Unified Digital Platform Agro-Industrial Complex of Russia as a Mechanism for Overcoming Digital Feudalism

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Abstract: The article is devoted to the search for the agro-industrial complex of Russia ways to overcome the negative consequences of abandoning the OGAS project back in the USSR, which currently allows the formation of a unified digital platform for managing the country's economy, and ways to overcome the peculiar digital feudalism generated as a result of this due to the erosion of the tasks of the digital economy by state corporations. For this, the results of mathematical modeling of the formation of a digital platform for managing the economy of an agro-industrial complex during the transition to the digital era are considered, the calculations for which formed digital standards that integrate all components of the information space of the industry. It is shown that the cloud interaction of all enterprises based on these standards makes digital technologies available for farms of all sizes, and not just for some of the largest of them. This standardization will also affect cross-sectoral relationships between all participants in the value chain.

1 INTRODUCTION

Based on the dramatically increased number of works and speeches on the digital economy (DE) in the past three years, it seems that digital technologies appeared unexpectedly, all at once as a result of some revolutionary scientific discovery capable of solving all the problems of Russian reality (Russia, 2020). Thus, (Khalin, 2018) states that digitalization replaced computerization and informatization, the technologies of which were used only to solve certain economic problems. Similarly, pursuant to Shklyaruk (Shklyaruk, 2), informatization is opposed to the digitalization process, in the first only purely existing processes are being automated, and in the second case, existing processes are already being enhanced by reengineering them and analyzing data when making decisions. And there is a lot of similar "researches". For a specialist in the field of information technology, such statements are surprising, since they do not correspond to the entire prehistory of informatization of society.

In this regard, the digitalization of the agro-industrial complex (AIC) needs a theoretical understanding of this stage of the development of informatization (digitalization) of the industry with a systematic analysis of the results of the previous stages of the introduction of information and communication technologies (ICT) to develop fundamentally new approaches to the effective implementation of the innovative capabilities of information technologies. adequate to the coming era of digital transformation of the economy, since the country continues to use information systems design technologies that have developed in previous periods and are more familiar to most developers.

2 MANUSCRIPT MATERIALS AND METHODS

Let us consider the evolution of ICT in a time frame to refute the thesis about the appearance of DE, in fact, from scratch. In our opinion, in its life cycle,

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information systems design technologies have gone through four evolutionary stages, at each of which there was a significant transformation of the methods of storing, transferring and integrating data (information resources) and software, based on the fact that the information systems project space has three main measurement axes: information resources (IR), applications (automated tasks) and tools, which are system-wide software and electronic equipment (Fig. 1).

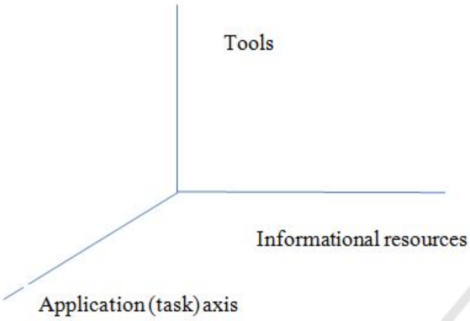

Figure 1: Project space of information systems.

In information systems, at the first stage, almost all application software was developed by the efforts of enterprise specialists. It was focused either on the needs of a particular enterprise, or on the needs of a narrow circle of similar enterprises. Herewith, it required significant costs to support it. It was a classic, so-called task-by-task approach.

The second stage is characterized by the emergence of elements of standardization for software, which is associated with the enhancement of ICT, which led to cooperation and integration and a decrease in the cost of software, the functionality of the systems has expanded. This process made it possible to optimize management functions and information processing methods.

The third stage is associated with the emergence of local area networks, database management systems (DB). Herewith, both software and data were physically and logically separated from specific computing facilities and placed on virtual computers in the nodes of local computer networks.

Herewith, starting from the second stage, economic feasibility arose in replicating information systems to a certain circle of enterprises, clearly represented by the so-called Brooks square (Fig. 2), which provides data on the increase in costs during the transition from software development based on original design to a software product and its integration into a software package (Brooks, 2001).

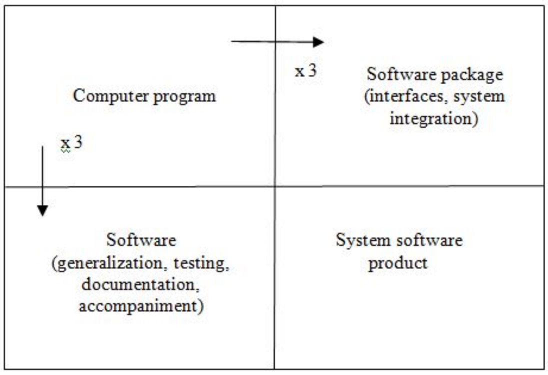

Figure 2: Brooks square.

The work shows that the cost of a software product replicated and integrated into some information systems, even into the industry when switching to a single DP, is an order of magnitude higher than the cost of developing the original software. Consequently, investments in complex information systems will provide a level of development self-sufficiency when implemented, starting from the second dozen enterprises, the huge economic effect of which is most obvious for AIC due to a large number of enterprises.

Thus, the variety of information technologies used, for the most part, ontologically and functionally incompatible, have basically turned the theoretical problem of integrating IR, applications and tools into an extremely urgent in economic and practical terms, the task of integrating them into a single information and management environment during the transition to the fourth stage. evolution of information systems associated with the digital age (Zatsarinnyy, 2019a; Zatsarinnyy, 2019b). This task cannot be resolved without coordination of digital standards on all axes of design space of information systems.

3 RESULTS AND DISCUSSION

If at the second or third stages, economic and technological expediency led, in terms of integration processes, to the emergence of international management standards such as ERP, which are only a methodology, and in logistics activities, standards for the terms and concepts used, called SCOR models (Toluev, 2009), then in the last 2-3 years in the US cloud platforms and services based on the following specialized platforms have begun to be widely used: aggregator platforms for the primary collection and accumulation of agricultural information and application platforms (J'son, 2021). Cloud-based interoperability based on already standards on all axes of the project space between these platforms makes them available to farms of all sizes, and not just to some of the largest of them.

This standardization will already have an impact on inter-industry relationships between manufacturers, processors, logistics, wholesale and retail companies through the development of cloud technologies, a direct sales model, when all the links in the chain "see" each other, down to the end consumer, as well as terms, volumes, nomenclature. and the quality of demand. In this case, the principle of product traceability is implemented, since production allows the transition from the phase of quality control after its release to the principle of operational control of all production operations. Thus, we may conclude that with each new stage in the evolution of information systems, the number of enterprises subject to automation based on integration and digital standardization grows with the potential inclusion of entire industries and countries in such a process.

In our country, back in the second half of the last century, an attempt was made to outstrip the market evolutionary path of integrating IR, applications and tools for the development and maintenance of information systems. Outstanding scientists Kitov A.I. and academician Glushkov V.M. suggested that the state leadership create a nationwide automated system for collecting and processing information for accounting, planning and managing the national economy in the USSR (OGAS) (Benjamin, 2016). The project was not adopted, which in the future doomed the country to the original, task-oriented design of information systems for many years, moreover, the country slipped into a kind of digital feudalism, since in Russia, when forming the DE strategy, they decided to rely on a number of large state corporations in its implementation. However, an analysis of the evolution of information systems shows that with such a corporate fragmentation of DE performers, without a thorough study of the project for the formation of a single digital space in Russia on the basis of uniform agreed standards, without the appointment of a general designer with the required scientific and production base, the implementation of DE tasks will be ineffective, rather, even impossible ... Integration of the developed branch DP will be very labor-consuming and inefficient further.

This situation, aggravated by the destructive consequences of market reforms, led to the fact that most AIC enterprises stopped developing information systems at the second stage, saving money (pursuant to Brooks), were forced to limit their original design, or acquire them on the market with significant adaptation to their daily activities.

The analysis of monitoring of informatization of 300 best enterprises AIC has shown top trends of this process (Kulba, 2020): at the considered time stage, accounting software is being introduced, but even they are often developed by several organizations, while the software is neither informationally, nor ontologically, nor ergonomically incompatible, which indicates the absence of a strategy for informatization of these enterprises.

This situation with information systems in AIC is, on the one hand, a consequence of the refusal to implement the OGAS project, when the refusal served as a catalyst for a haphazard, non-comprehensive approach to the process and digitalization in the country, on the other hand, digital feudalism, as a result of which a large number of isolated and incompatible local information systems at AIC enterprises, governing bodies, scientific and educational institutions. According to our calculations, with this development of events in the near future, there will be potentially about 4,800,000 information systems, which are beginning to be designated as DP, in the AIC with the same problems.

Moreover, this situation gave rise to the illusion of the uselessness of scientific organizations, systematically, from a complex position, dealing with the digital transformation of society, economy and science. Thus, with the tacit agreement of both the Russian Academy of Sciences and the Ministry of Agriculture, the Institute of Cybernetics AIC, which was an integrator of scientific developments, was eliminated (Fig. 3), and just before the adoption of the DE Program and with the approval of FANO at the Institute of Agrarian Problems and Informatics (VIAPI), the research topic on DE AIC was closed, the Timiryazev Academy did not turn into a center of competence in DE, moreover, a testing ground where the most advanced, promising digital technologies. For example, such studies are given in the following works (Kannan, 2019; Vecchio, 2020, Huang, 2018).

If we are closing innovation centers, in developed countries, on the contrary, they are actively creating. Thus, in the UK, in order to implement the ambitious task of becoming leaders in the creation of new digital technologies in agriculture, within the framework of the state program "Transformation of food production: from agricultural farm to plate", innovation development centers are being created, pursuing another goal - working out a new model of government interaction. science and business (Raikov, 2021).

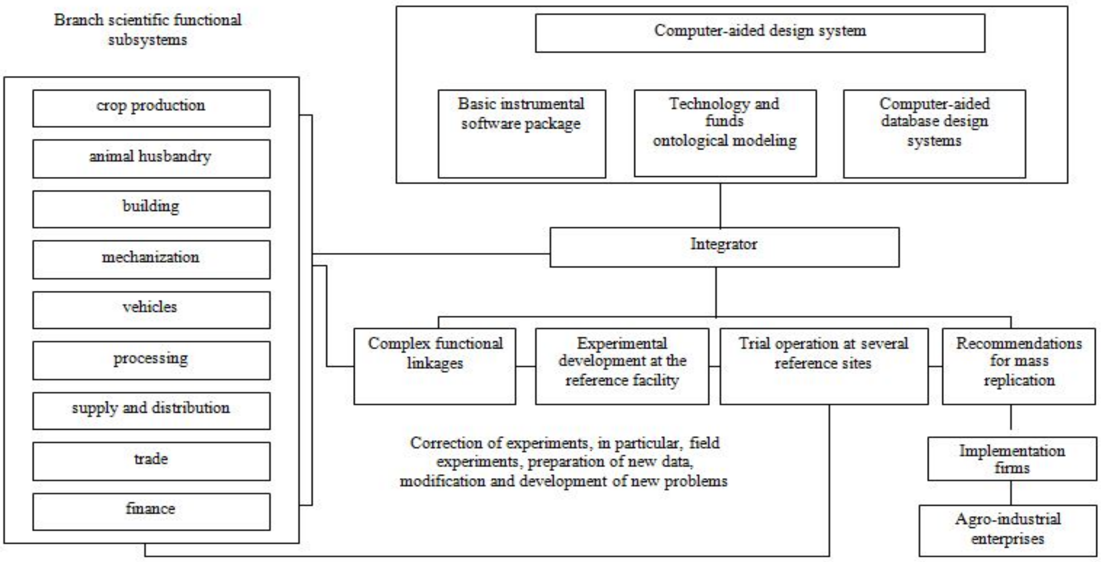

Figure 3: Scheme for the transfer of agricultural knowledge to production based on a single digital platform

Based on the considered evolution of ICT, which resulted in the emergence of international management standards; analysis of the rejection of the ideas of OGAS, as a result of which a kind of digital feudalism appeared; monitoring the informatization of the 300 best AIC enterprises, which confirmed the consequences of digital feudalism in the form of the absence of a strategy for integration processes in the digitalization of AIC by the Ministry of Agriculture, it is proposed to use a mathematical model for the formation of a unified DP for managing the AIC economy as an effective tool for the digitalization of the industry (Ereshko, 2018). In this paper, we present an abbreviated version of the core of the model so as not to go into the details of cluster analysis, semantic adjacency matrices, and the theory of automatic classification, which are required for the correct determination of optimum DP in the future.

Thus, we consider a system that includes a given set of control centers *j* (the level of the Ministry of Agriculture, region, district, enterprise, its structural unit), a set of management applications *K,* used to process information arrays on the data centers, situational centers (SC); data classes *L*; types of communication for data transmission *R*. It is assumed that the entire control process takes place on a time interval with a period of *T* with averaged actions on this interval, which is due to finding the standards used in the model, for instance, with data transmission. Based on the capabilities of the fourth stage of the evolution of IS, considered above, we will assume that any task may be solved at any node. To store and process data when solving management problems, a certain amount of technical means is required. Then let us enter model parameters.

k – identifier of the application, $k \in K$; l – identifier of information element, $l \in L$;

j – identifier of control center, $j \in J$;

f_{kli}^e – averaged volumetric, time, frequency requirements, etc. characteristics identifying information of *l-th* group required for the solution of application k generated in the center j, $e \in E$;

$x_{ik} = 1$, defines a condition under which application k is solved in center j, 0 – otherwise; $\alpha_{kli} = 1$, defines a condition under which the *l-th* group is generated in center j for a problem k, 0 – otherwise;

$y_{lj_1j_2r} =$ 1, if information from the *l*-th group is transmitted from the j_1-th node to the j_2-th by the *r*-th means of communication;

d_{mjk} —required resources of the *m*-th type to solve the task k at the *j*-th node;

M_m —*m*-th equipment resources;

$s_{lj_1j_2r} =$ 1, if the *r*-th link type is used to transfer the *l*-th group from the j_1-th to the j_2-th node;

G_r^e —communication characteristics; c_j^1 - the cost of a piece of equipment in the *j*-th node; $c_{j_1j_2r}^2$ - the cost of the *r*-th means of communication when transferring information from j_1 to j_2; $c^3_{j_1 j_2 r}$ - the cost of transferring a unit of information from j_1 to j_2; c^4_{mjk} - the cost of the *m*-th resource for solving the task k in the *j*-th node; c^5_k - generalized cost of the *k*-th task; c^0 - funds allocated for the development of a digital platform.

Restrictions for possible requirements for distribution of applications on the centers and hardware components:

$$\sum_j x_{jk} \geq 1,$$

$k \in K^3 \in K$ – condition of need of the solution of application *k* at least in one center; $x_{ik} \geq 1$, $j \in J_1$, $k \in K^4 \in K$, condition of need of the obligatory solution of a part of applications from a set *K* in some centers $j \in J_1$.

Required conditions of information transfer from center j_1 to center j_2:

$$\sum_r y_{lj_1 j_2 r} = \sum_k \alpha_{klj_1} x_{j_2 k}, \quad j_1 \neq j_2.$$

Data for application *k* is transferred from center j_1 to center j_2 if it occurs at center j_1 for use at center j_2;

$$\sum_r y_{lj_1 j_2 r} \leq 1,$$

i.e. the information transfer from center j_1 to center j_2 is carried out by one communication means.

Restrictions for loading of the equipment:

$$\sum_{jk} d_{mjk} x_{jk} \leq M_m.$$

Restrictions for communication channels:

$$\sum_{l,k} y_{lj_1 j_2 r} f^e_{klj_2} \leq G^e_r s_{j_1 j_2 r}.$$

Restrictions for investments:

$$\sum_{j,k} c^1_j x_{jk} + \sum_{j_1, j_2, r} c^2_{j_1 j_2 r} s_{j_1 j_2 r} + \sum_{j,k} c^5_k x_{jk} \leq c^0.$$

The efficiency criterion determines the minimization of costs for the formation of an optimum CP:

$$\sum_{j,k} c^1_j x_{jk} + \sum_{j_1, j_2, r} c^2_{j_1 j_2 r} s_{j_1 j_2 r} + \sum_{j_1, j_2, r} c^3_{j_1 j_2 r} f^e_{klj_2} y_{lj_1 j_2 r} + \sum_{m,j,k} c^4_{mjk} d_{mjk} x_{jk} + \sum_{j,k} c^5_k x_{jk} \to \min.$$

Based on this mathematical model, digital standards were obtained, represented by uniform conceptual and ontological models of technological DBs for the entire agricultural industry (Ereshko, 2018). Herewith, a unified digital standard of the information structure of primary accounting was obtained in the following format: the type of the operation being carried out, its object, the place of the operation, the subject of the operation, the date of the operation, the time interval of the operation, the means of production used during the operation, the volume of the operation, the type and the amount of consumed resource herewith. With this structure, all primary data of any enterprise may be stored in a single cloud DB in a unified form (Kulba, V., Medennikov, V., 2020; Kannan, B., Rajasekar, M., Jayalakshmi, K., Thiyagarajan, G., Selvakumar, S., and Rajendran, V., 2019). This standard overlaps with the above-mentioned platforms-aggregators for primary collection and accumulation of agricultural information being developed in the USA.

4 CONCLUSIONS

Analysis of the initial data of the model shows that to use it, it is required to do a tremendous amount of work on ontological modeling of all production activities not only in AIC, but also in the country due to large intersectoral ties with many sectors of the national economy with the creation of uniform standards for R&D, management functions and tools; classifiers of a significant amount of resources related to the DP. Taking into account, in addition, some tunnel effect of overcoming the regularities of the Brooks square, the Ministry of Telecom and Mass Communications responded to the proposals for the implementation of the DP presented above from 10.09.2019 that the implementation of this DP is premature due to the lack of both human and financial resources. Apparently, our country has forgotten how to make large integration science-intensive projects.

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