e-commerce system for his business (to compare alternative systems or assess the systems used by the competitors);
– business actors while choosing the online supplier or making benchmarking;
– the third party (for independent e-commerce systems' rating by quality).

The structure and content of the work

The dissertation consists of lists of tables and figures, introduction, three chapters, conclusions, references, and annexes. The first part of the dissertation reveals the theoretical understanding of e-commerce and of quality in the e-commerce context, as well as the existing quality assessment models that could be applied for assessing e-commerce systems' quality. In the second part, the methodology and the results of surveys (conceptual analysis of the literature, experts' and customers' opinion surveys) are presented. The third part of the work describes the compilation of the e-commerce systems' quality assessment model and its validation.

The volume of dissertation is 227 pages (without annexes) with 28 tables, 64 figures, 147 references, and 18 annexes.

A brief content of the dissertation

Concept of e-commerce system

E-commerce systems are specific; in the literature, they are investigated in most cases from the technical point of view. However, the managerial view of this subject is important as well. The prospects of e-commerce in the market depend on the perception of its value, which depends on e-commerce features and their quality.

The development of information society changes the traditional approach towards business processes. It involves the emergence of new challenges for business and of a different understanding of business problems and opportunities.

Quite often e-commerce is explained as a specific part of e-business, which is focused on the selling of products and services (*Knoppers, 2000; Isaac et Volle, 2008*). E-commerce applications support sales processes, which traditionally are subdivided into the phases of information, agreement, and transaction *(Schubert, 2006)*. Moreover, e-commerce is more than just a technology; it implies thinking what customers need and uses the internet and other information and communication technologies to enhance business performance and success *(Pavic et al., 2007)*.

The author of the dissertation considers e-commerce as a complex of online and offline processes with a set of critical attributes in each of them (Figure 1).
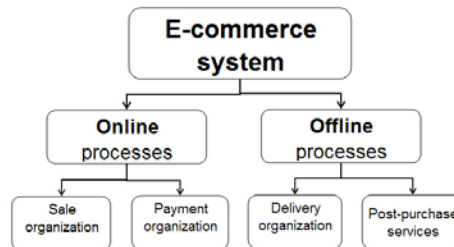

Fig. 1. E-commerce system's analysis scheme (compiled by author)

Online processes are linked with sale and payment. The main tool of sales in the internet is an e-shop; there one can find offers and aspects important for consumers' choice (trust supporting messages, marketing announcements, etc.). In the payment process, the most important point is the safety of data flows (personal data, payment details, etc.). The delivery is already an offline activity; it is the point where the consumer and the retailer meet in reality. So, it is very important to keep a good image and to be on a high level during delivery: to be in time, to control delays, etc. Good delivery practice can attract new clients, because often people do not trust the internet and prefer first to make a little purchase so as to test the e-shop. The success of this purchase defines whether the consumer will buy something else from this e-shop. To gain consumers' loyalty, it is necessary to ensure the post-purchase service; this is especially topical for long-used products (e. g., domestic electric appliances) and for personally adapted products (clothes, footwear). It convinces the customer that he pays only for the product he really wants, with the possibility to return the products that are not appropriate. The existence of such warranty eliminates the possibility of unfair marketing regarding the customer.

The nature of the environment (online / offline) influences the character of possible troubles and opportunities. Thus, when the processes are separated in regard of the environment, they can be analyzed with respect to its peculiarities.

In view of the dynamic evolution of information technologies (IT) and of the variety of e-commerce systems in use, it would be difficult to give a universal definition of the e-commerce system. The aim of the definition itself is to reveal the essential features of an object in a way that allows to separate this object from the neighbouring ones (*Plečkaitis, 2006*). Therefore, in this work, a flexible e-commerce system concept is used, which allows to separate them from other e-solutions, but does not give a detailed

view of its elements. The e-commerce system is defined as a complex product, through which the ordering of goods and services, payment, delivery, and post-purchase services are performed, if at least one of these processes is carried out in the cyberspace.

Models of e-commerce

The e-commerce models described in the literature can be constructed by the nature of the processes, the number of participants or their characteristics. According to the typology based on the number of participants, which allows assessing the profitability of the technology, e-commerce in this work is analysed in the context of the "one-to-many" model. In another classification, the e-commerce is considered in "business-to-consumer" (B2C) model frames, i. e. is limited to electronic transactions with end-users and to processes of its implementation. This type of e-commerce is focused on retail trade, involves a large number of participants and is developing most rapidly (*Isaac, Volle, 2008*).

Advantages and weaknesses of e-commerce

An efficient use of potentially positive features and the compensation of weaknesses impact a lot the perception of e-commerce and the improvement of its quality.

The advantages of e-commerce are considered as time and cost saving, convenience, improvement of competitive positions on the market and client-relations (*Sodžiutė, Sūdžius, 2003*). These benefits are more relevant to e-commerce developers. However, there are advantages for consumers as well: easy ordering, large assortment, lower prices, fast services and delivery, clear and detailed e-offer (*Nielsen, 1999*) – i. e. the process of purchase must be easy, enjoyable, and efficient.

The potential disadvantages of e-commerce are associated mainly with reliability (important for customer) and appropriate e-commerce system functionality on a global scale, which is often conditioned by the system's adaptation to the target markets (important for business).

Reliability of e-commerce

Some authors (*Isaac, Volle, 2008; Rolland, 2003*) believe that the slow acceptance of e-commerce by users is associated with the low level of trust from the customer's side. The factor of trust is of special importance for e-commerce, where the buyer–seller dialog is established in the virtual, and often ephemeral, environment that requires an additional evidence of credibility. Trust is crucial for e-commerce, since the operations are carried out at a distance and with a time gap between the buyer and the seller (*Pavlou, 2003; Wang, Emurian, 2005*). To build trust in the cyberspace is much harder than in the real environment as the customer has less information on the seller's reliability (*Wirtz, Lihotzsky, 2003*). The information provided by the e-shop usually reflects the seller's interests, so its reliability is often considered the least in comparison with other sources. Trust can be destroyed by any non-compliance of the provided information with reality. E-business must work much more than the traditional one to gain the same customers' trust.

At the first glance, it is quite difficult to distinguish a trustworthy website from a questionable one. It is therefore necessary to draw attention to the quality certification marks provided by the accredited independent third party. This may be a means to gain the visitor's confidence.

Certification is carried out in many areas, but everywhere there are similar problems – the credibility of the certification body and the customers' awareness of the meaning of a particular certification mark. The potential of certification process positively impacts the processes of e-commerce. It works out through the clarification of imperfections and the improvement of the e-commerce system during adaptation to the certification requirements. However, the problem areas can be named as well; first of all, it is a wide variety of marks and insufficient identifiability among consumers. This may lead to limitations of the certification potential use, as it ensures the credibility of the system, but affects little a consumer's confidence in the e-commerce system's security. The use of a well-known certificate given by a recognized certification body provides final customers with the transaction and data safety warranty, which is based on a clearly regulated certification system.

The certification mark of a system's security and compliance with requirements of fair trade can offer a double benefit to the e-commerce system's quality and prospects. On the one hand, during the certification process, the developer has a possibility to identify the weaknesses of the used e-commerce system and to improve its quality. On the other hand, the customer can easily navigate among different e-shops and to check their reliability by a simple click on the certification label. Thus, the potential of certification must be used in e-commerce aiming at both to convince the e-customer and to improve the characteristics of the e-commerce system.

Localization of e-commerce systems

The companies intended to expand globally must take into account the cultural impact on the internet-based communication and on the quality of its tool – website. It is clear that trying to standardise communication in the internet limits the usage of the e-commerce potential.

In order to create a suitable tool for communication and to effectively use the global market potential, it is critically needed to define the target audience and to tailor the e-commerce system to each target market after its cultural impact assessment. Due to cultural differences, the purchase preferences and the experience of customers from various countries may differ. In most cases, there is a positive customers' reaction to marketing actions adapted to the local culture (slang, colours, image, pricing). Cultural adaptation (localization) has a great potential in improving the quality and efficiency of e-shops. It can be argued that the interactivity of the e-commerce system is defined by the degree of cultural adaptation, and that localization makes a positive impact on the customer–seller dialogue.

Localization includes the adaptation of the product to the target linguistic and cultural group. Knoppers (2000) defines localization as a coherence with something not global manifested through such a set of parameters:
– linguistics: natural and specific languages;
– juridical characteristic: juridical, regulator or geopolitical particularities;
– sectorial characteristic: particularities of industry, science, professional branches;
– human rights: particularities of privacy understanding, handicap rights, etc;
– particularities of customers' behaviour.

All measures of e-commerce system's adaptation to the target market must be consistent with cultural particularities. The world's cultures have various sets of social behaviour and interactions. They boosted the anthropologists and communication specialists (such as *Hofstede (1980); Schwartz (1994); Baumgartner (2003); Marcus*

(2001, 2004); Singh, Zhao and Hu (2003, 2005)) to develop the models of culture that would allow to describe existing cultural differences. The dimensions of the mentioned models are often quite similar. The Hofstede's cultural dimensions in one or another form figure in all considered classifications: (1) power distance – hierarchy – authority conception, (2) collectivism-individualism – intellectual, emotional autonomy – egalitarian engagement, and also it is often referred to (3) uncertainty avoidance, (4) long-term orientation – time perception, (5) gender roles dimension, so we can suggest that they are the underlying dimensions. However, in the context of e-commerce systems the information-technology-related aspects are of particular importance (technology development level, public tendency to adopt innovations), because the high-grade communication through an e-shop is stimulated by the technology development and willingness to use it.

So far, there are no universal solutions described in the literature, which foresee an introduction of cultural orientation into designing the e-commerce system. Scientists analyzing the cultural impacts on the e-commerce system treat it as a communication tool, but often underestimate its complexity. However, the e-commerce system is complex and heterogeneous, thus it requires a deeper analysis. With emergence of the internet in different countries and social layers, the cognition and appliance of cultural particularities in e-commerce strategy gather especial importance.

Review of e-commerce statistics

The 2005 was a very important year in the internet development history, because the number of internet users crossed a symbolical barrier of 1 billion (*Augey, 2006*). The US Commerce Department has measured a continuous growth in American consumers' spending, with e-commerce retail sales at $15 billions in 1999, $28 billions in 2000, $34 billions in 2001, $44 billions in 2002, and $56 billions in 2003. A similar pattern of growth is seen in consumer spending on e-commerce services: from $26 billions in 1999 to $50 billions in 2003. The Forrester Research forecasts an increase in the US e-commerce to $329 billions by 2010 (*Cassidy et al., 2006*). As to Europe, the 2005 year revenues from e-commerce in West Europe were 70 billions euros, and this parameter increases every month by a dozen million euros (*Enzo, 2005*). This shows that the use of e-commerce is definitely growing and creates a significant flow of transactions.

Analysis of statistical data enabled to identify the main trends of e-commerce in the EU and Lithuania. In 2008, the EU countries (except Bulgaria) reached the Lisbon target of 30% of the internet penetration. Lithuania reached this target in 2006, and the growth of the internet penetration rate is rapid. According to the Internet World Stats data, in 2009 there were about 2 millions of internet users in Lithuania. It can be noted that even one-fifth of Lithuanian internet users do not use Lithuanian web resources (visit mostly foreign websites); this may indicate an insufficient attractiveness of Lithuanian websites even for local residents.

By Eurostat data, 32% of 16–74-year-old EU residents purchased online in 2008. However, this indicator in Lithuania is low – only 6%. On the other hand, despite such a low level of e-purchases in Lithuania, a considerable interest of businessmen in e-commerce can be noted, i. e. in 2008 Lithuania was on the 5th place among the EU countries by the percentage of businesses involved in e-commerce (*Eurostat, 2009*).

Thus, the rate of involvement of Lithuanian companies in e-commerce exceeds the rate of customers' involvement, i. e. there is a gap between the level of proposed and expected services. Therefore, for the business discovering a potential market niche, it is

important to find appropriate ways for an efficient use of available technologies, i. e. to find the quality criteria and counselling.

Concepts and models of quality assessment in the context of e-commerce

The quality of e-commerce is more than just the quality of software. E-commerce contains in it not software only, but also all processes typical of traditional commerce. The efforts to define the components important for e-system's performance can be found already in the 1980s (e. g., *Ives et al., 1983*); the interest in e-commerce increased in the late 90s when more and more papers discussing internet products and their evaluation appeared. A review of the literature shows similar online aspects of e-commerce, raised year by year by different authors: design (*Liao et al., 2006; Jin and Park, 2006*), quality of information provided in website content (*Liao et al., 2006; Lin, 2007*), safety (*Shin and Fang, 2006; Jin and Park, 2006*), technical characteristics, usability, and reactivity of the system (*Liao et al., 2006; Shin and Fang, 2006*). In addition, Jin and Park (2006) introduce the aspects of order fulfilment, communication, and advertising. Nowadays, the number of requirements to e-commerce is increasing and expands from security context to the context of comfort and practicability; e. g., Isaac and Volle (2008) defined four e-commerce analysis axes: communication, management, offer, and profitability. Liang and Chen (2009) identified the aspects of e-commerce mostly oriented to the user's comfort: relevance of information, proposed assortment, usability, user-friendly navigation, reliability, client relations. A review of quite vast essays found in the scientific literature shows that there is no common and universally accepted way to evaluate e-commerce quality. Moreover, in most of essays there is any indication how to improve the e-commerce system after its quality assessment. There is a lack of Lithuanian literature directly linked with e-commerce quality criteria. If we take as the basis ISO 9000 quality definition of the quality as the degree of conformity between characteristics and clearly described requirements, we can define the e-commerce system's quality as the degree of conformity of its characteristics to clear requirements for such products. Thus, it must be defined what elements and requirements will be considered in order to evaluate the quality of the e-commerce system.

Thus, a considerable part of the analysed quality assessment models is based on a theoretical set of detailed criteria; less papers use vague dimensions of quality; rarely, the proposed quality assessment criteria are empirically tested. Thus, in most cases the analysis is conducted on a theoretical level; therefore, this work aimed at compiling a quality assessment model which would be more approximated to reality.

The following features of the new model in the context of existing models can be noted:
– the e-commerce systems' quality assessment model is based on the dimensional approach as well as other analysed models;
– the main (critical) criteria are selected to assess each dimension;
– the criteria are selected and the range of the acceptable variation of their values are defined on the basis of empirical research.

Methodology of e-commerce systems' quality research

The e-commerce system was reduced to elements in order to assess the importance of each of them. Such a breakdown and the hierarchical organization of the elements are invoked to allow the usage of objective assessment methods which enforce to get the final assessment and to identify the strengths and weaknesses of the object. The classification method and the hierarchical-logical model were used for quality

assessment. The compiled quality evaluation model was checked by analysis of illustrative cases.

Thus, in this work there is an attempt to bring together the objective and subjective components of evaluation, i. e. the knowledge gathered during the research is a complex of knowledge based on interpretation and knowledge based on perception, which with the help of fuzzy logic was adapted to interpretation and measurement.

The reliability of research results was improved by approaching the e-commerce system from several perspectives: (1) opinions and results presented in the scientific literature were invoked, (2) a survey of experts' opinion was conducted, (3) the preferences of customers were investigated by an opinion poll. In addition, data of different sources were compared.

The main problem of empirical research can be defined as follows: the lack of literature on e-commerce systems' quality does not allow to perceive and summarize the structure of this object and the quality assessment methods and criteria to be applied.

The aim of the empirical research was based on data analysis, to identify the appropriate e-commerce systems' quality criteria that could be used in the e-commerce systems' quality assessment model.

The tasks and methods of the study:

1) to identify criteria of the e-commerce system's quality, presented in the literature.

The method used was a conceptual content analysis. The analytical basis for identification of relevant criteria of e-commerce quality assessment was collected by the principle of publications' network, i. e. by searching the pertinent papers referred in articles concerning the quality of e-solutions. It was examined through selection of aspects mentioned by authors as quality criteria. The analytical basis consists of 39 sources from scientific literature and 6 practices in use. The interactive coding method was invoked when both implicit and explicit e-solutions' quality criteria in the texts had been noted; thus, a high level of generalization was achieved. While reviewing the literature and employing the method of conceptual content analysis, criteria mentioned in the literature more than once were selected and ranged by mentioning frequency. Such a list enforced identification of the most frequently mentioned criteria. Upon grouping the criteria by topics and ranking their groups by summed mentioning frequency, it became possible to assess the importance of thematic groups and the eliminate risk of criteria overlapping;

2) to identify the actual criteria of e-commerce systems quality by experts' opinion survey.

The experts were selected according to their experience in the field of e-solutions and contribution to e-solutions' development and research (publications, monographs, presentations at international conferences, practical activities in the field during the last five years). To ensure the equality of scientific and practical approaches, an equal number of experts from scientific and practical fields was selected. The opinion on e-commerce quality criteria were expressed by eight experts – from France (5), Lithuania (2), and Russia (1); they were selected considering their scientific publications and good practice in developing e-commerce;

3) to identify the e-commerce systems' aspects important to the customers.

The main objective of customers' survey was to define the most important criteria of e-commerce quality. The target audience was individuals making purchases on the

internet, who might be interested in purchasing from e-shops of Lithuanian origin. The users' answers were collected by a web-based questionnaire. Such questionnaire allows to collect the opinions of internet users only; in case of this survey, it had a positive impact on the result as it focused the survey on the target group. However, there is also a disadvantage: the demographical characteristics of a sample cannot be controlled. This is especially important for demographic surveys. However, the main characteristics of this survey are the characteristics of purchases, i. e. the demographic aspects were not analysed.

The geographical location of Lithuania is favourable for logistic solutions and goods' delivery to the EU and the markets of neighbouring third countries. The number of respondents was defined on the basis of Chernyshova's sampling table, in which the sample depends on the coefficient of variation and the acceptable sample error. When sample error is 7% and variation 50%, the sample must comprise 204 respondents. Since the geographical location of Lithuania in the context of logistics is favourable for the transactions both with EU and CIS countries, along with the answers of e-customers from Lithuania, also answers from the EU and CIS countries were accepted in the random sample of 204 filled questionnaires. For a greater accuracy, the sample should be larger, but such a survey would be more costly and hardly reasonable.

E-commerce systems quality criteria in the literature

Analyzing the review of literature and employing the method of conceptual content analysis, criteria mentioned in the literature more than once were selected and ranged by their mentioning frequency.

Table 1. Grouping of e-commerce quality aspects (compiled by author)

Resumptive characteristic	E-commerce quality element	Mentioned	Total
Content (online)	Information	30	56
	Offer	11	
	Price	8	
	Assortment	7	
Technical components (online)	Safety of transactions and personal data	24	50
	Loading time	9	
	Personalization	5	
	Efficiency	12	
Using (online)	Usability	26	41
	Access	13	
	Utility	2	
Client Relation (online+offline)	Interactivity and communication	15	35
	Services	9	
	Online support	6	
	Reactivity	2	
	Empathy	3	
Loyalty (online+offline)	Reliability	15	28
	Trust	9	
	Image	4	
Perception (online)	Design	15	23
	Aesthetics	7	
	Pleasure	1	
Components of *offline* environment	Warranty, goods returning conditions	10	18
	Delivery	8	

The first three positions in the list accrue to information quality, usability, safety of transactions and personal data. In such a list criteria are scattered; therefore, for the further analysis they were grouped by topics. The topics (not separate criteria) defined by the "resumptive characteristic" were ranged by frequency (Table 1). This allows eliminating the risk of criteria overlapping and to make conclusions on the importance of thematic groups. The list of grouped criteria shows both the topics most often considered by scientists and developers and those lacking attention. The most often mentioned criteria are related with the online content, technical characteristics, and the particularities of e-commerce system's usage. Client relation management (both in the online and offline environments) and factors of loyalty creation are in the middle of the rank. The aspects of user perception are mentioned less often, and e-commerce components of the real environment are least involved in e-commerce quality assessment in the reviewed literature. It is important to emphasize a special position of safety: this criterion, even not grouped with the others, occupies the third line in the list of solitary criteria. This shows a particular importance of safety, especially in e-commerce with online paying. This criterion dominates in the block of technical quality criteria.

Analysis of the literature has shown that there is a vast range of criteria proposed for e-solution quality assessment, but no one of the models prevails. However, due to similarities noted among the models the main groups of criteria to be applied for e-commerce systems quality assessment were identified. Considering the fact that the analytical basis covers the sources of a long period, the actual most relevant criteria of e-commerce systems quality could be reviewed nowadays; thus, the experts' survey was performed to refine the actual criteria of quality.

E-commerce systems quality criteria indicated by experts

The refining of e-commerce quality criteria was performed with the help of a reconnaissance survey of experts' opinion conducted in November 2008 – January 2009. To ensure the equality of scientific and practical approaches, an equal number of experts from scientific and practical fields was chosen. The opinions on e-commerce quality criteria were expressed by eight experts.

On the first customer–businessman contact, the experts highlighted the importance of e-shop quality, the quality of e-offer, as well the number of e-purchases, which can be treated as an indication of e-commerce quality. On the payment stage, payment security was evaluated as the most important (a valid certificate of security was indicated as a possible security proof); also the payment alternatives' variety was treated as a significant issue for the positive perception of payment organization quality. Four from eight experts indicated the clearness of the operational payment system as a relevant criterion of e-payment assessment. At the delivery stage, its term and mode were presented equally in experts' considerations; also the provision of client support during delivery was highlighted by experts. For the post-purchase service quality assessment, the term of provided warranty and service point dislocation criteria were indicated. Some of the experts mentioned the importance of client support in the post-purchase stage. Thus, the experts consider client support as indispensable in the offline e-commerce stages (delivery and post-purchase) which take place after payment.

At the first stage of e-commerce, the content quality (e-offer quality) prevails; experts' opinion on the importance of payment security is similar to the e-payment priorities found in the literature. Offline e-commerce stages are insufficiently considered in the literature, but attracted the experts' attention. Thus, to enrich knowledge about

relevant criteria of e-commerce quality assessment from the e-customers point of view, the e-customers' survey was performed.

E-commerce systems quality criteria important for customers and selection of final criteria

A survey of e-customers' opinion was conducted in 2009. It was focused on e-customers potentially interested in purchasing from Lithuanian e-shops. During the poll, 625 visits to the questionnaire were recorded, 312 questionnaires were filled out, from which 204 questionnaires filled by users that purchase on the internet were selected. The response rate reached 32.7% of the persons that had visited the questionnaire. One third (33%) of the sampled questionnaires were filled by e-customers from Lithuania, 36% by those from CIS countries (mostly from Russia), and the rest by customers from other European countries. The frequency of purchases in the sample can be divided into three groups: about 23% of respondents purchase online every month, near a half (49%) of respondents makes online purchases every 3–6 months and others less than once in every six months. Thus, half of the results of this survey were influenced by the opinion of moderately active buyers and part by the opinion of respondents with a greater and lesser than average purchase frequency.

Considering that quite a large variety of goods can be sold online, the respondents were asked to indicate which goods they purchased online; mostly books, household goods and electronics were mentioned – they are successfully marketed via traditional sales channels, while a quarter of respondents purchase online games (4%), software (5%) and media content (music, video, audio books, etc. – 16%), i. e. the production that can be supplied online via the internet and does not demand physical delivery.

Thus, there is a reason to believe that, with such a structure of e-shopping covered by this survey, not only general e-shopping preferences but also specific aspects related to delivery and post-purchase service quality will be revealed.

The structure of the sample by gender is similar to the EU population distribution: among survey participants 52% were women and 48% were men. However, the respondents' gender distribution slightly deviates from the EU internet users' distribution by the same characteristic (where women are more numerous – 57%). The sample distribution by respondents' age showed the maximum in the 25–49 years age group (69% of respondents), 29% of respondents belonged to the 15–24 years age group, and only 2% to the 50–64 years age group.

Respondents were asked to assess the importance of proposed e-commerce elements on a 9-point scale. The mean values of the assessment are provided in the Fig. 2.

In the online ordering step, we can identify three main units of e-sales organization that were important for customers: technical-logical e-shop implementation (via navigation and technical characteristics), e-shop special-purpose adaptation (via offer and localization), and e-shop social role (via communication possibilities).

The analysis based on the customers' purchasing frequency showed differences between perceptions of online support importance; if we divide the judgments by customers' e-shopping experience: highly experienced customers (purchase online every month and more often), middle-experienced customers (purchase online once in 3–6 months), less experienced customers (purchase online less than every 6 months), we will see that the less experienced in e-shopping customers are, the more important for them is

online support when choosing and ordering goods online (the mean values of online support importance for each group of customers were 5.1, 5.5, 5.9 respectively).
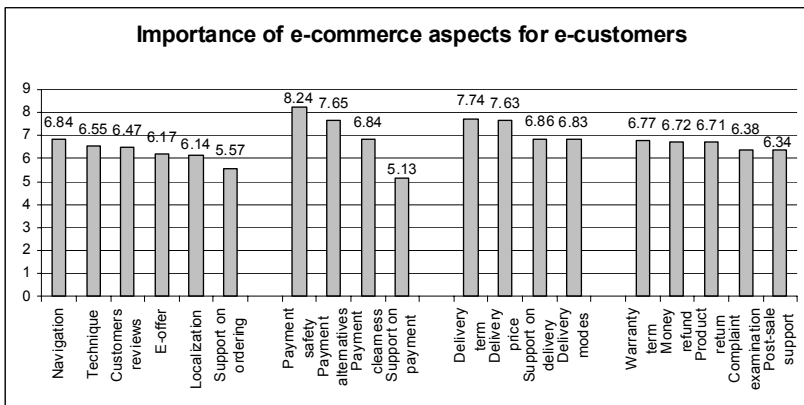

Fig. 2. Mean values of e-commerce elements' importance evaluated on a 9-point scale (compiled by author)

Thus, there is a need to customize the e-shop structure and e-offer content in a comfortable, readable, and easily understandable way, as well as to ensure the possibility of a dialog on e-shop; this is important for stimulating the interest and purchase. The ANOVA test (N = 204, α = 0.05) showed a statistically insignificant difference between the mean values of the following criteria: navigation, technical aspects, reviews, e-offer, and localization; thus, these criteria are to be treated as equal by importance and can be used in a quality evaluation model. Considering the quality aspects mentioned in the literature, by experts and customers, the main criteria of e-sales organization were selected as follows: navigation usability in e-shop, the technical quality of e-shop, the content and localization of e-offer, the possibility of interaction through e-shop. Thus, at the e-shopping start-point, e-customer expects a customized environment with simulations of live communications typical of the shopping in a substantial store.

According to the survey results, we can identify two main poles of payment organization: payment security (via ensuring data safety and user trust) and comfort (via providing alternatives, clearness, and support). The wish of a customer to pay in the most secure way dominates. E-customers prefer to pay on delivery when they are sure that the e-seller fulfils his engagements. Moreover, the fees for the way e-customers pay are of fundamental importance when choosing among payment alternatives. The payment safety criterion is mentioned by all considered sources; however, experts and customers indicated the payment comfort aspects: requirements for payment safety can be complemented by requirements for payment clearness and alternatives. Thus, the customers extended requirements from those related to payment safety to those related to the payment comfort.

Analysis of the scientific literature showed that offline e-commerce elements are deficient in attention and poorly explored. The information on the possible criteria of evaluating the offline part of e-commerce, provided in the considered literature, is quite imprecise; the experts' and customers' surveys enriched the list of relevant criteria for delivery and post-purchase service quality assessment.

When talking about delivery, in the literature the image of a company is mentioned as well as the term and methods of delivery and client support. The experts echo the mentioned delivery aspects and highlight the importance of client support at the moment of transition from the online to offline environment. The customers raised an additional delivery criterion not mentioned by previous sources – delivery price. Thus, the quality of delivery organization can be evaluated by delivery term, price, a variety of modes, and client support. These elements reflect practical e-customers' expectations concerning delivery – the moment when the customer meets the seller's representative in real life. The similarity of importance of all delivery aspects indicates that for the respondents important are not only separate characteristics of the delivery, but also their complex. The complex assessment of a delivery through the relative values, such as the ratio of delivery term and price, etc., could be more useful than the analysis of separate indicators of delivery. The aspect of a possible delay term was rejected, as the assessment of its importance is ambiguous, and this criterion was not mentioned in other sources.

As concerns the post-purchase service, the warranty was figured in all contributions; other guarantees are required as well and can be considered as quality indications. In the literature, the conditions of refund and product returning, client's support after purchase are mentioned. The experts added as important aspects for post-purchase services the number and dislocation of service points on the territory. However, the customers did not value these two factors as important. The customers evaluated the importance of post-purchase aspects (mentioned in the literature as well) quite similarly (Fig. 2). Customers want to have a possibility, when needed, to use their rights provided by warranty. They need quite a high level of indemnity in case of online purchase. Hereby, analysis of this section shows the customer's need to be in contact with the seller after purchase to ask for help or to lay claim in case of possible problems. Here it is important to mention that a long-term post-purchase service can be less considered on the market of perishable goods (flowers, meals, etc.); the longer is the lifecycle of a product after purchase, the more important post-purchase services and long-term warranty become.

Principles of formation of e-commerce systems quality model

The process of e-commerce development demands to make a choice between e-commerce system alternatives and to decide on its further elaboration. Nowadays, the decisions are made in conditions of uncertainty. It was like that in the past, when it was difficult to get valuable data for the analysis. It is like that nowadays when the volumes of available data are huge and difficult to process, to pick out the most important and to make a deliberate decision.

Another source of uncertainty lies in the concepts used. Most concepts of social science are difficult to define, because it is hard to assign the objects to sharply defined categories (*Verkuilen, 2005*).

On the one hand, the quality assessment is a subjective matter, which is difficult to define and which often uses abstractions; on the other hand, since e-commerce systems are characterized by specific features and a fast development, there is a need to find an appropriate logic (technique of thinking) for the formation of the model of e-commerce systems quality.

As is well known, a model is a conditional representation (scheme, description) of an object or of a system of objects. Modelling may be understood as a study of objects

by using models of these objects (*Plečkaitis, 2006*). Models are used for various purposes: simulation, system analysis, decision making, process control, diagnosis, monitoring, etc. The traditional modelling is based on a full understanding of a system and of the mathematical mechanisms that describe the existing relationships. However, this approach is no longer sufficient for unexplored and very complex processes. The knowledge about the process is often qualitative and imprecise, and therefore is difficult to transpose into a traditional mathematic model. The inclusion of such knowledge into modelling could be possible by using natural language, rules, semantic networks or qualitative models.

While choosing an appropriate method of modelling, logic comes to the aid, with a view to identify the most efficient means of reaching a logical truth (*Plečkaitis, 2006*). Logic itself has many variants: binary logic, ternary logic, multivalued logic, probability logic, modal logic, fuzzy logic, etc. (*Plečkaitis, 2006; Guc, 2003*).

As quality assessment is often impacted by subjectivity, it cannot be strictly described in the context of binary logic. There is not enough precise information to use the stochastic approach; thus, the probability model cannot be constructed for quality evaluation. In such cases, the use of fuzzy logic can be more advantageous (*Sevastjanov, Rog, 2003*). This idea is supported by Zadeh (2006) who indicates that as we move further into the age of machine intelligence and automated decision-making, the basic limitation of probability theory becomes a serious problem: it cannot deal with information described in natural language.

Most conventional data-processing techniques are more suitable for expressing the objective data numerically, which in quality assessment is not entirely sufficient. Much of quality assessment models found in the literature include subjective assessments. It is quite difficult to operate with such estimates insomuch as the results of different e-commerce systems would be comparable. A lot of today's goals cannot be reached by classical methods because of the complexity of the mathematical models that could describe the situation. A complex but precise model may be useful for direct simulation, while the understanding of a system's basic concepts requires an understandable interpretation (*Setnes et al., 1998*). For a better interpretation, the use of linguistic variables can be advised; however, in view of using digital technologies for calculations, there is a need to transform the linguistics in a numerical format; this can be done by fuzzy logic (*Griniajev, 2001*). Quality has qualitative characteristics rather than quantitative in nature. Furthermore, the classes of software components are often not well separated and there are no well-defined boundaries (*So et al., 2002*). Soft quality control procedures tend to be more frequently applied in production processes where it is difficult to obtain a precise quality description of the inspected item. Under these conditions, the analyst assesses the quality of the inspected item on the basis of his or her subjective judgment, and hence the inspection process yields a vague outcome. The vague observations can be reduced to exact numbers, which can then be used to automate the evaluation process. However, this approach has two potential blemishes: (1) in reducing the vague observations to exact numbers, the information content of the original data is also reduced; (2) the uncertainty (i. e. variation) of vague observations is essentially non-statistical in nature, and hence these observations may not adequately support the random variation assumption inherent in automated quality assessment. Fuzzy set theory addresses the development of concepts and techniques for dealing with

sources of uncertainty or imprecision, which are non-statistical in nature (*Huang et al., 2008*).

The fuzzy logic is a rigorous mathematical theory which provides a mathematical expression to the cognitive, cogitative, and percept concepts. Fuzzy systems are chosen instead of other modelling systems (neural networks, genetic algorithms, etc.) because of the possibility to integrate the logical information processing with properties of mathematical approximation (*Setnes et al., 1998; Puente et al., 2001*). Fuzzy classification is the basis for fuzzy decision support systems and is based on the theory of fuzzy sets developed by Zadeh (1965). This technique allows an uncertainty component to be incorporated into models, making them more effective in terms of approximating to reality. Linguistic variables can be used to handle qualitative or quantitative information, so that its content can be labelled taking words from common language as values (*Puente et al., 2001*).

IT enables the analysis of a large volume of data by automatic and semi-automatic means, but in order to reveal meaningful rules or to obtain a meaningful estimate the used data must be properly organized. It is necessary to reduce the complexity and amount of data to be analysed. This can be achieved with help of data grouping, structuring and classification methods. Grouping, structuring and classifying the similar elements on the typical units facilitate the analytical process. The hierarchical organization of attributes allows identification of the potential weaknesses and advantages of the analysed object at each level of hierarchy. Given that the primary input data are numerous, it is necessary to organize them into a coherent logical structure for assessment, which would ensure the proper interpretation of data. Considering the nature of input data, they can be grouped into thematic groups which, as logic units, give the meaning to the entire assessment of an object's quality.

The main advantage of a fuzzy classification compared to a classical one is that an object is not limited to a single class but can be assigned to several classes. The result of sharp classification is often not reliable because of disregarding the influence of some individual factors. In fuzzy classification, each object has one or more membership degrees (μ) which show its dependence to each class. The membership degree allows a better description of each of the objects and identification of their weak and strong elements. The object can be a high-grade member (100% membership) or a partial member (0–99%). Thus, the dependence to the class can have a meaning of 0, 1 and whatever between them as well. Thus, the assessed object can be partly (*x* %) assigned to the "low quality" category and partly ((100-*x*) %) to the "high quality" category. This is not a logical contradiction; on the contrary, the existence of an intermediate truth approximates the evaluation to the reality. There exist many different operators which calculate the conjunctions of membership values. If we would weigh up two indicators, the compensation of the second indicator by the first one will be somewhere between the logical conjunction and disjunction, depending on the value of the γ operator. This operator was empirically tested and suggested as "compensatory" with a γ-value of 0.5 (i.e. both attributes have the same weight) by Zimmermann and Zysno (*Werro et al., 2005*). The final membership degree can be calculated by the formula (1) (*Werro et al., 2006*).

$$\mu_{A_s}(x) = \left(\prod_{i=1}^{m} \mu_i(x) \right)^{(1-\gamma)} \times \left(1 - \prod_{i=1}^{m} (1 - \mu_i(x)) \right)^{\gamma} \tag{1}$$

E-commerce systems are interactive, evolvable and therefore hard to define universally. On the other hand, the assessment of quality is a domain difficult to automate as it covers the qualitative rather than quantitative characteristics. Therefore, the creation of structures of concepts which are not sharply defined and therefore would be wrongly interpreted by trivial mathematics based on binary logic, necessitates the use of not trivial fuzzy logic. Fuzzy classification assumes the hierarchical division of the object's features, where the assessment is carried out from the bottom to the top of the hierarchical structure, i. e. from single elements to thematic units and the final evaluation.

The fuzzy classification of e-commerce systems by quality will be carried out in accordance to assigned membership functions and in dependence on the object's position in the classification chart. The membership degree is normalized to percentage. The result for every object is expressed by a coefficient which depends on the weight of a class. Two examples of classification charts are given as an illustration of classification principles. The example of the 3D classification chart is shown in Fig. 3.
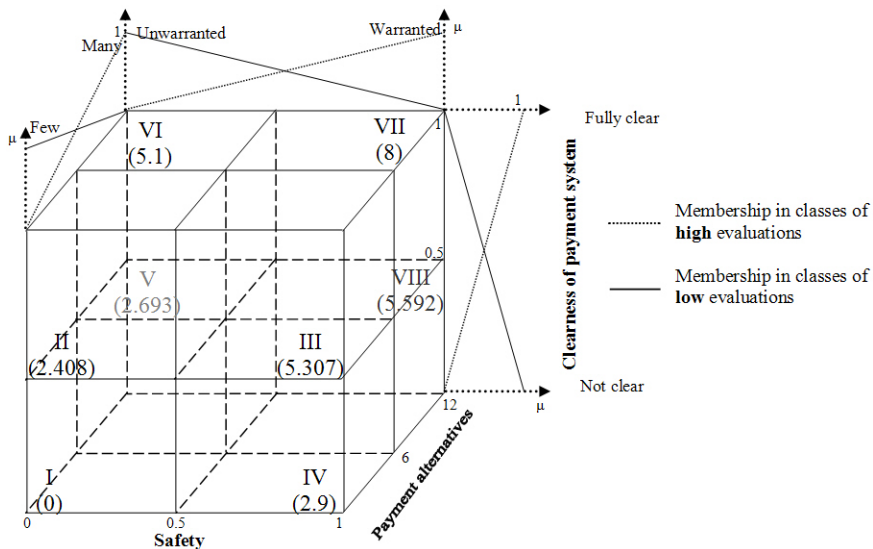

Fig. 3. Chart of e-commerce systems classification by quality of payment organization (compiled by author)

This is the payment organization quality chart, in which the evaluation is calculated in three dimensions. Each of the dimensions has assigned membership functions and individual maximum values. The weight to each class is given according to the customer-defined importance of dimensions, i. e. weight depends on the importance of dimensions united in each class. An example of a 2D classification chart is shown in Fig. 4. The e-commerce systems with low online and offline quality coefficients would be put into a class defined as the first stage of e-commerce development, it shows a quite primitive and undeveloped level of e-commerce system in both virtual and real areas. The systems with a low online quality coefficient but a high mastering of the offline processes would be put into the class of classical commerce not

enough oriented on e-area, which signify that there dislocated systems are poorly adapted to the virtual environment and the online part of the system demands improvements.
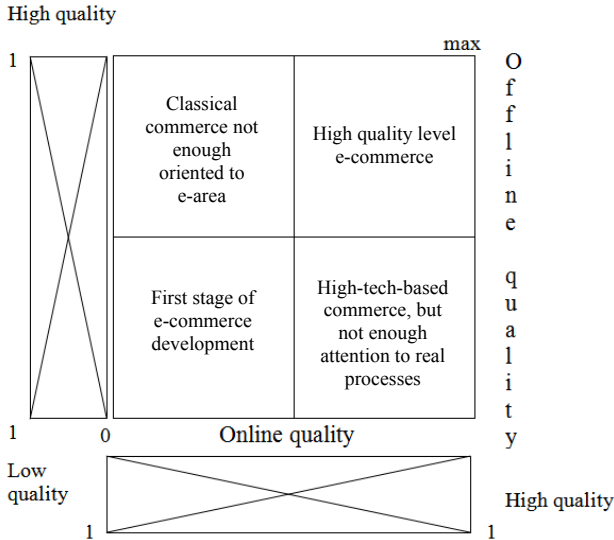

Fig. 4. Final chart of e-commerce systems' classification by quality (compiled by author)

Systems with a low offline quality coefficient but a high online quality coefficient would be classified as high-tech-based commerce with not enough attention to real processes, which signifies that in such a system problems can arise in a real framework, i. e. when meeting a client in the real environment. Those systems could be also called "phantoms", which are able to create a solid virtual platform, but in a real environment are incapable of a high-level competition. The system with both high coefficients would be classified as high-quality-level e-commerce comprising systems with the best rates. However, the systems that are within the same class can differ considerably; on the other hand, systems belonging to different classes but placed close to each other in the boundary zones of classes could be quite close by characteristics. Thus, a sharp classification seems to be unfair; to resolve this problem, fuzzy logic was applied. The calculation of the individual coefficient for each considered object will enable the analyst to rank the objects with regard to their individual (not collective as in the case of a sharp classification) rate and defined priorities.

The final result of calculations in the model will get the form of a coefficient which assumes the sense in comparison with the coefficients of other objects or an exemplary object. The periodic (continuous) assessment of objects by such type of classification allows to monitor the evolution (or degradation) of the objects and their transition from class to class.

Formation and summarizing of e-commerce systems quality assessment model

The model was based on surveys considering the importance of e-commerce system's elements indicated by customers. The model, its structure, hierarchical levels and element relations are presented in the Fig. 5.
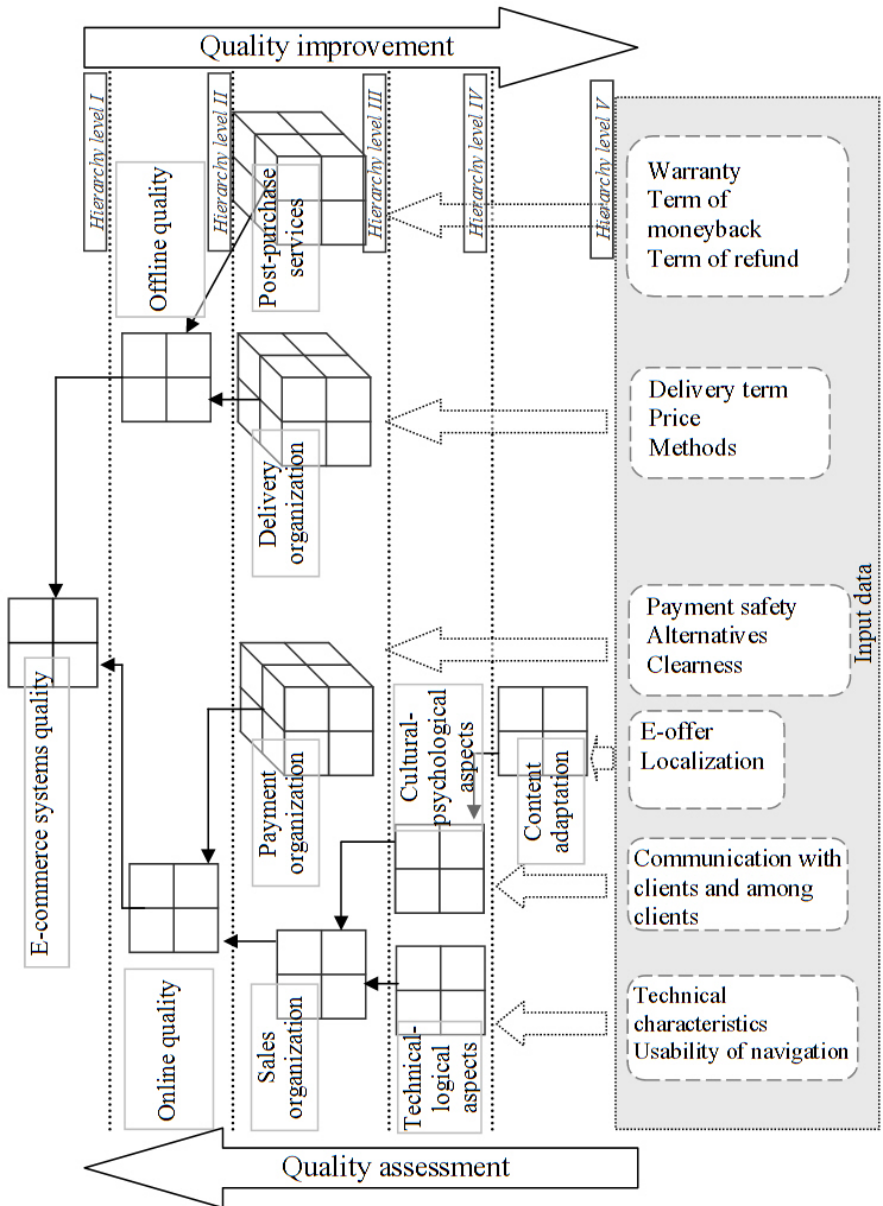
Fig. 5. E-commerce systems' quality assessment model (proposed by author)

The quality assessment in the model is directed from the bottom (input data) to the top layers of the structure, while the identification of weaknesses was carried out from the top to the detailed problematic areas. Such a structure facilitates the work of a

quality analyst and developer and makes the assessment flexible through disclosing the general concepts by the factual indicators actual at the moment of assessment. Such a model can be applied not only to a particular situation it was created for, but also it may be adapted depending on changes in structural parameters and operating conditions.

The proposed e-commerce systems quality assessment model is characterized by the following features:

– sustention of the assessment criteria relevancy: the model allows assessing e-commerce systems' quality according to selected criteria which are in line with the customer's needs and business priorities;

– assessment results show the level of quality potential use: quality assessment is derived in the form of a coefficient. It shows the individual quality assessment of each object in a group, or in comparison with an exemplary object which fully uses the quality potential. Moreover, the analysis of hierarchical calculations identifies the strengths and weaknesses of the e-commerce system;

– comparability of results: the quality assessment conducted by homogeneous criteria and calculations logic ensures the comparability of results;

– objectivity: the hierarchic and thematic organization of data and indicators, as well as the method of the quality coefficient calculation, reduce the impact of subjectivity on the final result;

– possibility to use a natural language in assessment: there is a possibility to use the estimates expressed in a natural language and to preclude the analyst's influence, which could be prejudicial when transforming the linguistic meanings into the numerical form;

– transparency of results' interpretation: the description of classes in a natural language on each of the model's hierarchical level facilitates the interpretation of the obtained results;

– compensation effect: the use of membership function and compensatory operator gives the effect of compensation between weak and strong elements of the assessed object. This ensures the approximation of results to the real situation;

– flexibility: the flexibility of assessment and the adaptability to the changing market requirements, particularities, and quality goals are ensured by (1) change of the criteria by those actual for a particular market and moment, (2) variation of the membership function according to the requirements of customers and the rates of criteria acceptability, and (3) adjusting the weights of classes according to changes of priorities.

– facilitation of choosing the quality improving direction: the model allows a targeted improvement of e-commerce system quality, an informed choice of development strategy in selecting the method of the optimal or acceptable implementation and development of the e-commerce system.

The proposed model is a tool for a flexible quality assessment, which takes into account the different importance of the used criteria and defined priorities. The model provides a possibility to automate the calculations of quality assessment. The automation of calculations enforces the processing of large data arrays (including qualitative ones expressed in a natural language) and facilitates quality assessment.

Employment of e-commerce systems' quality assessment model

The proposed e-commerce systems' quality assessment model was validated by testing selected e-commerce systems. Since the respondents of the survey purchased mainly leisure and household goods, it was decided to perform a testing of the market of these products; six e-shops of computer electronics were selected. The factual data were

collected and used in calculations according to the model's criteria and algorithm presented above.

The level of using the quality potential can be assessed by comparing the obtained estimates with the best possible score. The ranking of e-commerce systems by quality and identification of the strength and weak areas of each system can be conducted by comparing the systems' scores on different hierarchical levels. This possibility is of especial importance for improving the quality, adoption of good practice from colleagues (competitors), for comparison of achievements. Analysis of classification charts clearly shows the results achieved by the assessed e-commerce systems, their differences, positive and negative areas of each system, and allows to identify the priority areas for quality improvement.

The way of quality assessment proposed in the dissertation was compared with several alternative methods: the traditional (sharp) classification and summing of accumulated points. In the sharp classification, the assessed object can be assigned only to one class in which it is dislocated. The estimate of cumulated points is obtained by summing up the points given to the assessed object, considering the weight of each criteria defined by customers' preferences.

Differences in the estimates of a fuzzy and a traditional classification can be seen already at the low levels of hierarchy; toward the top of the assessment structure, these differences become more considerable. The traditional classification ignores the particularities of objects, which are in the boundary zones of classes, and unifies all the objects located in one class by the same estimate. Thus, the ranking of the objects is impossible in they are located in the same class. Such a method could be suitable for a mass classification when high errors can be tolerated.

The method of summed points allows the ranking of objects, but a compensation among different aspects' estimates is impossible. The fluctuation of customers' opinion and of the acceptability of evaluated features is not taken into account. Such an assessment is a mere statement of the obtained result, but it does not give a possibility to trace the strengths and weaknesses and to define the direction and priorities of quality improvement.

Thus, the assessment based on fuzzy logic allows to obtaining more precise results with regard to the customer's preferences. Such an assessment ensures the causal traceability, which determines the priorities of quality improvement, the advance of system's elements, and the level of quality potential use. Therefore, the mentioned features of the proposed method enable not only e-commerce systems' quality assessment by most important criteria, but also prediction of the consequences of different quality-targeted actions and foreseeing the further optimal direction of quality improvement. The analysis of classification charts shows the area that most requires improving and the shortest way to a better result. The mentioned alternative assessment methods do not provide such possibilities.

Conclusions

The performed analysis of e-commerce concepts, collected data, quality assessment models and empirical an e-commerce systems' quality research allow to make the following conclusions:

1. A gap between the level of proposed e-services and the level expected by customers is obvious. Such a conclusion is based on the analysis of available statistical

data on e-commerce, which show differences between the rates of Lithuanian business and customers' involvement in e-commerce. The lower rate of customer involvement, despite the increased level of competence, indicates that there is a need to find appropriate methods of an efficient use of available technologies for strengthening the business market position by satisfying the growing demands of consumers. It is therefore important to identify the e-commerce systems' quality assessment criteria and the guidelines of their improvement, which would facilitate e-commerce development in accordance with customers' expectations and business potential.

2. Upon analyzing e-commerce notions provided in the literature and considering the content and nature of e-commerce processes, the e-commerce system was defined in this work as a complex through which the processes of goods and services ordering, payment, delivery and post-purchase services are conducted, assuming that at least one of them is carried out online.

3. The literature analysis has revealed that the main problematic points of e-commerce are related to e-commerce system reliability (from the customer's point of view) and a proper functioning of the e-commerce system in the global market, which is often dependent on the system's adaptation to the target market (from the business point of view).

3.1. In the scientific literature, a relationship between the quality of the website and the trust gained can be observed. It is also recognized that commercial information is perceived by a user as hardly reliable. Therefore, there is a need for a reliability indicator approved by an independent third party which would earn the trust of the user. Such an indicator could be an e-commerce conformity (certification) mark provided by a certification body.

3.2. A comparison of the requirements brought forward by existing e-shop certification marks has shown that in Europe there is no certification mark that would be unified, familiar to users, and widely used by businesses. Thus, there is a need for such a mark, which would be based on a unified strategy and harmonized requirements on the European level. The mark certifying the e-commerce system's security and compliance with fair trade requirements certification will have a dual benefit for the e-commerce system's quality and perspectives: on the one hand, in the process of certification, a company has a possibility to reveal the weaknesses of the system and to improve it; on the other hand, the customers can easily navigate among e-shops and to ascertain the reliability of the e-commerce system by clicking on the certification label.

3.3. The internet expands and covers more countries and social layers, thus the recognition and appliance of cultural differences in e-commerce strategy becomes indispensable for business success. Aiming to make an e-shop the appropriate tool of communication and to use the potential of the global market in an efficient way, it is necessary to define the target audience and to adapt the e-commerce system to the target market considering its cultural and other particularities. The adaptation to the target market (localization) has a considerable potential in the improvement of the e-commerce system's quality and efficiency, since the interactivity of an e-shop is conditioned by the level of its cultural adaptation.

3.4. Analysis of the cultural dimensions that could impact the perception and success of e-commerce on the markets of different cultures has revealed the main cultural aspects important for e-commerce system's localization, which are as follows: the power distance dimension (shows the public recognition of power symbols and

hierarchy, the structure of relationships in society (reflects the orientation towards collective or individual goals), the gender roles (reveals a separation or a fusion of gender roles in society), uncertainty avoidance (shows the degree of uncertainty acceptance in society), time perception (reflects the accepted time standards covering punctuality, orientation to the short- or long-term business relations), and the technological development (the level of technologies on the target market and public readiness to adopt the new ones).

4. To identify the e-commerce system's quality criteria, three sources of information were used:

4.1. Analysis of the scientific literature and e-commerce practices have shown that there is no commonly accepted model of e-commerce systems' quality assessment. The literature analysis was summarized by a list of e-commerce quality criteria arranged by the mentioning frequency. The main groups of criteria to be applied to evaluate e-commerce systems' quality were identified as follows:

- most often mentioned are criteria related to e-shop content quality, technical issues (especially the safety of transactions and private data), and usability aspects;
- second most often mentioned are the factors of client relations, creation of loyalty and customer-perceived quality aspects;
- the offline aspects of e-commerce are rarely discussed.

4.2. A reconnaissance survey of experts' opinion allowed to elaborate and supplement the set of criteria found in the literature by actual quality aspects: experts highlighted the importance of e-offer content, the safety of transactions, the choice of payment alternatives, the term and alternatives of delivery. The importance of client relations after the payment stage, i. e. the necessity to ensure the long-term client relations, was accentuated.

4.3. A customer survey revealed the most important aspects of e-commerce (evaluated on a 9-point scale):

- at the stage of ordering, for customers important are: usability of navigation in the e-shop (6.84), technical state (6.55), possibility to take a look at other customers' reviews (6.47), the content and attractiveness of the e-offer (6.17), localization of the e-shop (6.14), and online support (5.57);
- at the payment stage: the safety of the payment system (8.24), choice of payment alternatives (7.65), and the clarity of the payment system (6.84);
- at the delivery stage: the term (7.74) and price (7.63) of delivery, online support (6.86), the choice of delivery alternatives (6.83), terms of a possible delivery delay (5.09);
- at post-purchase stage: term of warranty (6.77), the term of money returning (6.72), the deadline of return policy (6.71), the term of complaint investigation (6.38), and post-purchase client support (6.34).

4.4. A historical analysis of e-commerce requirements showed that with the development of e-commerce they developed as well – from safety towards comfort. Therefore, on the basis of the three mentioned resources, the most important quality assessment criteria for e-commerce systems were selected and grouped into four thematic groups:

– criteria of sales organization quality: usability of e-shop navigation, technical characteristics, content and localization of the e-offer, possibilities to socialize (client support and reviews);

– criteria of payment organization quality: safety of the payment system, the number of available payment alternatives, clarity of the payment system;

– criteria of delivery organization quality: the term of delivery, the price of delivery, alternatives of delivery, and client support;

– criteria of post-purchase services organization: the term of warranty, the term of money returning, the deadline for return policy, and client support.

5. As quality evaluation is a subjective concern often using abstract concepts, there is a need to find an appropriate modelling logic to compile an e-commerce systems' quality assessment model. In case of such a complex object as e-commerce systems, which are impacted by subjective assessments, there is a need to use not only quantitative but also qualitative data. This can be implemented by using the principles of fuzzy logic.

6. The classification of e-commerce systems by quality, based on fuzzy logic, ensures an understandable interpretation of the quality model basic concepts and improves the possibilities of quality refinement. Employing fuzzy logic it is possible to model the subjectivity and fuzziness typical of human thinking and natural language.

7. The proposed e-commerce systems quality assessment model is based on the principles of fuzzy logic, thematic grouping of criteria and hierarchic data organization considering the nature of the used criteria, their relationships, importance and the empirically defined acceptable ranges of variation. Such a model can be used not only in the situation it was created for, but it can also be adapted in view of changes in the structure of the parameters and the environment.

8. In this dissertation, there are empirically identified and presented: (1) the parameters of the e-commerce systems' quality model and its measurement, (2) the weight of each quality class impacting the final result, (3) the functions of membership in quality classes, and (4) the algorithm of final result calculation. The revealed indicators, the description of their relations and reliability allow the researchers and developers of e-commerce systems to adapt the model to a particular situation by correcting the indicator values according to the actual data of the case under analysis.

9. The model presented in this dissertation is designed for the assessment and refinement of e-commerce systems' quality. However, it can be also used for objects' ranking by quality, benchmarking, making a choice among several alternative objects. The flexibility of the model allows its development in view of the objects' specifics, changes in business environment, IT progress, the growing needs and expectations of users. Moreover, the proposed e-commerce systems quality assessment model can be used as a basis for compiling quality assessment models for analogous objects.

10. It can be concluded that the principles of fuzzy logic make e-commerce systems quality assessment advantageous in comparison with conventional classifications and the method of summed points. The mentioned advantages are demonstrated by (1) flexibility, (2) control of sensibility to data modifications, (3) adaptation to the market requirements, (4) approximation and interpretation of the results.

11. E-commerce systems are dynamic objects; therefore, their quality assessment cannot be a single action. It must be of a continued character and show how e-commerce

systems are developing, adapting to market changes, as well as demonstrate their ability to maintain stable results.

12. The proposed quality assessment model allows not only to judge about the quality of an e-commerce system depending on the actual criteria and to rate the systems by quality, but also to foresee the strategy of the further development of the e-commerce system. It turns to be possible due to causal traceability, which allows estimating the advance of separate system's elements, the rate of using the quality potential, and priorities for quality refinement.

13. The particularities of fuzzy classification (on which the calculations in the model are based) provide a basis for predicting the consequences of quality refinement actions and choosing the optimal quality refinement direction in each particular case. This allows to improve the abilities of quality assessment and refinement.

14. The following directions of further investigations in the field of e-commerce systems quality can be offered to the interested researchers:

– to identify the particular underlying criteria of e-commerce system's quality in different trade areas;

– to investigate the differences in users' requirements to e-commerce systems in different countries;

– to elaborate the methodology of a balanced e-commerce system's quality improvement.

15. The recommendations for business actors solicitous of improving the quality of the e-commerce system they use can be conveyed as follows:

– to identify the requirements of the target market, the ranges of their tolerance, and cultural particularities;

– to specify (if necessary) the indicators of the model presented in this dissertation according to actual requirements of the target market;

– to evaluate the quality level attained by the employed e-commerce system, as well as the compliance with requirements of the target market; to identify the strengths and weaknesses of the system;

– to consider the importance of elements (which require improvement) in projecting the directions of quality refinement; it is advisable to give the priority to elements of a greater importance.

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List of published works and scientific presentations on the topic of the dissertation

The results of scientific research were presented at international and national scientific conferences, published in conference proceedings and in recognized scientific journals.

The main propositions of dissertation are presented in 18 scientific publications:

In the scientific periodical publications included ISI Master List:

1. Guseva, N. Fuzzy classification in the assessment of e-commerce systems' quality. Transformations in business and economics. 2008, Vol. 7, No. 3, suppl. C., p. 193–206. ISSN 1648-4460.

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1. Guseva, N. Assessment of the E-Commerce Systems' Quality. – International Scientific Conference "International Business Development: Globalization, Opportunities, Challenges", 15–16 of May 2008, Vilnius (Lithuania).

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About the author

Born on 7 April 1982, Vilnius (Lithuania).
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2005: Internship at European Summer University on "Innovation and Business Intelligence" in Cherbourg (France).
2006: Fellowship at the University of Fribourg (Switzerland), development of the website quality assessment technique and introduction in fuzzy logic.
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REZIUMĖ

Temos aktualumas

Verslo specialistai pripažįsta, kad internetas tampa galinga skatinamąja ekonomikos jėga. Jau 2005 metais interneto vartotojų skaičius viršijo vieną milijardą (*Augey, 2006*), 2010 metais – priartėjo prie dviejų milijardų ribos (pagal InternetWorldStats.com – 1,971 milijardo). JAV Komercijos departamento ir *Forrester Research* kompanijos duomenimis, vartotojų išlaidų elektroninės komercijos (toliau – el. komercija) mažmeninėje prekyboje tendencijos rodo spartų augimą. Didėja el. komercijos svarba kiekvienos šalies ekonomikai. Plintant interneto naudojimui atsirado ir nauja erdvė, kurioje verslo atstovai gali konkuruoti, atsirado naujas kanalas, kuriuo jie gali siūlyti, pirkti ir parduoti prekes ir paslaugas, t. y. atsirado elektroninė rinka, kuri daro vis didesnę įtaką ekonomikai. 1997 metais Europos Komisija pabrėžė, kad greitas el. komercijos įdiegimas yra neatidėliotinas iššūkis Europos verslui, pramonei ir vyriausybei, nes el. komercija leidžia įgyvendinti žemų kainų prekybą, nepaisant nacionalinių ir regioninių sienų (*European Commission, 1997*). Dauguma Europos šalių priėmė tą iššūkį, iš jų ir Lietuva.

Lietuva yra atvira visuomenė, imli ir veikiama pasaulio procesų, susijusių su žinių ekonomikos bei elektroninio verslo (toliau – el. verslas) plėtra. Siekiant padidinti Lietuvos verslo konkurencingumą ir išplėsti verslo geografines ribas, ypatingą dėmesį skirti reikėtų el. verslui, ypač jo sudedamajai daliai – el. komercijai. Informacinės technologijos, iš jų – el. komercijos sistemos, padeda sumažinti atstumo veiksnio įtaką, optimizuoti keitimąsi informacija, tampa nepakeičiamu verslo įrankiu.

El. komercijos sistemos, kaip interneto sprendimas, yra specifinės ir gana sparčiai besivystančios, todėl sudėtinga rasti tinkamą ir operatyviai pritaikomą rinkos pokyčiams sistemos veiksmingumo ir kokybės vertinimo būdą. Kalbama būtent apie el. komercijos sistemų kokybės vertinimą, nes naudojamos sistemos kokybė lemia konkurencines verslo objekto savybes rinkoje, platesnėje negu vidaus rinka, vadinasi, galinčioje daryti reikšmingą įtaką ekonomikai ir prisidėti prie jos augimo.

Mokslinė problema

Atlikus el. komercijos ir kokybės vadybos mokslinių publikacijų analizę specializuotuose leidiniuose ir internete, pažymėtina, kad nėra bendros nuomonės, kas sudaro el. komercijos sistemos turinį ir kaip parinkti el. komercijos sistemos kokybės vertinimo būdą. Remiantis bendrosios kokybės vadybos teorija reikėtų apibrėžti šį objektą ir parengti tinkamas tyrimo metodikas. Kuriant tyrimo metodikas atsižvelgtina į el. komercijos sistemos ypatumus ir pažinimo lygį.

Dabartiniu metu, kai pažangios technologijos versle naudojamos vis plačiau ir didėja el. komercijos sistemų paklausa, tai, kad nėra šio objekto aiškaus apibrėžimo ir kokybės vertinimo metodikų, gali būti traktuojamas kaip svarbi problema.

El. komercijos sistemų kokybės vertinimas svarbus verslo subjektams:

• el. komercijos sistemos kūrėjui, nes nuo jo sukurto produkto kokybės priklauso jo verslo perspektyvos;

• el. komercijos sistemos užsakovui, nes el. komercijos sistema yra jo veiklos marketingo instrumentas, nuo kurio kokybės priklauso jo panaudojimo efektyvumas, įmonės įvaizdis, investicijų grąža;

• galutiniam vartotojui, nes nuo naudojamos el. komercijos sistemos kokybės priklauso apsipirkimo internetu sėkmė.

Šiame darbe analizuojama **problema apibrėžiama taip**: literatūros el. komercijos sistemų kokybės vertinimo tematika trūkumas neleidžia suvokti ir apibendrinti šio objekto struktūros ir kokybės vertinimo būdų bei kriterijų, todėl būtina apibrėžti el. komercijos sistemų turinį ir parengti šio objekto kokybės vertinimo metodiką, pritaikytą dinamiškiems procesams interneto sprendimų rinkoje.

Darbo objektas – el. komercijos sistemų kokybė.

Darbo tikslas – konsoliduoti el. komercijos sistemų teorinius aspektus ir kokybės vertinimo kriterijus bei sukurti dinamiškiems rinkos pokyčiams pritaikomą el. komercijos sistemų kokybės vertinimo modelį.

Darbo uždaviniai:

1. Išnagrinėjus mokslinę literatūrą, pateikti kokybei vertinti tinkamą el. komercijos sistemos sampratą.

2. Išanalizuoti esamus interneto sprendimų kokybės vertinimo modelius.

3. Nustatyti el. komercijos sistemos kokybės rodiklius pasitelkiant:

    3.1. literatūros analizę;

    3.2. el. komercijos ekspertų nuomonių analizę;

    3.3. el. komercijos vartotojų nuomonių analizę.

4. Suformuoti el. komercijos sistemų kokybės vertinimo modelį.

5. Pritaikyti parengtą el. komercijos sistemų kokybės vertinimo modelį ir įvertinti jį palyginus su alternatyviais vertinimo būdais.

Tyrimo metodika

Darbe tyrimo objektas nagrinėjamas iš keleto perspektyvų. Pagrindiniai naudojami tyrimo metodai – mokslinės literatūros apžvalga ir sisteminė analizė, mokslo darbų ir praktikų, aprašančių el. komercijos vertinimo modelius ir kriterijus, koncepcinė turinio analizė, apklausa ir testavimas pirminiams duomenims rinkti, rezultatų palyginimas, modeliuojant remiamasi grupavimo, rangavimo ir klasifikavimo metodais. Tyrimo duomenys statistiškai apdoroti taikant statistinių skaičiavimų programas (*StatGraphics, SPSS*), *Microsoft Office Excel 2003* programą. Duomenų analizei naudojami aprašomosios statistikos metodai (rodiklių vidutinių reikšmių vertinimas, koreliacinė analizė, duomenų sklaidos analizė).

Apžvelgus mokslinę literatūrą buvo atrinkti teoriniai ir empiriniai mokslininkų darbai, susiję su el. komercijos kokybe ir jos vertinimo kriterijais. Remiantis literatūros analize darbe pateikiama el. komercijos sistemos teorinė interpretacija, pagrįsta el. komercijos procesais. Atlikus mokslo darbų koncepcinę turinio analizę, buvo atrinkti el. komercijos aspektai, kurie autorių buvo paminėti kaip kokybės savybės. Tokios kokybės savybės buvo ranguotos pagal minėjimo darbuose dažnumą. Gautas sąrašas leido identifikuoti svarbiausius el. komercijos ypatumus, kurie galėtų būti naudojami kaip el. komercijos sistemų kokybės kriterijai.

Siekiant išgryninti ir papildyti gautą sąrašą aktualiais kriterijais, atliktas žvalgomasis ekspertų nuomonės tyrimas. Šis tyrimas parodė, kad literatūroje išskirti kriterijai yra aktualūs, bet jų nepakanka. Nagrinėjamų kokybės kriterijų sąrašas buvo papildytas ekspertų nurodytais pristatymo ir aptarnavimo po pardavimo vertinimo kriterijais.

Atlikus vartotojų apklausą, paaiškėjo el. pirkėjams svarbios el. komercijos savybės ir jų priimtinos svyravimo ribos. El. komercijos sistemų kokybės vertinimo kriterijai buvo atrinkti palyginus literatūroje, ekspertų ir vartotojų pabrėžiamus kokybės

aspektus. Jais remiantis buvo suformuotas el. komercijos sistemų kokybės vertinimo modelis. Modelio veiksnumui patikrinti atliktas šešių el. komercijos sistemų testavimas.

Ginami teiginiai

• El. komercijos sistema apibrėžiama kaip sudėtingas produktas, kurio pagalba vykdomi prekių (paslaugų) užsakymo, jų apmokėjimo, pristatymo bei aptarnavimo po pardavimo procesai, kurių nors vienas vyksta elektroninėje erdvėje.

• Remiantis literatūros analize, ekspertų ir vartotojų nuomonių tyrimais atrinkti svarbiausi el. komercijos sistemos kokybės vertinimo kriterijai, sugrupuoti į keturias temines grupes:

    o pardavimo organizavimo kokybės vertinimo kriterijai: el. parduotuvės naršymo struktūros patogumas, techninė kokybė, el. pasiūlymo turinys ir lokalizacija, bendravimo galimybės;

    o mokėjimo organizavimo kokybės vertinimo kriterijai: mokėjimo sistemos saugumas, siūlomų mokėjimo alternatyvų skaičius, mokėjimo sistemos aiškumas;

    o pristatymo organizavimo kokybės vertinimo kriterijai: pristatymo trukmė, pristatymo kaina, pristatymo būdai, tiesioginė pagalba klientui pristatymo metu;

    o aptarnavimo po pardavimo kokybės vertinimo kriterijai: garantijos trukmė, pinigų grąžinimo trukmė, taip pat periodas, per kurį galima grąžinti prekę, ir pagalba klientui po pardavimo.

• Suformuota automatizuojama lankstaus kokybės vertinimo priemonė – el. komercijos sistemų kokybės vertinimo modelis, pagrįstas netiksliosios klasifikacijos principais, teminiu kriterijų grupavimu ir hierarchiniu duomenų organizavimu atsižvelgiant į naudojamų kriterijų prigimtį, ryšius, svarbą ir priimtinas jų svyravimo ribas. Sukurtas modelis apibūdinamas tokiomis savybėmis: lankstumas, galimybė naudoti natūralia kalba išreikštus vertinimus, rezultatų palyginamumas, interpretavimo skaidrumas, kokybės tobulinimo krypčių identifikavimo palengvinimas.

• Netiksliosios logikos principai el. komercijos sistemų kokybei vertinti teikia pranašumų darbe nagrinėtų alternatyvių vertinimo būdų atžvilgiu. Pranašumai pasireiškia jautrumo duomenų pokyčiams kontrolės, pritaikymo rinkos reikalavimams, rezultatų aproksimacijos realybei ir interpretavimo aspektais.

Mokslinis naujumas, teorinė ir praktinė reikšmė

Lietuvoje el. komercijos sistemų kokybės vertinimo būdai teoriniu požiūriu nėra ištirti, todėl stokojama atitinkamų teorinių nuostatų ir metodikų, kuriomis remiantis būtų galima nagrinėti juos atsižvelgiant į technologijų vystymąsi ir didėjančius vartotojų poreikius. Užsienyje teorinis el. komercijos sistemų kokybės tyrimas atliekamas tik tiek, kiek jis gali būti naudingas praktiškai. Įžvalgūs verslininkai siekia išnaudoti visas pažangių technologijų ir interneto teikiamas galimybes, todėl, norėdami išplėsti savo verslo reklamavimo, klientų informavimo ir pardavimų kanalus, jie nusprendžia kurti interneto svetainę arba elektroninę parduotuvę (toliau – el. parduotuvė). Tačiau dauguma užsakovų kreipdamiesi į el. komercijos sistemų kūrimo įmonę tiksliai neįsivaizduoja, iš ko susideda jų užsakoma sistema, ką būtent jie yra pasirengę pirkti ir kaip įvertinti jų nupirkto (ir galbūt jau naudojamo) virtualaus produkto kokybę, kaip numatyti to produkto evoliuciją tobulėjant technologijoms.

El. komercijos sistemos, palyginti su tradicinėmis dešimtmečius naudojamomis pardavimų sistemomis, pasižymi specifiniais ypatumais ir spartesne raida, todėl

sudėtinga rasti tikslų, bet lankstų ir operatyviai pritaikomą besikeičiančiai realybei, sistemos veiksmingumo ir kokybės vertinimo būdą.

Praktikoje el. komercijos sistemų vertinimai yra dvejopi: pagrįsti tik atitiktimi specifikacijai arba tik subjektyvia vartotojų nuomone. Tačiau dar nėra sukurta (paskelbto literatūroje ar naudojamo praktikoje) lankstaus kokybės vertinimo modelio, kuris sujungtų objektyvius ir subjektyvius vertinimus taip, kad būtų galima palyginti įvairių objektų kokybės vertinimus. Tokio kokybės vertinimo modelio formavimas atskleidžiamas disertacijoje, nagrinėjant sistemą el. komercijai įgyvendinti reikalingų procesų aspektu.

Darbo praktinė reikšmė: suformuotas el. komercijos sistemų kokybės vertinimo modelis, vertinimo kriterijų sistema ir galutinio kokybės rodiklio skaičiavimo algoritmas, kurie leidžia:

• lanksčiai vertinti el. komercijos sistemos kokybę;
• lyginti tam tikrus el. komercijos sistemos kokybės rodiklius;
• ranguoti el. komercijos sistemas pagal kokybę;
• identifikuoti kokybės tobulinimo sritis ir prioritetines kryptis.

Toks el. komercijos sistemos kokybės vertinimas yra aktualus:

• pačiam el. komercijos sistemų kūrėjui (vertinant savo sukurtas sistemas: kuri labiau atitinka užsakovo prioritetus, kur silpnumai ir privalumai);
• pirkėjui pasirenkant el. komercijos sistemą (palyginant keletą jam siūlomų arba jam patikusių sistemų);
• verslo dalyviams pasirenkant tiekėją internetu ir vykdant sugretinimą;
• trečiajai šaliai (nešališkai ranguojant el. komercijos sistemas pagal kokybę).

Disertacijos struktūra ir apimtis

Disertacija susideda iš lentelių ir paveikslų sąrašų, įvado, trijų skyrių, išvadų, literatūros sąrašo bei priedų. Darbo apimtis 227 puslapiai (be priedų), 28 lentelės, 64 paveikslai, 147 literatūros šaltiniai, 18 priedų.
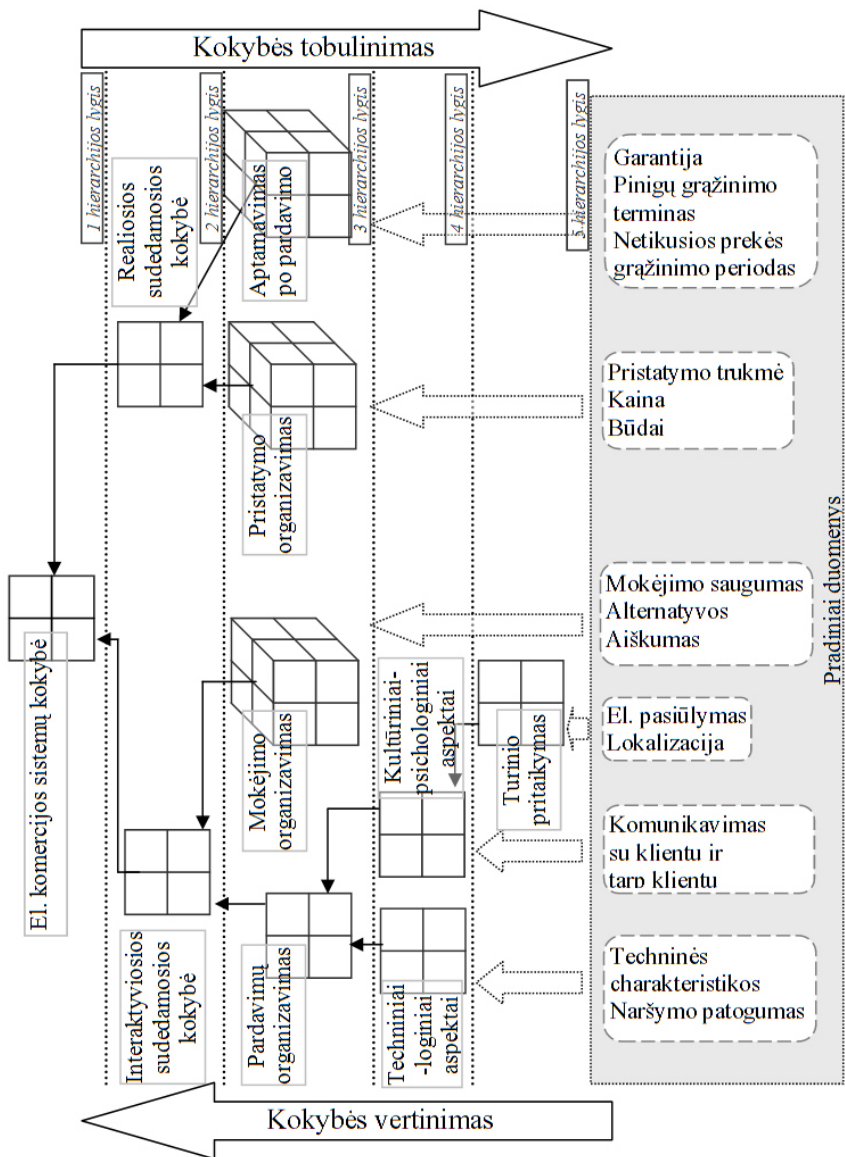
El. komercijos sistemų kokybės vertinimo modelis

Formuojant el. komercijos sistemų kokybės vertinimo modelį vertinimui atrinkti kriterijai buvo sugrupuoti į giminingas vertinimo grupes. Jų pagrindų apskaičiuoti rodikliai buvo suskirstyti į vertinimo sekcijas – taip hierarchiškai formuojant vertinimo modelį. Toks teminis suskirstymas palengvina remiantis modeliu gautų rezultatų interpretavimą. 1 pav. pavaizduoti pirminių duomenų ir jų pagrindu apskaičiuotų rodiklių sąryšiai ir išsidėstymas modelio hierarchijos lygiuose.

Modelyje kokybės vertinimas atliekamas judant nuo apatinių struktūros sluoksnių (pirminių duomenų) link viršutinio, o el. komercijos sistemos tobulintinų sričių identifikavimas – nuo viršaus į apačią detalizuojant konkrečias problemines sritis. Tokia vertinimo struktūra palengvina kokybės analitiko ir el. komercijos sistemos vystytojo darbą bei suteikia vertinimui lankstumo numatant bendresnių koncepcijų atskleidimą remiantis vertinimo momentu aktualiais faktiniais rodikliais. Toks modelis gali būti naudojamas ne tik konkrečiai situacijai, kuriai buvo sukurtas, bet ir adaptuojamas keičiantis struktūros parametrams ar veikimo sąlygoms.

Siūlomą el. komercijos sistemų kokybės vertinimo modelį apibūdina tokios savybės:

– Vertinimo kriterijų aktualumo išlaikymas: suteikia galimybę vertinti el. komercijos sistemos kokybę pagal pasirinktus kriterijus, atitinkančius šiuolaikinius vartotojo poreikius, ir atsižvelgus į el. komercijos vystytojo nustatytus prioritetus.

1 pav. El. komercijos sistemų kokybės vertinimo modelis (sudaryta autorės)

– Vertinimas parodo kokybės potencialo panaudojimą: kokybės vertinimo išraiška – koeficientas. Jis parodo individualų objekto kokybės vertinimą vertinamų objektų grupėje arba lyginant su siektinu objektu, visiškai panaudojančiu kokybės potencialą. Taip pat nagrinėjant hierarchinių skaičiavimų rezultatus identifikuojamos vertinamos el. komercijos sistemos stiprybės ir silpnybės.

– Rezultatų palyginamumas: užtikrinamas rezultatų palyginamumas, nes įvairių el. komercijos sistemų kokybės vertinimas atliekamas pagal tuos pačius kriterijus, remiantis ta pačia skaičiavimų logika. Taip pat svarbus yra to paties vertinamo objekto rezultatų palyginamumas laiko perspektyvoje. Modelis leidžia klasifikavimo matricose stebėti objektų kokybės evoliuciją (degradaciją) laiko požiūriu, lyginant to paties objekto skirtingų laikotarpių rezultatus.

– Objektyvumas: hierarchinis ir teminis duomenų ir rodiklių organizavimas ir kokybės koeficiento apskaičiavimo būdas mažina subjektyvumo įtaką rezultatui.

– Galimybė naudoti natūralia kalba išreikštus vertinimus: sudaro galimybes naudoti natūralia kalba išreikštus vertinimus eliminuojant analitiko įtaką, kuri galėtų pasireikšti pervedant žodinę reikšmę į skaitinę formą.

– Rezultatų traktavimo skaidrumas: palengvina gautų rezultatų traktavimą pateikiant kokybės klasių natūralia kalba aprašytą apibūdinimą kiekvienu duomenų organizavimo hierarchijos lygmeniu.

– Kompensavimo efektas: naudojamų narystės funkcijų ir kompensuojančio operatoriaus pagalba pasiekiamas kompensavimo tarp silpnųjų ir stipriųjų vertinamo objekto elementų efektas, užtikrinantis vertinimo priartinimą realiai situacijai.

– Lankstumas: užtikrinamas vertinimo lankstumas ir galimybė greitai pritaikyti vertinimo modelį besikeičiantiems rinkos reikalavimams ir ypatumams, prioritetams ir kokybės tikslams. Tai gali būti pasiekta (1) keičiant vertinimo kriterijus vertinimo momentu aktualiais konkrečiai rinkai kriterijais, (2) pagal besikeičiančius vertinimo kriterijų priimtinumo laipsnius ir vartotojų išreikštus reikalavimus varijuojant modelyje naudotas vertinamų objektų narystės kokybės klasėse funkcijas bei (3) pagal pasikeitusius prioritetus koreguojant kokybės klasių svorius atliekant vertinimą išlaikant pirminę loginę vertinimo struktūrą.

– Palengvina kokybės tobulinimo krypties pasirinkimą: sudaro sąlygas tiksliniam el. komercijos sistemos kokybės tobulinimui, informatyviam tobulinimo strategijos pasirinkimui, sprendžiant, kuris iš el. komercijos įgyvendinimo ir tobulinimo būdų yra optimalus ir priimtinas konkrečiai įmonei.

Siūlomas vertinimo modelis – tai lankstaus kokybės vertinimo, kai atsižvelgiama į vertinimo kriterijų skirtingą svarbą ir apibrėžtus prioritetus, priemonė. Modelis numato galimybę automatizuoti kokybės vertinimo skaičiavimus. Skaičiavimų automatizavimas leidžia apdoroti didelius duomenų masyvus ir palengvina kokybės vertinimo darbus.

Išvados ir pasiūlymai

Atlikta el. komercijos teorinių koncepcijų, duomenų, kokybės vertinimo modelių analizė ir empirinis el. komercijos sistemų kokybės kriterijų, kuriais remiantis suformuotas el. komercijos sistemų kokybės vertinimo modelis, tyrimas leidžia daryti šias išvadas:

1. Įžvelgiamas siūlomų el. paslaugų kokybės lygmens ir pirkėjų laukiamo lygmens atotrūkis. Tokia išvada remiasi prieinamų el. komercijos statistikos duomenų analize, kuri parodė skirtumus tarp Lietuvos įmonių ir pirkėjų įsitraukimo į el. komerciją

tempų. Žemesnis pirkėjų įsitraukimo tempas, nepaisant didėjančios jų naudojimosi internetu kompetencijos, patvirtina, kad atsiradus potencialioms rinkos nišoms ir techninėms galimybėms tas nišas užpildyti, svarbu rasti tinkamus efektyvaus prieinamų technologijų panaudojimo būdus verslo pozicijoms stiprinti siekiant patenkinti didėjančius vartotojų poreikius. Todėl svarbu surasti el. komercijos sistemų kokybės vertinimo kriterijus ir tobulinimo orientyrus, palengvinančius el. komercijos plėtotę atsižvelgiant į vartotojų lūkesčius ir verslo galimybes.

2. Išanalizavus mokslinėje literatūroje pateikiamas el. komercijos sąvokas ir atsižvelgus į el. komercijos procesų turinį ir prigimtį, siūloma el. komercijos sistemą traktuoti kaip sudėtingą produktą, kurio pagalba vykdomi prekių ir paslaugų užsakymo, jų apmokėjimo, pristatymo bei aptarnavimo po pardavimo procesai, kurių nors vienas vyksta elektroninėje erdvėje.

3. Atlikta literatūros analizė padėjo atskleisti, kad el. komercijos pagrindiniai probleminiai taškai labiausiai yra susiję su el. komercijos sistemos patikimumu (iš kliento pozicijos) ir tinkamu el. komercijos sistemos funkcionavimu globaliu mastu, kurį dažniausiai lemia sistemos adaptavimas tikslinėms rinkoms (iš verslininko pozicijos).

3.1. Mokslinėje literatūroje įžvelgiamas interneto svetainės kokybės ir pasitikėjimo joje teikiamomis paslaugomis ryšys, taip pat pripažįstama, kad komercinė informacija vartotojo suvokiama kaip turinti žemą patikimumo lygį. Reikia trečiosios nepriklausomos šalies patvirtinto el. komercijos patikimumo indikatoriaus, kuris padėtų pelnyti lankytojo pasitikėjimą. Toks indikatorius galėtų būti sertifikavimo įstaigos suteiktas atitikties (sertifikavimo) ženklas.

3.2. Atliktas egzistuojančių el. parduotuvių sertifikavimo ženklų reikalavimų sugretinimas leido konstatuoti, kad Europoje nėra bendro, vartotojams pažįstamo ir el. komercijos organizacijų plačiai naudojamo sertifikavimo ženklo, bei įžvelgti tokio ženklo, paremto vieninga strategija ir suderintais reikalavimais, poreikį. Toks el. komercijos sistemos saugumo ir atitikties sąžiningo verslo reikalavimams sertifikavimo ženklas turėtų dvigubą naudą el. komercijos sistemos kokybei ir perspektyvoms: viena vertus, sertifikavimo procese įmonė turi galimybę išsiaiškinti sistemos trūkumus ir pagerinti jos kokybę, kita vertus, vartotojas gali lengviau orientuotis tarp el. parduotuvių ir įsitikinti el. komercijos sistemos patikimumu kompiuterio pele paspaudęs sertifikavimo ženklą.

3.3. Kadangi internetas plečiasi ir apima vis daugiau šalių ir visuomenės sluoksnių, kultūros skirtumų pažinimas ir pritaikymas el. komercijos strategijose tampa būtinu sėkmės aspektu. Tam, kad el. parduotuvė būtų tinkama komunikavimo priemonė bei norint efektyviai panaudoti globalios rinkos potencialą, būtina apibrėžti tikslinę auditoriją ir pritaikyti el. komercijos sistemą kiekvienai tikslinei rinkai įvertinus kultūros ir kitų tikslinės rinkos ypatybių įtaką. Adaptavimas tikslinės rinkos ypatybėms (lokalizacija) turi didelį potencialą gerinant el. komercijos sistemos kokybę ir efektyvumą, nes el. parduotuvės interaktyvumas yra nulemtas adaptavimo kultūrai laipsniu.

3.4. Atlikus kultūros dimensijų, galinčių daryti įtaką el. komercijos sistemos suvokimui ir pasisekimui įvairių kultūrų rinkose, analizę buvo identifikuoti tokie pagrindiniai kultūriniai aspektai, į kuriuos reikėtų atsižvelgti lokalizuojant (pritaikant) el. komercijos sistemą užsienio rinkoms: „galios atstumo" dimensija (parodanti valdžios simbolių ir hierarchijos pripažinimą visuomenėje), santykių struktūra visuomenėje (parodanti orientaciją į asmeninius arba visuomenės tikslus), lyčių vaidmenys

(atskleidžiantys lyčių vaidmenų visuomenėje atskyrimą arba susiliejimą), neapibrėžtumo vengimas (parodantis neapibrėžtumo priimtinumo visuomenėje laipsnį), laiko suvokimo dimensija (parodanti visuomenėje priimtus laiko standartus, apimančius punktualumą, orientaciją į trumpalaikę ar ilgalaikę verslo santykių perspektyvą) ir technologinis išsivystymas (pasiektas technologijų lygis tikslinėje rinkoje ir visuomenės pasirengimas priimti naujas technologijas).

4. Parenkant el. komercijos sistemų kokybės vertinimo kriterijus buvo pasitelkti trys informacijos šaltiniai:

4.1. Atlikta mokslinės literatūros ir naudojamų el. komercijos įgyvendinimo praktikų analizė, kuri parodė, kad šiuo metu nėra visuotinai pripažinto bendro modelio, taikomo el. komercijos sistemų kokybei vertinti. Literatūros analizė buvo apibendrinta sudarant el. komercijos kokybei vertinti taikomų kriterijų sąrašą, suranguotą pagal kriterijų minėjimo šaltiniuose dažnumą. Identifikuotos pagrindinės kriterijų, taikytinų el. komercijos sistemų kokybei vertinti, grupės:

• dažniausiai minimi kriterijai yra susiję su turinio kokybe, el. parduotuvės techniniais (tarp jų – transakcijų ir asmens duomenų saugumo) bei naudojimosi patogumo aspektais;

• rečiau minimi santykių su klientais ir lojalumo kūrimo veiksniai ir kliento suvokiamos kokybės aspektai;

• mažiausiai autoriai nagrinėja realioje (angl. offline) aplinkoje pasireiškiančius el. komercijos aspektus.

4.2. Žvalgomasis ekspertinės nuomonės tyrimas leido išgryninti ir papildyti literatūroje minimų kriterijų rinkinį šiuo metu aktualiais aspektais: ekspertai išskyrė klientui teikiamo el. pasiūlymo turinio svarbą, transakcijų saugumą, mokėjimo būdų pasirinkimą, pristatymo trukmę ir būdus. Pabrėžiama santykių su klientais svarba, t. y. būtinumas palaikyti ryšius su klientais po mokėjimo etapo, taip užtikrinant pagrindą ilgalaikei partnerystei.

4.3. Vartotojų apklausa parodė jiems svarbiausius el. komercijos aspektus, kurie galėtų būti naudojami kaip el. komercijos sistemų kokybės kriterijai (svarba įvertinta 9 balų skale):

• pasirenkant prekes vartotojams yra svarbus el. parduotuvės naršymo struktūros patogumas (6,84), techninė būklė (6,55), galimybė susipažinti su kitų pirkėjų atsiliepimais (6,47), el. pasiūlymo turinys ir patrauklumas (6,17), el. parduotuvės lokalizacija (6,14) ir interaktyvi pagalba (5,57);

• apmokant užsakymą vartotojai daugiausia vertina mokėjimo sistemos saugumą (8,24), mokėjimo alternatyvas (7,65) ir mokėjimo sistemos aiškumą (6,84);

• kalbant apie pristatymą ypatingas dėmesys skiriamas pristatymo trukmei (7,74) ir kainai (7,63), interaktyviai pagalbai (6,86), siūlomų pristatymo būdų įvairovei (6,83), galimų vėlavimų trukmei (5,09);

• gavus prekes vartotojams rūpi suteikiamos garantijos trukmė (6,77), pinigų grąžinimo trukmė (6,72) ir periodo, per kurį galima grąžinti prekę, trukmė (6,71), taip pat skundų nagrinėjimo trukmė (6,38) ir pagalba klientui po pardavimo (6,34).

4.4. El. komercijai keliamų reikalavimų istorinė analizė parodė, kad besivystant el. komercijai didėja ir reikalavimai jai – nuo saugumo išsiplečia iki patogumo reikalavimų. Todėl remiantis minėtais trimis šaltiniais buvo atrinkti svarbiausi el. komercijos sistemos kokybės vertinimo kriterijai ir sugrupuoti į keturias temines grupes:

• Pardavimo organizavimo kokybės vertinimo kriterijai: el. parduotuvės naršymo struktūros (navigacijos) patogumas, techninė kokybė, el. pasiūlymo turinys ir lokalizacija, bendravimo galimybės (pagalba ir kitų vartotojų atsiliepimai);

• Mokėjimo organizavimo kokybės vertinimo kriterijai: mokėjimo sistemos saugumas, siūlomų mokėjimo alternatyvų skaičius, mokėjimo sistemos aiškumas;

• Pristatymo organizavimo kokybės vertinimo kriterijai: pristatymo trukmė, pristatymo kaina, pristatymo būdai, tiesioginė pagalba klientui pristatymo metu;

• Aptarnavimo po pardavimo kokybės vertinimo kriterijai: garantijos trukmė, pinigų grąžinimo trukmė, taip pat periodas, per kurį galima grąžinti prekę, ir pagalba klientui po pardavimo.

5. Kadangi kokybės vertinimas yra subjektyvus dalykas ir kaip dauguma socialinio mokslo koncepcijų yra sunkiai apibrėžiamas bei dažnai naudojantis abstrakčias koncepcijas, el. komercijos sistemų kokybės vertinimo modeliui suformuoti buvo ieškoma tinkamos modeliavimo logikos. Esant tokiam sudėtingam objektui, kaip el. komercijos sistemos, kurių kokybei vertinti didelę įtaką daro subjektyvios nuomonės, atsiranda būtinumas šalia kiekybinių duomenų be iškreipimų įtraukti į vertinimą kokybinius kintamuosius. Įvertinus egzistuojančias logikos atmainas, prieita prie išvados, kad tai galėtų būti įgyvendinta pasitelkiant netiksliosios (angl. fuzzy) logikos principus.

6. Remiantis intuityviu aiškinimu netikslioji logika gali modeliuoti subjektyvumą ir neapibrėžtumą, būdingus žmogaus mąstymui ir natūraliai kalbai. Todėl netiksliąja logika paremtas el. komercijos sistemų klasifikavimas pagal kokybę užtikrina kokybės vertinimo modelio bazinių koncepcijų suprantamą interpretavimą bei pagerina esamus kokybės tobulinimo gebėjimus.

7. Suformuotas el. komercijos sistemų kokybės vertinimo modelis yra paremtas netiksliosios klasifikacijos principais, teminiu kriterijų grupavimu ir hierarchiniu duomenų organizavimu atsižvelgiant į naudojamų kriterijų prigimtį, tarpusavio ryšius, svarbą bei empiriškai nustatytas priimtinas jų svyravimo ribas. Toks modelis gali būti naudojamas ne tik konkrečiai situacijai, kuriai buvo sukurtas, bet ir adaptuojamas keičiantis struktūros parametrams ar veikimo sąlygoms.

8. Disertacijoje pateikti empiriškai nustatyti (1) el. komercijos sistemų kokybės vertinimo modelio parametrai, apimantys vertinti naudojamų kriterijų matavimo svyravimo ribas, (2) turintys įtakos bendrajam vertinimui kokybės klasių svoriai, (3) priklausomumą kokybės klasėms aprašančios narystės funkcijos bei (4) rezultatinio kokybės rodiklio apskaičiavimo tvarka. Išdėstyti rodikliai, jų santykių ir priklausomybių aprašymai leidžia kitiems el. komercijos sistemų tyrėjams ar vystytojams adaptuoti modelį konkrečiai situacijai, koreguojant pateiktų rodiklių skaitines reikšmes pagal faktinius nagrinėjamo atvejo duomenis.

9. Disertacijoje pateiktas modelis yra skirtas el. komercijos sistemų kokybei vertinti ir tobulinti. Tačiau taip pat jis gali būti naudojamas vertinamiems objektams pagal kokybę ranguoti, gretinti, pasirinkti tinkamą iš alternatyvių objektų ar tuos objektus siūlančių potencialių verslo partnerių. Modelio lankstumas sudaro sąlygas toliau jį vystyti atsižvelgiant į vertinamų objektų specifiką, verslo aplinkos pokyčius, informacinių technologijų pažangą bei didėjančius klientų poreikius ir lūkesčius. Be to, siūlomas el. komercijos sistemų kokybės vertinimo modelis gali būti pagrindu formuojant analogiškų objektų kokybės vertinimo modelius.

10. Prieita prie išvados, kad netiksliosios logikos principai el. komercijos sistemų kokybei vertinti suteikia pranašumų klasikinio klasifikavimo ir suminių balų vertinimo būdų atžvilgiu. Pranašumai pasireiškia (1) lankstumo, (2) jautrumo duomenų pokyčiams kontrolės, (3) adaptavimo rinkos reikalavimams, (4) rezultatų aproksimacijos realybei ir interpretavimo aspektais.

11. El. komercijos sistemos yra dinamiški objektai, todėl jų kokybės vertinimas negali būti vienkartinis veiksmas. Jis turi būti tęstinis, atskleisti, kaip el. komercijos sistemos sugeba vystytis, prisitaikyti prie rinkos pokyčių ir išlaikyti pasiektus rezultatus.

12. Siūlomas kokybės vertinimo modelis leidžia ne tik įvertinti el. komercijos sistemos kokybę pagal aktualius kriterijus ir surikiuoti vertinamus objektus pagal kokybę, bet ir numatyti tolesnę el. komercijos sistemos kokybės tobulinimo strategiją. Tai tampa įmanoma dėl priežastinio atsekamumo, leidžiančio nustatyti tam tikrų vertinamos el. komercijos sistemos elementų pažangumą, kokybės potencialo panaudojimo laipsnį ir kokybės gerinimo prioritetus.

13. Netiksliosios klasifikacijos, kuria remiasi skaičiavimai el. komercijos sistemų kokybės vertinimo modelyje, savybės sukuria pagrindą kokybės gerinimo veiksmų pasekmėms prognozuoti ir iš galimų alternatyvų pasirinkti konkrečioje situacijoje optimalią kokybės tobulinimo kryptį. Tai leidžia gerinti kokybės vertinimo ir tobulinimo gebėjimus.

14. Vystant el. komercijos sistemų kokybės nagrinėjimą tyrėjams siūlomos tokios tolesnių tyrimų kryptys:

• nustatyti prioritetinius el. komercijos sistemos kokybės kriterijus atskirose prekybos srityse;

• ištirti įvairių valstybių el. pirkėjų reikalavimų el. komercijos sistemoms skirtumus;

• suformuoti subalansuoto el. komercijos sistemos kokybės tobulinimo metodiką.

15. Verslo subjektams, siekiantiems gerinti naudojamos el. komercijos sistemos kokybę, rekomenduojama:

• identifikuoti tikslinės rinkos reikalavimus, tolerancijos ribas ir kultūrinius ypatumus;

• prireikus patikslinti disertacijoje pateikto modelio rodiklius pagal faktinius tikslinės rinkos reikalavimus;

• įvertinti naudojamos el. komercijos sistemos pasiektą kokybės lygį ir atitikti tikslinės rinkos reikalavimams, identifikuoti sistemos stipriąsias ir silpnąsias sritis;

• numatant prioritetines kokybės tobulinimo kryptis, atsižvelgti į tobulintinų elementų svarbą bendram kokybės vertinimui (prioritetą skiriant svarbesniems elementams).

Mokslinio tyrimo rezultatų aprobavimas ir sklaida

Mokslinio tyrimo rezultatai pristatyti tarptautinėse ir nacionalinėse mokslo konferencijose, publikuoti konferencijų medžiagose ir daktaro disertacijai pripažįstamuose mokslo leidiniuose.

Pagrindiniai disertacijos teiginiai pateikti 18 mokslinių publikacijų.

Mokslinės informacijos instituto (ISI) duomenų bazėse referuojamuose leidiniuose:

1. Guseva, N. Fuzzy classification in the assessment of e-commerce systems' quality. Transformations in business and economics. 2008, Vol. 7, No. 3, suppl. C., p. 193–206. ISSN 1648-4460.

Recenzuojamuose mokslo leidiniuose, referuojamuose kitose tarptautinėse duomenų bazėse:

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1. Ruževičius, J., Guseva, N. Models for Web Applications Quality Assessment. Commodities and Markets. 2007, No. 2, p. 27–40. UDC 004.738.5:658.

Konferencijų medžiagose:

1. Guseva, N., Ruževičius, J. Interneto produktų kokybė ir jos vertinimo modeliai. Šiuolaikiniai kokybės vadybos pokyčiai: respublikinės kokybės vadybos konferencijos medžiaga, 2007 m. gruodžio 6 d. Kaunas: Technologija, 2007, [CD] –7 p. ISBN 978-9955-253945.

2. Guseva, N. Assessment of the E-Commerce Systems' Quality. International Scientific Conference „International Business Development: Globalization, Opportunities, Challenges", Collection of articles, 15–16 of May 2008. Vilnius: Publishing House TEV, 2008. p. 15–22. ISBN 978-9955-87-906-0.

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2007–2011: Doktorantūros studijos Vilniaus universitete. Socialiniai mokslai: vadyba ir administravimas. Vilniaus universiteto Ekonomikos fakulteto 2009 ir 2010 m. mokslinių pasiekimų konkurse užėmė atitinkamai 1 ir 2 vietą lektorių ir doktorantų grupėje.