Methodological and technological aspects of creation of digital platforms in ideology of open information systems

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Abstract. In the article it is shown that the process of digitalization of the information society, which is now a trend of world development, should be considered in the context of consumer, management and technological aspects. The conceptual model of interrelation of concepts of digital economy, which are associated with objects of digitalization, is described: digital transformation, cloud computing, information infrastructure, the digital platform, the integrated digital platform, platform economy, an ecosystem. These concepts are interpreted from the point of view of service-oriented architectures; properties of public service are described. Methodological and technological aspects of digital economy platforms design are considered in terms of open systems model, for which the main definitions and properties are given. The example of the OSE/RM open systems model shows the specifics of digital platforms related to their reorientation towards application industries. It is stressed that a feature of digital platforms is the fact that the platform becomes a provider of application platform services to external consumers. The tasks that the digital platform should solve in a new capacity are formulated.

1. Introduction

After the world community took a course towards a digital way of existence, all scientific, practical, expert platforms began to discuss the adaptation of their industries to new tasks. The technological basis of industry modification is information technology. It is obvious that first of all digitalization is required - the economic system of the state. However, many sources, such as [1, 2], note that there are no clear guidelines and boundaries of what is in the field of interests of the digital economy (CE), even less understanding in the design of digitalization objects. This situation is explained, obviously, by the fact that digitalization creates conditions for overriding the priorities of social development. Therefore, there are so few scientific sources that describe issues of technical design of information systems supporting the ideas of digitalization. The exception is work [3]. The following important idea was made in the work: the design of digitalization objects is multifaceted. Design should be carried out taking into account the synthesis of the following factors:

- Consumption patterns, which are formed based on social and psychological preferences of individuals in conditions of digitalization.
• Cultural and historical priorities that exist in society and influence the choice of certain directions of development of the digital economy of the state.
• Economic and production management models aimed at increasing efficiency in the introduction of information technologies into public life.
• Technological principles of design and functioning of information systems accumulating new end-to-end technologies [4].

The article discusses methodological aspects of the design of new generation information systems, which are implemented on the basis of digital platforms and form the technological layer of the digital economy.

2. Methodological and Technological Aspects
The concept of "Society" is a system consisting of 4 subsystems or spheres of social life (Figure 1): social, political, spiritual, economic. At the same time, the social sphere includes relations between members of society due to their social role and importance. The political sphere determines order and security in society. Within the framework of the spiritual subsystem, relations related to the creation and perception of cultural, artistic, scientific, ideological and other intangible values are carried out. The economic sphere is aimed at the production, distribution and consumption of wealth in society. During various periods of human life, a subsystem became determinative (the problem of determinism), i.e. influenced the nature of relations in other spheres (Karl Marx considered determinative of the economic sphere).

The information society differs from the industrial period of development in that information and telecommunication technologies become the means of production in industry (economic sphere). This feature affects relationships between individuals and groups of individuals in all spheres of social life.

![Figure 1. Spheres of public life.](image)

On the other hand, the information society is a natural stage in the development of humanist ideology. A distinctive feature of this ideology is that the problem of determinism is always solved in favor of man. Therefore, it is human needs that dictate the target development vectors for any of the subsystems of social life. And the opportunity for this is created by information technologies.

The terminology that has emerged today should also be noted. The meaning of the concept of "digital economy" implies that the digital way of activity should determine relations not only in the economy, but also in all other social spheres.

Many international and Russian governmental organizations pay great attention to CE issues. Organizations such as the World Bank, the Organization for Economic Cooperation and Development (OECD), the BCS Institute (Great Britain), the Eurasian Economic Commission (ECE), the Autonomous Non-Profit Organization Digital Economy (Russia), the Agency of Strategic Initiatives (Russia) are engaged in research of trends and priorities of world and national
development; Identifying the challenges and tasks facing Governments; Methodological elaboration of concepts and terms of the digital economy.

3. Concept and Discussion

Today, concepts such as "digital transformation," digital platform, "end-to-end technologies," platform economy, "cloud platform," information infrastructure" have become common. They reflect the technological essence of digitalization and are present in the texts of many scientific publications and government documents [4].

Figure 2 presents the conceptual model of the relationship between these terms developed by the authors in this work. This model demonstrates the chronological basis and shows the mutual concepts of the technological (implementation) aspect of digitalization.

The central link of the model is the concept of "digital transformation." Implementation of this concept implies synergy of three aspects. They are compiled on the basis of the factors described in the introduction. These aspects define, in fact, a high-level digital transformation algorithm, and consist of the following:

- Consumer aspect, within which the goals of digital transformation of relations in social subsystems are formed based on social-psychological and cultural preferences of members of society. This aspect reflects the "charms" consumers would like to get from digitalizing public life. In other words, this factor determines the goals and criteria of digital change. Therefore, it should be considered first.
- Further, it is necessary to organize the objectives expected by consumers in the form of some models of activity (managerial aspect). For this purpose, in accordance with the goals and criteria of consumption, it is necessary to develop new business models or modify old ones in each of the specified social spheres of life. This is the basic essence of the digital transformation process. At the same time, the purpose of the target criteria according to which business models are transformed is as follows. The new (modified) business model should give the consumer additional value (compared to the old model) through the introduction of information technologies.
- The technological aspect is the implementation of new business models in the form of information systems of the next generation. The principles of development of such information systems are devoted to this work.

Thus, the digital transformation of society consists in modifying old models of activity in various spheres of society or developing new ones. It should be guided by the fact that (a) human interests and needs are the goal of economic development, (b) the large-scale penetration of information technologies into all spheres of society.

Let us turn to the technological aspect of digitalization. Figure 2 shows that cloud computing and information infrastructures are the technology base for digital transformation of business models. Let us explain the meaning of these terms.

Cloud computing is based on the concept of cloud service. A service is an information service (IT service) that is mapped to the multitancy property. This means that [5, 6, 7]:

- IT service can offer the market any independent service provider. To do this, the service must be based on standards or publicly available descriptions.
- Any independent consumer can use the IT service (each user should know how to access the services as well as the functional description of the services.

Thus, there is some relationship between the provider and the consumer. The nature of this relationship differs from that of a private cloud service. In the private cloud, the relationship between service providers and users is based on functional interaction. In a functional interaction, providers and users can always agree on access rules for the service and its interfaces.

The separability property allows navigating to the service view of the information infrastructure. Within the framework of this presentation, the information infrastructure is a set of standardized information resources and services. At the same time the volume of the set of services is unlimited [5, 6, 7]. Such an understanding is typical not only of the information infrastructure, but also of any
other. For example, to create a transport infrastructure facility, you must have standards that describe the requirements for facility parameters. It is the list of such parameters describing the route from different points of view that contain the national standards in the field of road construction.

![Diagram](https://via.placeholder.com/150)

**Figure 2.** Conceptual model of the technological layer of the digital economy. Here: DP – digital platform, IDP – integration digital platform

Thus, the model of access to network resources in the form of a public service, which is implemented in cloud computing or information infrastructures, has the following features:

1. The functional content of the service that the provider brings to market for universal use must be described by standards or open specifications of this subject area. The specific implementation of such a service in the form of an IT service can be carried out by any provider on its resources, but in accordance with current standards and specifications. This is due to the fact that the consumer of IT service needs protection against unscrupulous producers. For example, there are a large number of accounting report service providers on the Internet. The user, using such a service, should be sure that his report would be formed in accordance with the existing standards and accepted by the tax inspectorate.

2. Interaction between service providers and consumers is carried out by means of a special open WEB resource, which operates on the Internet. For a consumer to use the service, the WEB resource must contain:
   - Information on what functions the service can perform.
   - Information on how to access the service (contain service signatures).

For a provider to use a WEB resource to post service information, must be developed:
   - General algorithms according to which functional descriptions of services are classified.
   - Standards describing the rules for storing functional service descriptions.
   - Standards describing service description access interfaces.

The existence of a shared resource is explained by the following circumstance. In conditions of digitalization of public and private life, when the Internet will contain many thousands of different services, the consumer needs to make it easier to find the necessary services, and the provider - to allow publishing information about the service.

A special UDDI standard has been developed by the international information community to store these data. Unfortunately, it has not received much distribution, but is still supported by some organizations.
3. Interaction of the user with the public service is based on the architecture of WEB-services, which is based on the property of multitaneity and is carried out through a special WEB-resource (Figure 3). This distinguishes the public service from private cloud IT services, where the interaction is based on a direct agreement between the service developers and its users.

![WEB Service Architecture View](image)

Figure 3. WEB Service Architecture View

The next layer of concepts in Figure 2 is represented by information digital platforms. The purpose of digital platforms is to [5]:

- At the technological level support the transformation of business models.
- Be the basis for the creation of various application products, services or technologies.
- Be a provider of application platform services for external consumers who work in these application areas.

The Program "Digital Economy of the Russian Federation" [4] defines the list of application areas for which the task of development of digital platforms is set:

- Interaction of universities, scientific organizations, companies to support software development projects to create digital economy technologies.
- Management of the country’s energy, water, transport and other resources.
- Organization of development of regulatory and legal acts of various purposes.
- Centralized storage and processing of data created by state and local authorities.
- Organization of management of intellectual activity results of citizens and organizations.
- Legal and intellectual support for the creation of competence centers for each of the "end-to-end technologies" [4]. Appointment of centers - coordination of research carried out in the country, training of personnel in the field of science and education, monitoring and responsibility for the quality of innovative achievements.
• Organization of export of innovative technologies through interaction of foreign and domestic organizations.
• Organization of marketplace services for scientific personnel based on universities, scientific organizations, companies.
• Building a national digital trust infrastructure on a biometric basis.
• Creation of digital technologies for development and implementation of Smart City projects.
• Implementation of digital technologies in the field of health care for the population of the country.

The main problem of digital objects implementation is to solve two issues: a) what is a digital platform from a technological point of view, b) on which methodological foundations and principles digital platforms should be designed in conditions of digitalization. In order to solve these issues we turn to terminology of functional standardization, one of the directions of which is the theory of open information environment.

The information system has certain properties in this context. These properties are as follows:
• Extensibility by function.
• Quantitative scalability.
• Application mobility (the ability to migrate applications to another platform with minimal change).
• User mobility (one-of-a-kind friendly interface across applications).
• Interoperability (ability of systems to interact).
• The ability of systems to integrate.

IEEE POSIX developed the OSE/RM (Open System Environment/Reference Model) [8, 9, 10] to represent an open information system with these properties. This model provides a clear structure of information system functions, both application and system. Structuring is two-tiered. Within the first level, the information system has two components.

The first component (and the main component) is the Application of the information system. Applications can operate in two modes:
• As local ones that implement enterprise business process functions.
• As cloud services provided by SAAS.

The second component is the Platform of the information system. Its purpose is as follows. First of all, the platform should ensure the functioning of local and cloud applications through system services necessary for the operation of applications. These application services are called using API functions (system calls). In addition, the platform can provide its resources to external users to:
• Their development of their own applications and their further migration to their own platforms (PAAS mode).
• The platform can provide its resources for operation of "foreign" external applications (IAAS mode).

The second level of structuring is matrix structuring of the platform and application in which:
• Vertically - components that provide functions of user interface, organization of calculations, organization of data, organization of systems interconnection.
• Horizontal - hardware layer, operating system layer and middleware components.

A detailed description of matrix structuring can be found in [9], and a description of the additional plane of the OSE/RM model concerning the information protection mechanisms of the system is provided. Information system lifecycle management is also an important second area of functional standardization. These issues are not within the scope of this work, but they are explored in article [11].

Thus, the OSE/RM model describes information systems of any scale and purpose. A feature of such systems is the fact that applications of the system, and especially platform services, generally speaking, do not reflect the specificity of subject areas: systems are universal.
In next-generation information systems that meet digitalization challenges, the semantic and role-based purpose of applications and platforms is changing. The differences are as follows. They relate to the platform part of the system and the overall structure. These are the following features:

- Systems as a whole become focused on a particular subject area.
- Traditionally, the purpose of the information system is determined by applications implementing business processes of the enterprise. The platform in such a system is the slave serving the component. In the next generation, the digital platform becomes independent. "Hard" API links between applications and itself are broken. Various external agents become users of platform services (services): other information systems and other digital platforms, various mobile devices, etc. Thus, the digital platform becomes the supplier of external services for users in concrete subject domain.
- The ability to deliver external services is ensured by the fact that the platform should include not only system services, but also application services. To do this, middleware of platforms (similar to database management systems) must contain algorithms for solving unified problems of this subject area in the form of application platform services.

Thus, it is necessary to solve the following tasks:

- The task of creating a unified environment to meet the application needs of external user applications. This means (by analogy to system calls to operating system services) that when designing a digital platform, the task arises to develop open APIs - signatures and semantics - of those application unified services that will be part of the middleware level of platform.
- Task of creating platform services (also middleware level) for interaction and understanding of users. Consists in the fact that in order to organize communication between the platform and external consumer applications it is necessary to develop uniform rules and protocols of interaction, uniform formats of data exchange, unified databases and knowledge (on the basis of integrated ontological models) and solve other tasks of a service nature.
- Create Platform Resource Administration Tools task. Technological solution of these tasks is performed by local (as opposed to public) applications of OSE/RM model administration plane [6].
- The goal of providing a common security requirement for the digital platform, i.e. implementing security mechanisms in the form of OSE/RM security plane applications [8].

Thus, digital platforms are high-performance, open to communication, delivering application services telecommunication information systems, operating on the same principles and requirements.

Next, Figure 2 shows the integrated digital platform layer. They are needed to solve complex tasks at the intersection of application areas when it is necessary to implement higher-level business processes. For example, for producers of agricultural products, the task of delivering fresh vegetables from the fields to the market counter is very relevant so that the producer gets the maximum profit, and the products do not deposit or spoil in the markets. This multi-criterion challenge requires data on agronomic data on vegetable cultivation, data on current demand in the region’s markets, logistics data on opportunities and means of delivery. Here you need a data service from three platforms working in different subject areas and integrated to solve this problem.

The set of interacting integrated digital platforms forms, as shown in Figure 2, a digital ecosystem that is associated with the digital platform economy.

The ecosystem is characterized by the same tasks described in paragraphs 1-4 above, but at a larger level. On the one hand - tasks of service to ensure integration of digital platforms, understanding and supply of application services to different users, on the other - tasks of creation of application platform services for solving complex problems of economic areas.

4. Conclusion

The article is devoted to issues of conceptual understanding of the essence and relationship of digital objects, which make up the concept of "digital economy". The paradigm of open information systems shows the specifics and differences of information systems of the new "digital" generation, as well as technological aspects of the implementation of such systems.
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