Digitalization of Agrarian Enterprises Management in the Frames of Renovation After the War in Ukraine

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Abstract In the paper the conceptual vision of digitalization of management of agrarian enterprises in the frames of renovation after the war in Ukraine is presented. It is important to provide the future development of the economy of Ukraine and of its branches and sectors, in particular of the agrarian sector, based on the intensive methods of management. Digitalization of management of agrarian enterprises of different size becomes crucial in the given conditions. As a matter of fact, the agrarian sector of Ukraine is extremely important for the whole economy of the country, because of its food security, social and creating the overall welfare functions. However, the process of management of agrarian enterprises is often characterized by old extensive approaches. Big agrarian enterprises of Ukraine can easily provide

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digitalization of management at all levels, but as for small and medium-sized enterprises (SME), the task is not so easy to be fulfilled because of their limited resource possessing. Implementation of such organizational form of activity at the agrarian enterprises as contractual farming can push the digitalization management processes at small and medium-sized agrarian enterprises in the frames of renovation after the war in Ukraine.

Keywords Agrarian enterprises · Digitalization · Management · Renovation · SME

1 Introduction

The economy of Ukraine is to face the new challenges in the nearest future. In particular it will be necessary to construct a new model of development after the war which will allow to switch from the previous extensive way of managing it towards the intensive one. The transformation is going to touch all the branches and sectors of the economy of Ukraine. As a matter of fact, the agrarian sector has always been one of the key sectors of the economy of Ukraine and it remains crucial as it is responsible for the food security, fulfills a number of social functions and contributes much to the overall welfare creation because of its prior role in the economy of the country. However, the process of managing the agrarian enterprises requires digitalization of their activities at all levels. There are enterprises of different size in Ukraine and they differ enormously in their ability to provide digitalization. The big agrarian enterprises are the pioneers in digitalizing their managerial activities whereas the small and medium-sized agrarian enterprises cannot do that quickly because of lack of resources and very often lack of information about the possible changes. At the same time the small and medium-sized agrarian enterprises (SME) are important for the economy of Ukraine because of their social role in creating the overall welfare. In this connection it is necessary to search for the forms of providing digitalization of them.

The following issues are considered in our paper:

- The necessity to submit the extensive ways of managing the spheres and sectors of economy after the war is well-grounded;
- The importance of the agrarian sector in the economy of Ukraine is determined as well as the necessity of digitalization of management of the sector;
- The forms of providing digitalization of agrarian enterprises of different sizes are offered.

2 Literature Review

The scientific research of great many of scientists is dedicated to implementing the digitalization processes in economy, in particular in the processes of management at different levels of all the branches and sectors of it.

The scientific concept concerning the digitalization of economy emerged in the economic science thanks to the contribution of Negroponte [1] who offered it to describe the processes in the world economy. The concept of digitalization found its development based on the works of the scientists of the previous century, in particular, of Vernadsky [2], Kingstone [3], Solow [4] who stressed the crucial role of the human mind and innovations for economic development.

Nowadays there is a vast amount of publications on the development of digital economy. The concept is considered as a way of development of welfare economy and sustainability because the digitalization lets implementing economic, ecological and social goals of development simultaneously. Digitalization as one of the major trends changing society and business due to the adoption of digital technologies in the organization is discussed by Parviainen et al. [5]. There is also interesting discussion concerning the sustainability of possible competitive advantages caused by digitalization initiated by Knudsen et al. [6].

Digitalization of management of different processes contains not only positive aspects of the process, but also some threats and potentially unexpected sides of digitalization for organizations. This issue is studied by Trittin-Ulbrich et al. [7].

As for working out the directions of agricultural policy offering better support for sustainability, there is interesting research provided by Ehlers et al. [8].

In Ukraine the researchers have already started to work at the model of development of the country in the post-war period. The evaluation of the importance of enterprise restructuring and trends of enterprise restructuring management over past 25 years in Ukraine (before Russian invasion) were presented in paper Mostenska et al. [9]. Without any hesitation the model is to be based on the innovative approach to managing all branches and sectors. In this connection the paper by Borodina [10] on the development of cluster model of nonindustrial modernization is of great interest. The paper presented by Alekseieva et al. [11] concerning the influence of digitalization on human development in the process of constructing the welfare economy is worth attention.

Despite the importance of all the research that has already been done it is necessary to develop the process of searching the models of development of the branches and sectors of the economy of Ukraine in the post-war period. The renovation should be based on the intensive and digital approaches implemented in management, in particular in management of the agrarian sector. The stated above has determined the purpose of the current research.

3 Purpose of the Study

The purpose of the article is to provide the conceptual vision of digitalization of management of agrarian enterprises in the frames of renovation after the war in Ukraine.

4 Methodology

In order to carry out the research some widely-spread scientific methods have been used. First of all, the *method of induction and deduction* allowed formulating conceptual vision of current research on the basis of the studying done before. Using *the method of analysis and synthesis* helped to make some important conclusions concerning the peculiarities of the managerial activity in the agrarian sector. The *method of abstracting* was used to neglect some specific details of the development of agrarian enterprises in order to carry out the research. Using the *method of logical conclusions* made it possible to make general conclusions on the development of the agrarian enterprises and to offer the forms of digitalization of their management.

All the stated above methods are used in the frames of searching the model of creating the welfare in Ukraine in the frames of its after-war renovation. The general *axioma of the research* is that after war in Ukraine the renovation of its economy should be based on intensive approaches to development of all the branches and sectors (including agrarian sector) of it, i.e. the management processes should be altered towards their digitalization.

5 Research Results and Discussion

The economy of Ukraine after the war will be put in conditions of searching the ways of its transformation towards the one with sustainable development. The basics of the previous economic model oriented mostly at extensive ways of managing the spheres and sectors of economy after the war should be submitted by the intensive ones and the new methods of managing the economy should be developed and implemented. The new model of management should be efficient in conditions of continues energy restrictions, aimed at implementing lean approach in using the natural resources and drawing acute attention to the ergonomic problems. The welfare should be constructed basing on intensifying the digitalization processes, whereas the economic growth should no more be dependent on the extensive factors. The role of digitalization is going to grow significantly in all branches and spheres of the national economy and the agriculture is not an exception at all.

Number of active business entities by type of economic activity in 2021 is presented in Table 1.

Table 1 Number of active business entities in Ukraine by type of economic activity, 2021

Category	Number of business entities					
	Total, units	In % to the total	Enterprises		Natural entities-entrepreneurs	
			Units	In % to the total	Units	In % to the total
Total	1,956,320	100.0	370,906	100.0	1,585,414	100.0
Agriculture, forestry and fishing	70,803	3.6	47,753	12.9	23,050	1.5
Industry	121,787	6.2	49,059	13.2	72,728	4.6
Construction	56,627	2.9	31,500	8.5	25,127	1.6
Wholesale and retail trade; repair of motor vehicles and motorcycles	777,419	39.7	97,038	26.2	680,381	42.9
Transportation and storage	94,633	4.8	17,619	4.8	77,014	4.8
Accommodation and food service activities	69,775	3.6	7560	2.0	62,215	3.9
Information and communication	284,141	14.5	16,384	4.4	267,757	16.9
Financial and insurance activities	10,643	0.6	4234	1.2	6409	0.4
Real estate activities	94,342	4.8	36,093	9.7	58,249	3.7
Professional, scientific and technical activities	143,210	7.3	29,556	8.0	113,654	7.2
Administrative and support service activities	54,153	2.8	18,587	5.0	35,566	2.2
Education	17,927	0.9	2682	0.7	15,245	1.0
Human health and social work activities	34,574	1.8	7569	2.0	27,005	1.7
Arts, entertainment and recreation	15,829	0.8	2264	0.6	13,565	0.8
Other service activities	110,457	5.7	3008	0.8	107,449	6.8

Source State Statistic Service of Ukraine [12]

Strategic orientations of development of all spheres of economy and, in particular, of the agrarian sector will be distinguished by the strengthening of the importance of innovations, on the one hand, and the realization that there is no alternative to a gradual transition to a new digital model of the economic system, on the other. It is clear that the main role on this path belongs to working out the new management model considering the digitalization factor. Today, it is necessary to force the economy to develop digitally, to accelerate the transition of traditional industries namely the agrarian sector to a higher technological system.

The agrarian sector of Ukraine is one of the key sectors of the economic development.

The dynamics of active business entities development (depends on size) in Ukraine is presented in Table 2.

The sector plays a very important role in the economy of Ukraine, consumes much to the GDP performance, provides a substantial share of the overall export of the country. According to the results of 2021, agriculture contributed the highest percentage to GDP among all sectors of the economy, i.e. more than 10%. Agri-food products also account for the largest percentage of total exports of Ukraine,

i.e. about 41% per year. In year 2021 agriculture showed the highest increase in production, i.e. 14.4%. At the same time, the products of the agricultural sector were exported in the amount of $ 27.7 billion (or 40.7% of the total export of products from Ukraine), which is 25% more than in 2020. The most important parts of the export of food and agricultural products in 2021 remained grain crops, oil, oilseeds and cakes, solid waste from the extraction of vegetable fats and oils [13]. However, according to preliminary estimates by scientists, the potential direct damage caused to the domestic agricultural infrastructure and its assets as a result of the Russian Federation's full-scale aggression against Ukraine exceeds 6 billion dollars. Additional economic losses to the industry from the war in 2022 are expected to be around $22 billion, with a 10–30% reduction in the income of agriculture and related sectors [14].

A set of measures to restore the agrarian sector after the war does not mean only physical revival of destroyed enterprises and objects of the social sphere, but tasks directed to restore its competitiveness, to adjust production, raising the standard of living of people in rural territories and internal and external demand on the basis digital approaches and technologies. Economic recovery should be based on constructing a new model for "reanimation" of the sector which is to be based on innovative approaches of management of the sector.

In this connection, the influence of the digitalization factor on the efficiency of agrarian enterprises is constantly and steadily increasing. If two decades ago, digital technologies acted as a supporting element of the management system, played an auxiliary (technological) role in the implementation of information exchange between the participants of the management process, today technical modernization and intellectualization allows them to transform into one of the main elements of increasing the competitiveness and strengthening the viability of agricultural enterprises. Development, implementation and use of an effective digital technology becomes the main component that determines optimality and success of any economic entity, including agricultural. The introduction of digital technologies

Table 2 Number of active entities of large, medium, small and micro-entrepreneurship by type of economic activity in Ukraine, 2010–2021

Category	Years	Number of active business entities, total							
		Large entrepreneurship entities, units	In % to the total of business entities of corresponding type of economic activity	Medium entrepreneurship entities, units	In % to the total of business entities of corresponding type of economic activity	Small entrepreneurship entities, units	In % to the total of business entities of corresponding type of economic activity	Of which micro-entrepreneurship entities, units	In % to the total of business entities of corresponding type of economic activity
Total	2010	586	0.0	21,343	1.0	2,161,999	99.0	2,093,688	95.9
	2011	659	0.0	21,059	1.3	1,679,902	98.7	1,608,819	94.5
	2012	698	0.0	20,551	1.3	1,578,878	98.7	1,510,776	94.4
	2013	659	0.0	19,210	1.1	1,702,201	98.9	1,637,180	95.1
	2014	497	0.0	16,618	0.9	1,915,046	99.1	1,859,887	96.3
	2015	423	0.0	15,510	0.8	1,958,385	99.2	1,910,830	96.8
	2016	383	0.0	15,113	0.8	1,850,034	99.2	1,800,736	96.5
	2017	399	0.0	15,254	0.9	1,789,406	99.1	1,737,082	96.2
	2018	446	0.0	16,476	0.9	1,822,671	99.1	1,764,737	95.9
	2019	518	0.0	18,129	0.9	1,922,978	99.1	1,864,013	96.0
	2020	512	0.0	17,946	0.9	1,955,119	99.1	1,898,902	96.2
	2021	610	0.0	17,811	0.9	1,937,827	99.1	1,880,858	96.1
Incl. Agriculture, forestry and fishing	2010	13	0.0	3445	4.3	76,863	95.7	72,421	90.2
	2011	16	0.0	3281	5.3	58,191	94.7	52,654	85.6
	2012	26	0.0	3158	4.6	65,313	95.4	59,671	87.1

(continued)

Table 2 (continued)

Category	Years	Number of active business entities, total							
		Large entrepreneurship entities, units	In % to the total of business entities of corresponding type of economic activity	Medium entrepreneurship entities, units	In % to the total of business entities of corresponding type of economic activity	Small entrepreneurship entities, units	In % to the total of business entities of corresponding type of economic activity	Of which micro-entrepreneurship entities, units	In % to the total of business entities of corresponding type of economic activity
	2013	27	0.0	2926	4.1	68,105	95.9	62,419	87.8
	2014	28	0.0	2876	3.8	72,756	96.2	66,258	87.6
	2015	29	0.0	2535	3.2	76,720	96.8	71,649	90.4
	2016	20	0.0	2505	3.4	72,095	96.6	66,905	89.7
	2017	18	0.0	2391	3.1	74,184	96.9	68,819	89.9
	2018	23	0.0	2307	3.0	73,998	97.0	68,492	89.7
	2019	34	0.1	2285	3.0	73,131	96.9	67,627	89.6
	2020	36	0.1	2137	2.9	71,195	97.0	65,753	89.6
	2021	49	0.1	2095	2.9	68,659	97.0	63,051	89.1

Source State Statistic Service of Ukraine [12]

into the activities of the agrarian enterprises determines efficiency of the elements of the production system: production, marketing, logistics, personnel and, especially managerial.

In general, the peculiarities of management of the agrarian sector are determined by the structure of the agrarian sector which traditionally includes three components, i.e. three areas: industries that provide the means of production for agrarian sector, the agrarian sector itself (agriculture, animal production, forestry) and the industries that process agricultural raw materials into finished products and semi-finished products for its production (Table 3). Each of these areas of the agrarian sector can be separately considered as a complex with own complicated and diversified structure (substructure).

The first includes engineering, chemical, construction, microbiological and feed industry enterprises. The second includes agrarian enterprises, i.e. farming enterprises, livestock enterprises and forestry. Such enterprises are aimed at producing products of both final and intermediate consumption for different consumer groups:

Table 3 Branches of the agrarian sector

Management of agrarian sector: Governing bodies, accounting, analytical, statistical and market organizations, consulting, industry science, personnel training, education in the agrarian science and management, social institutes, etc.		
Industries that provide the means of production for agrarian sector: – Agricultural machinery and engineering; – Manufacture of technological equipment for food, flour-grinding, feed and processing industries; – Manufacture of machines for animal production; – Manufacture of machinery and equipment for the storage of raw materials and food products; – Repair of agricultural machinery and equipment at industrial enterprises; – Production of mineral fertilizers and plant protection products; – Compound feed and microbiological industry for the agrarian sector; – Rural construction, incl. land reclamation and road	*The agrarian sector, including agriculture itself, animal production, hunting, forestry:* – Plant growing: vegetable growing, horticulture, grain production, cotton growing, flax growing, etc.; – Animal production: cattle breeding, dairy cattle breeding, pig breeding, sheep breeding, meat and wool sheep breeding, poultry breeding, etc.; – Forestry: reforestation	*Processing of agrarian products:* – Food industry: food flavouring, meat, dairy, flour and cereals, mixed fodder, baking, pasta, fish; – Light industry: textile, leather and fur, footwear; – Feed industry; – Procurement organizations; – Trade organizations

Source Created by authors

citizens and enterprises of different industries. The third is focused on recycling of agrarian raw materials. Its structure is one of the most complex. This is due, firstly, to the difference between raw materials and technological base. Second, enterprises processing agrarian raw materials and related to the food industry tend to have special requirements for raw materials. The process of processing of raw materials into finished products includes a complete production cycle. It includes procurement, production, transport, trade, as well as facilities that provide storage of agrarian products.

A significant difference in managing the enterprises of the agrarian sector lies in the features of the production period which leads to additional managerial risks in the sector. In the agrarian sector the production period is approximately longer than that at the enterprises of the first and the third structural groups of the agrarian sector. It is necessary to stress that there are increased managerial risks especially typical for the agrarian sector and the projects in the agrarian sector. This is due to the fact that the results of the activities of agrarian producers are determined not only by the quality and quantity of labor invested, but also by the objective conditions of managing of the process of agrarian production. The important thing here is not avoidance of managerial risks at all, but to forecast and reduce it to an acceptable level. This is also a reason of the quick widespread of digital technologies in the sector which helps to reduce these risks. Digitalization is becoming a new "format" of using data to make the right management decisions and to reduce risks. Processes, data, algorithms are all very important components for the modern model of managing the agrarian enterprises. Reliable data about the state of fields, processes of production, storage, logistics and algorithms allow predicting the risks to achieve effective figures in the sector. Practically digitalization in the agrarian sector plays the role of transfer to the information system of a huge array of data describing all the characteristics of the production, in particular agrochemical, physical and chemical, climate history, yield history, history of applied plant protection products, norms, yield obtained etc.

It is a well-known fact that there is a relationship of interdependence among three areas of the agrarian sector (industries that provide the means of production for agrarian sector, the agrarian sector itself, and industries that process agricultural raw materials into finished products). These three important areas of the sector should be coordinated and developed from a single center. Therefore, it is necessary to introduce the fourth component into this classification—a superstructure that ensures the organization and management of the agrarian sector in terms of digitalization. Then the structure of the branches of the complex will cover four areas (Table 3). Thus, both the agrarian sector and the spheres that form it are formed according to the principle of a complex hierarchical structure. The hierarchical principle of managing the agriculture refers also to the territorial branch organization of it, namely three levels of management system can be distinguished: the national level, the regional level and the level of agrarian enterprises (Fig. 1).

Such division of management of the sector into levels implies continuous improvement of its digital support and increasing the degree of use of digital technologies, whereas the process of digitalization of management of the agrarian sector should correspond to the implemented functions of the agricultural management system

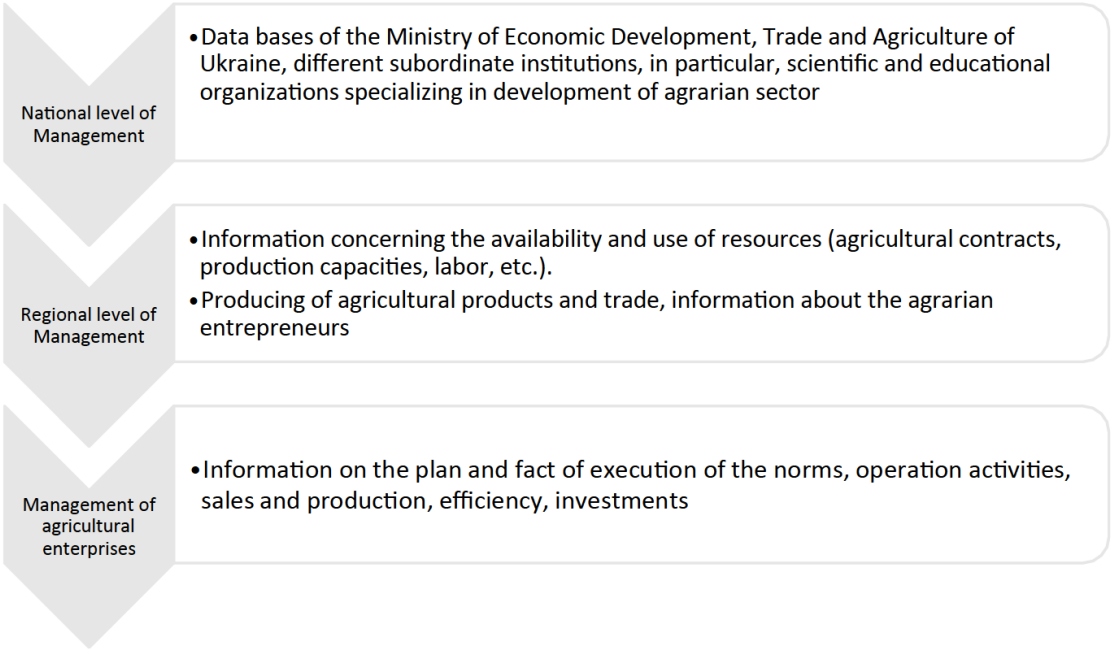

Fig. 1 The hierarchical principle of data managing in agriculture. *Source* Created by authors

of all the levels. So that, the hierarchical principle of data managing in agriculture determines collecting of data at the national, regional levels and the level of enterprises (Fig. 1) and the reliability of information at the highest level of management depends on the entire chain of its occurrence, processing, storage and transfer from the lowest (operational) level, i.e. level of the agricultural producer, his qualifications and integrity into the process of digitalization. Otherwise the picture of the real state of affairs can be significantly distorted.

Numerous studies concerning issues of digitalization of agrarian enterprises provide an opportunity to highlight a number of problems limiting the possibilities of their development. First of all, the absence of a strategy for digitalization of agrarian enterprises should be named which is accompanied by lack of both implementation of digital support of management of the agrarian sector and use of best practice in the area of perfection of the information provision of the sector. Secondly, there is still low level of digital skills of managerial staff of agrarian enterprises, in particular, digitalization of the agrarian sector provides new requirements to acquisition of digital competences by managerial staff. Also, underdevelopment of the infrastructure of digitalization can be stated as a problem in Ukraine because purchase of computing equipment and software as well as payment for related communication services requires significant financial resources which is not easy in current conditions for many agrarian entities. So that, the basis of digitalization of managerial functions of agrarian enterprises lies in various digital technologies which can be used to solve a wide variety of managerial tasks.

It should be admitted that the practical implementation of digitalization also depends often on the size of agrarian enterprises and their ability to use financial resources for digitalization. Analyzing a complex organizational structure, for

example, in agrarian holdings which have significant volumes of various unstructured information to achieve a large the number of both current and long-term goals, then, as a rule, the basis of the digitalization of management and the improvement of information provision are corporate digital systems optimized for the specific needs of agrarian holdings.

For the implementation and use of such systems in the company's activities, significant investment resources are necessary, which make it possible to purchase powerful modern computers and software, provide effective communications and training of specialists at all levels, development of an information security system, etc. For representatives of medium-sized and small agrarian businesses digitalization of their enterprises becomes a problem because of limited financial opportunities. As a result, the fragmentary model of digitalization of small agrarian enterprises is introduced and can be characterized by partial automation of individual management processes and tasks. And as a result, small agrarian enterprise often hires personnel with insufficient level of digital skills and does not possess a completely automated set of management tasks. This can be characterized as "patch digitalization" of some management functions of small and medium-sized agrarian enterprises that appears in the low level of development of applied software, which does not allow implementing a complex approach to the implementation of management functions.

The stated above forces to answer the question whether the small and medium-sized agrarian enterprises should be supported in their future development or it is less consuming to let big agrarian holdings to develop within the agrarian sector. Currently in Ukraine, the model of the development of the agrarian sector is actively being discussed. On the one hand, big agrarian companies can use more resources for "digitalization" and renewal of the production, implement active introduction of new technologies and bring more income to the budget. Economies of scale are guaranteed within the big agrarian companies, and the cost-effectiveness principle can best be applied. In order to ensure the rapid growth of the national product in the economy of Ukraine, development of large agrarian enterprises means rapid multiplicative growth of exports and gross product, as well as rapid digital renewal of the whole sector, which in its turn stimulates the renewal of related industries, including food and processing and the spread of digital technologies. On the other hand, judging by the size of the national economy, its base is considered to be small and medium-sized enterprises. Development of the small and medium-sized agricultural enterprises provides an opportunity to create a multicultural model of agricultural production, as they guarantee the achievement not only of economic but of social goals, serve as a kind of social elevator for young people in rural areas and create opportunities for self- realization in market conditions. In addition, the role of small and medium-sized farms is important for the country's food security. Therefore, the development of small and medium-sized agrarian enterprises remains one of the necessary prerequisites for the sustainable development of both rural areas and the country as a whole. That is why it is necessary to construct a model of development of the agrarian sector in future where the agrarian holdings could successfully cooperate with small-and medium-sized agrarian enterprises in Ukraine, Reznik et al. [15].

To promote digitalization of management process of small and medium-sized agrarian enterprises in conditions of constructing a new model of development of agrarian sector after the war it is possible to implement such form of interaction among the agrarian entities of different size as contractual farming.

Such form of cooperation as contractual farming can be mentioned as the one offered by the international organization FAO to stimulate developing countries, Murekezi et al. [16]. The private association is mainly seen as a toolkit of coordinating the value chain via contract farming to help increase agricultural productivity and provide food security, particularly through its digitalization. For instance, to develop poultry farming and aquaculture, the use of contract forms of farming is recommended. Fish and poultry tend to spoil quickly, that is why it is very difficult to solve the problem of delivery of finished products to agrarian enterprises. Such form as contract farming can become a solution to this problem. Hence, there are many ways to determine contract farming, but generally, contract farming can be seen as vertical integration of producers and agents further along the value chain, such as agribusinesses, processors, exporters or retailers. Large companies can involve small and medium-sized businesses in cooperation, creating business environments, ecosystems to strengthen their competitiveness. The mechanism of such cooperation is rather simple: larger companies give smaller companies access to new technologies, resources, sales markets, and sometimes even finance them. Afterwards the results of the work of the smaller farmers, i.e. the final products, can be bought by the larger companies. Both farmers and companies develop very quickly and become successful. In its essence, the agrarian ecosystem is created, where not only farmers benefit, but also rural residents [17]. In addition to access to new digital technologies, experience and resources, enterprises involved in such interactions cultivate among their partners and local communities the principles of sustainable business development and careful treatment of natural resources.

6 Conclusion

After the war, the structure of the Ukrainian economy will inevitably change. A great number of enterprises are currently destroyed and different branches of economy including the agrarian sector are suffering huge losses due to the large-scale aggression of the Russian Federation at the territory of Ukraine. In such conditions, in order to construct a new model of the Ukrainian economy it is necessary to work out mechanisms which will allow to escape from the previous extensive way of managing economic relations, in particular, in the agrarian sector via modification it towards the intensive one.

This assignment can be implemented through digitalization of managerial processes in the sector. As a matter of fact, the agrarian sector of Ukraine plays a key role in the overall economic performance of the country, fulfills social function and it is responsible for the food security. Digitalization of management of agrarian

sector does not mean "patch" digitalization, i.e. digitalization of some selected activities in the sector and their managing, but digitalization of the whole sector, the way of managing it at all levels. It is not easy to fulfill practically because the process of digitalization requires substantial financial resources. The agrarian holdings are often able to provide digitalization of management of their enterprises whereas the small and medium-sized enterprises cannot do that by themselves. At the same time development of small and medium-sized agrarian enterprises is extremely important because of their remarkable social function in the economy of Ukraine. Implementing of such form of cooperation as contractual farming can accelerate digitalization of management of all the enterprises of the sector and intensify the development.

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