Балджи М. Д.

КЛАСТЕРНЕ ОЦІНЮВАННЯ РЕЗУЛЬТАТІВ РОЗВΙТКУ РИНКУ ІНФОРМАЦІЙНО-КОМУНІКАЦІЙНИХ ТЕХНОЛОГІЙ

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Анотація. В статті розглянуто передумови розвитку ринку інформаційно-комунікаційних технологій, чим і обумовлена тема дослідження. Обґрунтовано, що інтенсивний розвиток інформаційно-комунікаційних технологій поставив людство перед початком нової фази свого існування – гlobalним інформаційним суспільством, перехід до якого, в свою чергу, передбачає здійснення певних трансформацій в економічній, соціальної, політичній, правовій, культурній структурі суспільства кожної країни. Досліджено досвід розвинених країн світу щодо розвитку галузі, які говорять про те, що розвиток інформаційно-комунікаційних технологій є каталізатором для зростання конкурентоспроможності національного ринку, економіки країни, вирішення соціальних-екологічних проблем тощо. Метою статті є розробка прогнозу розвитку ринку інформаційно-комунікаційних технологій на економіку України на основі вивчення досвіду розвинутих країн.

Для цілісного та об'єктивного аналізу стану ІКТ у світі та їх впливу на економіку відбирано 5 кращих країн із 6 основних економічних регіонів світу за рівнем розвитку ІКТ (Західна Європа, Азіатсько-Тихоокеанський регіон, Східна Європа, Америка, Африка, арабські країни), розглянуто їх на рівні соціально-економічного, науково-технічного розвитку. В процесі дослідження й вирішення поставлених завдань використовувались різні наукові методи, до основних з них належать: порівняння, систематизації, графічного аналізу, метод кластерізації, а також використано системно-інформаційний підхід. В результаті проведенного аналізу ринку інформаційно-комунікаційних технологій та застосування методу кластерізації отримано 9 кластерів за схожістю рівня показників соціально-економічного та інформаційного розвитку. Це дозволило детально визначити лідерів та аутсайдерів у розвитку інформаційно-комунікаційних технологій та їх впливу на національну економіку. Науковою новизною виступає створення кластерів країн за рівнем розвитку ІКТ, що надало право виявити величину впливу ІКТ на національну економіку тієї чи іншої країни. Практична значущість дослідження полягає у застосуванні існуючих досягнень для виявлення та розвитку ситуації на світовому ринку інформаційно-комунікаційних технологій та визначення розвитку України в сфері ІКТ.

Ключові слова: ринок інформаційно-комунікаційних технологій, використання кластерних методів, міжнародне співробітництво

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CLUSTER ASSESSMENT OF THE DEVELOPMENT RESULTS IN THE MARKET OF INFORMATION AND COMMUNICATION TECHNOLOGIES

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Ministry of Education and Science of Ukraine,
Abstract. The article considers the prerequisites for the development in the market of information and communication technologies, which is the reason for the research topic. It is substantiated that the intensive development of information and communication technologies has put humanity before the beginning of a new phase of its existence – the global information society, the transition to which, in turn, involves certain transformations in economic, social, political, legal, cultural structure of each country. The experience of developed countries in the development of the industry has been studied, which shows that the development of information and communication technologies is a catalyst for increasing the competitiveness of the national market, the country's economy, solving social and environmental problems and more. The purpose of the article is to develop a forecast development in the market of information and communication technologies for the economy of Ukraine based on the experience of developed countries.

In the process of research and solution of the tasks different scientific methods were used, the main ones are: comparison, systematization, graphical analysis, clustering method, as well as the system-information approach. As a result of the analysis of the market and application of the clustering method, 9 clusters were obtained according to the similarity of the level of indicators of socio-economic and information development. This allowed to identify in detail the leaders and outsiders in the development of information and communication technologies and their impact on the national economy. The scientific novelty is the creation of clusters of countries according to the level of ICT development, which gave the right to identify the magnitude of the impact of ICT on the national economy of a country. The practical significance of the study lies in the application of existing developments to identify the situation on the world market of information and communication technologies and determine the development of Ukraine in the field of ICT.

Keywords: information and communication technology market, developed countries, economic development, cluster analysis, clusters, international cooperation.

Introduction. In the modern world, information and communication technologies (ICT) are increasingly used in various spheres of society, changing them and giving social and human development new qualities, meanings and dimensions. The information component also plays a significant role in shaping the competitive potential of states, the development of international relations and economic integration.

Both foreign economists are engaged in the study of ICT development on the basis of its market competitiveness: Aron R., Merle M., Ryabov S.P., Spikan N.J., Shakhnazarov G.H., Schneider R., and domestic – Azhnyuk M.O., Sakalosh T.V., Romashko S.M., Budagovskaya S.A., Voitko S.V., Gerasimchuk V.G., Danilenko N.B. etc. Numerous experts studies confirm the fact that ICTs have great potential for economic growth in the future. All this indicates the need to systematize the accumulated knowledge on certain topics, the adaptation of basic theoretical provisions to changes in ICT in Ukraine at the national economic level and justify the need to develop a forecast.

The definition of "information and communication technology" is often used as a synonym for information technology, although ICT is a more general term that emphasizes the role of unified technologies and the integration of telecommunications (telephone lines and wireless connections), computers, software, storage and audiovisual systems that allow users to create, access, store, transmit and modify information.

Information and communication technologies are a powerful tool for influencing the development of the state and society and the real sector of industry, which can act as a
"locomotive" not only for economic development in general, but also for changes in political and social life. The urgency of the chosen problem is to study the development of the market of information and communication technologies and develop an appropriate forecast that will significantly affect the modern economy of Ukraine.

Objectives. The formulation of the purpose of the study is based on a study of the experience of developed countries, which allows forecasting the prospects of the market of information and communication technologies and its impact on the economy of Ukraine. General scientific and special methods are chosen as research methods. The first group includes: comparison, systematization, graphical analysis, as well as system-information approach. The second group includes the clustering method and economic-statistical methods based on the application of trend extrapolation methodology.

Results. For a holistic and objective analysis of the state of ICT in the world and their impact on the economy, we select the top 5 countries from 6 major economic regions of the world by level of ICT development (Western Europe, Asia-Pacific, Eastern Europe, America, Africa, Arab countries), consider them at the level of socio-economic, scientific and technological development and compare the studied indicators of these countries with Ukraine. Based on the obtained indicators, there will be an opportunity for Ukraine to adopt the successful experience of high-tech developed countries in terms of significant informatization of society.

The main indicators of the level of socio-economic development of the countries are: GDP per capita, human development index (HDI) and the global competitiveness index – composed of 113 variables that describe in detail the competitiveness of countries at different levels of economic development [1].

Ranking of countries by level of economic development allows us to analyze the dynamics of ICT development within each group and clearly demonstrate the impact of ICT on the level of socio-economic development of countries. Table 1 presents the location of the studied countries according to the ICT development index for 2010-2017, which allowed them to be grouped by this indicator. The highest value of the ICT index is South Korea (8.93), the lowest – Ukraine (5.23) and African countries (Seychelles) (4.96), Par (4.90), Tunisia (4.73), Cape Verde (4.62).

As can be seen from Table 1, the location of countries in the ICT index generally corresponds to their location in terms of GDP per capita, which indicates the determining influence of information factors on economic development in the modern world. We believe that the group of leaders in ranking has a high level of influence of ICT on the development of national economies of the countries selected for the study.

The ICT Development Index, based on the methodology of the International Electronic Communications Union, includes so-called sub-indices: access, use and skills, which reveal in more detail the gradation of ICT development in the world. Countries such as Luxembourg (9.49), Iceland (9.37), and Hong Kong (China) (9.32) have the highest level of ICT access. The lowest values are in South Africa (5.31), Tunisia (5.0) and Cape Verde (4.9). This indicates an inadequate level of fixed and cellular telephone lines in countries, low bandwidth of international Internet channels, and a small percentage of households with access to PCs and the Internet.

Regarding the sub-index of ICT use, the leaders in 2017 are Denmark (8.83), Great Britain (8.42), Korea (8.42), which indicates a high share of Internet users in the population of these countries, a large number of users of fixed wired broadband access (broadband) and a significant number of contracts for mobile broadband services per 100 inhabitants. According to this sub-index, the outsiders in the ranking of the studied countries are: Mauritius (3.25),
Ukraine (2.17) and Cape Verde (1.18). The latter, in turn, received the lowest value, ranking 118th in the ITU rankings.

Table 1

Top 30 countries and Ukraine according to the ICT Development Index

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Source: calculated by the authors on the basis of materials [2-9].
According to the ICT skills sub-index, which characterizes the high level of adult literacy rate, the percentage of people with secondary and higher education, the leaders among the studied countries are South Korea (9.82), Belarus (9.75), USA (9.57). The last positions are occupied by Cape Verde (6.77) and Seychelles (5.76). It should be noted that Ukraine (9.17) according to this indicator ranks 14th in the ITU ranking in the world, emphasizing the presence of a high level of highly qualified personnel in the country, which is a positive sign in the further development of society informatization. This indicator is the key to effective international cooperation, so the higher its value, the better the level of cooperation with other countries.

Another important indicator that reflects the level of development of the information society and market research is the value of the ICT price basket. According to this indicator, Moldova takes the leading position (5.54), which indicates the high cost of ICT services in the country, which significantly hinders the further development of informatization, thus ensuring the lag of Moldova from highly informatized countries. Cape Verde (3.55), Barbados (3.35) and Mauritius (2.87) also have high prices. The lowest cost of the ICT price basket is presented in the following countries: USA (0.37), Kuwait (0.29) and Weltka Britannia (0.47).

It should be added that all the surveyed countries have achieved the target of broadband services offered by the Broadband Commission at prices not exceeding 5% of GNI per capita, thus improving their position in the global informatization arena.

Integrated indices and key indicators of the industry are used to assess and compare the level of development of the information society. The high level of such indicators indicates a significant development of informatization of the country, which serves to further improve cooperation in the field of ICT. ITU uses the number of cellular subscribers per 100 inhabitants (mobile density) as the main indicators; number of Internet users per 100 inhabitants (Internet density); the number of broadband Internet subscribers per 100 inhabitants (density of broadband Internet access) and the number of secure servers per 1 million inhabitants. Let's analyze these indicators in the studied countries for 2017 and determine the change in the value compared to 2007. During 2007-2017, there has been tremendous progress in ICTs around the world. However, the "digital divide" between developed and developing countries remains significant. The analysis of the dynamics of ICT development over 10 years for the countries of the world shows that the peak value of the level of the number of Internet users lies in a rather wide range from 40.3 (Cape Verde) to 98.2 (Iceland). A number of factors affect not only the level of saturation (the number of Internet users per 100 inhabitants), but also the time of transition from the phase of stable growth to the phase of saturation and decline. However, it was Ukraine that made one of the biggest jumps in this indicator in the period from 2007 to 2017 (+36.85).

According to the value of the indicator "number of broadband Internet subscribers", the countries selected for the study are almost at the same level.

Ukraine, Kazakhstan, South Africa, Cape Verde and Qatar have the lowest rates. Belarus shows the largest improvement (+27.03).

The dynamics of cellular density development for the group of the studied countries for the period from 2007 to 2017 testifies to the fact that the cellular communication systems of the first generation began to be introduced in the industrial, regional, and other countries. In other countries, development has been much slower. Hong Kong (China) (239) has the highest number of cellular subscribers per 100 inhabitants, followed by Canada (83). Ukraine is at an average cellular density of 144, gradually improving its position. The largest increase in the last 10 years is in Kuwait – 162.17.

The security of servers indicates the level of ability in the country to protect the Internet, because the protection of personal data is a key step towards further development of ICT in the world. The largest share of protected servers per 1 million inhabitants and the largest
change in this indicator is characteristic of Iceland (3214, +1795.36) and the Republic of Korea (2178, +1680.51). Russia (14.5, +10.06), Moldova (13.5, +9.03) and Tunisia (17.9, +9) lag behind in the ranking of selected countries. The protection of personal data in our country is low, which is due to the lack of a clear legal framework with a high level of piracy.

For the most part, in 2007-2017, exports of ICT goods in% of the total number of exports of goods tended to decrease. The exception is Hong Kong (China), where exports have increased from 35% to 43% in recent years, characterizing the country's high potential in the development of goods production, trade, and as a consequence, the level of development in the field of ICT. In Ukraine, the dynamics of exports of ICT goods is stable – at 1%.

Regarding the dynamics of imports of ICT goods in 2007-2017, there is also a downward trend in the countries, although not significant. Imports increased in Ukraine (from 2 to 4%) and Hong Kong (China) (from 40 to 41%).

To determine the impact of information and communication technologies on the market situation in Ukraine, we will build an econometric model, using data from 30 countries from 6 regions of the world on 20 indicators. To do this, use the program Wolfram Mathematical – a system of computer algebra, used in many scientific, engineering, mathematical and computer fields. The system was originally proposed by S. Wolfram, currently being developed by Wolfram Research (Wolfram). With this program we use the method of clustering to calculate – the problem of dividing a given sample of objects (situations) into subsets, called clusters, so that each cluster consisted of similar objects, and objects of different clusters differed significantly. The task of clustering refers to statistical processing. In our case, due to the complexity of calculating a large data set for the 30 countries studied, the clustering method will divide countries into groups according to similarity of indicators and, as a consequence, will create clusters of countries according to the level of ICT development. This, in turn, will give the right to identify the magnitude of the impact of ICT on the national economy of a country.

The clustering method has the following type of construction (Wolfram):

\[ \text{FindClusters} \{ \{e_1, e_2, \ldots \}, n \} \]  

where \( e_1, e_2 \) – indicators related to \( n \)-clusters.

With the help of calculations, which are the basis of the clustering method, 9 clusters were obtained on the similarity of the level of indicators of socio-economic and information development (Fig. 1).

Using the clustering method allows us to draw the following conclusions:

1) Denmark and Sweden fall into the same cluster due to similar indicators. Both countries have high levels of socio-economic development and ICT. We believe that it is the prudent policy of the government, the right development strategy and the vector of informatization that have helped the countries to achieve high results. Therefore, we claim that the higher the level of ICT, the higher the level of development of the country. Thus, the impact of ICT on the economies of Denmark and Sweden is quite high;

2) Iceland and Luxembourg – the economies of the countries are similar to the previous cluster, but have slightly lower indicators of ICT development (but are in the top 10 countries on this indicator), indicators of socio-economic development remain high. The difference between these economies from the previous cluster can also be explained by the geographical remoteness of Iceland and the small territoriality of Luxembourg, which creates certain obstacles to economic development. The impact of ICT on the economies of these countries is high;
3) Great Britain, Australia, Canada – highly developed countries and have a significant rate of development, have long occupied leading positions in the rankings of various indicators. The value of ICT is high, but it should be noted that the economy of these countries is indirectly affected by the field of ICT, because there are other strong areas of development for these countries. Therefore, the impact of ICT on the economies of the United Kingdom, Australia and Canada is considered to be above average;

4) South Korea, Japan, USA – highly industrialized countries with high rates of information society development. Given the importance of each indicator, we consider the impact of ICT on the economy of these countries is high, which allows countries to quickly adapt to new technologies and focus on creating innovative factors of informatization in society;

5) Hong Kong, New Zealand, Argentina, South Africa – are countries representing different regions of the world. According to the division, we can distinguish these countries as those that have a high rate of informatization, which is quite promising in the development of ICT, and as a consequence, increases the impact of ICT on the national economies of these countries. Therefore, due to the high pace of development of information technology, countries have managed to improve the level of economic development. We consider to estimate high influence of ICT on national economy in the given cluster;

6) Belarus, Kazakhstan, Ukraine – countries that are similar in territory, level of development and common economic past. They are promising in the development of informatization of society, but have low indicators of ICT and socio-economic development. Governments need to reorganize the economy, develop a series of laws that will create a favorable climate to improve the field of information technology, which, in turn, will have a

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**Fig. 1.** The clustering structure of the countries selected for the study

Source: compiled by the authors based on [12].

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positive impact on the economy. In this cluster, the impact of ICT on the economies of these
countries is considered average;

7) Russia – a country that is part of a separate cluster, because it has its own specific
values of indicators. ICT ranks above average in development, but there are a number of
barriers in the country's economy that hinder the growth of information technology, making it
impossible to improve the national economy. We consider the impact to be assessed as
average;

8) Moldova, Azerbaijan, Barbados, Uruguay, Mauritius, Seychelles, Cape Verde,
Bahrain, Qatar, Kuwait – countries with low socio-economic and technological development,
which are combined into one largest cluster. OPEC countries, such as Bahrain, Qatar, Kuwait,
believe that the error was included in this cluster due to lack of data on the studied indicators.
The countries of the cluster need to review the policy of informatization, to create all the
conditions for the development of ICT, which will improve the level of informatization and
the national economy as a whole. The level of ICT impact is considered average;

9) Tunisia, UAE, Saudi Arabia – countries with high rates of economic development
and promising direction of development in ICT. Today, governments are placing great
emphasis on improving the field of ICT, which provokes a positive growth of national
economies. We consider the level of influence of ICT to be high.

Thus, the clustering method helped to divide the countries into groups by indicators and
to identify in more detail the leaders and outsiders in the development of information and
communication technologies and their impact on the national economy.

Conclusions. Thus, the study highlights the scientific novelty of creating clusters of
countries by level of ICT development, which made it possible to identify 9 clusters by
similarity of indicators of socio-economic and information development and identify the
impact of ICT on the national economy. Theoretical significance lies in the generalization of
existing developments on the cluster approach in the national economy. The practical value is
due to the peculiarities of the application of the clustering method and the application of
existing developments to identify the situation on the world market of information and
communication technologies and determine the development of Ukraine in the field of ICT.

Prospects for further research can be specific proposals for the development of the
market of information and communication technologies in Ukraine in a post-crisis situation
due to the effects of the global pandemic. In order to increase the level of information and
communication technology impact on the economy, Ukraine must establish relations and
work closely with foreign partners – leading countries in the level of ICT development.
International cooperation with the best ICT countries in the world will allow Ukraine to
develop the national industry, create competitive products and services based on the world
experience of highly developed countries, expand international trade, increase the level of
ISTC and create a strong union (technology parks, cluster system, associations, etc.),
communication technologies. We believe that Ukraine has a high potential for development in
the field of ICT, which will strengthen and expand international relations with other countries
in terms of informatization of society and improve the level of development of the national
economy.
ОСОБЛІВОСТІ ЕТИКИ ДІЛОВОГО СПІЛКУВАННЯ У СУЧАСНОМУ РИНКОВОМУ СЕРЕДОВИЩІ

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Анотація. Успішність будь-якої організації напряму залежить від ефективності ділового спілкування. Для того, щоб спілкування було результативним потрібно дотримуватись норм та правил етики. Етика ділового спілкування передбачає вибір дієвого способу встановлення взаємозв’язку та обмін інформацією між організацією та стейкхолдерами, керівником та працівниками, а також всередині організації. Окрім того, вона регулює службові обов’язки працівників, їх зовнішню й внутрішню поведінку, а також формує ділову репутацію кожного окремого працівника. Завдяки нормам, правилам і принципам етики працівникам організації вдається підтримувати в колективі доброзичливу атмосферу, уникати суперечок та непорозумінь. Метою написання статті є дослідження особливостей етики ділового спілкування у сучасному ринковому середовищі та пошук шляхів її удосконалення. У статті наведено характеристику понять «спілкування» та «ділове спілкування». Охарактеризовано функції ділового спілкування, серед яких були виокремлені наступні: повідомлення службових обов’язків працівникам, забезпечення отримання зворотного зв’язку, взаємозв’язок із стейкхолдерами, мотивація працівників та формування соціальних зв’язків. Відображено взаємозв’язок основних елементів ділового спілкування. До таких елементів належать: відправник інформації, ділова інформація, канал і спосіб зв’язку, одержувач інформації та зворотний зв’язок. Кожен елемент є невід’ємним та відіграє важливу роль у реалізації комунікативного процесу. Наведено та здійснено характеристику компонентів, що слід врахувати в організації з метою підвищення рівня етики ділового спілкування: прозорість, емоційний інтелект, невербальне спілкування, ясність, слухання та швидкість. У діловому спілкуванні присутні бар’єри зв’язку, що можуть перешкоджати його успішній реалізації.