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Innovative Development of Agrarian Enterprises of Ukraine in the Context of the Fourth Industrial Revolution

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Abstract. The purpose of this article is to investigate the innovative development of Ukrainian agricultural enterprises in the context of the Fourth Industrial Revolution. The article presents the organizational and economic mechanism of innovative provision of competitive development of agrarian enterprises on the basis of the Fourth Industrial Revolution through inter-sectoral integration and development of digital agriculture to stimulate the diffusion of innovations, the implementation of the program of innovative entrepreneurship in the countryside, the formation of a symbiotic-complementary system of activation of technological and managerial innovations. It is proved that the basis of organizational and economic mechanism of innovative investing is creation of favourable business environment for realization of innovation-investment projects by agricultural enterprises, stimulation of integration of scientific developments and results of strategic management into production, formation of market competitive advantages in the long run. It is proved that the development of agrarian enterprises in Ukraine occurs under the conditions of radical economic changes aimed at strengthening the economic management methods and innovative component of their functioning. The aim of such transformation is to achieve economic growth and balance of functioning; ensuring the organic combination of the interests of business entities; transformation of scientific and technological progress into the main factor of economic growth; creation of conditions for realization of consumer priority in economic relations. Innovative changes in the functioning of agricultural enterprises contribute to the solution of the issues of technological and technological renewal, innovation-marketing development and economic growth. Increasing the competitiveness of enterprises in the agrarian sector of the Ukrainian economy, their timely adaptation to changes in the competitive environment, the formation of sustainable competitive advantages based on the most complete alignment of strategic capabilities of enterprises with internal potential and unused reserves, maximal synergies of the efficiency of work in a competitive market are also directly dependent on the technological renewal and diffusion of innovation. Taking into account the contradictions of the Fourth Industrial Revolution, it can be concluded that mankind can be saved from the stagnation only by collective mind which is capable to transform the absence of work and reduction of human's employment into means of social and personal development.

Keywords: competitiveness of the enterprise, competitive development, agrarian enterprises competitiveness management, competitive strategy, strategic management, innovative development, diversification.

I. INTRODUCTION

The actualization of transition to the innovative way of agrarian formations' development problems necessitates the search for the possibility of integrating the new type enterprises into the traditional model of management. At the same time, the innovations are the lever of shifting the economy to a qualitatively new development benchmark. Innovation is considered as the

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main criterion that ensures the formation of a competitive position of the subject in the market. At the same time, management priorities are actively shifting towards the search for a new innovative form of the enterprise, the advantages of which would contribute to the achievement of the main strategic goals such as high profitability, efficiency and competitiveness in the market. Today, not only the new generation of machinery, the latest technologies, but also the new organization of labor and production, new motivational system, alternative entrepreneurship are the innovative factors for the development of agricultural enterprises. These very innovative components integrated can transform the production system by updating the production apparatus, forcing to use it effectively. All of these are the first steps in the development of the Fourth Industrial Revolution (Industry 4.0). Further innovative development will inevitably bring about the transition to the fully automated digital production, driven by the real-time intelligent systems in constant interaction with the external environment beyond the boundaries of one enterprise, with the prospect of integration into a global industrial network of goods and services. These trends determine the relevance of the research topic, which aims to identify the trends and tendencies of agricultural enterprises innovative development in Ukraine at the beginning of Industry 4.0 – a new level of production and value chain management throughout the entire product life cycle.

II. LITERATURE REVIEW

Analyzing the modern paradigm of competition, it is necessary to consider the need to supplement the existing theoretical approaches with the fourth component, which would take into account the impact of globalization processes and the integration orientation of Ukraine into the world economic area. This approach should be based on current realities of economic development. The scientifically substantiated theoretical and methodological aspects related to competition, in particular in the context of globalization (Knysh M., 2000) and characterize competition as adversarial relationship for “higher value added” segments, where the growth of real income of a country depends directly on the integration of labor and capital into the business sector and creates high value when calculated per employee. This makes it possible to maintain the competitive status of the country in the world market in comparison with the competing countries.

The one of the world-renowned international competition researchers, identifies competition as emulation between the country's producers and transnational producers in the area of the highest-profit products they produce (Krippendorf K., 2018). S. Petrovskaya describes competition as a struggle between firms in different countries for more favorable conditions of production and sale of goods on the international market and obtaining the highest profit (Hrebnov H., 2012), A. Pricener - as emulation of firms, in terms of which independent actions effectively limit the possibilities of each firm to have one-side impact on the general conditions of the global circulation of products or certain national or regional markets (Makarenko M., 2010).

The term "competitiveness" was introduced in the late 1970's by M. Porter, who saw competitiveness as resource efficiency and productivity. Domestic economists began to explore the meaning of this term in the mid-1990’s. The term competitiveness, proposed by M. Porter and other authors, covers its various aspects and, as a rule, they complement each other. According to M. Porter, competitiveness is the ability of a commodity, a service or a subject of

market relations to be in the market on a par with similar goods, services or competing subjects of market relations (Porter M.,1993). According to the interpretation of R. Skupskyi and M. Volosyuk competitiveness is a condition under which an entity acts freely in market conditions, receiving full economic benefits and providing motivation for employees, and as a result the final product of their work is characterized by superior quality and produced on an innovative basis (Skupskyi R. and Volosyuk M., 2012).

III. PURPOSE OF THE STUDY

To justify the priority of innovative mechanism of competitive development in the system of agro-formations.

IV. METHODOLOGIE

General scientific and special methods of research were used in the process of solving the set tasks, in particular: historical and logical to consider the evolution of competitiveness and conditions of formation of the system of management of competitiveness of agricultural enterprises; quantitative and qualitative comparisons, analogies, observations, statistical and graphical methods to consider the state and efficiency of functioning of agricultural enterprises and prospects of foreign trade integration and diversification; institutional analysis to study the development of the institutional environment for the functioning of agricultural enterprises, to develop the institutional mechanism of competitiveness and the formation of a system of management of agricultural enterprises; method of theoretical generalization in formulating general conclusions.

V. FINDINGS AND DISCUSSION

The development of the agrarian sector of the economy enterprises in Ukraine is carried out under the influence of the integration processes in the world economic space. Accordingly, the task is to improve the existing economic system, increase the producers' competitiveness as well as to enhance the ability to respond in time and adapt to the changes in the economic environment. It is important to create a supportive business environment for the businesses to function. The transition to an innovative path of development involves choosing the most effective technical, technological and organizational-economic solutions based on the achievements of science and technology. Today, the innovative policy of agricultural enterprises is a significant lever for ensuring their restructuring, expanding the range of products and saturating the market with quality competitive products. The transition to an innovative model means not only stabilization but also a gradual increase in the technical and technological level of national production, bringing it closer to a group of technologically advanced countries in the world. The components of the competitive development of agricultural enterprises innovative model are shown in Fig. 1.

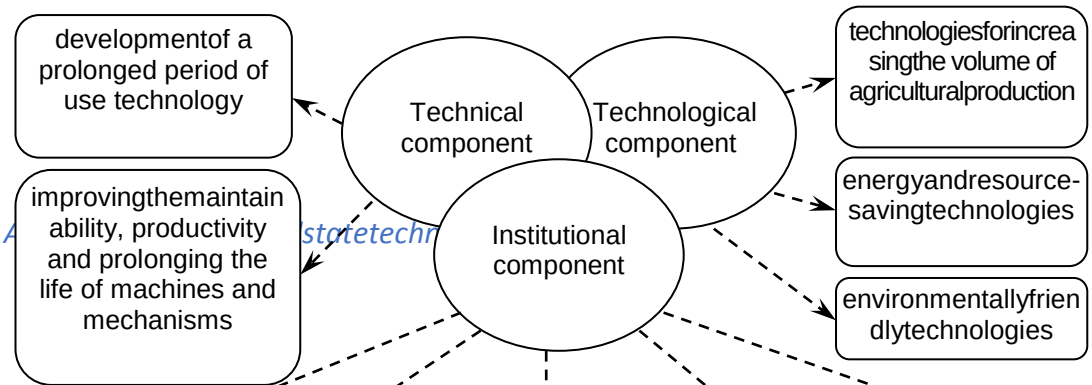

Fig. 1. Components of the innovative model of agricultural enterprises' competitive development

Source: formed by the authors.

The national priorities in the field of agricultural enterprises innovation are: active use of energy and resource-saving technologies in the production, storage and processing of agricultural products; introduction of modern technologies and developments in the sphere of ensuring agricultural production volumes increase and saturation of the domestic market with the accessible and quality products; application of environmentally friendly methods of production, concern for environmental safety of production; development of national machine building that will provide farmers with the new generation machines and mechanisms of higher maintainability, productivity and longer life.

Modern agricultural companies are not ready to accept and innovate, but are focused on the simplest and most commercially viable technologies. Another reason for the low innovation activity of agricultural enterprises is the lack of investment, which hinders their development, increases unemployment and widespread labor migration and emigration. Thus, according to UNCTAD, in 2017 foreign direct investment per capita in Ukraine was less than $ 1,000, while in Belarus it was $ 2,000, Poland – about $ 5,000, in the Czech Republic – about $ 11,000, in Estonia – $ 15,000 and in the USA it was about $ 18,000 (Ihnatiieva I., 2004). For these reasons, agricultural production is characterized by a decrease in technical and technological level and a low percentage of agricultural innovation.

The current trends in global development, the dynamism of the Fourth Industrial Revolution (Industry 4.0), characterized by the fusion of technologies and the blurring of the boundaries between the physical, digital and biological spheres and requires the improvement and change of the approaches to the instruments of ensuring the competitiveness of agricultural enterprises, in particular their innovation functions. The McKinsey Global Institute estimates that the global economy will be most impacted in the coming years by: the proliferation of the mobile Internet and the Internet of things; the automation of the routine intellectual work; the cloud

technologies and energy storage solutions; the progressive approaches to genome management; the new robotics and AI driverless transportation; 3D printing, etc. (Zborovska Yu., 2015).

According to the expert evaluation conducted by the State Statistics Service of Ukraine (UNIAN, 2017), the main factors hindering the full development of the innovative activity of domestic enterprises are: lack of own funds (80.1% of the surveyed enterprises), increase in the volume of innovation costs (55.5%), insufficient financial support from the state (53.7%), high economic risk (41%), imperfection of the legal framework (40.4%), long payback period for the innovations (38.7%), customers lacking funds (33.3 %), lack of the qualified staff (20%), absent opportunities for the cooperation with other enterprises and scientific organizations (19.7%), lack of trade area information (17.4%), lack of the information about new technologies (16.1%).

It should be noted that these negative trends are also associated with a significant decrease in the number of scientific organizations in the industry. Thus, in 2017, this indicator was 119 units, which is 13 units (9.85%) less than in 2015 and 47 units (28.31%) less than in 2010. Also in 2017 compared with 2015, there has been an increase of 66.5%, or UAH 132.5 million, of the cost of the industry organizations and enterprises' inside scientific developments. The distribution of financing by the type of work shows that in 2017, the largest shares of funding are in applied research (49.6%), while fundamental ones account for only 30.4%. In 2015-2016, the trend of funding was reversed; the basic researches were the leaders in funding: 50.8% and 49.6%, respectively (Table 1).

The innovation process goes through a series of stages from the development of an innovative product to its testing and product introduction. Today, however, the innovation activity in Ukraine is often imbalanced by the stages of the innovation process, which participants are poorly informed and show no interest in cooperating. This is especially true of the agricultural production and consumption.

In the agricultural sector innovation processes and innovations are very diverse. The most important are the technical, technological, environmental, biological and other innovations, most of them affect the life of living organisms, which must be taken into account at all levels of the innovation management. In addition to those mentioned in the agro-industrial complex, organizational and economic innovations are being developed and implemented, intended for the industry as a whole or for its individual sub-sectors and components. Each type of innovation is applied in different fields, but it is necessary and indispensable for the successful development of the country: the technical and technological innovations are aimed at improving the parameters of the production process and its results; the organizational innovations are developed and implemented to improve the organization of work, management, economic and production process, the market, etc.; economic innovations provide an increase in economic performance and performance of the national, sectoral economy and the economy of certain regions or economic entities. A separate group is formed by technological innovations and engineering, classified by the stages of the technological process in the economic entities.

Table 1: dynamics and structure of the scientific researches and development funding by the type of workfor 2010-2017

Year	Total cost, thousand UAH / %	Including scientific research implementation		
		fundamental,	applied,	scientific and technical

		thousand UAH / %	thousand UAH / %	(experimental) developments, thousand UAH / %
2010	44168,8	8900,7	11950,2	23317,9
	100,0	20,2	27,1	52,8
2011	37772,3	8918,7	10478,4	18375,2
	100,0	23,6	27,7	48,6
2012	37226,6	16576,3	7737,3	12913,0
	100,0	44,5	20,8	34,7
2013	28986,4	14400,2	7658,6	6927,6
	100,0	49,7	26,4	23,9
2014	33182,5	14148,6	9966,3	9067,6
	100,0	42,6	30,0	27,3
2015	26912,9	13677,0	8699,4	4536,5
	100,0	50,8	32,3	16,9
2016	39473,3	19563,8	11052,4	8857,1
	100,0	49,6	28,0	22,4
2017	44803,0	13625,1	22226,3	8951,6
	100,0	30,4	49,6	20,0

Source: Data of the State Statistics Service of Ukraine (Kushlyn V. and Chichkanov V., 2004).

In the broadest sense, agro-innovation is an innovation implemented in the agricultural sector. Scientists offer different approaches to defining this concept. Thus, agro-innovation is also interpreted as a systematic introduction of the research results into the agricultural sphere, contributing to the positive qualitative and quantitative changes in the characteristics of the relationship between the biosphere and technosphere, and improving the state of the environment, or it is viewed as a result of labor obtained through the use of the new scientific knowledge that transforms the process of functioning and development of the production and economic system of agriculture in the direction of improving its efficiency, stability and systemic quality of relations (V. Anfylatov et. al., 2002).

In view of the above, in order to ensure the balanced development of the agrarian sector of the Ukrainian economy, it is necessary to develop its own model of innovative activity promotion, taking into account the innovative capabilities of agricultural enterprises, increasing the motivation of all participants of the agrarian market, facilitating "the diffusion of innovations" process, active involvement of the state in the regulatory legislation (Fig. 2).

It is advisable to focus on the implementation of the innovative entrepreneurship, aimed at the innovative products, technologies and services creation, primarily based on the company's adaptive capacity to external influences, balanced organizational and management approaches, which will ensure a guaranteed innovation development in the future. Strengthening the effect of the innovation mechanism and maximizing the beneficial effect of innovation lies in their diffusion and symbiosis. Using these technologies separately, the effect of their implementation will be negligible. But their combination allows to achieve maximum social and economic

effects. Alongside with the innovations in the field of agro-industrial technologies, the technologies of crop and soil cultivation, EM-technologies, resource-saving, the search of the alternative sources of energy, etc., the organizational and economic innovations in the agricultural land market formation are necessary, namely the creation of the progressive activity of the agriculture large-scale innovative directed cluster structures, development of cooperative associations, balancing of the inter-branch economic relations, formation and development of infrastructure of the advisory activity, organization on the ground of innovative formations, etc.

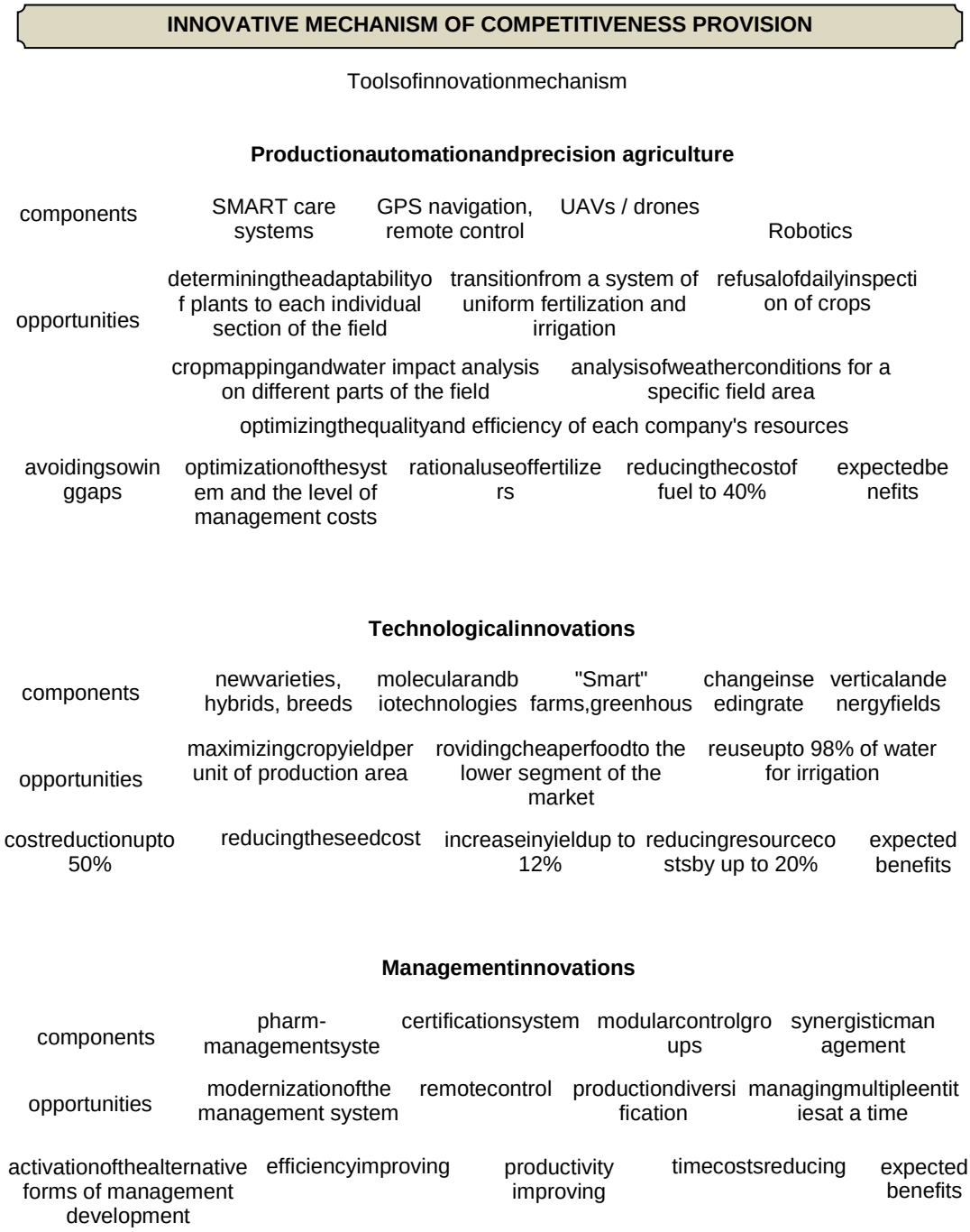

Fig. 2. Tools of the Innovative Mechanism for Ensuring the Agricultural Enterprises Competitiveness
Source: formed by the authors.

According to the findings of the Committee on the World Food Security, the well-being of the modern world depends largely on the dynamics of food production. The planet's population is steadily increasing, while the space available for growing crops is limited. Therefore, for agrarian enterprises, the issue of finding and implementing various innovations, adapting them for the use by the manufacturers of different shapes, sizes, methods of management and directions of production activity is relevant (Bazylevych V., 2014).

In terms of agricultural exports, national agricultural enterprises have emerged as world leaders, owing to the availability of the country's fertile black earths, the total area of which is comparable to that of the United Kingdom (Zhovovach R., 2011). Land use efficiency in Ukraine is relatively low compared to the countries in the world. In terms of crop yields, our country lags behind them by 10 years, 40% of agricultural machinery is outdated. In addition, land resources are not used rationally, the chernozem layer degrades due to the loss of fertility, erosion and man-made pollution. Almost half of the country's fertile lands are prone to erosion. At the same time, agricultural production is becoming more automated in the world. In contrast, domestic enterprises use outdated management methods.

The intensification of agriculture is a major priority in the development of agricultural enterprises in the world. The practice of introducing industrial and space developments in agricultural production is a world-wide modern trend, which is now significantly activated and introduced in enterprises of different shapes and sizes. The farming machines are equipped with computers, the labs are showing new varieties of crops, satellites and unmanned aerial vehicles monitor the state of crops in real time. In a globalized and integrated world characterized by the volatility and rapid changes in the environment, competitive relations have shifted from a price and non-price competition phase to the integrated method of competition. This stage is called "efficiency competition" and characterizes the conditions in which the manufacturer can no longer directly influence and manage the price, so the competition is moving into the field of cost management. The agribusiness market has become so global, that the most cost-effective way of managing profitability is the cost of production. Modern competitive wars involve the use of minimum resource and maximum effect strategies, their basis being the most efficient allocation of resources and the maximum result.

The Ukrainian agrarian sector needs to look for the alternative ways for its further development, strengthen export positions, and satisfy domestic demand for agricultural products. In the environment where energy, phosphorites and other types of raw materials for agriculture are constantly rising in price in the world, it is necessary to optimize their use per unit of acreage for maximum efficiency in each field. This will allow domestic manufacturers to enter the world markets with high quality competitively priced products, providing profit. It is necessary to abandon the unprofitable principle: "for sure" and go to the management based on the principle "how much you really need". This system is already actively used by agricultural producers in the developed countries and should find its distribution in Ukraine.

Space monitoring, or as it is also called, Earth Remote Sensing (ERS), allows you to study the Earth's surface with the help of electromagnetic radiation. Precise agriculture is being built on the data obtained by this method. Its essence is that the electronic maps of fields are made on the basis of satellite images. Then, due to the results the yield of different areas is analyzed and with the help of special technologies the chemical composition of the soil is studied. And according to the results of these studies, scientists give recommendations to the manufacturer, warn about the threat of pest infestation, the spread of plant diseases, provide an analysis of the status of seedlings, predict the harvest. And what is equally important for farmers that is they provide comprehensive recommendations for economical, ie accurate and optimal in terms of environmental safety, fertilizer application. The advantages of ERS compared to ground surveys are: speed, accuracy, ability to quickly analyze what is happening on the ground. However,

terrestrial research still plays an important role. Together with space monitoring, they make it possible to correlate the methods of recognizing crops on the field, their heterogeneity from space.

The authors of the study consider the introduction of modern cultivation technologies, including precision agriculture, which can significantly improve the efficiency of production and profit of agroformations, one of the leading areas of innovative development. Precision farming is seen as a symbiosis of different technological solutions that can increase the yields and manage agricultural resources better. It involves the use of the heterogeneity concept within one field or for the cultivation of one culture. Such features can be conditioned by the specificity of the landscape, the composition of soils with shallow mineral deposits, the state of groundwater, the climatic features and the characteristics of crops grown in this area earlier. Precision agriculture requires constant monitoring of the condition of crops and soil for the operational planning of a set of actions to optimize the condition of problem areas (Bazylevych V., 2014). The main innovations in precision agriculture are the following: surveillance systems, GPS/GNSS, robotics, UAVs/drones, wireless sensors and more.

With the increasing intensity of crop production, there is a growing need to obtain information on the state of the environment and the land on which the crops are grown. Remote sensing, including satellite imagery, on-board photographs, UAVs/drones, and terrestrial spectral measurements, can greatly simplify crop development monitoring and decision making to optimize the payments for agricultural claims incurred by farmers (Ermakov Yu., Nadvynychnyi S., 2018).

It is also advisable to photograph large land masses from satellites, which allows to observe the crops and decide on the "spot" application of fertilizers, insecticides or herbicides, irrigation, and the processing of such images with the overlay in the red and infrared spectra. In addition, the data of such programs can be downloaded to any electronic medium or on-board computer of agricultural machinery, which greatly simplifies the task for the agricultural enterprise employees (Bazylevych V., 2014). The most famous and effective providers of this service are companies such as Cropio (USA/Germany), eLeaf (Netherlands), PrecisionAgriculture (Australia), Astrium-Geo (France), MapExpert (Ukraine), Vega (Russia). The use of such systems not only allows you to quickly monitor the status of the fields, but also receive real-time reports and notifications of the most important events; predict field yields; receive related information; compare current and historical values of vegetation indices, soil moisture, fertilizer content.

There are various drones' modifications. For example, an unmanned aerial vehicle DV Wing equipped with an 18.2 megapixel camera can reach speeds of up to 50 km/h. The flying height is about 3 km. This unit is suitable for aerial photography and field mapping. Lightweight and compact, it can fly unassisted for 85 minutes. Another interesting solution of French company is Drone Spray Hornet. It is a drone sprayer designed to destroy the nests of Asian hornets. BioCarbon drones are used for planting gardens and forest strips. Based on the analysis of the area covered with green space, a decision is made on the quality and suitability of soil, plant density. If trees are needed, drones descend to as high as 2-3 m above the surface and discard seed capsules impregnated with nutrients. The speed and height of the unmanned aerial vehicle are designed so that the seeds germinate. In 1 minute it is planned to plant about thirty units of seeds, thus dropping several capsules. Planting trees with the drones is 85% cheaper. 70 to 90% of seeds are planted, and the cost of the drone is only 15% of the cost of human labor.

Large farms already have the first samples of self-propelled tractors that can plow the fields using satellite navigation data. Once farmers gained access to GPS in the 1990s, operators and manufacturers found ways to use this technology to simplify field work. Thus, GPS trackers track the mechanizers' work, thanks to antennas, you can process the fields more accurately.

GNSS, in turn, makes this technology versatile. It covers all existing GPS, Galileo and GLONASS satellite positioning systems [140]. A GPS sensor mounted on the tractor allows you to solve several problems at once. In addition to controlling the use of machinery and the consumption of fuel and lubricants, the farmer will be able to accurately determine the area of his land, since some fields have not been measured since the 1960s. By additionally equipping a tractor or harvester with an autopilot ($ 10-20,000 for one machine), you can greatly increase the capabilities of GPS navigators and their efficiency. One of the problems is sowing gaps (20 cm) though they are usually as wide as 50-70 cm. In a farm unit with 1 thousand hectares, 2 hectares of land are left untreated, so 7-8 tons of wheat are lost, which is 11-13 thousand UAH.

Wireless sensors are used in precision agriculture to collect data on humidity, compaction, soil fertility, climate change, and other important aspects to better allocate the resources. In Ukraine, there even has been developed a sensor to determine CO2 levels in the air.

The next major innovation of the last 20 years is the development of mobile devices. With the mobile devices, you can use various applications in the agribusiness with a great effect: trace element calculators, weather forecast, field maps and GPS navigation. Gadgets are able to distinguish crops from weeds and combat them both through the plant protection and mechanical means. In Germany, a conceptual optical sensor for herbicide application online called H-Sensor has been developed. It was the first sensor to distinguish crops and weeds. Its cameras automatically recognize different types of plants in real time. Due to its own light source, the sensor can be used around the clock. Its powerful hardware allows it to operate at a speed of 12 km/h. H-Sensor detects weeds and inflicts herbicides on the spot, reducing plant protection costs and reducing environmental stresses. The sensor can save 50-70% of the crops growing cost. The PF Box was designed specifically for the H-Sensor. Together, they allow to keep a diary and share it to your tablet or other mobile device.

According to the World Bank, if the planet's population continues to grow at he same rate, the world will produce 50% more food by 2050. But due to global warming, the yield of basic crops may decline by 25%. Global automation plays a key role in solving this problem. According to the US firm Winter Green Research forecasts, the volume of the agricultural technology market will grow to $ 16 billion by 2020. Goldman Sachs Investment Bank's somewhat more optimistic projections are $ 240 billion in market volume in five years.

Robots are assigned various tasks in agriculture, such as planting crops, monitoring crops, and even cutting weeds in the garden. For example, Knize engineers have created an autonomous grain basket system that allows the cart to follow the combine across the field at a safe distance. Another interesting project is Fendt MARS, which provides for the design of small and light robots for sowing corn. These robots consume little power, are managed from a tablet and transfer data to a cloud storage.

The new-generation agricultural robot BoniRob is now able to distinguish different crops from weeds, has the function of an "environmental weeder" and mechanically removes weeds without use of herbicides. In addition, the robot can determine the GPS coordinates of individual plants, draw appropriate maps of the work and prepare a report of where and what plants were sown and which were removed. The robot is able to distinguish weeds and cultures using a built-in algorithm based on the uploaded images, comparing leaves the color, shape and size. Thus, BoniRob is able to accurately identify weeds and push them into the ground with a special handler. The field robot is the size of a small car. It can navigate on its own, adapting to different field sizes. The modular compartment can handle up to 150 kg of material, and the energy generator operates for 24 hours without recharging. The cutting mechanism is 1 cm wide and capable of weeding into the ground as deep as 3 cm. It first detects plants, compares them to a built-in database, and destroys small weeds and removes large ones in several approaches. BoniRob's top speed is 3.7 cm /s with a weed density of 43 units a minute (1 m), at a lower weed

density it can develop a speed of 9 cm/s (Yehupov Yu., 2009).

The economic impact of innovations implementation is to reduce the number of agronomists, reduce the cost of fuel for detouring and working the fields, and reduce the cost of fertilizers. By having one or more satellite monitoring centers, you can optimize some of the costs that have previously led a business to profitability. The main thing is to optimize the quality and the efficiency of each resource: land, worker, machinery or fertilizer. Each operation should provide qualitative, not quantitative changes.

In the world practice, precision agriculture has long been successfully led by agrarian enterprises in the production of agricultural products, which in Ukraine is considered to be an innovation. Precision farming can be adapted to any farm shape and size. Not only agroholdings but also small and medium-sized agricultural enterprises (up to 10 thousand hectares) can get significant effect from the use of certain elements of precision agriculture. For the automation and optimization of production processes, and therefore, cost reductions, agrarians can use the systems of parallel control of motion and autopilots, GPS-monitoring systems, automatic unlocking of sections of equipment, mapping of crops, local-tape and differential application of fertilizers, etc. With a minimum economic effect of $ 30-40 per 1 hecter, the cost of modernization will pay off during the marketing year due to the differentiated local tape and the optimal fertilizers distribution. Today, there are some problems with the willingness of manufacturers to refocus on the new ways of managing. This is due to the fear of change, the use of the latest technologies in which they are not competent, and the possible loss of work or lower quality and productivity compared to the modern automated systems. However, technology automation allows to control the work and the exact actual use of resources (commodities and materials), and the results from the introduction of the precision agriculture far exceed "traditional" expectations. In arguing the choice of this innovative form, the author of the thesis considers it necessary to note that one should not copy the foreign experience, but adapt it to the domestic conditions, even to the conditions of a particular field.

Along with the high cost of capital investment for the implementation of the precision agriculture, its individual elements pay off in just a year. When using a single element, such as a parallel driving system or the automatic shutdown of sections on floors, the total economic effect can reach 7 to 10%. In case of the whole complex of technologies introduction - up to 50% and more.

Variable seed sowing technology and automatic cut-off of the sections allow sowing with the automatically controlled variable seed sowing rates within one field. Accordingly, it is possible to optimize the density of the plants growing in different parts of the field. With it, you can effectively use the resources and the potential of each section of the field, in particular, different stocks of productive moisture, organic matter, nutrients, light distribution and more (Ermolaev A. et. al., 2015).

Practical use of the proposed technology in the conditions of Ukraine provides a yield increase of up to 12% compared to the use of one seeding rate. Using the technology of the automatic section switching off of (controlled by each sowing machine of the seeder) during corn sowing allows to avoid overlappings and excess of plant density, provides saving of seed material from 3 to 8%. This is due to the absence of overlaps on the repeated strips and wedge-shaped sections of the field. Of course, it largely depends on the culture, cultivation technology, fields configuration and size. The cost of the re-equipment of the 24-row seeder for the implementation of automatic sections switching off and control of seeding is about $ 15,000. The economic effect is: $ 7 savings per 1 ha of seed, the cost of modernization is offset by the sowing of corn in the area of 2100 ha. The introduction of the precision farming elements should begin with the agrochemical soil analysis, field heterogeneity studies, gender passport study, and selection of the technologies that are most appropriate for the economy. The implementation of

these measures and the use of the information obtained in the production of agricultural products allows to increase the efficiency of the precision farming technologies by 20-30% (Ermolaev A. et. al., 2015).

Innovative sensors have also been used in livestock farming. For example, Smartbell sensor monitors an animal's motor activity and transmits data to a cloud storage. Motion sensors can help determine if a cow is ready for insemination. Some devices are installed directly in the first section of the stomach (scar), which measures the acidity and diagnoses problems. Scientists are also using genetic modification to make animals safer for staff and other animals. For example, cows without horns are bred. Gene modification has also been used to create swine immunity to African swine flu (Zhmailov V. and Danko Yu., 2011).

Therefore, the main tasks of the biotechnologies introduced into production are the development of new biologically active substances and medicines for medicine; microbiological plant protection products against diseases and pests, bacterial fertilizers that promote plant growth; new high-yielding and resistant to adverse environmental factors of varieties and hybrids of agricultural plants obtained by genetic and cellular engineering; nutritional supplements and biologically active substances to increase livestock farming productivity; new methods of bioengineering for the effective prevention, diagnosis and control of major animal diseases; technologies for deep and efficient processing of agricultural, industrial and household waste, the use of wastewater and gas and air emissions for biogas and high quality fertilizers. Biotechnology has the potential to play an important role in improving the efficiency of agriculture. The advantages of their application include the satisfaction of need for food, increase of the population incomes and the environment preservation.

The main advantages of using biotechnologies are the provision of cheaper, low-solvency consumer foods that are actively responsive to changing prices for relatively inelastic products; improving the productivity of agricultural production, stimulating economic growth and expanding trade opportunities, accompanied by the creation of the new high-paying jobs and positive shifts in various areas of management; the reduction due to a more efficient system of overhead and transaction costs.

It is important to analyze and evaluate the competitive advantages of agricultural innovative-oriented enterprises which are formed under the influence of the biotechnology. The first group of them are the trade competitive advantages that promote the development of trade relations and the free exchange of safe biotechnological products, as well as expand the scope of the biotechnological developments practical application to ensure economic development. The next group is the technological competitive advantages that are manifested in reducing the risk of the negative characteristics in hybrids appearance, compared with the use of traditional technologies; increasing crop production without threat to the environment; reducing the use of pesticides and the widespread adoption of the advanced tillage technologies, including plowed agriculture, which counteracts erosion and reduces the need for fertilizers; reduction of technogenic impact on the environment while intensifying production and increasing its volume in order to provide food for the population.

The next group of advantages is the economic competitive advantage of introducing biotechnology to agricultural enterprises. The feasibility of biotechnological production is determined by: reducing the cost of pesticides and hazardous agrochemicals; reduction and distribution of production risks; increasing the income of business entities; redistribution of additional profit for innovative development; expansion of production activities; changing the quality and structure of consumption; increasing the share of savings in the general structure of consumption and income of the population; changing the structure of expenditures (for study, travel and entertainment); the opportunity to ensure economic growth, development and prosperity. However, it is important to realize that the innovative development of agrarian

enterprises is a complex process and one that should be based on innovative perspectives, not just on the introduction of biotechnology. Increasing the economic effect of biotechnology is facilitated by their implementation in combination with strategic measures that ensure the elimination of negative external threats, which creates an environment of direct influence (political, economic, social, technical and technological) and enhance the competitive potential of the internal environment, activation of the explicit and implicit competitive advantages of the enterprise in the market.

Increasing the innovative biotechnological activity of agricultural enterprises is considered as one of the criteria for their competitive advantages formation in the organic market in particular. The system of competitive advantage formation is of key importance for managing the enterprise as a subject of competitive and public relations. In addition, competitive advantages in the global market are the basis of the international division of labor. Therefore, the main argument for the innovative development of agricultural enterprises and the use of biotechnology in particular is the provision of economic growth, diversification and intensification of production and the formation of the higher-level competitive advantages system; achieving maximization of economic efficiency while minimizing costs, increasing output volumes for 1 ha of area; optimization of the ratio of industries providing a synergistic effect of management; improvement of risk distribution and insurance systems; increase of economic security of the enterprise and its financial stability.

Innovative biotechnologies include the production of organic fertilizers, which is of paramount importance, as humus content in soils has decreased by 20% over the past 10 years. Today, a unique fertilizer plant has been developed and operates. The principle of its work takes into account that agricultural enterprises always produce secondary raw materials, which are either simply left on the field or burned. Fertilizer production requires compost, humus or a mixture of them with the addition of peat, sawdust, straw and special microbial kits due to which biothermal fermentation takes place. At 35 degrees Celsius, the pathogenic microflora and fungi are neutralized in the burt, and the organic matter decomposes and becomes available for assimilation by plants. Microorganisms getting into the soil improve its fertility. Such fertilizers replace 10 tonnes of fresh humus.

Also, breeding vermiculums of earthworms is one of the promising ways to dispose organic waste. The presence of the earthworms in the soil makes it possible to significantly accelerate the decomposition of organic matter, so that in a relatively short time it is possible to turn a variety of organic waste into a valuable humic fertilizer in an environmentally friendly way. The second product derived from the vermiculture is earthworm biomass, which has been successfully used as a protiene additive to the food and as a biochemical feedstock. Vermiculture is quite widespread in Western Europe, some countries of Eastern Europe (Hungary, Poland), USA, Japan, and the countries of Southeast Asia. There are quite a number of small and medium-sized enterprises that produce earthworms for amateur fisheries and pet food, garden soil or organic vermicompost fertilizer (Lupenko Yu. et. al., 2014). In the application of the mouldboard method of plowing, as well as the application of pesticides and fertilizers, the soil in a very short time partially loses its qualitative characteristics: salinity occurs, its structure is destroyed, humus content as the main source of fertility is reduced, soilmicroflora and fauna are destroyed. As a result of such imprudent human actions, the yields are sharply reduced, and the unreasonable increase in fertilizer application further exacerbates this process.

It takes at least 300 years to create a centimeter layer of black earth in natural conditions. For 10 years of improper use of soil and excessive chemisation, the soil that the nature had neen creating for thousands of years can be destroyed. Thanks to the developed biotechnologies, it is possible to increase the humus content significantly in 3-5 years. Biohumus exceeds manure and compost by 4 to 8 times the humus content. The nutrients needed to feed plants in biohumus

interact with the mineral components of the soil to form complex compounds. Thus, they are reliably kept from washing, slowly dissolving in water, providing the plants with the nutrition for a long time.

The next promising area for innovative development of agricultural sector enterprises considered is a bioenergy one. The demand for bioenergy is a global worldwide trend, and Ukraine has all the prerequisites for it to succeed. This trend in has been developing quite actively in our country in the last few years. Thus, the average rate of increase in the share of bioenergy is 42% per year (Lupenko Yu. and Kropivko M., 2013). According to the agrarian sector development strategy, biomass consumption will increase by 2020: 40% will be covered by wood biomass and 60% will come from the agricultural sector. These are the agricultural waste and residues (straw, stems, husks) that are recyclable.

In many countries of the world, bioenergy accounts for up to 40% of total energy consumption, primarily in Sweden, Finland, Latvia, Denmark, and Austria. The average for Europe is 9%, in Ukraine the figure for the renewable energy is 4.5%. These include bioenergy (about 60% of the total), large-scale hydropower (about 30%), small-scale hydropower, sun and wind (Lupenko Yu. and Kropivko M., 2013). The raw materials for agricultural biomass are wheat straw, corn stalks, chicken manure, sunflower waste or food processing waste, elevator waste and husk. The innovative management practice for the elevators may be the refusal of gas in favor of grain cleaning waste, harvesting, pelletizing and burning corn straw. The agricultural waste processing might become the promising area of bioenergetics, such as harvesting and baling straw and corn stalks. In recent years, corn and corn by-products have been expanding more than wheat ones. However, our country has not yet developed a corn husk taking the US and Canada as an example.

One of the major national systems that help agribusinesses optimize production, improve planning and can even minimize crop losses (Zhydiak O., 2012) is the comprehensive accounting, planning and analysis system for agricultural enterprises such as Soft.farm. It was developed as a software solution focused on improving the production processes management in the agribusiness. The program is designed for the companies engaged in plant and animal husbandry. In this case, all data is stored in the cloud storage. The program allows to plan sowing, including crop rotation, maintain electronic agrochemical passports of the field, as well as draw up technological maps and a book of field history. Its functionality makes it possible to automatically calculate the needs for seeds, fertilizers and plant protection products, it is also possible to form planned and actual costs, which makes it possible to manage the budget. In this case, the formation of analytical reports will allow you to make informed decisions on managing the economy in a timely manner. In animal husbandry, the program deals with the automatic planning of the structure of the herd, the accounting of genealogy and analysis of the growth and weight of animals, the preparation of diet and veterinary measures, the control and planning of daily work, as well as the analytical reports generation.

The basis of eFarmer is the "Parallel Control" module, which allows you to track equipment movements, control the tractor with a smartphone and generate reports. "Parallel control" will be useful for the tractor driver to monitor the movement of equipment and the supervisor to see the quality of the work performed. The program allows to create and edit field maps, spot obstacles and take photos of field notes. In the field log, you can monitor the nutrients and the amount of the fertilizer used. The "Parallel control" module allows to control the movement of the tractor from the tablet, as well as the operation of the mechanic by the GPS tracking of the field work completed. AgroController is an enterprise management system that has great functionality for the field and technology monitoring. The capabilities of the device are the compilation of technological maps of the fields such as crop rotation control, analysis of the crop development dynamics, tracking the history of the field condition and assessing the yield

forecast. The monitoring of equipment is aimed at controlling the area treated, as well as the working time of each type of equipment. Fuel consumption accounting provides a set of sensors in the system that monitor the consumption of fuel and lubricants.

The startups provide farm management or agricultural management systems in different formats: in the form of a co-operative bank of anonymized data, a standard management system, or specialized programs, for example, for grape harvesting management. All of these projects make it possible to evaluate data from the sensors, satellites and other sources to increase productivity (Zhmailov V. and Danko Yu., 2011).

The problem with the introduction of innovative technologies in agriculture using wireless sensors, satellite navigation and drones is their sensitivity to signal loss when using a mobile network or wi-fi. Therefore, the aircraft have to exchange signals through a non-mobile broadband radio connection. There is a need for a solution of the of employment problem in agricultural production. The active automation and robotization in agriculture can lead to unemployment in the industry. Thus, during 1950-2010, according to the International Labor Organization, the share of agricultural employment in the countries of the world decreased from 81 to 48%, and in the developed countries from 35 to 4%. The active involvement of robotics in agricultural production will undoubtedly accelerate this process. But without it farmers will not be able to create effective businesses in the future to feed the planet's growing population. The main ways of overcoming the contradictions are the development of rural territories, the establishment of informational, educational, advisory and consultative support to the village. Overcoming the negative consequences of the agricultural production processes automation and the release of human capital is also possible due to its re-orientation to other sources of income in the countryside. One example is the experience of one German village council, which initiated the development of innovative industries in their territories in 1997. Over the past 20 years, the village has built more than 10 solar power plants, 5 biogas stations and more than 10 wind generators. The complex of these measures made it possible, on the one hand, to preserve the identity and habitual rhythm of the settlement, and on the other, to give the community an alternative source of additional income. Each private home in Wildpoldsried has got solar panels. The surrounding small rivers and streams have mini-power plants. As a result, the settlement of more than 2500 people generates 350% more electricity than needed for their own consumption. The sale of surplus electricity annually generates over € 5 million (ErmakovYu.andNovalok I., 2017).

The diversification of agricultural production is also linked to the processing as a promising area of innovation. Thus, such type of products processing as dried borscht and soup mixes production is becoming widespread. For example, a pack of dry borsch that costs 37 UAH is 3 liters of ready-made product and is cooked in half an hour. Dried vegetables can be stored for more than a year (Zhovovach R., 2011).

Therefore, agricultural enterprises are now integrated into the system of world economic relations and are undergoing a strong globalization influence in their activities. The low level of their competitiveness dictates adjusting to the needs of the entities with a stronger competitive position and falling into the so-called trap of globalization, when the weaker economy, interacting with the structurally more advanced, becomes their peculiar appendage. Thus, it becomes quite likely to become a supplier of raw materials and labor to the world markets. Structural excellence, and hence competitiveness, is ensured, first of all, by the advanced manufacturing industry, to which industries of different technological levels belong. A perfect structure enables the developed economies to redistribute resources to their advantage through various mechanisms of global interaction between countries (Zbarsky V. and Misevich M., 2009). Therefore, the current conditions for ensuring the competitive development of the country and its subjects require a change in the structure of material production in favor of the sectors

where a higher added value is created. Therefore, the new industrial transition is a key issue in the economic strategy of ensuring the competitiveness of the agricultural enterprises. Strengthening the competitive position of Ukrainian agricultural sector enterprises in the process of innovative development will allow them to make the most of the globalization opportunities, namely: borrowing of knowledge, technologies and productive capital (Fig. 3).

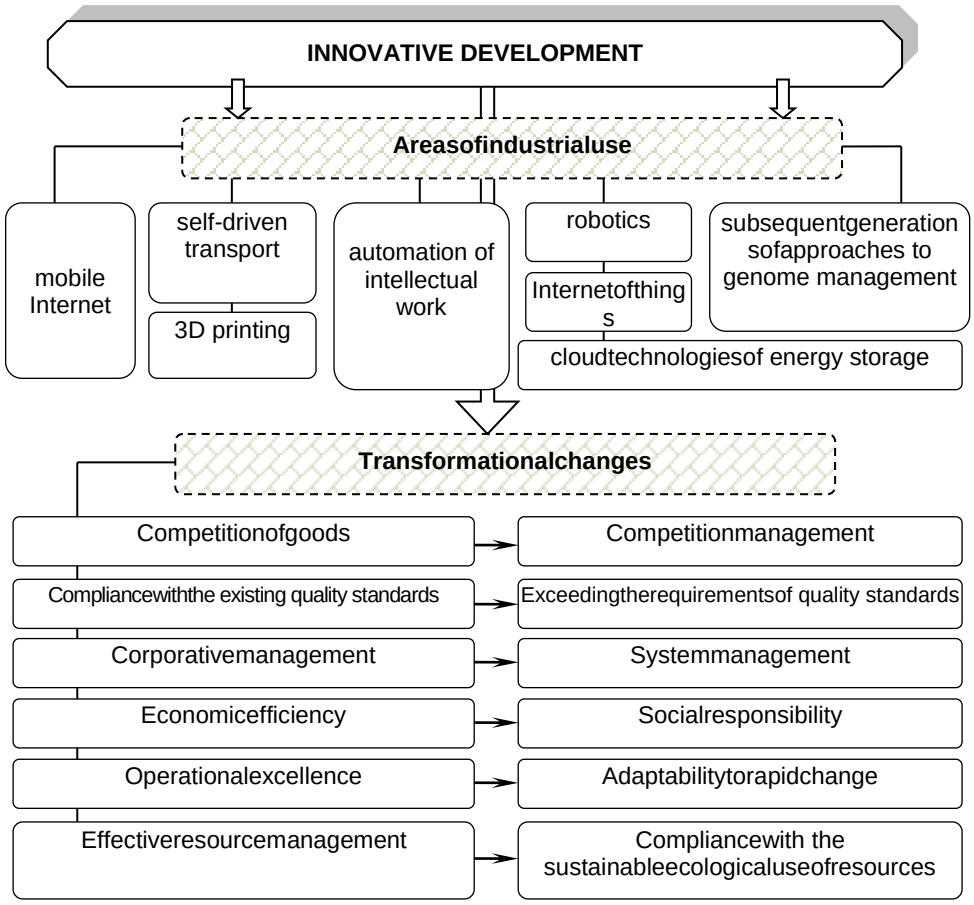

Fig. 3.Trends and tendencies of innovative development of Ukrainian agricultural enterprises in the context of the Fourth Industrial Revolution.
Source: formed by the authors.

The transformations are also being traced to the competitive methods. The competition of management models comes to replace the competition of goods and services. Also in the G20, in 2016 in China, taking into account the significant role of the management systems in ensuring competitiveness in a globally saturated market, the global trends in transforming the corporate governance models into the systemic governance were discussed. This is due to the social organizational relations development, the change of emphasis in terms of their priority. Depending on the level of the society maturity, the emphasis of competitive relations in it changes.

In the first stage of development (Level 1 of society maturity) the main attention is paid to the products, or more precisely to the issues of products safety (services). In the second stage (Level 2) the same focus is on the products themselves, but the main focus shifts towards quality, that is, its consumer properties. In the third stage (Level 3) considerable attention is already paid to the organizations, improving their local target management systems, primarily quality management, based on the standard requirements for these systems. In the final, the fourth stage is met when reaching the highest level of development (Level 4 of society maturity), the main

attention of the organization is paid to the holistic management systems.

Improved organizational and economic mechanism of innovative provision of competitive development of agricultural enterprises on the basis of the fourth industrial revolution through inter-sectoral integration and development of digital agriculture to stimulate the diffusion of innovations, implementation of the program of innovative entrepreneurship in the countryside, the formation of symbiotic-complementary technologies.

VI. CONCLUSION

The innovative component provides the new paradigms of competitiveness. Thus, the behavior of the enterprises is reviewed from the standpoint of maintaining their competitiveness. The vector of interests shifts from the operational excellence, quality performance of the processes, stable production of high-quality products, ISO 9001, kaizen, economical production towards the formation of the consumer demand; corporate social responsibility, recognizing the inevitability of the unforeseen changes and building the resilient systems. Therefore, not only the industrial change but also managerial experience requires innovative change. The best practices and approaches to the enterprises organization and management, mastering these approaches and practices should be summarized.

Thus, the development of the agriculture enterprises in Ukraine occurs under the conditions of the radical economic transformations, aimed at strengthening the economic management methods and the innovative component of their functioning. The goal of such transformations is to achieve the economic growth and balance of functioning; to ensure the organic combination of the interests of business entities; to transform the scientific and technological progress into the main factor of economic growth; to create the conditions to actualize the principle of consumer priority in economic relations. The innovative changes in the functioning of agricultural enterprises contribute to the technical and technological renewal, innovation-marketing development and economic growth issues solution.

Increasing competitiveness of the Ukrainian economy agricultural sector enterprises, their timely adaptation to changes in the competitive environment, the formation of sustainable competitive advantages based on the most complete alignment of the strategic capabilities of the enterprises with internal potential and the unused reserves, the maximum work efficiency synergization on the competitive market also depends on the pace of technological innovation and the diffusion of innovations.

Taking into account the contradictions of the Fourth Industrial Revolution, we can conclude that the humanity can be saved from stagnation only by the collective mind able to make the absence of work or the human employment reduction into s means of social and personal development.

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