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EXPERT AND STATISTICAL ANALYSIS OF EFFECTIVENESS OF VIRTUAL BUSINESS RELATIONS OF ENTERPRISES

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Abstract

The use of digital economy tools creates a number of additional advantages in the competition, improves the management structure, reduces transaction costs, increases labor productivity and, as a result, the business efficiency. In the digital economy, there is a constantly increasing volume of investment. However, the economic justification of this fact is often made quite unsatisfactory. The analysis of economic efficiency factors of the business relations virtualization process in the digital economy is performed. All possible efficiency factors of information technologies in virtual business relations were considered first in the practice of calculations due to the applying of the expert-statistical approach. The general statement of a choice problem of effective virtual business relations is formulated and possible ways of decision defined basing on principles of fuzziness and the analytic hierarchy process. The best way to estimate the uncertainty of the cash flow is using simulation methods. Modelling allows conducting multiple generation of the whole set of undefined system parameters statistics (in accordance with specified uncertainty intervals) and constructing an uncertainty interval for the annual cash flow or profit. The purpose is to justify the applicability of the expert-statistical approach to assessing the effectiveness of virtual business relations between enterprises. The main scientific idea of the research is based on the expert-statistical approach, consisting in the expert evaluation of various factors values as a range of uncertainty, the generation of distributions of these factors values, a different form of generalizations of these random variable distributions for selected research objectives.

Keywords: Economic efficiency, digital economy, virtual business relations, efficiency factors, expert-statistical approach.

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1. Introduction

Virtual business relations in the digital economy are characterized by high dynamics of business model change. This requires constant monitoring of all changes in the virtual environment to support business in a state of profitability. Processes of consolidation and cooperation of the companies are observed with a view of economic synergy, i.e. association of entrepreneurs in electronic communities "by interests", which is similar to the formation of e-business. The speed of information and communication technologies (ICT) development influences the dynamics of the audience - the "face" of the potential client, its social and geographical characteristics are changing rapidly (Efimov, Efimova, & Fomenko, 2009; Efimov & Efimova, 2014).

The formation of a global network space confronts the management of companies with the task of adapting business processes to new conditions and determining the correct innovation policy. In a virtual environment, new business conditions are created for companies. In these conditions, the integration of companies into a virtual business environment becomes a pressing problem for economic agents. The same applies to virtual educational structures (Cherkezov, 2009).

The use of ICT creates a number of additional advantages in the competition, ensures the improvement of the management structure, reduces transaction costs, increases labour productivity and, as a result, the efficiency of business.

In 2000, the total expenditure of corporations on computer technology exceeded 1.5 trillion dollars (Ananin, 2009). According to IDC data already in 2013, the world market of information technologies (IT) was already about 2 trillion dollars. (Russian market - 34.49 billion dollars), and in 2017 is expected to 2.3 trillion. (The Russian market is about 43 billion dollars) (Agapov, Yakovlev, & Pratusevich, 2014). At the same time, we state that it is in this area of activity, increasing volumes of investments sometimes have a very mediocre economic justification, which characterizes the absence of breakthrough ideas in assessing the economic efficiency of IT in recent times.

The analysis of monographic literature and scientific periodicals shows the ambiguity of the assessment of the network environment for the economy and the tools available in it, which, in turn, does not allow to correctly assess their advantages, new possibilities and efficiency of application. There are no studies conducted in the context of assessing the productivity of labour when integrating business processes into a virtual environment. The increase in labour productivity after transferring business relationships to a virtual environment in the analysed sources is either implied or not considered at all. Sometimes possible risks of implementing the economic relations of subjects in the virtual environment are not taken into account while assessing the efficiency of such process. Practically there are no methods that take into account specific factors of Internet projects efficiency (Efimov, 2017; Khubaev, Shpolianskaya, Doljenko, Scherbakov, & Efimov, 2017).

2. Problem Statement

It is known that the efficiency (productivity) is a relative indicator that characterizes the relationship between the achieved or expected final results of activity acting in the form of an effect and the costs (resources) necessary to achieve it:

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$$E = R / C, \quad (1)$$

where E is the efficiency, R - results; C - the cost of obtaining this result.

Efficiency expresses its relative value, obtained from a unit of produced costs or resources. Therefore, efficiency increase means obtaining the maximum effect at constant costs, or the specified effect at minimum costs, or the maximum effect at minimum costs. In practice, efficiency calculations have difficulties, since the numerator and the denominator of a fraction in some cases cannot be quantified or cannot be calculated in common units.

The efficiency criteria of an enterprise in the framework of virtual business relations can be purely economic (labor productivity, total cost of ownership - TCO, net present value - NPV, internal rate of return - IRR, return on investment - ROI, etc.) or technical (system performance, reliability, availability, scalability, functional completeness, ease of maintenance, quality of documentation, compliance with corporate rules, norms and standards) (Efimov, 2016; Zhilina, Miroshnichenko, Savelyeva, & Veretennikova, 2017).

All the efficiency factors on investing in information technology (IT) have both quantitative and qualitative form. If the intangible component has a small share in the IT project expenses, then the non-material advantages play a leading role in the benefits. If the intangible benefits are not taken into account, then this reduces the overall project efficiency rating. In the modern economy it is the non-material benefits that have a major impact on the efficiency of the production system. Thus, the market value of efficiently operating companies, which are leading in their industries, significantly exceeds the value of their tangible assets (stocks, equipment, cash, etc.). Today, for example, the market value of Microsoft is many times greater than its book value. The recognized authority of this subject area Strassman (Pisello & Strassmann, 2003) recommends the mandatory consideration of quality factors of efficiency, allowing more comprehensive assessment of all sources of IT effect.

For quantitative factors, there are almost no problems in assessing their values. In assessing the quality factors of efficiency, statistics may not be available, be inadequate or inaccessible for decision-making. Therefore, the only method of assessing the values of factors remains the development of a special methodology.

The sequence of assessing the qualitative factors of IT efficiency can be described as follows.

- Intangible benefits are compared with factors critical for a company's success, and correlate with such opportunities as support and increase in sales, price increase, cost reduction or the creation of a new business, possibly by others.
- The identified opportunities are described in units that can be measured. In this case, the values of these quantities are determined using methods such as marketing research, expert assessments, benchmarking and other.
- The amounts described earlier are transferred to indicators related to the funds income, i.e. an increase in revenues or a decrease in costs.

3. Research Questions

The functioning of enterprises and organizations in a market environment occurs in conditions of uncertainty. Uncertainty about the parameters of the operation generates an accidental value, for example,

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the annual revenue or profit of the enterprise, and as a result - assessments of IT efficiency. The best way to estimate the uncertainty of the cash flow is using of simulation methods. Modelling allows one to conduct multiple generation of the whole set of undefined system parameters statistics (in accordance with specified uncertainty intervals) and to construct an uncertainty interval for the annual cash flow or profit.

4. Purpose of the Study

The purpose is to justify the applicability of the expert-statistical approach to assessing the effectiveness of virtual business relations between enterprises.

5. Research Methods

The main scientific idea of the research is based on the expert-statistical approach, which consists in the expert evaluation of various factors values (in this study for economic efficiency factors) as a range of uncertainty, the generation of distributions of these factors values, a different form of generalizations of these random variable distributions for selected research objectives (Efimov, 2017).

When evaluating the efficiency of projects, which implement virtual business relationships, it becomes possible, firstly, to simulate the relative uncertainty of the actual reality of production systems operation with the help of simulations. Secondly, modelling can take into account not only direct, but also indirect factors of economic efficiency. Thirdly, the results of basic parameters object simulations allow specifying and carrying out a scenario calculation of the effect evaluation from the project implementation. All this makes it possible to increase the feasibility of calculating the investments efficiency.

Virtualization of business processes and business relationships provides a significant increase in the efficiency of labour. The productivity of workers depends on many factors, but one of the determining factors is how efficiently the business processes in the enterprise are organized.

Enterprise management bases on corporate business processes (BP) with the required level of detailing, criteria and standards for their implementation, service levels of the enterprise activity by the enterprise system (ES), which determine the basic metrics for planning and control of corporate processes, evaluation of business performance.

The business process (BP) in a general form can be represented as following transformation:

$$BP\ (X,\ R,\ F,\ Z,\ G) \longrightarrow Y, \tag{2}$$

where $X = \{X_1, X_2, ..., X_I\}$ – inputs and their sources; $Y = \{Y_1, Y_2, ..., Y_J\}$ – outputs and their consumers; $R = \{R_1, R_2, ..., R_k\}$ – set of resources used to perform the BP (technical, material, information); $F = \{F_1, F_2, ..., F_n\}$ – set of functions implemented by BP; $Z = \{Z_1, Z_2, ..., Z_m\}$ – set of participants and actors of BP; $G = \{G_1, G_2, ..., G_l\}$ – borders and interfaces of BP.

It is clear that business processes of the enterprise are the main objects of management and a possible source of increasing labour efficiency. To analyse the performance of business processes in a virtual environment, it is suggested to use key performance indicators (KPI).

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BP consists of a sequence of individual functions (operations), for which resources are spent (financial, labour, material, energy, and others). The processes of production and sale of goods and services are more or less uncertain in terms of time and other resources. That is because of their implementation in the framework of various factors caused by external (market) and internal (production) environment.

Based on the retrospective data, it is possible to estimate the actual laws for allocating the costs of resources to the implementation of each operation and the process as a whole, and in the absence of the necessary information, to determine the ranges of uncertainty in the values of the BP parameters (min, mid, max) and generate triangular distributions. The description of a random variable with the help of a triangular distribution is considered as the best option with insufficient or even missing statistical data. Savings (Q) as a random value appear both when comparing BP costs in the traditional form (Zbas) and when implementing BP in virtual environment (Znew). Therefore, Q is the main source of their efficiency:

$$Q = Z_{bas} - Z_{new}. \quad (3)$$

Knowledge of distribution laws makes it possible to compare the BP with labour and resource costs, carry out an objective analysis of the degree of staff utilization, identify the most labour-intensive processes, assess the likelihood of the process in a given time, identify the reserves of increasing labour productivity, determine the probability of a particular process for a certain time, and much other (Tishchenko, Sharypova, Zhilina, & Cherkezov, 2016).

In turn, the criteria and priorities for the implementation of the enterprise's BP determine the requirements for the functioning characteristics of Web-oriented corporate ES. These characteristics are subject to increased requirements, which are not critical for other distributed systems. These include the architecture and functional completeness of the system, network bandwidth, availability, manageability, performance, reliability, scalability, security of applications and data, the size of objects received by the browser from the Web server, the number of users, etc. (Dolzhenko, 2009; Zhilina, Triputa, & Sergienko, 2018).

Taking into account the foregoing, the efficiency of the virtual business relations project depends on its compliance with the strategic objectives of the enterprise, the models of interaction between the main participants of the electronic market and the tools (technologies) of electronic business relations implemented in the network environment of the BP, the characteristics of ES and possible risks.

Taking into account the set of admissible alternatives, criteria K and scales of their evaluation, the task of selecting an effective project of virtual business relations in the general form can be represented as multicriteria:

$$F(ZE, MV, T, BP, W, RS) \xrightarrow{K} opt, \quad (4)$$

where F - an operator that ensures the optimum values of performance criteria; ZF - objectives of the enterprise; MV – interaction models (business-to-business, business-to-customer, business-to-government, etc); T - tools (technologies) represented by websites, e-shops, electronic trading platforms, virtual auctions, Internet marketing, trading, insurance, consulting, etc.; BP – business processes, which are being improved during the project implementation; W – set of web-oriented ES characteristics; RS – possible risks.

Multicriteria selection is a common task for many application areas. Known methods for multicriteria selection usually involve transforming the vector of particular criteria by which the system is

evaluated to a scalar integral criterion. However, in a number of cases, alternatives are evaluated by both quantitative and qualitative criteria. A significant limitation of the traditional approach is that it is not adapted to the inclusion of qualitative criteria. At the same time, one should also take into account a certain vagueness of the notion of the alternative properties.

The solution of the problem is based on the principles of fuzziness and the method of analysing hierarchies that does not require quantitative assessment of particular criteria or the procedure for scalarization, since it uses information only about the quality of variants in the form of paired comparisons (Efimov, 2013).

When evaluating the efficiency of an IT project of a business system, most often a risk analysis is carried out, which involves considering all changes, both in terms of deterioration and in the direction of improvement. In the process of risk analysis, it is advisable to use a scenario approach, which can be carried out according to the following scheme: choose the parameters of the investment project to the greatest degree undefined; perform a project efficiency analysis for the limit values of each parameter. There are three scenarios, while considering the investment project: basic, most pessimistic, most optimistic (Krepkov, Efimov, & Fomenko, 2010).

6. Findings

We conducted the primary analysis of economic efficiency factors of enterprises business relations virtualization in the digital economy: models of participant's interaction in the electronic market; tools (technologies) of electronic business relations; business processes that are improved during the implementation of the project; characteristics of a Web-based ES; possible risks of project implementation.

The general formulation of the problem on choosing an effective project of virtual business relations is formulated and possible ways of solving this problem are determined, which is based on the principles of fuzziness and the method of analysing hierarchies.

7. Conclusion

The consideration of efficiency factors is proposed to be carried out by modelling processes (expert-statistical approach), which allows one to take into account the uncertainties of the of business systems functioning in the market environment, take into account all possible factors of IT efficiency (quantitative and qualitative), formulate calculation scenarios and take into account possible project risks.

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