INNOVATIVE ENTREPRENEURSHIP MODELS FOR INFORMATION ECONOMY DEVELOPMENT

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ABSTRACT

To achieve the task of creating the structure of cloud services, standard methods of analysis of complex systems by the criterion of functional suitability while maintaining the basic principles of innovative entrepreneurship model are modified and supplemented. The methods are supplemented by the following elements: taking into account the hierarchy of the cloud environment, grouping of functions and structural elements of services, establishing dependencies between the functions of the service, taking into account the requirements of different technologies of building elements of cloud services, using quantitative and qualitative Quality of Service (QoS) parameters of structural elements of the service. A new model of creation of the cloud service structure based on the methods of complex systems analysis is developed. A new modular approach to building a multi-cloud service monitoring system is proposed, which will help specialists focus on abstract, non-specific cloud providers and concepts when setting up a system to control the activity of complex and heterogeneous services operating in multiple clouds. While creating the structure of the cloud service monitoring system, the proposed methods will allow simultaneously creating and controlling the Service Level Agreement (SLA) together with the system of metrics and performance indicators for cloud services.

Keywords: Innovative Entrepreneurship, Quality of Service, Cloud Service, Monitoring, Industry.

INTRODUCTION

The modern world is characterized by the dynamic rates of new economy creation, which is based on intellectual resources, information and communication technologies (ICT). Accordingly, different countries face different tasks in this area, but practically each country tries to prevent lagging in the development of competitive potential of advanced information technologies and its productive use in order to develop the economy and social sphere.

The transformation of the structural and organizational component of the modern economy is related to the tendency of the rapid development of the services in the structure of the world economy. Information technologies, as an integral business tool, are constantly creating new tools for maximizing efficiency. The appearance of a new paradigm in the area of information technologies usually intensifies the competition of market participants for the right to exploit this new paradigm.

In the past, the markets of databases, enterprise management information systems, and service-oriented architectures, etc. have been created in the intense struggle. The most relevant example of the creation of a new market based on innovations in the area of information technologies is the growing competitive struggle for the possibility of providing certain resources as services. Such paradigm was called "cloud computing".

Cloud technologies are an alternative to the traditional model of local use of hardware and software. At the enterprise level, cloud technologies will allow to abandon own hardware and software infrastructure replacing it with connection to a corresponding network service – a cloud. Therefore, the cloud computing paradigm is able to influence the balance of powers both in software and hardware markets.

Although the idea of cloud is not new in itself, as a paradigm it is still in an early stage of its development. The novelty of cloud computing is to extend the model of Internet hosting beyond the lease of web-sites and to cover the widest range of business-relevant tasks that are achieved by traditional information technologies, such as enterprise management systems, customer relationship management systems (CRM) or human resource management systems (HR).

Cloud computing is not only an innovation in the area of information technologies but also a source of new business models when small producers of IT products are given a chance to quickly market their services and a low-cost method to realize their business ideas. The development of the cloud computing paradigm, coupled with growing investment in startups across the globe, will create a rapidly evolving ecosystem of innovative enterprises.

The relevance of the problem, its theoretical and practical importance, determined the choice of research topic, its purpose and objectives.

The purpose of the work is to develop the institutional and organizational foundations of a new innovative paradigm for the development of the information economy – the paradigm of cloud computing and, on its basis, the models, methods and information technologies for the creation and operation of cloud services in the economy of the countries of the world.

REVIEW OF PREVIOUS STUDIES

According to the forecasts of consulting companies, the rapid development of cloud technologies, the digital transformation of the economy and the penetration of the cloud computing paradigm into new spheres of life are one of the major trends that will significantly affect the transformation and development of not only the IT industry, but also the spheres of business, finance, trade, government, medicine, education and many other spheres of human life in the next 5-8 years (de Beer, et al., 2014; Kasych & Vochozka 2019).

For example, IDC predicted that by 2018 more than 50% of IT expenses of world companies would be accounted for by the technologies of the third platform of the evolution of the IT market (cloud technologies, mobile technologies, social networks, Big Data, etc.), and by 2020 cloud technology expenses would reach 60% of overall IT infrastructure expenses, including software, IT services and hardware (Abdel-Basset, et al., 2018).

“Industry 4.0” digitizes and integrates processes vertically across the organization, from product development and product purchase through manufacturing, logistics and services (Ghahramani, et al., 2017). All data on operational processes, process efficiency and quality management, as well as operations planning are available in real time, supported by augmented reality and optimized into integrated networks.

Horizontal integration goes beyond in-house operations from suppliers to consumers and all key partners in the area of value (Del Vecchio, et al., 2020; Dubova, 2018). It includes technologies from tracking devices and monitoring systems to integrated real-time scheduling and execution.

Product digitization involves extending existing products by adding smart sensors and communication devices, which can be used with big data analytics tools, as well as creating new digitized products focused on fully integrated solutions (Amato & Moscato 2017). By integrating new data collection and analysis methods, companies can generate product usage data and refine products to meet growing end-user needs.

Leading industry companies are also expanding their propositions by delivering innovative digital solutions such as full-featured, data-oriented services and integrated platforms. Innovative digital business models focus on generating additional digital revenue and optimizing customer relationship (Fernandez-Guadaño, et al., 2020; Huang, et al., 2020). Digital products and services create closed-loop production cycles in separate digital ecosystems.

However, in spite of the growing amount of studies in this area, the issues of using cloud computing in the sphere of IT and the economic implications of their implementation are still poorly discussed in economic science and require detailed analysis, concretization and development.

METHODOLOGY

In the study for the research of the cloud technology market there were used the methods of statistical data analysis, methods of economic and mathematical modeling (development of models and methods of building cloud services), methods of analysis of complex systems (for the development of tools for building cloud services), calculation and design method of economic research and methods of hierarchy analysis, systemic, inductive and deductive approaches to the interpretation of research results.

RESULTS AND DISCUSSIONS

Since cloud services have three-tier architecture: infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS), the model of a cloud service structure should also be focused on analyzing these levels.

We suggest an advanced and complementary method of analyzing complex systems by the criterion of operational suitability allowing to:

Compare different projects of cloud services in terms of operational suitability and match them with customer requirements; build a list of functions of the structural elements of the cloud service; carry out comparative analysis of structural elements by the criterion of operational suitability, to identify the elements that dominate the others, to create the groups of elements that are similar in operational suitability; create a list of options for implementation of cloud services, taking into account the use of different technologies and platforms; carry out a comparative analysis of options for implementation of cloud services taking into account requirements to the cloud service being created and its components.

In Figure 1 a diagram of an algorithmic model for creation of a cloud service structure is presented. It is based on the standard method of analysis by the criterion of operational suitability at different stages of creation of a cloud service structure.

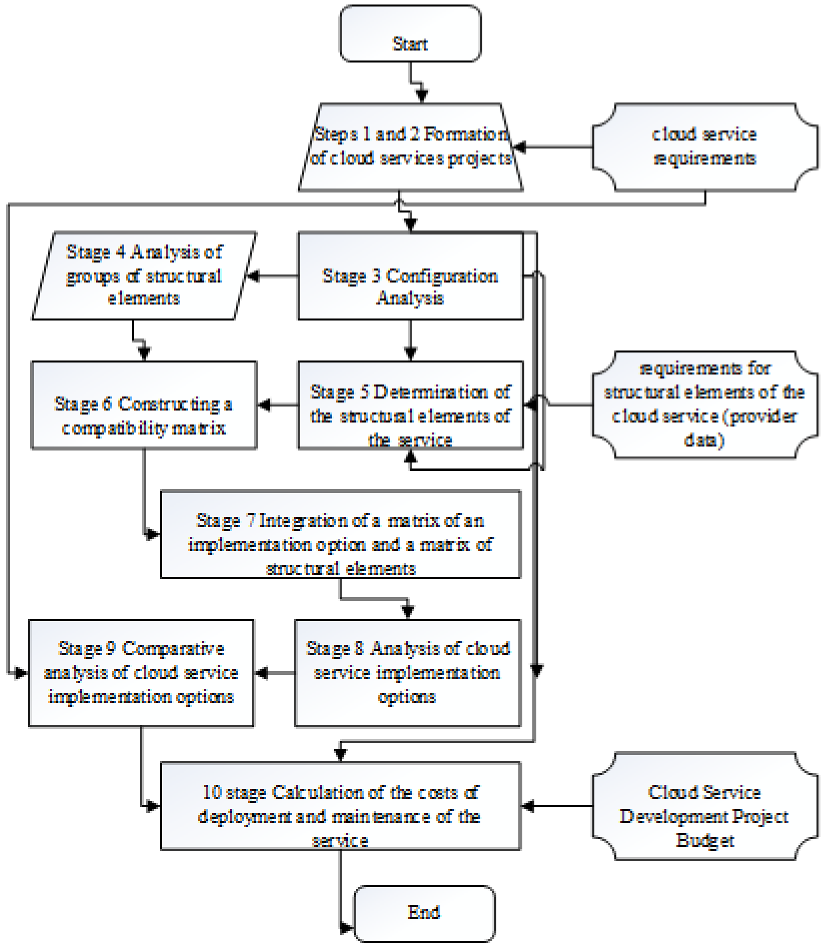

FIGURE 1
ALGORITHMIC MODEL FOR CREATION OF A CLOUD SERVICE STRUCTURE (AUTHOR'S RESEARCH)

Consider an example of testing the model. As a subject area, we will use the project of creating a cloud-based SaaS service designed to generate quotes for social networks. Quotes (copyright) are an affordable and popular format used by small (and sometimes large) companies who cannot afford the more expensive type of content. Therefore, such services for the creation of unique pictures-quotes are popular.

The purpose of the service development (based on the many purposes of creating the service the requirements to it will be developed) is mass and automatic creation of unique content in the form of pictures-quotes for social networks with the logo of a customer. The content creation has a mass a unique nature as it is convenient for customers to get a set of pictures right away and post them on their own site and because social networks love uniqueness, accordingly. And they are generated with the logo of a customer as customers want those who read the quote to see their brand. We have chosen to generate quotes with pictures, because this format is efficient and cheap to produce.

In Table 1 there presented an example of the generated projects of the service and the implementation of the functions listed in each of these options. The KA matrix of the method is transposed here for convenience of presentation. After creating the P matrix for the cloud service projects, necessary calculations can be performed (obtained intersection, absorption and similarity matrices), and corresponding graphs can be built.

TABLE 1
IMPLEMENTATION OF FUNCTIONS IN THE PROJECTS OF CLOUD-BASED SERVICE FOR GENERATION OF PICTURES-QUOTES FOR SOCIAL NETWORKS (AUTHOR'S RESEARCH)

Function code	Function	P1	P2	P3	P4	P5	P6
F1	Administrative component	0	0	0	0	0	0
F2	Quote text base	0	0	1	1	1	1
F3	Picture base	0	1	1	1	0	1
F4	Picture-quote generator	1	1	1	1	1	1
F5	Font catalog	0	1	1	1	0	0
F6	Animation generator	0	1	1	1	0	1
F7	Payment acceptance component	0	0	1	1	0	1
F8	Short notes on the order	0	0	1	1	0	1
F9	Picture demonstration	1	1	1	1	1	1
F10	Service main advantages	1	1	1	1	1	1
F11	Feedback	0	1	1	1	1	1
F12	Picture archiving component	1	1	1	1	1	1

According to the standard methodology, the matrix of P projects is supplemented by a row corresponding to the functions of the conditional project of the cloud service p7. The conditional project (functional specification) presents the requirements for the functional suitability of the cloud service for generating pictures-quotes for social networks.

The functional specification and the list of these requirements are drawn up by the customer of the service, based on the purpose of its creation.

Table 2 shows, accordingly, the intersection matrix calculated based on the supplemented P matrix for the cloud service for generating pictures-quotes for social networks.

TABLE 2
INTERSECTION MATRIX OF CLOUD SERVICE PROJECTS (AUTHOR'S RESEARCH)

Projects	*P1*	*P2*	*P3*	*P4*	*P5*	*P6*	*P7*
P1	0	8	12	14	3	12	4
P2	0	0	4	6	1	5	1
P3	0	0	0	3	0	2	0
P4	0	0	1	0	0	0	0
P5	0	6	9	11	0	9	2
P6	0	1	2	2	0	0	0
P7	4	9	12	14	5	12	0

The similarity matrix calculated based on the supplemented P matrix for the cloud service for generating pictures-quotes for social networks is presented in Table 3.

TABLE 3 SIMILARITY MATRIX OF CLOUD SERVICE PROJECTS (AUTHOR'S RESEARCH)							
Projects	***P1***	***P2***	***P3***	***P4***	***P5***	***P6***	***P7***
P1	1	0.53	0.43	0.39	0.75	0.42	0.38
P2	0.53	1	0.81	0.74	0.61	0.72	0.44
P3	0.43	0.81	1	0.83	0.57	0.83	0.43
P4	0.39	0.74	0.83	1	0.52	0.91	0.39
P5	0.75	0.61	0.57	0.52	1	0.57	0.5
P6	0.42	0.72	0.83	0.91	0.57	1	0.43
P7	0.38	0.44	0.43	0.39	0.5	0.43	1

The absorption matrix calculated based on the supplemented P matrix for the cloud service for generating pictures-quotes for social networks is presented in Table 4.

TABLE 4 ABSORPTION MATRIX OF CLOUD SERVICE PROJECTS (AUTHOR'S RESEARCH)							
Projects	***P1***	***P2***	***P3***	***P4***	***P5***	***P6***	***P7***
P1	1	1	1	1	1	1	0.56
P2	0.53	1	1	1	0.65	0.94	0.47
P3	0.43	0.81	1	0.95	0.57	0.9	0.43
P4	0.39	0.74	0.87	1	0.52	0.91	0.39
P5	0.75	0.92	1	1	1	1	0.58
P6	0.42	0.76	0.9	1	0.57	1	0.43
P7	0.56	0.89	1	1	0.78	1	1

The graph of complete absorption of projects of cloud services for generating pictures-quotes for social networks built with a node that meets the list of requirements of the customer of the service (conditional project) is presented in Figure 2.

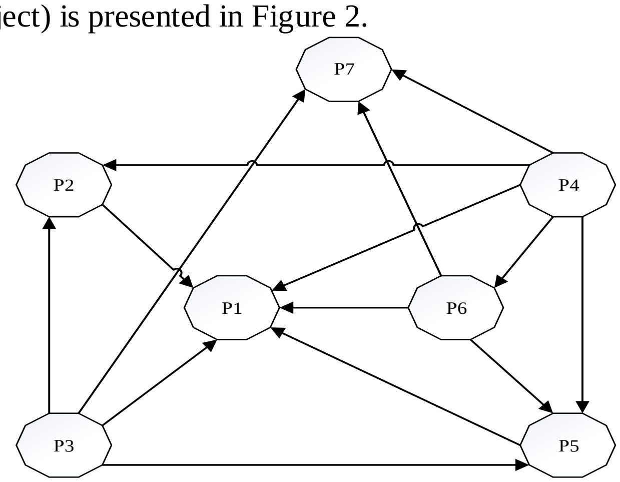

FIGURE 2

GRAPH OF COMPLETE ABSORPTION OF CLOUD SERVICE PROJECTS TAKING INTO ACCOUNT THE REQUIREMENTS OF THE FUNCTIONAL SPECIFICATION (AUTHOR'S RESEARCH)

The analysis of matrices and graphs allows to conduct a comparative analysis of cloud service projects in terms of functional suitability, separate groups of similar service projects, identify projects that superior to the other (projects), compare the functions of service projects with the customer functional specification for creating a cloud service.

For the above service example, the analysis shows that we will continue to consider p3, p4 and p6 projects. As these projects completely absorb the requirements conditioned by the functional specification and are generally superior to the other projects. The exclusion of the p6 project from the analysis, which is possible on the basis of the analysis of absorption and similarity graphs, is not justified, since there is a small list of projects left for review.

RECOMMENDATIONS

The definition of the Total Cost of Ownership (TCO) is used as a target function in the estimation of cloud service projects, but it requires some modification and improvement to be used in the cloud computing paradigm.

The definition of the Total Cost of Ownership is carried out using the methods, which are developed and are the intellectual property of relevant consulting companies, such as Gartner. Therefore, to justify this estimate, we will use a general approach based on the distribution of total cost of ownership by major cost categories: hardware and software costs; management and support costs; administrative costs; personnel training; solving technical issues related to end users; costs of restoring the system in the case of unavailability.

At the same time, the authors of TCO claim that such costs make up most of the total cost of owning an IT infrastructure, and these costs are called indirect costs and typically exceed direct costs by 3-5 times (Chen, et al. 2017).

CONCLUSION

Further analysis is based on the use of criteria such as cost of development, cost of building and operating a cloud service using the model of TCO (Total Cost of Ownership). The developed method, focused on reflecting the peculiarities of cloud technologies, allows to take into account: groups of functions of cloud services; quantitative and ordinal parameters; technologies of implementation of services; dependency between functions; a hierarchy of cloud service components.

The method also makes it possible to select the software for the implementation of the cloud service, to form the composition of the components and functions of such service, and to select the subset of options for the implementation of the cloud service.

In the work there proposed a model for optimizing the selection of cloud providers using a dynamic cloud service architecture, which allows users, unlike existing models, to get services from several cloud providers from different cloud levels, to perform a targeted search for an effective acceptable way to deploy a new cloud service.

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