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# *Digital technologies as a factor in the innovative development of the agro-industrial complex to ensure the food security of the country*

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***Abstract* — In article the main possibilities of the innovative development of agro-industrial complex are considered, approaches of use of digital technologies in data management by processes, forming of the digital platform on the example of the agrarian sector of economy are investigated, the reasons of delay of digital transformation are established, features of use of information resources in the course of acceptance and implementation of management decisions are specified. The use of digital technologies will accelerate the pace of innovation development and improve the management efficiency of the agro-industrial complex in Russia. Unfortunately, these processes are not well developed. Key trend of management of processes of the innovative development is the digital transformation based on creation of new economic models of participants of the market, typification and integration of information resources and the software with use of Internet technologies. And to reach management efficiency on the basis of digital technologies it is necessary to create various programs for professional development of personnel which will advance farm-production, providing its competitiveness and stability of development of rural territories.**

***Keywords* — *digital technology, automatic control systems, innovative development, service systems.***

## I. INTRODUCTION

Agro-industrial complex is one of the most important sectors of the national economy, from the management efficiency which depends on the food and partly the economic security of the country. Instruments of state regulation for the accelerated import substitution stimulated the dynamic accumulation of the manufactured product volumes. Herewith, there is the whole complex of problems in activity of AIC enterprises of the Russian Federation: insufficient level of development of source of raw materials and forming of natural and ecological potential; low rates of modernization of the industry and updating of the fixed production assets; financial instability, lack of own funds and complexity of attraction of investments; deficit of qualified personnel; low rates of digital transformation and development of the innovation processes. If innovation activity in agriculture is the foundation of its effective development, in Russia it is only available to separate strong households. Currently, the old system of distribution of innovations and information on them was destroyed, and the new one, being complete, self-organizing, envisaging the model of the digital platform as a service, has not yet been created.

At the same time in the conditions of the amplifying competition in the food market and preferences of consumers, inclined to changes, the solution of above-mentioned problems of agro-industrial complex is possible only on the basis of activation of the innovation processes with use of digital technologies of management.

## II. MATERIAL AND METHODS

Understanding of intrinsic fundamentals of digital technologies in management of social and economic systems directs us to more detailed research from positions of number of the theoretical approaches which are available in science. The methodological basis is the dialectical method of scientific perception. In our opinion, the conceptual aspects in determining the digitalization of agro-industrial complex management should be considered on the basis of a systematic, institutional and structural-functional scientific approaches, including the training of relevant specialists. The methods of analysis and synthesis, comparison and analogy were used in the research. As methodical base of this article normative and legal and program documents in the field of management of the innovative development of agro-industrial complex in Russia were used.

## III. RESULT AND DISCUSSIONS

The concept of a systems approach provides for the different definition of the essence of digital management platform as a system. It can be identified with certain quantity of open information resources which are necessary for adoption of management decisions, or with specific difficult organized set of various subsystems: information and legal support, technical, program (general and special), staffing, the communications in which are compatible and have the sustainable internal character. In our opinion, it is necessary to accept the second point of view as simply certain quantity of information resources, technical means and various programs do not represent system, and only set of elements to it relating. Only at integration of resources and existence of functional

compatible linkages and also the relevant structure which provides organization and orderliness of elements the system of the digital platform of management will form [1, 2]. The exception of any element of system will cause changes in its functioning.

According to system approach, the created platform management decisions are shown through the modular platform as the certain subsystem inseparably linked with the through platform of management of the industry, that is it is part of more complex system. The digital platform for management of agro-industrial complex as the complex system, includes set of the main interdependent subsystems:

- digital ecosystem of agricultural management;
- subsystem of management of innovations, pilot projects, forming and algorithmization of scenarios of management;
- the subsystem directly management process implementing the created platform decisions, technologies and bonds between them oriented to implementation of solutions of producers in the conditions of the changing external environment.

Staffing in this system is defined as active element or the platform of knowledge of digitalization of management in general [3, 4].

The system of digital technologies of management of agro-industrial complex represents set of the integrated product and service subsystems. It is allocated with the purposes, functions and the principles of the automated control system concerning the specific enterprise, the region and the industry, created within legal and organizational norms and regulations and also in complex of the used economic mechanisms and methods of state regulation, means, resources, bonds between subjects and objects of management with use of digital models.

As well as in other complex systems, digital technologies of management in agro-industrial complex have to consider changes of the factors of external and internal environment representing the conditions arising independently objectively (external environment) and is subjective, as a result of activity (internal environment) and making considerable impact on system.

Digital transformation of management of agriculture is influenced by such environmental factors as the features of rural educations significantly differing by the sizes of the territory, number and the structure of the population, situation in structure of territorial division of labor, economic and production capacity, condition of municipal economy, the level of development of social and engineering infrastructure. Rural territories form with different structure of solvable tasks and according to functions of management therefore they differ with opportunities for forming of digital technologies in management.

The factors of internal, environment influencing digitalization of administrative technologies in agro-industrial complex, are: technical support and the organization of work (the organization of jobs, regulation), level of automated control systems on the basis of their use in the course of adoption of management decisions (directory, information advising and management information), professionalism, efficiency and personal qualities of specialists (qualification, organizing abilities, leadership skills, interest in acceleration of processes of innovation and digitalization). These factors not only influence implementation of digital technologies in management, but also directly define the digital platform of the innovative development of agro-industrial complex. Digital technologies in combination with the thought-over style of work of the head of social and economic system of any level will allow to lower elements of uncertainty and subjectivity of the made and implementable management decisions in control system [5, 6].

Thus, from position of the theory of system approach digital technologies are special type of the formalized administrative activity of heads and specialists whose vocational training allows to implement successfully the functions taking into account uncertainty and risks of the organizational environment, providing the innovative development of agro-industrial complex.

The special value to understanding of process of formation and development of automated control systems for agro-industrial complex on the basis of new digital technologies has institutional approach according to which economic, organizational and public relations form in such a way that allow to provide social order and balance of interests of different groups of the population. At the heart of fixing of such relations there is satisfaction of pressing needs of the population where ensuring stable equilibrium of supply and demand in the agrarian food product market, the innovative development, rendering state support to producers of agricultural products, the help in bank and insurance coverage is defining [7, 8].

As institute digitalization in the field of management of the industry represents "digital agriculture" (DA) not only system information, program, technical, staffing and also the list of the operating legal, organizational, moral and other standards and rules which define borders of powers of participants in implementation process of the direct functions by them. It is necessary to add here also higher education institutions, scientific research institute, the innovation enterprises, the administrative organizations and institutions which the group of the officials working in the direction of forming and algorithmization of scenarios of management (the equipment, devices, things, processes, finance) on the main, preparatory, production and sales projects has.

Digital technologies of management of agro-industrial complex affect different groups of the relations:

– the office, forming between public authorities managements of different levels and the public municipal servants;

– organizational (subordinations and approvals), the resulting distributions of powers between heads and hierarchy levels specialists in structure of management of the organization;

– public and private partnership, forming between business and the state in five basic directions of the Digital Economy of the Russian Federation Program: "Information infrastructure", "Normative legal regulation", "Transport and logistics", "Personnel and education", "Forming of research competences and technical backlogs";

– the international cooperation, it is priority between the countries participants of EEU according to specific projects of joint activity "Electronic customs", "Payment and payments,

electronic commerce", "Transport and logistics", "Information technologies";

– public, forming between the official and the citizen.

In such relations interaction on implementation of scenarios of management, forming of the providing subsystems for the digital platform is carried out.

Let us mark out the main signs of the digital platform directed to creation of the new economic models corresponding to new information technologies and automation of perfect management of agro-industrial complex (ACS of agrarian and industrial complex) as social institute:

1. the regulation of administrative work directed to its rationalization and effectiveness, increase in efficiency of interaction of participants of business model "The platform as service" among themselves and with the state;
2. the depersonalized distribution of powers on creation of the public structured bank of knowledge and technologies in section of subsectors of agriculture and regions for daily use of the platform and its applications (API) by clients, developers, suppliers of goods and services with professional skills and competences;
3. division of administrative work according to levels of hierarchy and functional links of "through technologies", vocational training and specialization in the innovation digital technologies for the purpose of increase in efficiency of administrative work;
4. fixing of necessary means and resources for implementation of powers of authority in the system of the basic software and applications for the solution of various applied tasks, forming of the perfect automated jobs (ARMs);
5. building not only the rational relations of subordination (taxonomy), but also coordination (approval) which are the relations of one level of hierarchy and is directed to closer cooperation in the subject of management.

The revealed signs of the digital platform for agro-industrial complex as social institute promote to build framework of social interaction of participants on implementation of administrative functions, having given to the office and public relations the self-renewing regular character.

Structurally functional scientific approach provides use at all levels of the innovation digital through technologies and represents integration of flows of objective "big" these agricultural producers and the state to the digital platform of agrarian and industrial complex for ensuring global planning in the industry and providing exact recommendations to participants of the market, including with use of the artificial intelligence (AI). For this, a certain set of permanently regulated public-service relations is needed, aimed at meeting the needs and interests of the population. Functional results of administrative work have to answer the purpose and problems of creation of the digital platform of agro-industrial complex (the CPU of agrarian and industrial complex). According to the structurally functional concept of digitalization fundamental basis of unity of administrative institutes is control over creation, scheduling and aggregation of data flows for formation of through chains from production of agricultural products before consumption with deep integration into allied industries of digital economy, motivation of actions of participants from the management of local governments, control over structure of forming of ACD. The basic principle of such major function of management as control, the possibility of development of the territory is [9, 10]. All types of control must be organically interrelated.

Despite improvements with food supply, the level of consumption of main types of agricultural products in Russia is significantly lower than in more developed countries and the share of costs of food stuffs is significantly high. The discrepancy of retail prices to level of really located income of the population is the main reason. So, the level of income in Russia by 6-8 times face value (by different estimates) is lower than in the developed countries at rather identical level of prices for food, the share of expenses on food stuffs in structure of expenses of households in Russia is nearly 5 times higher (50% and 11%).

The relatively high price in Russia for the end user consists of:

- low labor productivity at the production stage, leading to high specific costs per unit of production;
- inefficient supply chains of agricultural products to the end user where on each of stages there is trade margin;
- the margin of each of links of resale is low (about 5%) because of the costs connected with incorrect determination of demand.

It is possible to solve considerable part of the specified problems only on the basis of activation of the innovation processes with use of digital technologies of management. The efficiency of the agrarian and industrial complex enterprises will increase due to widespread introduction of new digital and through technologies, the innovation business models of market interaction of participants on the basis of model the platform as service.

Obviously, such a concept provides for the integration of information resources (IR), software (SW) and information systems (IS), since digitalization as the basic elements is represented by continuously transforming integrated product-service systems (PSS). Without it, it is impossible to imagine the innovative development of the agro-industrial complex.

If innovation activity in agriculture is the foundation of its effective development, in Russia it is only available to separate strong households. Currently, the old system of distribution of innovations and information on them was destroyed, and the new one, being complete, self-organizing, envisaging the model of the digital platform as a service, has not yet been created. Automation needs to be directed not on the existing and sometimes imperfect management processes, and on creation of the new economic models corresponding to new information technologies. There is an acute problem with the software. Still the method of "one task" of development and deployment of the software when separate tasks are got from various producers of goods and services which can be not connected at all functionally prevails, it is information. In the system of the modern Internet when there is possibility of access of unlimited number of users to various information resources, only complex informatization is capable to provide the necessary effect [11].

Considerable part of the specified problems is caused by rather low amount of investments into information and communication technologies which in general on agrarian and industrial complex was 3.6 billion rubles or 0.5% of the total

amount of investments into fixed capital. According to Rosstat in 2017 in the field of agro-industrial complex 4.7 million people, from them about one IT specialist on 1000 busy persons or 113 thousand people were busy. It is the lowest indicator on the industries that demonstrates to low digitalization of domestic agrarian and industrial complex and competitive advantage of foreign producers that allows them to find way out to international markets of sale.

At the federal level the operating information systems of the Ministry of Agriculture of the Russian Federation (FGIS) which operators are specialized departments are created. The Analytical Center of the Ministry of Agriculture of Russia performs the function of data collection and aggregation. According to experts, Federal State Information System capacities are used by only 2-3%, it is necessary to increase the efficiency of their use.

The level of development of regional information systems of AIC has significant differences. There are regions - leaders, which have their own automated information systems (AIS) deployed. Them only 33, and in the others own AIS in development or are absent. The Smolensk region does not treat regions – leaders in this direction.

In control system of the agricultural organization where the accounting programs managing are most distributed from AIS and the managed subsystems are interconnected. Changes of structure of production involves changes of structure of control system. For the purpose of creation of the automated control systems (ACS) on the basis of the management information systems (MIS) of similar effects did not happen to the beginning of mass implementation of the personal computer. It was necessary to refuse the idea when the information management system the enterprise (ASUP) represents set of the appropriate automated jobs (ARMs) of heads and specialists in due time. However, some approaches are still of interest.

In modern conditions at implementation of the standard website of the agricultural organization such logical structure of the database (DB) which will be the integrator of all systems of exact agriculture, space monitoring of lands and other IUS is offered and to do them compatible. This approach will allow on the set algorithm to implement the standard decisions almost free for producer. The advanced logical structure and ordered classification of the specified tasks for ACS or IUS can become basis for standardization of the digital platform of specific industry. Similar approach for the separate industries, including livestock production, at placement of the corresponding DB in some "cloud", for example, at the provider having the powerful database management system (DMS) will broaden the digital platform on all industries of agriculture. Obviously, these DBs will be integrated with each other.

Conducting researches on this problem, it is possible to draw conclusion that creation of reference digital models of productions in agriculture will allow to increase efficiency of business of agricultural producers. But universal open circuits of management of agricultural production with hundreds of entrance conditions (parameters) and the analysis of big data with the AI elements where forming and algorithmization of scenarios of management (the equipment, devices, things, processes, finance) on the main cases - preparatory enters, production and sales are for this purpose necessary.

Each platform of the management decision is under construction on the open platform of management of processes of crop production, livestock production, logistics of deliveries and sale, including the systems of traceability, forming of the platform of seed and genetic funds, managements of introduction of fertilizer and chemistry. The main created platform is platform of knowledge that reflects presence of professionals in creation of necessary programs and providing to farms new IT opportunities for increase in value added.

Similarly, at implementation of the standard website of the agricultural enterprise and obligation of providing generally "cloud" of reliable statistical information the system of Rosstat has to undergo changes.

On the basis of the analysis of the innovation processes the model of interaction of subjects of the innovation activity in management of agrarian and industrial complex on the basis of the digital platform (figure 1) is offered and ways of its transformation in the direction of ensuring long-term competitive advantages of domestic manufacturers of products are defined.

The specified model, unlike known, recommends digital technologies of management of information infrastructure on the basis of the innovation centers in the integrated agrarian and industrial complex enterprises interacting with the subplatform of consulting services and included in the Uniform digital platform of agrarian and industrial complex. Also the model assumes possibility of the direction of expansion of administrative functions of this system towards creation of subsystem of information support of innovations and the system of "converse connection" that allows to provide effective interaction of producers, the financial, scientific organizations and public authorities of management.

Digital technologies will be directed not to automation of already existing and sometimes imperfect management processes, and to creation of new models of economic behavior of participants of the market that will stimulate process of implementation of innovations in economic practice. Considering information infrastructure, we will note that within standard organizational structures there can be diverse intra-corporate forms of the innovation activity – from allocation of special personnel before creation of special innovation divisions.

The innovation center is special division which defines the innovation policy large integrated the enterprise and also the strategic directions of the innovation activity. He can independently be engaged in creation of new and advanced products, or participate in this process together with other divisions and departments.

Let us note that in the specified model of digital technologies of management national associations of the industrial companies define national vision of scientific and technical development of the country, industry associations promote improving competitiveness of the enterprises on the basis of implementation of scientific and technical and technology innovations. Creation of new models of economic behavior of participants of the market is aimed at approbation of innovation from the different parties, at the same time

partner efforts promote concentration of resources on the major directions.

The All-Russian Association has to be included in the Uniform digital platform of agrarian and industrial complex and perform exchange of information about the innovation developments not only with the enterprises of specific industry, but also with other subjects of the innovation activity: credit and financial, scientific and state organizations.

Association, representing the interests of producers, is attracted by the state to the solution of current problems of the industry, development of measures for protection of domestic manufacturers at implementation of foreign economic activity, takes part in legislative activity of the Ministry of Agriculture of the Russian Federation.

Let us note that digital technologies in AIC management are based on the development of analytical tools and the use of databases. Analytical tools can quite include various economic-mathematical models (EMM) from which are most applicable: economic-mathematical model of the analysis and forecasting of the main agrarian food product markets, economic-mathematical model of optimization of placement of agriculture and processing industry, model of partial market balance for the analysis of impact of agrarian policy on development of agriculture, welfare of consumers, export trade and expenses of the consolidated budget. Databases are various forms of reporting. As a result information for adoption of qualitative management decisions will be medium-term forecasts about state and development of the main agrarian food product markets, schemes of placement of agriculture and processing industry, impact assessment of various options of agrarian policy on condition of agriculture, consumer income, dynamics of export trade, expenses of the consolidated budget, monitoring of state and trends of development of researches in the field of agricultural sciences.

The algorithm of the selection of management decisions in the integration enterprises agrarian and industrial complex with use of the device of economic-mathematical modeling in figure 2 considering risk of inconsistency of the innovative solutions in discount rate of the innovation projects that allows to define the most reasonable directions of the innovation activity is offered and to perform the selection of the innovation projects.

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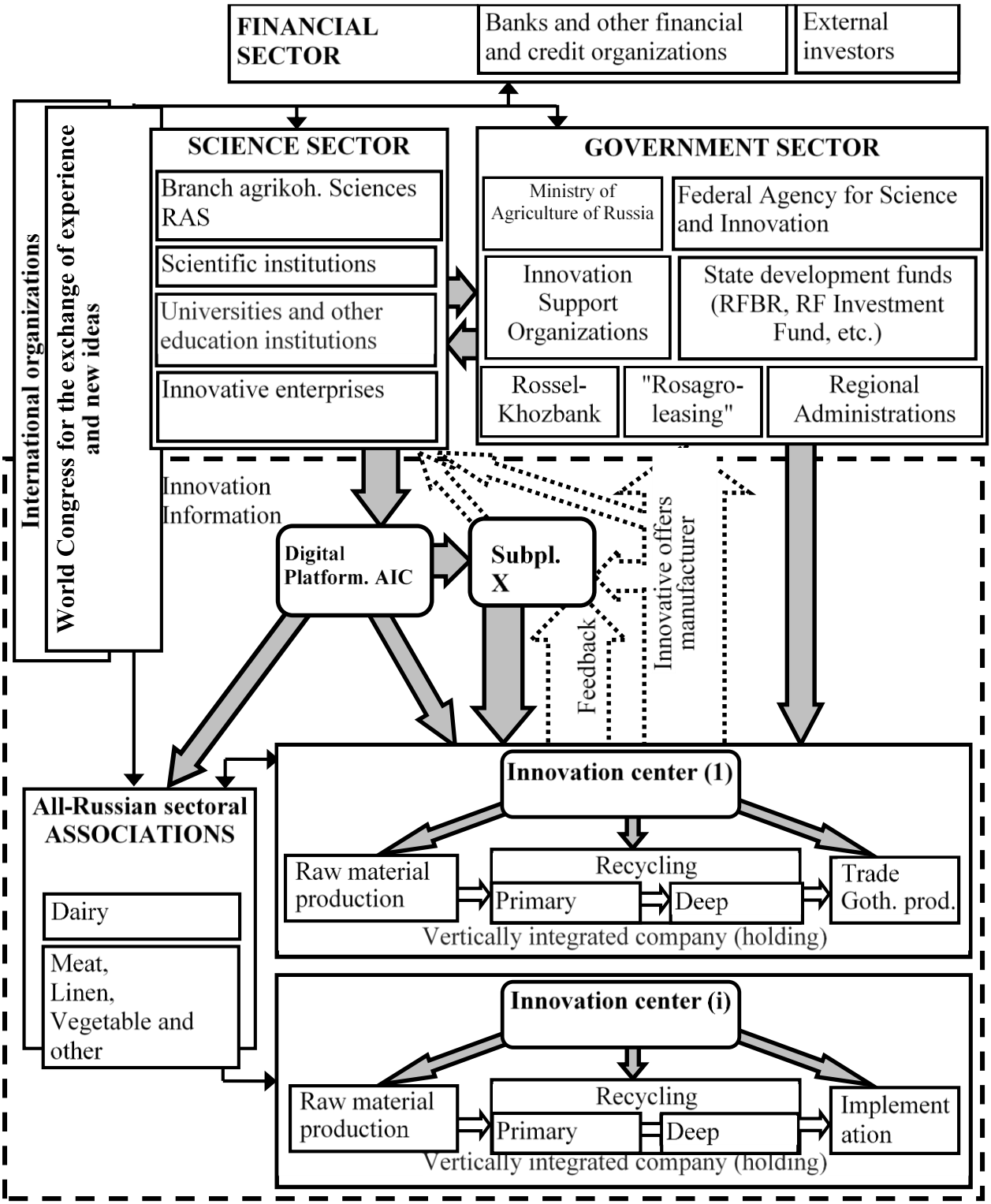


Fig. 1 Model of interaction of subjects of the innovation activity in management of agro-industrial complex on the basis of the digital platform

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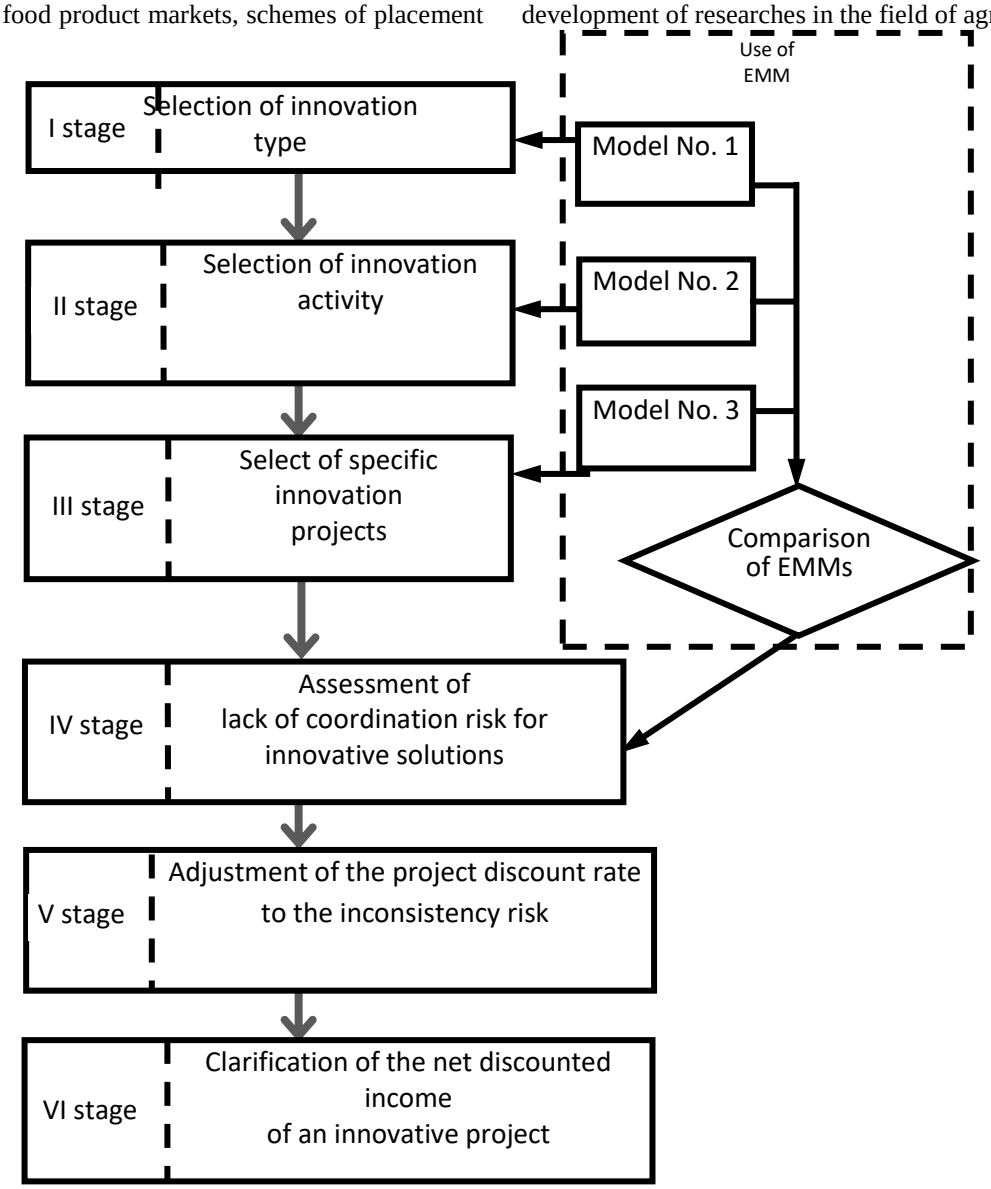


Fig. 2. Generalized algorithm for selecting innovations using economic and mathematical modeling

The algorithm of the choice of management decisions in the integration enterprises agrarian and industrial complex with use of the device of economic-mathematical modeling in figure 2 considering risk of inconsistency of the innovative solutions in discount rate of the innovation projects that allows is offered determine the most relevant areas of innovation and select the innovative projects.

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## IV. CONCLUSION

The offered algorithm considers the hierarchical nature of administrative bonds between the objects which are the first three stages and can be provided as the tree is more whole, consisting of objects of various levels. The highest level in hierarchy occupies object of the first stage "Types of Innovations", the following level – objects of the second stage "Directions of the Innovation Activity", and at the lowest level there are objects of the third stage "The Innovation Projects". There are stable connections between the objects: each of them may include several lower level objects.

It is important to note that the main question of use of digital technologies in management of agro-industrial complex will become selection of prototypes of already existing and effective digital platforms, and sets of program modules which after completion can be used as applications (API), having connected everything in uniform program complex. This task quite difficult also demands expert community which will undertake role of the Center of competences in the field of digitalization of agrarian and industrial complex. We suggest to use the economic-mathematical models provided in figure 2, in applications of application programs (API) of subsystem "Agriculture" of the digital platform of agrarian and industrial complex for the solution of practical tasks.

Thus, integration of uniform information Internet space of agrarian knowledge with the standard websites of the agrarian and industrial complex enterprises, agricultural scientific research institutes and higher education institutions; standard IUS and the systems of primary accounting, implemented by means of Internet technologies, represents basis of the digital platform, with the logical structure being ready to further integration into various digital devices and instruments. Use of the offered digital technologies of management of the innovation activity in agrarian and industrial complex will allow to bring share of the innovation products to 30%, share of profit on the innovation products generally of profit volume up to 41% and also to increase profitability of production by 25 items.

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