Formalization of the Information Model of the Shipbuilding Cluster for the Implementation of the Technological Platform Shipbuilding 4.0

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Abstract

The problem of reforming of the shipbuilding industry of Ukraine is considered.

Based on completed studies of global shipbuilding industry development processes it is shown that the prospects for the development of this branch of the economy relate to introduction of the main elements of the technological platform Shipbuilding 4.0. The technological platform is based on the digitalization of all stages of the ship's life cycle. It was established that the processes of project formation require formalization information model of the shipbuilding cluster. Methodological basis developed information models were the basis of management theory projects, system analysis and information technologies. Structural scheme of the information model of the shipbuilding cluster, as well as its main components, were developed.

Keywords

Information model, technology platform, Shipbuilding 4.0, shipbuilding cluster

1. Introduction

An urgent problem of the development of the marine infrastructure of Ukraine is the problem of reforming its shipbuilding industry, as evidenced by the relevant legislative and regulatory documents [1]. First of all, the existing problem is connected with the fact that the main elements of the shipbuilding industry of the state (shipbuilding enterprises, design bureaus, relevant scientific research institutions, etc.) do not satisfy the existing in the world practice requirements for organizational and technical and technological ensuring shipbuilding processes. The obsolescence of technological processes, the practical absence of an appropriate personnel policy, and the availability of the necessary resources hold back the creation of an economy that is competitive on world markets.

The effective development of the shipbuilding industry of Ukraine is an important scientific and applied problem, the solution of which is of national importance.

2. Problem statement

One of the ways of solving the problem of the development of the shipbuilding industry of Ukraine should be considered the development and implementation of the promising technological platform Shipbuilding 4.0 into the practice of the enterprises and organizations of the shipbuilding cluster (SC) of the state.

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The experience of the leading shipbuilding countries of the world has proven that the transition of enterprises and organizations of the SC to new principles of creating a ship's life cycle allows to significantly increase the competitiveness of the industry and guarantee its presence on the global shipbuilding markets.

The key element of the technological platform Shipbuilding 4.0. should be considered the idea of digitalization of all elements of the life cycle of the vessel, i.e., creation of its digital double [2...13].

The main components of the Shipbuilding 4.0 technological platform are: 3D-printing, 3D-scanning, 3D-modeling; "cloud" technologies; digital platforms; modeling and numerical experiments; production technologies and directly new materials; robotization of processes; virtual and augmented reality; Internet of things; cyber security; blockchain technology; big data technologies; autonomous transport elements and systems; artificial intelligence technologies. At the same time, the analysis of publications devoted to the development of the technological platform Shipbuilding 4.0 in various countries of the world proved that they lack data on effective models of formation and implementation of its main components in production practices. Under the conditions of the current organizational and technological state of the SC of Ukraine, the absence of the necessary regulatory and legislative framework, limited resources, etc., the development of an appropriate model for the development of the state's shipbuilding industry becomes an urgent task.

The creation of a model for the formation and implementation of the Shipbuilding 4.0 technological platform at the corporate and national levels in accordance with the conditions of Ukraine requires the solution of one of the key tasks - the creation of a single information space for SC development projects by construction of its information model.

The purpose of the research is to create an information model of the shipbuilding cluster.

The object of the study – the processes of management of development projects of enterprises and organizations of shipbuilding cluster.

The subject of the study – the methods, models, mechanisms of management of development projects of enterprises and organization of the shipbuilding cluster under the conditions of digitalization.

The theoretical basis of the research for obtaining scientific results was the fundamental provisions of the theory of project management, system analysis, and information technologies [14... 16].

3. The main material

The development of the information model of the SC was carried out on the basis of existing information technologies and a system approach, which ensures adequate research formulation and the generation of an effective task strategy. The information model is considered in relation to the existing infrastructure of the industry, development plans of enterprises and organizations of the cluster, their main technical and technological indicators, etc.

Based on the research carried out the shipbuilding cluster of Ukraine can be represented as a collection of enterprises and organizations that ensure the implementation of the tasks of all stages of the ship's life cycle - the creation of a digital double (Figure 1).

The information model is a set of information models of the main components of the shipbuilding cluster: training organizations, research and design organizations, shipbuilding enterprises, organizations and enterprises of material and technical support of shipbuilding, operating enterprises, as well as the territorial community, the Customer, financial and credit institutions.

Each of the components of the SC information model is based on the expert determination of the information needs of participants in shipbuilding development projects and programs:

$$I_i^j = I_1^j \cup I_2^j \cup I_3^j \cup I_4^j,$$

where I_1^j, I_2^j, I_3^j, I_4^j – sets of information needs of the project participants, necessary for the creation of the project product at various stages of its development, respectively at the stages of initiation, design, implementation and completion of the project.

The information needs of project participants are conditionally divided into three main groups [17], which form relevant information models of a technical-technological, economic and organizational nature:

$$I_1^j = I_1^{j,T} \cup I_1^{j,E} \cup I_1^{j,O};$$
$$I_2^j = I_2^{j,T} \cup I_2^{j,E} \cup I_2^{j,O};$$
$$I_3^j = I_3^{j,T} \cup I_3^{j,E} \cup I_3^{j,O};$$
$$I_4^j = I_4^{j,T} \cup I_4^{j,E} \cup I_4^{j,O},$$

where $I_1^{j,T}$, $I_1^{j,E}$, $I_1^{j,O}$, $I_2^{j,T}$, $I_2^{j,E}$, $I_2^{j,O}$, $I_3^{j,T}$, $I_3^{j,E}$, $I_3^{j,O}$, $I_4^{j,T}$, $I_4^{j,E}$, $I_4^{j,O}$ – a set of information arrays of a technical-technological, economic and organizational nature, which are necessary for the fulfillment of the stages of the ship's life cycle.

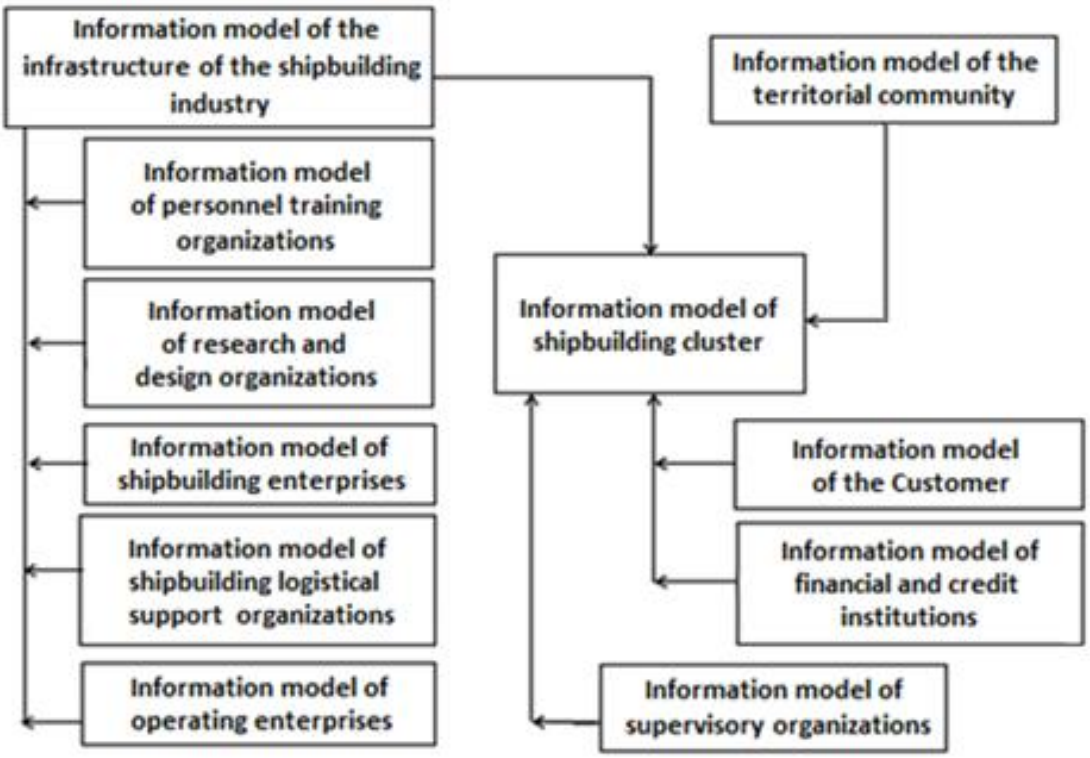

Figure 1: The main components of the information model of the shipbuilding cluster

The technical and technological information model (TTIM) includes arrays of data that characterize the structural and parametric characteristics of the main components of the SC.

The array of data that make up the economic information model (EIM) contains the cost indicators of the SC elements.

The Organizational Information Model (OIM) provides shipbuilding development project participants with basic data regarding current regulatory documents, project teams, stakeholders, existing organizations and their structural indicators working in the industry, etc.

The developed information models of the main components of the SC information model are presented partially.

The process of creating an information model of "Training Organizations" is provided by a set of information arrays that provide an idea of organizations segmented by educational service markets and their integral indicators:

$$I_2^{j,TOT} = (\{2OR_{Oi}\}, i \in 2ORIS) \cup (\{2OS_{Oi}\}, i \in 2ORSS) \cup (\{OИ2S_{Oi}\}, i \in 2ORIST) \cup$$
$$(\{OS2S_{Oi}\}, i \in 2ORSSS) \cup (\{2M_{Oi}\}, i \in 2MO));$$

$$I_2^{j,\text{ТИН}} = (\{2DRM_{\text{ИИi}}\}, i \in 2MRD) \cup (\{2DRS_{\text{ИИi}}\}, i \in 2SRD) \cup (\{2DRVS_{\text{ИИi}}\}, i \in 2SVRD) \cup (\{2M_{\text{ИИi}}\}, i \in 2\text{МИН}))\,,$$

where $2ORIS$, $2ORSS$ – sets of organizations of segmented markets of educational services: basic educational institutions and organizations for advanced training and retraining; $2ORIST$, $2ORSSS$ – sets of structural and parametric indicators of organizations of segmented markets of educational services, plans for their future development respectively; $2MO$ – a set of models that ensure the determination of indicators and characteristics of organizations engaged in the provision of educational services; $2MRD$, $2SRD$, $2SVRD$ – sets of data results of the analysis of prospects for the development of the constituent elements of the SC, which highlight its functioning in terms of technical and technological support, structural and parametric indicators, financing, respectively; 2МИН – a set of models that ensure the determination of predictive indicators and characteristics of the development of organizations engaged in the provision of educational services.

According to a similar scheme, an information model is being built regarding scientific research and design and development organizations, while the issues of personnel composition, structural and parametric characteristics of the relevant research laboratories and stands, used IT technologies and software, etc. are additionally highlighted.

The main content of the "Shipbuilding Enterprises" information model:

$$I_1^{j,A} = (\{(x_{\text{Ии}}, y_{\text{Ии}})\}, i \in 1...n) \cup (\{T_{\text{Ии}}\}, i \in \text{ТИ}) \cup (\{Q_{\text{Ии}}\}, i \in \text{ТП}) \cup (\{Q_{\text{Ri}}\}, i \in \text{ТПП}) \cup (\{V_{\text{Ии}}\}, i \in \text{ВТ}) \cup (\{(x_{\text{Si}}, y_{\text{Si}})\}, i \in 1...n)\ (\{K_{\text{Ti}}\}, i \in \text{ТК}) \cup (\{K_{\text{TXi}}\}, i \in \text{ХК}) \cup (\{O_{\text{Ии}}\}, i \in \text{ОК}) \cup (\{UP_{\text{Ии}}\}, i \in \text{ПУ}) \cup (\{XS_{\text{Ии}}\}, i \in \text{SV}) \cup (\{XT_{\text{Ии}}\}, i \in \text{ТИ}) \cup (\{Z_{\text{Ии}}\}, i \in \text{XZ}) \cup (\{TR_{\text{Ии}}\}, i \in \text{XT}) \cup (\{RA_{\text{Ии}}\}, i \in \text{АИ}) \cup (\{I_{\text{Ai}}\}, i \in A_{\text{Ии}}) \cup (\{I_{\text{Bi}}\}, i \in B_{\text{Ии}}) \cup (\{T_{\text{ИЕi}}\}, i \in \text{ЕСОИ}) \cup (\{M_{\text{Ии}}\}, i \in \text{МИ}))\,,$$

where $\{(x_{\text{Ии}}, y_{\text{Ии}})\}$ – the coordinates of the location of the enterprise; ТИ, ТП, ТПП, ВТ, ТК, ХК – sets characterizing the general situation on the territory of the enterprise, temperature gradients by season, state of the water area of the enterprise, depths, coastal slopes and ice situation; ОК, ПУ, SV, ТИ, XZ, XT, $\{(x_{\text{Si}}, y_{\text{Si}})\}$ – sets of characteristics of coastal zones, enterprise objects, structural and parametric characteristics of industrial objects, characteristics of ship channels, characteristics of buildings, structures, obstacles and their coordinates; АИ, $A_{\text{Ии}}$, $B_{\text{Ии}}$, ЕСОИ – sets of data on the state of ship channels, parametric and structural indicators, environmental indicators of industrial facilities located on the territory and outside the enterprise, buildings, structures, obstacles, respectively; МИ – a set of models that ensure the determination of indicators and characteristics of the space of the enterprise's territory, as well as the management of their development projects.

The main content of the information model "Shipbuilding Enterprises" also includes information sets regarding: ships built at the enterprise and other types of products; serial number, time and place of construction of the vessel, purpose and type of the vessel, main dimensions of the vessel (maximum length, width, height of the side, draft to summer cargo mark), capacity (gross, net), main mechanisms (type, number, total power), main steam boilers (type, number, total steam capacity), cargo holds (type, number, total capacity), refrigerator holds (number, total capacity), hull material, number of decks, number of watertight compartments, passenger capacity, crew, date of registration , ship name, ship call sign, IMO identification number, navigation area, ship owner and its legal address, ship owner or charterer of the ship and its legal address, organization that carries out technical supervision (classification, convention), etc.

An important element of the shipbuilding enterprise should be considered its main infrastructural elements: railway and roadways, energy supply systems. Information models of infrastructural components of the shipbuilding enterprise were developed in accordance with [17]. For example, to form an idea of the existing energy supply system, the information model "Integral indicators of the existing energy supply system of the shipbuilding enterprise" was developed:

$$I_1^{j,\text{ТИН}} = (\{DRM_{\text{ИИi}}\}, i \in MRD) \cup (\{DRS_{\text{ИИi}}\}, i \in SRD) \cup (\{DRVS_{\text{ИИi}}\}, i \in SVRD)\ (\{M_{\text{ИИi}}\}, i \in \text{МИН}))\,,$$

where MRD, SRD, $SVRD$ – sets of data results of the analysis of the dynamics of the development of the enterprise, energy supply systems, auxiliary systems that ensure the operation of the enterprise (in terms of technical and technological structural and parametric indicators), respectively; $МИН$ – a set of models that ensure the determination of indicators and characteristics of the dynamics of development, energy supply systems, auxiliary systems that ensure the operation of a shipbuilding enterprise, as well as, project management.

The information section "Integral indicators of the existing energy supply system of the shipbuilding enterprise" includes cost indicators and financial results of the enterprise:

$$I_1^{j,EOT} = (\{SOИ_{Oi}\}, i \in SORIS) \cup (\{SZИ_{Oi}\}, i \in SOZS) \cup (\{SRИ_{Oi}\}, i \in SOR) \cup (\{SO_{Oi}\}, i \in SMO)),$$

where $SORIS$, $SOZS$ – a set of value indicators of the main and production funds of energy enterprises and energy resource suppliers; SOR – set of indicators of financial activity; SMO – a set of models that ensure the determination of cost indicators and characteristics of elements of enterprises and suppliers of energy resources.

Under the conditions of digitization of shipbuilding enterprises, an information model of test stands and laboratories was developed for the information model of the shipbuilding enterprise. The main content of the information model is following:

$$I_1^{j,ЗТ} = (\{(x_{Ti}, y_{Ti})\}, i \in 1...n) \cup (\{TS_{Ti}\}, i \in TRS) \cup (\{TP_{Ti}\}, i \in TRP) \cup \{(x_{TKi}, y_{TKi})\}, i \in 1...n) \cup$$
$$(\{TKS_{Ti}\}, i \in TKRS) \cup (\{TKP_{Ti}\}, i \in TKRP) \cup \{(x_{TZi}, y_{TZi})\}, i \in 1...n) \cup (\{TZS_{Ti}\}, i \in TZRS) \cup$$
$$(\{TZP_{Ti}\}, i \in TZRP) \cup \{(x_{TIi}, y_{TIi})\}, i \in 1...n) \cup (\{TIS_{Ti}\}, i \in TIRS) \cup (\{TIP_{Ti}\}, i \in TZIP) \cup$$
$$\{(x_{TSi}, y_{TSi})\}, i \in 1...n) \cup (\{TSS_{Ti}\}, i \in TSRS) \cup (\{TSP_{Ti}\}, i \in TSRP) \cup (\{TG_{Ti}\}, i \in TGR) \cup$$
$$\{(x_{TPi}, y_{TPi})\}, i \in 1...n) \cup (\{TPS_{Ti}\}, i \in TPRS) \cup (\{TPP_{Ti}\}, i \in TPRP) \cup (\{TUG_{Ti}\}, i \in TRUG) \cup$$
$$(\{RA_{Ti}\}, i \in AT) \cup (\{I_{Ai}\}, i \in A_{Ti}) \cup (\{I_{Bi}\}, i \in B_{Ti}) \cup (\{M_{Ti}\}, i \in MT))$$

where $\{(x_{Ti}, y_{Ti})\}, \{(x_{TKi}, y_{TKi})\}, \{(x_{TZi}, y_{TZi})\}, \{(x_{TIi}, y_{TIi})\}, \{(x_{TSi}, y_{TSi})\}, \{(x_{TPi}, y_{TPi})\}$ – the sets of coordinates of test stands, laboratories, communication routes, locations of measuring and auxiliary equipment, metrological control points, places of repair of devices and equipment, respectively; TRS, $TKRS$, $TZRS$, $TIRS$, $TSRS$, $TPRS$ – sets of structural characteristics of test stands, laboratories, communication routes, locations of measuring and auxiliary equipment, metrological control points, places of repair of devices and equipment, respectively; TRP, $TKRP$, $TZRP$, $TZIP$, $TSRP$, $TPRP$ – sets of parametric indicators of test stands, laboratories, communication paths, locations of measuring and auxiliary equipment, metrological control points, places of repair of devices and equipment, respectively; $TRUG$, TGR – a set of parametric indicators and characteristics of the places of passage of communication routes; A_{Ti}, B_{Ti}, AT, MT – sets of indicative indicators, data on the technical state of elements of test stands and laboratories, models that ensure the determination of indicators and characteristics, as well as the management of their development projects.

The informational component of the organizational platform for the development of the shipbuilding enterprise contains the following main sets:

$$I_1^{j,ОИ} = (\{ZT_{Иi}\}, i \in ZTИ); I_1^{j,OT} = (\{ZTS_{Ti}\}, i \in ZTRS);$$
$$I_1^{jОП} = (\{ZПS_{Пi}\}, i \in ZПRS); I_1^{j,OO} = ((\{ZOИ_{Oi}\}, i \in ZORIS) \cup (\{ZOS_{Oi}\}, i \in ZORSS));$$
$$I_1^{j,ОИН} = ((\{ZDRM_{ИИi}\}, i \in ZMRD) \cup (\{ZSM_{ИИi}\}, i \in ZSMИН)),$$

where $ZTИ$, $ZTRS$, $ZПRS$, $ZORIS$, $ZORSS$, $ZMRD$ – sets of regulatory and legislative provisions regulating the organization and operation of elements of shipbuilding components, the activities of logistics organizations for shipbuilding activities and energy supply, as well as the activities of

management bodies, respectively; ZSМИН – a set of models that provide access to the given arrays and their processing, as well as the control models.

Based on the results of the research, the components of the information model "Shipbuilding enterprises" were developed, which relate to hull and mechanical production, production of systems and pipelines, human resources of the enterprise, management of technological processes, production management, etc.

The information content of the section "Information model of shipbuilding logistical support organizations" contains the necessary information about enterprises and organizations engaged in the field of shipbuilding logistical support:

$$I_1^{j,\text{ТОТ}} = ((\{\text{ОИ}_{\text{Oi}}\}, i \in \text{ORIS}) \cup (\{\text{OS}_{\text{Oi}}\}, i \in \text{ORSS}) \cup (\{\text{ОИS}_{\text{Oi}}\}, i \in \text{ORIST}) \cup (\{\text{OSS}_{\text{Oi}}\}, i \in \text{ORSSS}) \cup (\{\text{M}_{\text{Oi}}\}, i \in \text{MO})),$$

where ORIS, ORSS c sets of organizations of segmented markets for shipbuilding logistics services; ORIST, ORSSS – sets of structural and parametric indicators of organizations of segmented markets of shipbuilding logistical support services; MO – a set of models that ensure the determination of indicators and characteristics of organizations engaged in the field of logistical support of shipbuilding, as well as project management.

The developed information model allows determining the departmental affiliation and location of enterprises, the level of technical support, their share in the service markets, etc. The list of these enterprises should include manufacturers of steel products, technological equipment, instruments and control and measuring equipment, electromechanical equipment, electrical and electronic products, etc.

The information model "Operating Enterprises" refers to a set of data regarding enterprises that operate the products of shipbuilding enterprises. The need to include an information component is explained by the accepted principles of the Shipbuilding 4.0 technological platform, and can be presented in general as following:

$$I_1^{j,\text{ТИ}} = (((\{(x_{\text{Иi}}, y_{\text{Иi}})\}, i \in 1...n) \cup (\{T_{\text{Иi}}\}, i \in \text{ТИ}) \cup (\{Q_{\text{Иi}}\}, i \in \text{ТП}) \cup (\{Q_{\text{Ri}}\}, i \in \text{ТПП}) \cup (\{V_{\text{Иi}}\}, i \in \text{ВТ}) \cup (\{K_{\text{Ti}}\}, i \in \text{ТК}) \cup (\{K_{\text{TXi}}\}, i \in \text{ХК}) \cup (\{O_{\text{Иi}}\}, i \in \text{ОК}) \cup (\{UP_{\text{Иi}}\}, i \in \text{ПУ}) \cup (\{XS_{\text{Иi}}\}, i \in \text{SV}) \cup (\{XT_{\text{Иi}}\}, i \in \text{ТИ}) \cup (\{Z_{\text{Иi}}\}, i \in \text{XZ}) \cup (\{TR_{\text{Иi}}\}, i \in \text{XT}) \cup (\{RA_{\text{Иi}}\}, i \in \text{АИ}) \cup (\{I_{\text{Ai}}\}, i \in A_{\text{Иi}}) \cup (\{I_{\text{Bi}}\}, i \in B_{\text{Иi}}) \cup (\{T_{\text{ИEi}}\}, i \in \text{ЕСОИ}) \cup (\{M_{\text{Иi}}\}, i \in \text{МИ})),$$

where $\{(x_{\text{Иi}}, y_{\text{Иi}})\}$ – the location coordinates of operating enterprises; ТИ, ТП, ТПП, ВТ, ТК, ХК – sets of types of enterprises, their parameters, types of operational resources; availability of auxiliary enterprises, equipment and their main indicators; ОК, ПУ, SV, ТИ, XZ, XT – sets of characteristics of enterprises, specific indicators of work, structural and parametric characteristics of main and auxiliary enterprises, characteristics of production activities, characteristics of buildings and structures; АИ, $A_{\text{Иi}}$, $B_{\text{Иi}}$, ЕСОИ – sets of data on the state of operating enterprises, parametric and structural indicators, environmental indicators, respectively; МИ – a set of models that ensure the determination of indicators and characteristics of enterprises.

The information model "Operating enterprises" also reflects their economic characteristics and cost indicators:

$$I_1^{j,\text{ЕИ}} = ((\{\text{СИ}_{\text{Иi}}\}, i \in \text{IS}) \cup (\{\text{SB T}_{\text{Иi}}\}, i \in \text{ST}) \cup (\{\text{SBB T}_{\text{Иi}}\}, i \in \text{SBT}) \cup (\{\text{SBB T}_{\text{Иi}}\}, i \in \text{SBT}) \cup (\{\text{SV T}_{\text{Иi}}\}, i \in \text{VS}) \cup (\{\text{SZ T}_{\text{Иi}}\}, i \in \text{ZS}) \cup (\{\text{SM}_{\text{Иi}}\}, i \in \text{СМИ})),$$

where IS, ST, SBT, SBT, VS, ZS – sets of value indicators of operating enterprises, types of main and auxiliary industries, buildings and structures, energy supply systems, respectively; SМИ – a set of models that provide definition of value indicators and characteristics.

The needs of project participants in economic indicators are defined by the following main data sets and models:

$$I_2^{j,ЕИ} = (\{2SИ_{Иi}\}, i \in 2IS) \cup (\{2SB\ T_{Иi}\}, i \in 2ST) \cup (\{2SBB\ T_{Иi}\}, i \in 2SBT) \cup (\{2SBB\ T_{Иi}\}, i \in 2SBT) \cup (\{2SV\ T_{Иi}\}, i \in 2VS) \cup (\{2SZ\ T_{Иi}\}, i \in 2ZS) \cup (\{2SR\ T_{Иi}\}, i \in 2SRT) \cup (\{2ASR\ T_{Иi}\}, i \in 2SRTF) \cup (\{2SM_{Иi}\}, i \in 2SМИ));$$

$$I_2^{jЕП,} = (\{2SПS_{Пi}\}, i \in 2SПRS) \cup (\{2SZS_{Пi}\}, i \in 2SZRS) \cup (\{2SR\ R_{Пi}\}, i \in 2SRRT) \cup (\{2ASR\ R_{Пi}\}, i \in 2ASRRT) \cup (\{2SM_{Пi}\}, i \in 2SМП));$$

$$I_2^{j,ЕОТ} = (\{2SОИ_{Оi}\}, i \in 2SORIS) \cup (\{2SZИ_{Оi}\}, i \in 2SOZS) \cup (\{2SRИ_{Оi}\}, i \in 2SOR) \cup (\{2SO_{Оi}\}, i \in 2SMO));$$

$$I_2^{j,ЕИН} = (\{2SDRM_{ИИi}\}, i \in 2SMRD) \cup (\{2SDRS_{ИИi}\}, i \in 2SSRD) \cup (\{2SDRVS_{ИИi}\}, i \in 2SSVRD) \cup (\{2RS_{ИИi}\}, i \in 2RDH) \cup (\{2SM_{ИИi}\}, i \in 2SМИН)),$$

where $2IS$, $2ST$, $2SBT$, $2SBT$, $2VS$, $2ZS$, $2SRT$, $2SRTF$ – sets of existing and prospective value indicators of constituent enterprises and organizations of the SC, types of energy sources, main and auxiliary enterprises, energy resources, buildings and, design and construction works, artifact technical solutions, respectively; $2SМИ$ – a set of models that provide determination of value indicators; $2SПRS$, $2SZRS$, $2SRRT$, $2ASRRT$ – sets of value indicators of land and other resources; $SМП$ – a set of models that provide determination of value indicators; $2SORIS$, $2SOZS$ – a set of forecast value indicators of the main and production funds of organizations; $2SOR$ – a set of forecast indicators of financial activity; $2SMO$ – a set of models that provide determination of value indicators, characteristics of organizations; $2SMRD$, $2SSRD$, $2SSVRD$ – sets of data results of the analysis of prospective characteristics of the development of the SC, enterprises and organizations that ensure its work; $2SМИН$ – a set of models that ensure determination of value indicators, characteristics of enterprises and organizations; $2RDH$ – sets of cost constraints and risks for the project (program).

In accordance with the proposed composition of the main components of the information model of the shipbuilding cluster, similar to the models described above, information models of territorial communities, the Customer, financial and credit institutions and supervisory bodies were developed.

The practical result of the implementation of the developed information models should be considered the formation of an appropriate database, which serves as the basis for the development of a program for the development of the shipbuilding industry of Ukraine based on the Shipbuilding 4.0 technological platform.

4. Conclusions

1. The development of projects and programs for the development of the shipbuilding industry of Ukraine is an actual scientific and applied problem, the solution of which is of national importance.
2. The experience of the shipbuilding countries of the world proves that the reformation of the shipbuilding industry should take place on the basis of the technological platform of the Shipbuilding 4.0 industry.
3. The formation of projects and programs for the implementation of elements of the technological platform Shipbuilding 4.0 requires the creation of an information model of the shipbuilding cluster.
4. The information models of the shipbuilding cluster developed for the first time provide the basic information needs for the implementation of the technological platform Shipbuilding 4.0.

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