

## Digital Ecosystems as A Tool for Ensuring Integration Interactions In Agro-Food Complex

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### Abstract

At the present stage of the information development of society, digital ecosystems are one of the most effective tools for organizing intra- and intersystem interactions. One of the stable forms of economic interactions is agro-industrial integration, which ensures the association of producers and processors of agricultural products into product chains. The digital ecosystem of communities is viewed as an innovative tool for building relationships between integrating entities and those carrying out organizational, economic and technological interaction within localized territorial and industrial formations. The digital ecosystem creates conditions for the implementation of a fundamentally new form of integration of subjects of the agro-food complex and changes in the entire business model of interaction between producers and processors of agricultural products, which allows balancing economic interests even between competing entities and more fully realizing their development potential. As the essential characteristics of the digital ecosystem of integrated formations of any type, it is proposed to distinguish: a set of interacting subjects, goals implemented by different types of subjects interacting within the digital ecosystem, key functions of the digital ecosystem, reflecting the set of tasks it solves. Reasoning of the range of tasks implemented by the digital ecosystem takes place within the framework of various strategies for their development (passive, adaptive, active and proactive).

**Keywords:** Digital Ecosystem, Business Ecosystem, Integration Interactions, Agro-Industrial Integration, Agro-Food Complex.

### Introduction

The quality and stability of intersubjective interactions largely determines the efficiency of the functioning of complex economic systems, which include the agro-food complex. The agro-food complex is a set of economic entities interacting within value chains and integrated into the common economic and information space based on the rationalization of organizational, economic and technological relationships arising in the process of agro-industrial integration. The presence of a significant number of vertical and horizontal links that exist within the value added chains require an adequate system of information support for the interaction of entities that are integrated with each other. At the present stage of the

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information development of society, digital ecosystems are one of the most effective tools for organizing intra- and intersystem interactions. Digital ecosystems provide the possibility to implement network forms of partnership and information coexistence of interacting subjects. At the same time, the model of organizing digital ecosystems of integrated formations will largely depend on their type and form of integration interactions.

## **Background Paper**

The word "ecosystem" comes from the Greek oikos (habitat), and the idea of using the term "ecosystem" in relation to economic systems has been proposed since the early 90s of the last century by Moore J.F. (1993), with the aim of identifying communities of interacting economic entities that provide opportunities for their joint development and implementation of private economic interests. The theory of business ecosystems has become quite widespread, posing before economic science the problems of classifying business ecosystems, determining their optimal structures, rationalizing horizontal and vertical relationships, forms and tools of intersubjective interactions (Cho S., (2019), Hou J. (2010), Kitsios F. (2017), Burda Ye. (2020), Solodilova N. (2020), Kleiner G. (2020)).

In the context of the transition to a new level of technological development associated with the massive introduction of digital technologies and the beginning of the digital transformation of the system of social production, it became possible to form business ecosystems on a fundamentally different basis, since the level of development of information and communication technologies ensures not only the provision of stable communication channels with high speed of information exchange, but also dramatically expands the functionality of services and information systems integrated into digital platforms (Tatarinov V. (2019), Akatkin Yu. (2017), Suleykin A. (2020), Karpunina E. (2020), Ivanova I. (2018)). It is digital platforms that form the hardware and software basis of digital ecosystems, which represent a qualitatively different level of development of business ecosystems.

One of the stable forms of economic interaction is agro-industrial integration, which ensures the unification of producers and processors of agricultural products in food chains. The presence of various models for organizing integration interactions objectively determines certain differences in business ecosystems that arise in localized economic and information spaces. At the same time, it was agro-industrial integration, that, according to Sycheva I. (2017), Glotko A. (2019), Frantsisko O. (2014), Ulezko A. (2019), Rodionova E. (2018), ensured the growth of the efficiency of the agro-food complex of Russia as a basic element of ensuring the country's food security.

The holding model of the organization of integration interactions prevailing in the agro-food complex of Russia determines the functionality of this type of business ecosystem. This model under the current conditions allows the most complete implementation of the principle of economic feasibility of vertical integration. Its essence, according to a number of researchers (Rodnyansky D. (2016), Tomilina E.P. (2013), Bogachev D.V. (2015), Turarova A. (2020)), is to minimize the profits of entities representing intermediate links of product chains, the optimal allocation of resources based on the concentration of the functions of systemic management of all elements of value chains in a special body that coordinates the activities of the entities that make up the integrated formation, and the processes of their interactions. The business ecosystem of communities of this type provides a high level of capital concentration, is rigidly structured, vertical and horizontal links are formed based on the interests of the integrator company, and the common information space is configured in accordance with the existing management system for integration interactions. The transformation of business ecosystems into digital ones for integrated formations of this type, as a rule, is carried out in the form of a massive introduction of digital technologies while maintaining the existing system of interlink and intersubjective interactions, and digital platforms that make it possible to implement a certain range of corporate governance tasks become the information basis of the new digital ecosystem.

The change in the institutional environment has created the prerequisites for the transition to a cluster model of organizing integration interactions. Integrated associations organized within this model, according to Makarevich L (2019), Nikitin A (2018), Makarevich L (2020), Huhurin A. (2016), Savchenko T. (2014), Zavyalov D (2017), are described by relatively flexible specialization, the predominance of soft forms of organizing intersubjective interactions and freedom of participation in integration processes, democratization of management process, the predominance of the coordination function, participation of the state in defining development goals and objectives, social responsibility of business for the development of territories, collegial methods of allocating financial resources and a wider range of financing sources, the mobility of the boundaries of the economic and information spaces. The specificity of the functionality of this model of integration interactions also determines the specifics of the organization of the digital ecosystem of this form and the digital platform on the basis of which it will be implemented.

## **Research Problem**

The digital ecosystem represents a new stage in the development of interaction between economic entities, the transition to a network form of partnership and information coexistence. At the same time, interaction is considered as a set of

predictable reactions of subjects to each other's actions, due to the presence of stable causal dependencies and allowing to coordinate the activities of interacting subjects. Intersubjective interactions, as a rule, are implemented within the framework of the exchange of information and benefits on the basis of stable direct and feedback links, regulating the forms of their organization. The choice of the form of organizing interactions depends on the number of interacting subjects, the complexity of vertical and horizontal ties, the method of integration of technologically, economically and organizationally related subjects that form value chains. The structure and functionality of the digital ecosystem depend on the type of interactions within the integration communities. In practice, three types of integration interactions are most often implemented: horizontal (integration of equal entities that retain economic and legal independence), vertical (integration of subjects of individual links of product chains if there are subjects in the product chain with dominant interests and determining the standards and conditions of interaction), network (integration of subjects of individual links of product chains on the basis of equal partnership). At the current level of technological development and division of labor, the main form of interaction between economic entities is their integration within the framework of creating economic benefits.

Integration relations are long-term in nature and, unlike random market interactions, presuppose the emergence of certain forms of cooperation of stably interacting subjects, reflecting the specifics of the organization of integration processes, and mechanisms of intersubjective interactions that ensure the coordination of the activities of economic entities and the realization of their individual interests as a result of the establishment of stable economic, organizational, technological and other types of relationships. In turn, the functionality of the mechanism of integration interactions inherent in one form or another of integrated structures will determine the specifics of the organization of digital ecosystems.

If the digital ecosystem of integrated formations of the holding type is focused, first of all, on organizing the interactions of entities integrated into product chains on the principles of vertical integration, then a wider range of actors belongs to the subjects of the digital ecosystem of the cluster model of agro-industrial integration. This is due to the fact that within the framework of the cluster such forms of integration interactions as lateral (integration of entities engaged in the production of heterogeneous products, but supplying them to the same customers) can be implemented; rearguard (integration of entities in order to form and use a common infrastructure, minimize transaction costs and production costs); combined (integration of entities within various product chains and in the production of products with similar consumer properties in order to diversify sales channels and minimize lost profits); parallel (integration of entities focused on the production of complementary goods through product chains or distribution networks); circular (integration of entities operating within the same local markets, but not being direct competitors), etc. In addition, the cluster model of integration allows the state to participate in the cluster, as an equal subject of cluster interactions, performing specific coordination functions in solving problems of economic and social development.

The digital ecosystem of cluster-type communities is considered as an innovative tool for building relationships between integrating entities and those carrying out organizational, economic and technological interaction within localized territorial-sectoral formations. The digital ecosystem allows of optimization of the intersubjective connections that arise in product chains within the framework of the division of labor and specialization of individual entities, representing their various links, but going beyond the boundaries of integrated holding-type structures operating within the boundaries of localized territories and developing one or more related industries.

The composition and structure of the digital ecosystem of economic clusters are formed on the basis of the need to realize the advantages of concentration of production based on the digitalization of stable formal and informal intersubjective relationships, to ensure high flexibility of integrated formation, the possibility of increasing the efficiency of the functioning of individual members of cluster associations. It is the digital ecosystem that creates the conditions for the implementation of a fundamentally new form of integration of the subjects of the agro-food complex and changes in the entire business model of interaction between producers and processors of agricultural products, which allows balancing economic interests even between competing entities and more fully realizing their development potential.

As the essential characteristics of the digital ecosystem of integrated formations of any type, it is proposed to distinguish: a set of interacting subjects, goals implemented by different types of subjects interacting within the digital ecosystem, key functions of the digital ecosystem, reflecting the set of tasks it solves.

## **Discussion And Results**

The model of a digital ecosystem of integration interactions in the agri-food complex is based on a set of theoretical and methodological provisions that determine its inner essence:

- the system of integration interactions presupposes the formation of a relatively stable set of subjects of the agro-food complex, interconnected within the framework of added value chains and concentrated within localized territories;

- participants in digital ecosystems can be any entities involved in the creation of final products of product chains and interested in maintaining sustainable relationships;
- being an open structure, the digital ecosystem presupposes a certain localization of the information space, the boundaries of which are determined by the number of integrating entities and the level of development of the information infrastructure;
- the basis of the digital ecosystem of integrated formations is the principle of consolidation of interests of entities competing with each other, which implies the establishment of horizontal integration relations that create conditions for the concentration of resources and efforts aimed at overcoming barriers limiting the development opportunities of entities united within the cluster model of integration;
- a digital system of integration interactions involves the participation of the state as in the activities of an integrated formation within the framework of public-private partnership;
- digitalization of intersubjective interactions should create prerequisites for the growth of the balance of territorial-sectoral formations and minimization of disparities inherent in traditional ways of organizing business communities, allowing you to get an additional effect by reducing transaction costs;
- the digital ecosystem should ensure the adequacy of the reaction of all participants in integrated formations to changes in the functioning environment and the flexibility of the system of intersubjective interactions;
- the formation of a digital ecosystem is carried out in the course of the natural evolution of the business ecosystem of integration interactions when conditions arise that give rise to the objective need for digital transformation of intersubjective interactions and the development of a common system of their infrastructural support while consolidating efforts to achieve a common development goal.

The key participants in the digital ecosystem of integrated agro-industrial formations are proposed to include economic entities of the following types:

- agricultural producers and processors of agricultural products integrated into food chains;
- entities that implement the functions of resource and infrastructural support of product chains, bringing manufactured products to the end consumer;
- entities that implement the functions of financial services for the participants of integrated formations;
- state and municipal government bodies that implement the functions of regulation and coordination of agro-industrial integration processes and balancing the interests of integrated formations and rural areas.

Each type of participants in digital ecosystems of integrated agro-industrial formations tries to achieve their own goals. For agricultural producers and processors of agricultural products, the goal of entering the digital ecosystem is to digitalize reproduction and management processes based on the use of uniform standards and regulations, as well as improving the quality of intersubjective interactions. For entities that implement the functions of resource and infrastructural support of product chains, bringing the manufactured products to the end consumer, as well as the functions of financial services for the participants of integrated formations - in ensuring online interaction with entities integrated into product chains and minimizing transaction costs. For the authorities it is digitalization of the implementation of the functions of state and municipal administration.

It is proposed to include the following in the range of tasks solved by the digital ecosystem of integrated agro-industrial formations:

- formation of a common information space of the subjects of integration;
- formation of a single information fund and regulation of the access to it;
- formation of a system of data standards and their exchange;
- improving the quality and expanding the functionality of online interactions;
- formation of a database of software systems and algorithms for solving standard production and management tasks;
- formation of a database of software systems and algorithms for solving non-standard production and management problems;
- formation of a base of optimization and simulation models for solving problems of development planning and forecasting;
- minimization of transaction costs by optimizing online interactions;
- ensuring information security of participants in the digital ecosystem;
- ensuring integration with adjacent digital ecosystems.

It should be noted that the substantiation of the range of tasks implemented by the digital ecosystem can occur within the framework of various strategies for their development. As part of a passive strategy, the functionality of the digital ecosystem is determined based on the achieved level of digitalization of the integrating entities and their emerging information needs. Within the framework of the adaptive strategy it is based on the projected information needs of the integrating entities, taking into account the development strategy of the entire integrated formation. Within the framework of the active strategy it is formed based on the ideas of the initiators of integration processes about the prospects for the development of the system of intersubjective interactions and the transformation of technical, technological and organizational and managerial processes. Within the advanced strategy it is based on the possibility of using promising digital technologies and innovative approaches to solving traditional problems of production, management and organization of intersubjective relationships.

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