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MODERN INFOCOMMUNICATIONS: RESEARCH OF FACTORS AFFECTING INNOVATIVE DEVELOPMENT

СУЧАСНІ ІНФОКОМУНІКАЦІЇ: ДОСЛІДЖЕННЯ ФАКТОРІВ, ЩО СТИМУЛЮЮТЬ ІННОВАЦІЙНИЙ РОЗВИТОК

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Стрій Л.О., Орлов В.М., Захарченко Л.А. Сучасні інфокомунікації: дослідження факторів, що стимулюють інноваційний розвиток. Оглядова стаття.

Викладено результати всебічного дослідження сучасних і можливих майбутніх факторів, які можуть впливати на ефективність управління інноваційним розвитком підприємств інфокомунікацій. Досліджено такі групи факторів: інформаційно-технологічної революції, конвергенції інформаційних і комунікаційних технологій, використання мережі Інтернет, «інформаційного вибуху» і «четвертої індустріальної революції». Деталізована сфера впливу досліджених факторів на інноваційну діяльність підприємств. Виконана систематизація виявлених чинників. На основі проведеного аналізу запропоновано рекомендації щодо використання стимулюючих факторів для підвищення ефективності управління інноваційною діяльністю підприємств в умовах сучасних ринків.

Ключові слова: інформаційно-технологічна революція, інформаційний вибух, інноваційний розвиток; конвергенція технологій, підприємства інфокомунікацій, ринки інфокомунікаційних послуг, мережа Інтернет, фактори стимулювання розвитку, економіка сфери інфокомунікацій

Striy L.A., Orlov V.N., Zaharchenko L.A. Modern infocommunications: research of factors affecting innovative development. Review article.

The results of a comprehensive research of modern and possible future factors which can influence effective management of innovative development of infocommunication enterprises are reported in this article. The groups of factors are investigated such as: information and technological revolution, the convergence of information and communication technologies, Internet use, "information explosion" and "the fourth industrial revolution". The sphere of influence of the studied factors on the enterprises innovative activity is detailed. The systematization of the identified factors has been carried out. The recommendations about the stimulating factors use for increasing effective management of the enterprises innovative activity in the conditions of the modern markets are offered on the basis of the carried-out analysis.

Keywords: convergence of technologies, economy of sphere of infocommunications, innovative development, infocommunication enterprises, infocommunication services markets, stimulating factors of development

Infocommunication enterprises develop stably under the conditions of modern turbulence. Today the infocommunications are becoming the foundation, the main backbone of nation economic development, one of the most profitable international institutions. Markets of infocommunication services which form the basis sphere of infocommunications, have the most adaptive progressive network structure for an effective engagement among all participants in the economy: manufacturers, consumers and intermediaries. The innovative development of infocommunication enterprises is ensured by using fast-growing opportunities offered by Internet, intensive improving of information and communication technologies and its convergence. However, the problem of innovative development of infocommunication enterprises hasn't been adequately reflected in the scientific literature yet. Therefore, her research is of undoubted interest for both scientists-economists and practitioners of all sectors of the economy and is relevant.

Analysis of recent researches and publications

The infocommunication enterprises' development experience hasn't been represented enough in scientific publications, especially in recent years. We can emphasize the work of T. Kuzovkova and her co-authors [1, 2], where the requirements of the economy for an information infrastructure and for the level of development of infocommunications, the laws of development of infocommunications are covered. Some developing factors of infocommunications are analyzed in N. Nikolskaya's article [3]. The problem of the use of the infocommunication impact pattern on the country's economic development is analyzed in P. Vorobienko and V. Granaturov's article [4]. The formation, assessment and effectiveness of using innovative provider's potential are studied in monographs [5]. The functioning of infocommunication service markets, some possible areas for improvement of infocommunication business activities are considered in the monograph [6]. The current state, structural organization, management of the network structures of the infocommunication sphere, the level of competition in the markets, and the development trends of enterprises are explored in articles [7-10]. The interdependence of scientific and technical development and innovation management was studied in the monograph of Professor M. Merkulov [11]. Some aspects of the problem have been studied in the works of K. Schwab (2016) [12], the monograph of M. Castells (2000) [13], in P. Drucker's book (2007) [14], the works of F. Kotler (2014) [15], F. Kotler (2005) [16], B. Gates (2004) [17], Litovchenko [18]. Some aspects of the problem are periodically examined in the scientific journal ONPU "Economika: realii chasu" [19].

Unsolved aspects of the problem

Among the many publications on the study of various factors that can stimulate the innovative activity of enterprises, there are practically no work on the generalization and systematization of all factors that stimulate the innovative development of enterprises, as well as on the detailed impact of these factors on the management of innovative activities in the field of infocommunications in modern conditions.

The aim of the article is the summarizing of the results of a comprehensive research of all modern and possible future factors which can stimulate innovative development of the infocommunication enterprises, in particular: the factors of information and technological revolution and the convergence of technologies; the opportunities of using Internet tools in economy; the factors of "information explosion" and "the fourth industrial revolution"; as well as the specification of a sphere of influence of the studied factors on the enterprises innovative activity and the systematization of the identified factors.

The main part

Information resources and research methods. The research was carried out by authors by studying and analyzing (in accordance with the purposes of the article) monographs, scientific books, scientific articles, accessible Internet publications, and also by using the results of the authors' own research. The main methods used to study the problem and systematize the results of the researches are: a review method, a logical analysis and a systematic approach.

The main areas of innovative activities of infocommunication enterprises. The modern sphere of infocommunications includes the following: traditional telecommunication enterprises segment, IT segment and mass communication segment including Mass Media [2, 4-5, 7-8]. The main field product is the infocommunication service. The consumers of this service are all government enterprises and organizations, and also the country's whole population. Market areas are characterized with high rivalry and consumers' desire to purchase high quality and high service level innovative products [1, 2, 4, 6, 7]. Therefore, innovative activity of infocommunication enterprises of are ongoing aimed at the introduction in practice of "new ideas". At the same time, the innovative activity of infocommunication enterprises and the management of its implementation relies on modern theories, described in the monograph of M. Merkulov [8], the works of P. Vorobienko and V. Granaturov [4], V. Orlov [5, 7], L. Striy [9-10] and others.

Information and technological revolution. M. Castells. Impacts of Information and technological revolution on the development of economy were studied by M. Castells (M. Castells, 2000) [13], who completed a comprehensive analysis of basic civilizational processes brought about with a new role of information technology in modern world. Relative to the economy of infocommunications this problem is studied in [6]. M. Castells articulated basic features of Information and technological paradigm of new economy, which in his opinion can become a foundation of emerging information society [13]. The first characteristic is that the information in new economy becomes a raw material. The technologies are developed in order to influence the media, before the information had been meant to influence different technologies of industrial economy [13].

The second characteristic notes all-embracing effects of new technologies. The information becomes an integral part of any human activity, that's why all the processes of human individual and collective action are directly formed by a new technological mean [13].

The third characteristic lies in network organization and networking logic of any system or aggregate relations using information technologies. Network morphology is well equipped to growing complexity of interactions and unpredictability of model development [13].

The fourth characteristic is that Information and technological paradigm requires a flexible organization of production [13].

The fifth characteristic points at growing convergence of several technologies in a highly integrated system [13].

The characteristics of Information and technological paradigm were used in the process of the development of innovative infocommunication enterprises: the convergence of information and communication technologies made possible the creation and ongoing improvement of the mail product of the field - infocommunication services; the infocommunication service markets have a well adapted networking structure for economic activity in the cyberspace of the Internet: economic activity of field enterprises is based on network logic, flexibility is the main feature of the economy of infocommunications.

In this way, the innovative development of infocommunication enterprises was stimulated and continues to be stimulated by factors, arising from the consequences of the information and technological revolution, specifically: the information becomes a raw material, new technologies are created to influence the information; new technologies have comprehensive effects; any system or set of relations that use new information technologies have networking logic; the information and technological paradigm is based on flexibility.

The convergence of technologies. P. Drucker, F. Kotler. In XIX century and in the first half of the XX century, as P. Drucker (P. Drucker, 2007) points out, there was no doubt that technology that exists outside of any industry does not have any influence on it, perhaps only a minimal one. Modern information technologies are constantly intersected. Increasingly, the branches of the economy and their technologies are innovating; about which experts of this industry have the most general idea. Consequently, today there is no one technology that would belong to only one industry, and that as a rule, all technologies, at least theoretically, can be of paramount importance for any industry and affect any industry [14]. F. Kotler (F. Kotler, 2014) considers the convergence of technologies as the reason of the convergence of industries. He points out that the boundaries between industries disappear at warp speed: companies realize that opportunities for development lie on the points of two or more industries. The basis for mass convergence, in his view, is the universal transition to digital technologies, when devices for example, the playback of entertainment content by its "filling" become more and more similar to personal computers [15-16]. The factor of convergence of technologies contributes to the development of the infocommunication fields and the development of innovative of infocommunication enterprises. For a long time, telecommunication and information technologies have been evolved in separate areas and practically independently of each other. The development of the Internet network stimulated the rapid development of services to provide users with a variety of information resources and, thus, facilitated the convergence of information and communication technologies. As a result, in the Internet environment, information and telecommunications services have merged, forming infocommunication services. Infocommunication services have made it possible to meet the growing needs of people in modern information products more effectively (more detailed in [5, 6]).

Thus, the factors of technology convergence (the convergence of different technologies in one highly integrated system) also contributed greatly to the formation of new infocommunication services, the formation of information and communication services markets and continue to stimulate the innovative development of infocommunication enterprises.

Influence on innovative development of enterprises on the use of Internet tools in the economy and the impact of the development of infocommunications on the growth of economic opportunities of the Internet. The use of the continuously expanding opportunities of the Internet in economic activity has caused significant changes in all fields of the economy and stimulates the development of innovative activities. These aspects of the problem, which is investigated in the article, are described in sufficient detail in many scientific publications, including those of the authors of the article [5, 6]. F. Kotler (F. Kotler, 2005) [16] believes that with the advent of the Internet, many aspects of business have radically changed, which contributes to its effectiveness. There was an opportunity for the enterprise to work in global markets and on a much larger territory, to explore markets, customers, potential consumers and competitors more effectively [16]. Bill Gates (B. Gates 2004) [17], thinks that the use of the Internet is a necessary and indispensable element of modern companies' work. B. Gates notes that at the beginning of the XXI century speed is becoming the key concept of development. These concerns: the speed of change in the nature of the business; efficiency of business process management; dynamics of changes in the lifestyle of consumers and their requests. The reason of the changes is the increasing of opportunities for obtaining information via the Internet [17].

Professor I. Litovchenko in the monograph [18] explores the advantages and limitations of using the Internet in the economy. The advantages: globality; the access to unlimited information; convenience for consumers; solvent and socially active audience; interactivity. The restrictions: strengthening and changing of competition nature; decreasing of the level of influence on the consumer; limited security of operations [18].

It is shown in [7-10, 20] that the development of the Internet and the development of telecommunications (now infocommunications) are interrelated and interdependent. Nowadays the development of communication, especially mobile communication, provides the growth of the number of Internet users. With the advent of mobile Internet the network access became possible due to smartphones, pads and other mobile devices of communication. At the same time the possibility of a network access considerably increased the demand for mobile devices.

The development of the Network stimulates the infocommunication development, especially increasing the demand for different devices for using the opportunities of the mobile Internet. The development of infocommunications provides the further expansion of the Internet opportunities and the growth of number of Internet users.

Thus, the following factors of using the opportunities of the Internet in economic activity have provided a significant impact on the innovative development of infocommunication enterprises: aspects of business have radically changed, which ensured a significant increase in its effectiveness; the advantages of using the Internet: the globality; access to unlimited information; convenience for consumers; solvent and socially active audience; the interactivity, limitations: strengthening and changing of the nature of competition; the level reduction of influence on the consumer; limited security of operations. The development of the Internet and the development of infocommunication fields are interrelated and interdependent.

"Information explosion." E. Toffler. At the beginning of the 21st century, the development of the economy is described as an ever-increasing rate of changes in all areas of economic activity. Rapid development of the Internet and other modern information networks caused a new problem, which is, the rapid growth of the amount of information that can be used by both producers and consumers both in the development of market strategies and in choosing the right solution in a given market situation. This problem was called the "information explosion". In addition to the accelerating growth in the volume of information about everything, an information explosion is characterized by: accelerating the process of creating and introducing innovations to the market and accelerating the pace of change in all spheres of human life; intensive growth of the information industry and an increase in its share in the country's GDP; rapid aging of information and available knowledge. According to the forecast of the famous futurist Alvin Toffler, humanity expects drastic changes. It faces a profound social upheaval. There is a new civilization. Any things in this emerging civilization contradict the old traditional industrial civilization. Three factors: the growth of the rate change, the factor of novelty, the diversity in this civilization will be dominant [21].

This way, the "information explosion" brought to life the following factors that stimulate the innovative development of infocommunication enterprises: an increase in change rate of the economy and other areas of human activity; rapid aging of information and available knowledge; an intensive growth of the information industry; an accelerating process of creating and introducing innovations to the market; the demand for innovative products and their diversity prevail in the markets.

"The Fourth Industrial Revolution." K. Schwab. The Swiss economist Klaus Martin Schwab in his book "The Fourth Industrial Revolution" summarized the experience and views of the world's leading experts in the field of economy and technologies, and also the leaders of the largest corporations and made a well structured overview of the main trends of this revolution. According to K. Schwab, this revolution has already started. The development of the "fourth industrial revolution," according to the research of K. Schwab, differs from the previous ones by certain features [12].

The study of this book allowed the authors to identify a number of factors of the "fourth industrial revolution" that could influence the innovative development of infocommunication enterprises.

The pace of development. Unlike the previous ones, this revolution is developing not by linear, but rather by exponential rates. This is the product of a multi-faceted, deeply interdependent modern world, and also that fact that modern technology itself can synthesize even more advanced and more efficient technologies [12].

The systemic impact. The revolution provides a holistic external and internal transformations of all systems across all countries, companies, industries and society in general [12].

Huge speed and powerful competition. The consequence of this revolution will be that the introduction of new technologies will be characterized by acceleration of development, a huge speed and accompanied by a powerful competition. It is already clear that innovative activity is becoming an arena for the struggle of many thousands of companies around the world, both large corporations and very small start-ups. All of them compete for the opportunity to become the first among those who can bring a new product, a new service to the market, and win the favour of customers [12].

New technological breakthroughs. Perhaps a staggering combination of emerging technological breakthroughs in the widest range of areas, including: artificial intelligence, robotics, the Internet of things, robot cars, 3D printing, nanotechnology, biotechnology, materials science, energy storage and storage, quantum computing and much more. Some of these innovations are just emerging, but they are already approaching the turning point when they start developing, layering and reinforcing each other, representing the intertwining of technologies from the realm of physics, biology and digital realities [12, 16-22].

Cardinal changes in the organization of economic activity. There can be cardinal changes in all sectors of the economy, the birth of new business models, a disruptive (destructive) impact on established traditional companies, as well as a radical transformation of production, consumption, transportation and delivery systems [12; 27-35].

Thus, we can expect that in the future the innovative development of infocommunication enterprises will be influenced by the following factors, which can be brought to life by the "fourth industrial revolution": exponential rates of development; modern technologies can themselves synthesize new increasingly advanced and efficient technologies; a huge speed of change and a powerful competition in innovation; new technological breakthroughs; cardinal changes in the organization of economic activity.

The systematization of factors that stimulate the innovative development of infocommunication enterprises. As already proved in the article, at the beginning of the 21st century several groups of factors formed that determine the innovative development of enterprises and the economy of the infocommunication sphere.

All the factors considered in this article are divided into several groups, indicated in the first column of the table: Factors of the information and technological revolution; Convergence of information and communication technologies; the economic dimension of the third industrial revolution; Use of the Internet in the economy; "Information explosion"; "The fourth industrial revolution." The essence of the factors is noted in the second column. Information sources are also indicated in the table.

The results of systematization are presented in tab. 1.

Table 1. Principles of ensuring the effectiveness of the instrumental environmental competitiveness' system

A group of factors	The essence of factors
1. Factors of information and technological revolution. M. Castells [6, 13].	1.1. Information is raw material, new technologies are created to influence the information. 1.2. New technologies have comprehensive effects. 1.3. Any system or set of relations that use new information technologies have network logic. 1.4. The information and technological paradigm of the new economy is based on flexibility.
2. Factors of technology convergence [4-6, 11-13]	2.1. Convergence of various technologies in one highly integrated system is provided. 2.2. Information and communication services converged into a single whole - in infocommunication services.
3. Factors of using the Internet in the economy [6, 11, 15, 16, 18].	3.1. With the advent of the Internet, many aspects of business have radically changed, which has significantly improved its efficiency. 3.2. Advantages: globality; access to unlimited information; convenience for consumers; Interactivity. 3.3. Restriction: strengthening and changing of the nature of competition; decreasing in the level of influence on the consumer; limited security operations.
4. Factors of "information explosion". E. Toffler [21].	4.1. The growth of change rate in all spheres. Accelerating the process of creating and introducing innovations to the market. 4.2. Rapid aging of information and available knowledge. 4.3. The intensive growth of the information industry. 4.4. The dominance of factors of novelty and diversity.
5. Factors of the "fourth industrial revolution". K. Schwab [12].	5.1. The revolution is developing not by linear, but rather by exponential rates. 5.2. Modern technologies can synthesize new more advanced and more efficient technologies. 5.3. The introduction of new technologies will be characterized by acceleration of development, a huge speed and accompanied by very powerful competition. 6.4. A stunning combination of technological breakthroughs is possible in a wide range of areas, including: artificial intelligence, robotization, Internet of things, nanotechnology, biotechnology, materials science, energy storage and storage, quantum computing. 5.5. Potential changes in all spheres of the economy are possible: the birth of new business models, as well as the radical transformation of production, consumption, transportation and delivery systems.

Source: compiled by the authors on the materials [4-6, 11-16, 18, 21]

Note: in the process of systematization of factors, a logical generalization of the materials is already described in the article is carried out, and some correction of their formulation.

It should be noted that, in our opinion, all groups of factors and the development of infocommunication enterprises are interrelated and interdependent.

Conclusions

Authors' scientific novelty of the approach to the solution of this problem is a comprehensive research of all modern and possible future factors which can stimulate innovative development of the infocommunication enterprises.

According to the results of the research the groups of factors are distinguished such as: information and technological revolution; the convergence of information and communication technologies; economic measurement of the third industrial revolution, the development of opportunities for using the Internet tools in the economy; "information explosion"; "the fourth industrial revolution". The sphere of influence of the studied factors on management of the enterprises innovative activity is detailed. The systematization of the identified factors has been done.

Practical realization by the enterprises of the scientific positions, formulated by authors in this article, can promote more effective adaptation of the enterprises innovative activity to real conditions of infocommunication markets and increase of its management efficiency.

Modelling of the management process of innovative activity in the infocommunication enterprises in order to search the ways of improving its efficiency can be possible as a direction of further researches.

Abstract

The article presents the results of a comprehensive research of current and possible future factors that can stimulate the innovative development of infocommunication enterprises, as well as detail the impact of identified factors on the innovation activity of enterprises and their systematization.

The research was carried out by authors by studying and analyzing (in accordance with the purposes of the article) monographs, scientific books, scientific articles, accessible Internet publications, and also by using the results of the authors' own research. The main methods used are: a review method, a logical analysis and a systematic approach.

The markets of the sphere are characterized by the desire of consumers to purchase innovative products. Therefore, enterprises need to continuously improve innovative development. The research revealed the following groups of factors: information and technological revolution; the convergence of information and communication technologies; economic measurement of the third industrial revolution, the development of opportunities for using the Internet tools in the economy; "information explosion"; "the fourth industrial revolution". The sphere of influence of the studied factors on management of the enterprises innovative activity is detailed. The systematization of the identified factors has been done.

Practical realization by the enterprises of the scientific positions, formulated by authors in this article, can promote more effective adaptation of the enterprises innovative activity to real conditions of infocommunication markets and increase the effectiveness of innovation management.

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