Digitalization As A Vector Of Technological Changes Of Ukraine

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Abstract. Research background: The paper covers the studying of the introduction of digital logistics in Ukraine, the effect of digital technologies on the development of some parts of the national economy and the minimization of risks in digital logistics. The factors which define the scope of world agricultural production are identified. It has been stated that at present a wide use of digital technologies is a key trend of the world economy of the last decade. World leaders in digital technology application are IT-companies, media, finance and insurance. The level of digitalization is much lower in true production and logistics. Agriculture is the last in the list. Basic components of digital infrastructure in the country were analyzed: telecommunication, geo-informational and mobile telecommunication. A successful experience in the introduction of updated financial technologies, oriented mostly on small agribusiness, farmers, was studied. It has been established that a branch standard in agriculture has to be the use of the system of geo-positioning, complex management of a machinery fleet, precise agriculture. A comparative analysis of the technology efficiency was made: aeroponics, hydroponics, traditional agriculture. The world market forecast of agricultural drone sales was presented. Major principles of the policy of "Ukraine's digitalization" were identified. Five key components which constitute "digital" economy and, in turn, are in the center of "Digital agenda of Ukraine-2020" are suggested. The example of the support of the development of digital technologies and the initiatives of the EU concerning the development of digital economy was presented. The problems of the adaptation of Ukraine’s logistic projects to the world digital infrastructure were studied. Purpose of the article are: to determine the key factors that determine the transition of domestic agricultural production to digital agriculture; to form the tendencies of integration of local actors of the agro-industrial complex to the international digital infrastructure, to define measures for minimizing risks in digital logistics. Methods: In accordance with the objectives set in the article were used the following methods of research: dialectical method; system-structured on the principle of system research economic phenomena and processes; quantitative and qualitative comparison, analogies, observation, statistical and graphic methods; analysis, synthesis, system approach and abstraction, hypotheses and assumption, formalization. Findings & Value added: to develop information society in Ukraine, further regulation of legislature, improvement of the national policy aimed at overcoming some obstacles on the way to the integration of domestic entities of the agro-industrial complex to the world digital infrastructure, improvement of the acting system of risk management were suggested. Keywords: agrarian business, technological innovations in AIC, digital infrastructure, logistics, precise arable farming

I. INTRODUCTION
Nowadays, Ukraine increases its positions in the world agricultural market, however, it requires a more efficient use of the potential and a faster technological development to maintain the results achieved and to become a leader in new commodity segments. Ukraine has a very beneficial geographical position in view of the organization of transit freight traffic, its transport potential includes the development of automobile, railway, sea, river, air and pipeline transport. All this motivates the evaluation, systematization and determination of the impact of digital technologies on Ukrainian logistics, also it requires urgent introduction and has to be used in a short term. However, a wide range of the available approaches to the challenges of the digital logistics development in the agrarian sector of Ukraine proves the necessity to form major ways of the integration of local entities of the agro-industrial complex into the world digital infrastructure. All the above-mentioned determined the relevance of the studied theme.

II. LITERATURE REVIEW

Despite a great number of publications as to the mentioned principles of digital economy, namely the creation of an efficient integrated regulation system of material and information flows and control over them, the issues of digital logistics in Ukraine, the effect of digital technologies on the development of some parts of the national economy and risk minimization in digital logistics have not been studied enough yet. According to the statistics of the UNO, by the year of 2050 the world population will have increased by 9 bln people, which will lead to the doubled increase in food resource needs by this time. Besides, there are some factors which define the volume of world agricultural production n:
- global climatic changes;
- increase and change in the consumption structure, connected with the increase of the number of population and that of their well-being;
- technological revolution, which has changed the structure of industrial production dramatically in recent decades, is coming to agriculture.

As to global climatic changes, it has to be stated that a serious decrease of clean water reserves, and it concerns not only China and India (water deficit is a traditional problem in these countries) but also middle west of America and southern region of Ukraine, becomes a problem to maintain continuous high yields, achieved on irrigated soil. The problem of soil degradation, limitation in ecologically harmful methods of running agriculture requires special attention. For instance, in the EU agriculture is a source of 10% discharges of CO₂ and over 50% of other greenhouse gases, and also AIC is a source of 90-95% of ammonia. In the EU countries 75% of the agricultural land are inclined to erosion, 20% of them lose more than 10 tons per hectare a year. Inter-state associations try to
reduce the effect of the factor connected with the increase of population and the country’s well-being through the enhancement of the system of global trade agreements, increasing the promotion of the output of the national AIC, strengthening the protection of the sale markets. The effect of technological innovations on AIC proves that in mid-term perspective they will define new leaders in the agro-market. In recent years the scope of innovations in start-ups, which specialize in new agrotechnologies, has increased by 10 times. Big Data, robotics, artificial intellect and other technologies become common not only in an industrial conveyer, but also in agro-production. The process of changes takes place not only in start-ups. Merger and takeover are expected to continue in large agro-technological companies. Thus, an extensive use of digital technologies is a key trend of the world economy of the last decade. A branch standard in agriculture becomes the use of a geo-positioning system, complex management of a machinery fleet, precise agriculture. However, as the preliminary research results show, a true digital revolution in the world agriculture is ahead. World leaders in using digital technologies are IT-companies, media, finance and insurance. The level of digitalization is much lower in true production and logistics. Agriculture is the last in the list. According to Accenture (AgFunder AgriFood Tech Investing Report: Year review 2017), the effect of the introduction of single cloud services for agriculture can be a doubled profit received from a hectare. These services will create preconditions for digitalization speed-up of agriculture.

III. RESEARCH METHODOLOGY
During the research were used general scientific methods: dialectical - to generalize the theoretical and methodical principles of digitalization as a direction of development of the agrarian sector; monographic - during the study of individual phenomena, processes that accompany the introduction of innovative technologies in agrarian production in Ukraine and in the world; abstractlogical - in the process of the implementation of theoretical and methodological generalizations, the formation of conclusions and recommendations; economic and statistical - to assess the current state of innovation support of agricultural production and trends in its development; statistical and graphic - to determine the regularities and correspondences in the formation of the efficiency of innovative provision of agricultural production through comparing the results of the past with modern ones, as well as the trends and factors that determine the corresponding results.

IV. RESULTS
The nationwide analyses confirm that digital infrastructure can be divided into hard and soft. Each of them contains certain components which, separately and together, influence the implementation of the tasks of modern logistics. It is hard to overestimate the importance of the key components of digital infrastructure which, at lower costs, ensure the maximal adjustment of companies to a changeable market situation, increase the participation in the market and create advantages over competitors.

Basic components of digital infrastructure are given in Fig. 1.

"Formed according to the “Digital Agenda of Ukraine 2020”

Figure 1. Components of digital infrastructure*

According to the statistics of the British institute “Rendle” and a transit coefficient, Ukraine takes the first place in Europe (2014). And according to LPI of the World Bank, Ukraine takes the 80th place in efficiency rating in 2017 (Logistics Performance Index, 2017). A quantitative evaluation of the efficiency criteria of logistic activity shows a great significance of digitalization for logistic processes:
- efficiency of custom and border paperwork (speed/time, simplicity and predictability of formalities);
- quality of infrastructure, connected with trade and transport;
- simplicity of the organization of international transportation at competitive prices.

These technologies are used both in the U.S.A., the EU, Canada and in other industrialized countries. A successful experience in the introduction of updated financial technologies is oriented mostly on small agribusiness, farmers. A system of a complex automated scoring – the estimation of farmers’ and farm producers’ solvency in Kenya – can present a great interest for local agrarians. The advantage of the system is a wide access to credit funds and a high level of repayment.

A very simple procedure of cooperation is suggested for users:
- Farmers and small businesses have to email an application and inform about a set of key financial data: yield, revenues, expenses. Then the system analyzes solvency, and, in case of a positive decision, it opens the access to the assets asked. An individual payment system based on a mobile communication is used.
- A complex of services, directed to solve such key problems as the decrease of transaction expenses, the increase of the reliability of borrowers’ analysis (risk management), a wider portfolio, is proposed to financial institutions.

A scoring system consists in the use of an updated financial technology which combines highly effective search algorithms, the processing of large arrays
of information, decision making on the basis of neuron networks. Another example of a similar project is Acre Africa which facilitates the development of agro-insurance in the region. A company provides all market participants with basic information which is necessary for risk calculation, works out the products, which are in great demand, on insurance companies’ request, cooperates with re-insurance companies. To provide companies, which work in the sphere of agro-insurance, with proper and timely information, to form key branch indices, to ensure efficient feedback between insurance companies and their clients are the urgent tasks for the Ukrainian agriculture. The adaptation of Ukrainian legislature to the introduction of new financial technologies will increase investment attractiveness of Ukraine’s AIC considerably, simplify export supplies of the agrarian output to the countries of Middle East and North Africa. It will also make it possible to take an important step in reaching the goals of the strategic development of Ukraine’s AIC. Section “Geo-informational infrastructure” is a completely new management strategy in agronomy, which is based on the use of “digital” technologies, new technical aids, and it envisages taking some technological measures aimed at crop cultivation keeping in mind some space non-uniformity of a field. This is a new stage of the agro-sphere development connected with the use of geo-informational systems, global positioning, on-board computers, managerial and executive mechanisms, capable to differentiate cultivation practices, fertilization rates, chemical ameliorants and pest management means. Precise technologies in arable farming are intended to improve economic efficiency and soil protection, to increase yield capacity per hectare, to decrease yield losses in the fields and in general – to enhance the coefficient of the country’s useful land bank use (Fig. 2).

![Figure 2. Comparative analysis of technology efficiency](image)

However these are not the major goals. First of all, the key goal of precise arable farming is healthy society which has to consume healthy agrarian produce with the least amount of chemicals and fertilizers. The application of chemicals “by eye” eventually leads to the increase of disease incidence of people, the spread of pathologies among young generations, the reduction of life expectancy, and so it has an impact on demographic situation, economy, etc. Promising opportunities of digital arable farming have been recognized without any doubts. The combination of “digital” and precise technologies, hard-working Ukrainian farmers and soil fertility can increase the efficiency of the agrarian sphere of Ukraine, its world competitive ability and afterwards – occupy the richest “niche” in the world – mass organic crop cultivation. The next trend in the world agro branch is the protected soil technologies, which ensure high efficiency of agricultural production and help solve one of the main problems of the investments in agriculture – a serious effect of unfavorable environmental factors. Protected soil agriculture requires the access to the technologies: computer control over nutrient solutions, temperature and humidity of the environment, etc. Israel gives a good example of the use of natural competitive advantages for the development of the protected soil agro-production. At present this country not only exports the vegetables grown in greenhouses, it is also the world largest supplier of agro-technologies. New technologies, such as LED (light-emitting diode) sources with a photosynthesis optimal spectrum for radiation and aeroponics, made it possible to take the next step in the development of the soil protected agro-production. From the practical point of view, the use of aeroponic technologies resulted in the creation of “vertical farms” – a new form of the agro-output production. To place vertical farms directly in cities, near a store or a restaurant, reduces transportation expenses considerably, maintains freshness of the output, etc. These farms can use any free areas or they can be mobile, e.g. on a truck (the decision was suggested by start-up “GrowTruck”). Nowadays the average growth rate of this segment is 25% per year (Fig. 3). The main components of this market are a lightning system, the equipment for aero- and hydroponics, framings, a container-type as a rule, also a computer equipment and software.

![Figure 3. Forecast of the market of vertical farm equipment](image)

The largest markets of vertical farm equipment are in South-East Asia and the U.S.A. – about 30% of the world market each. The task to develop the protected soil arable farming is of paramount importance for Ukraine. The use of these technologies will make it possible to become one of the world leaders in using updated agro-technologies and to reduce investment risks in the branch. The market of vertical farm equipment is at the stage of fast growth. This direction of the development has a great potential for domestic highly technological production. One of the new tendencies of the technological development is the market of agricultural drones. According to the forecast, this is one of the largest fast-growing and highly technological markets in the world. The average annual growth rate is 30% (Fig.4).
The largest national market of agricultural drones is the U.S.A. At present the third part of all agricultural drones is sold in this country. But soon the markets of the European countries will show a great potential. Nowadays digital technologies open unique opportunities for the development of our economy and the improvement of the life quality of the people. Fast outcomes will result from the use of innovation technologies when digital transformation becomes the life basis of the Ukrainian society, business and public institutions ("Digital Agenda 2020", 2016). The main principles of the policy “digitalization of Ukraine” are “Digital code”. Digitalization is to be rather a tool than an end in itself. In a system state approach, “digital” technologies will stimulate the development of an open informational society as one of the important factors of the democracy development in Ukraine, the productivity increase, the economic growth, the job creation, and the improvement of life quality of the citizens of Ukraine. Five key components which constitute “digital economy” and are in the focus f “Digital agenda of Ukraine-2020” are the following:

- digital industry, i.e., ICT as a branch of the national economy;
- digital infrastructure;
- digitalization of business, industry;
- digital skills, competence and leadership;
- digital culture.

Digitalization of Ukraine requires new forms of solidarity, partnership and cooperation. Based on the analyzed documents concerning the creation of digital areas in Europe and in the world, we classify the major principles of digitalization of Ukraine. To follow these principles will be crucial for the process of development, implementation and use of the advantages which are provided by digital technologies:

1. Digitalization of Ukraine is to provide equal opportunities of the access to services, information and knowledge, which are given on the basis of information-communication technologies (ICT), for every citizen. In the year of 2011 the UNO declared a free access to the Internet network as a fundamental human right.

2. Digitalization has to be aimed at the creation of advantages (benefits) in various aspects of everyday life. Digital technologies, applied applications and others are the tools to reach the goals which are associated with different spheres of the life of man and the country: health care improvement, creation of new jobs, development of entrepreneurship, agriculture, transport, environmental protection and natural resource management, culture enhancement, poverty elimination, catastrophe prevention, etc.

3. Digitalization is a mechanism (a platform) of economic growth due to the efficiency and productivity increase resulted from the use of digital technologies. It is possible to get this growth provided the ideas, actions, initiatives and programs which concern digitalization will be totally integrated into national and regional strategies and programs of the development. A key purpose of this principle is to carry out digital transformation of the acting branches of the economy, spheres of the activity, their new qualities and properties.

4. Digitalization of Ukraine is to promote the development of informational society, mass media, “creative” environment and a market, etc. When open informational society is created, a significant role is given to the development, spread and preservation of a meaningful part, namely, the content in different languages and formats with proper recognition of the authors’ rights. Freedom to look for, to receive, to communicate and to use information for the creation, accumulation and dissemination of knowledge is a key factor of a healthy development of informational society.

5. Digitalization of Ukraine has to be oriented on the international, European and regional cooperation with an ultimate goal to integrate Ukraine into EU, Ukraine’s entry to the European and world market of electronic commerce and services, banking and stock exchange activity, etc., cooperation and interaction in the regional markets. This principle is one of the priority tasks, which favors Ukraine’s economic growth. It is digitalization that has to help Ukraine integrate with European and global systems; it is globalization that is a result of the spread of information-communication technologies.

6. Standardization is the foundation of digitalization of Ukraine, one of the key factors of its successful implementation. Standards strengthen competition, they enable to decrease expenses and output cost, to guarantee compatibility, quality support, to increase the country’s GNP. The basic element of the development and spread of digital technologies is the creation and use of the open, functionally compatible non-discriminating standards. It is not acceptable to work out digital systems which are oriented on business and an open market by “internal” standards. The system of electronic commerce, stock exchange and financial markets has to follow international and European standards.

7. Ukraine’s digitalization is to be accompanied by the increase of trust and safety when using ICT. Strong trust, including information safety, cyber security, confidentiality protection of personal information, immunity of private life and rights of users of ICT are the preconditions of the simultaneous development and security of digitalization. The necessity to form, develop and introduce national culture of cyber security is a key step in Ukraine’s fight with cyber criminality.

8. Digitalization is to become the object of focus and complex public management. Public management and politicians have to play a leading role in the development, promotion, introduction of comprehensive national “digital” strategies. Public management is to
concentrate on the obstacle elimination on the way to the country’s digitalization, the correction of shortcomings of market mechanisms, the support of honest competition, the investment attraction, the development of digital infrastructure and “digital” economy with the aim of reaching national priorities.

As an example of the support of the development of digital technologies, it is worth considering the EU initiatives as to the development of digital economy:

- “Industrial policy for the era of globalization – 2020” (Industrial Policy for Globalisation Era, 2010);
- “Digital agenda for Europe” (Europe Digital Agenda, 2010);

The purposes of the Strategy “Europe 2020”, which envisages the implementation of “The plan of the development of digital technologies in Europe” (European Commission, 2015) are to get stable economy and social well-being through the creation of a common digital market of the EU, founded on a broadband access (BBA). According to the EU guideline IP/10/581 Brussels (May 19, 2010), “Digital agenda for Europe” means that by the year of 2020 100% of the EU citizens will have BBA at speed 30 Mbit/sec and 50% of European households – up to 100 Mbit/sec.

V. CONCLUSION

Accordingly, the countries of Europe and the whole world, gradually via their own “Digital development programs”, raised the issue of BBA importance to ensure the rights of their citizens. Since 2010 in Europe, the era of whole-fiber access has started. The most promising option is FTTH (Fiber-to-the-Home). The number of the subscribers of the network with FTTH access is increasing in all the regions of the world. A high-speed broadband access in the European countries is financed through the EU instruments (e.g., the European fund of regional development, English “Program of rural area development”, European agricultural fund for the development of rural areas, “the EU Program of competitive ability and innovations”) and with investment credits of EIB. Thus, in the near 50 years the development level of the agrarian sector of Ukraine and its competitive ability in the world markets will be determined, in fact, by digital technologies. The key factors which define the transition of domestic agrarian production to digital arable farming are:

- Resource and economic factors. According to the statistics, precise arable farming reduces the need of fertilizers and pest management means by 30-50%. In present-day conditions, when Ukraine is lagging behind in agro-chemical application for 30-40 years, the introduction of precise arable farming will be a serious measure for the intensification of arable farming without substantial additional expenses (only due to redistribution and more accurate application of fertilizers).

- Ecological factors. The decrease of the chemicalization level of arable farming and the increase of business efficiency will mean a fuller use of chemicals and their limited migration beyond an upper soil layer. This will definitely reduce soil contamination, a lito-, atmos-, hydro- and biosphere as a whole.

- Health-protective factors. The produce contains fewer chemicals that influences consumers’ health condition; a so-called effect of natural recovery occurs - food, which is rather to cure than “to kill” quietly, etc.

- Social and public factors. The introduction of digital technologies facilitates the increase of labor attractiveness in agro-sphere; it will gradually change an agronomist into a modern manager, increase the level economic culture and ecological consciousness in the rural area.

The introduction of digital technologies demands from Ukrainian politicians and public figures to apply economic-production and social mechanisms, directed towards: the support of manufacturing, technical, educational and scientific aspects of precise arable farming; the training of qualified specialists who have the latest knowledge; the creation of a favorable atmosphere for digitalization of the agrarian sector. Therefore, the issue of the information development of society in Ukraine requires further adjustment of the legislature, the improvement of the national policy of overcoming obstacles for the integration of the domestic entities of the agro-industrial complex into the international digital infrastructure, the improvement of the acting system of risk management.

REFERENCES


