Institutional and architectural design of organisational development of large-scale economic and industrial systems

Abstract
Introduction. There exist a great number of researches devoted to integration interaction of enterprises in this scientific field. Typically, they focus only on studying corporate relations and require expansion in the area of all possible organizational forms of enterprises interaction within the formation of large-scale economic and industrial systems (LSEIS).

The purpose of this article is to prove the hypothesis about the appropriateness of proceeding organisational transformation of business entities through involving enterprises in integration interaction. Accordingly, the purpose can be achieved by applying methodologies of institutional and architectural design of LSEIS organizational development.

Methods. To achieve the purpose, the authors have used the technology of conceptual design. By its means, a model of substantive research and the system of hypothesis is formed to implement organizational development. The adjustment of interaction between LSEIS participants has been carried out according to the multi-agent approach and standards of architectural description of the systems.

Results. The application of these methods allows developing spiral submission of the process of organisational development, as well as presenting the developed conceptual model to form institutional and architectural description of LSEIS. The model designed to operate the mechanism of organisational development of integrated association of enterprises is based on the principles of reflexive management and recursive coordination of the concerns of the target system with the interests of all its stakeholders.

Conclusion. The proposed concept allows coordinating the guiding influences of the mechanism of LSEIS development management at micro- and mesolevels (at the level of LSEIS participants and LSEIS interaction with other integrated associations).

Keywords: Institutional Design; Enterprise Architecture; Organisational Development; Large-scale Economic and Production System; Change Management

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Інституційно-архітектурне проектування організаційного розвитку великокомп'єнтних економіко-виробничих систем

Анотація
У статті представлено концепцію інституційного проектування організаційного розвитку інтегрованих об'єднань підприємств, в основу якої покладено стандарти архітектурного опису складних соціально-економічних систем та розширення методології управління змінами. В основу розробки концепції покладено онтологічне та мультиагентське моделювання механізму управління розвитком великокомп'єнтних економіко-виробничих систем.

Ключові слова: інституційне проектування; архітектура підприємства; організаційний розвиток; великокомп'єнтна економіко-виробнича система; управління змінами.

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Інституційно-архітектурне проектування організаційного розвитку крупномасштабних економіко-виробничих систем

Анотація
В статті представлена концепція інституційного проектування організаційного розвитку інтегрованих об'єднаних підприємств, основана на стандартах архітектурного опису складних соціально-економічних систем і прийняттій методології управління змінами. В основу розробки концепції покладено онтологічне і мультиагентське моделювання механізму управління розвитком крупномасштабних економіко-виробничих систем.

Ключові слова: інституційне проектування; архітектура підприємства; організаційне розвиток; крупномасштабна економіко-виробнича система; управління змінами.
1. Introduction

The development of national and world economy is possible only in case of consolidation of resources and competences of all types of entities (even those which have never entered into close cooperation before). The relevance of this approach is confirmed by high activity in the field of M&A and growth of the total value of mergers and acquisition agreements in a long term perspective. As it is shown in Figure 1, despite the crisis since 1995, there has been an increase in the number and value of M&A agreements in the global market.

The total value of M&A agreements worldwide in 2015 was USD 4.1 trillion. It is by 18% more if compared with their value in 2014 (although the number of agreements increased by only 2.7%) [1]. A decline in M&A amount took place in 2016. According to [2], it was 18% (from USD 4.66 trillion to USD 3.84 trillion). Although, the income from M&A agreements decreased by only 2% in 2016. This shows that there was a growth in the value of individual M&A agreements. A confirmation of such a trend is provided in Table 1, along with detailed information by region. This information shows us the difference in the structure of M&A agreements in different regions of the world. In any case, this information proves the relevance of studying the integration process, especially in the case when the enterprise is part of a supply chain.

In Figure 1, the flip side of the growth in the value of M&A agreements is the distribution of other forms of interaction between enterprises to create new consumer value or obtain joint competitive advantages. By its legal form, such an interaction differs from M&A agreements. However, its content is similar to the definition of logic and business rules of coexistence typical of the participants of the integrated logistics network. This is confirmed by the relevant information provided in Table 2.

The organizational form which can combine results and benefits of both corporate integration (see Table 1) and cooperative relations (see Table 2) is presented by large-scale economic and industrial systems (LSEIS) which are hypercomplex formations created from a range of diverse systems characterised by relationships of diverse character and probabilistic behaviour of the participants (M. A. Kizim, 2000) [5, 12-16].

It is within the framework of LSEIS that the consolidation of resources and competences of individual enterprises happens. The effectiveness of such consolidation mainly depends on the completeness of the regulation of functions performed by LSEIS participants, the correctness of distribution and regulation of business roles between strategic units of the integrated formation, and the extent to which LSEIS components are linked together within the framework of the fundamental description of the system organisation and the ability of individual entities to implement changes while being involved in the LSEIS structure. According to the problem of theoretical and methodological development, as well as methodological support, of institutional and architectural design LSEIS activity and its development is actualised. Only the formation of such support will allow achieving the optimal correlation between LSEIS objectives and the parameters of their reflection on integrated business processes.

2. Brief Literature Review

Integration processes and organisational development of enterprises has always been in the area of attention of domestic and foreign scientists and economists. This is primarily due to the constantly changing conditions of business activity and the objective need to adapt to them from the part of economic agents. At the same time, it should be noted that the existing developments of scientists and economists are quickly losing relevance because of changing economic conditions. One of the related trends is the corporatisation and distribution of integration and cooperative interaction between enterprises. The study in the area of corporate governance is rather widespread: from the development of theoretical and methodological base (V. V. Bokovets, 2015) [6] to the improvement of its specific components (M. Aluchna, S. Idowu, 2017) [7].

A similar situation occurs in the field of proceedings related to cooperative processes (E. G. Popkova, 2017) [8] and
the development of mild integration forms such as the cluster (P. Agarkov, R. S. Golov, 2016) [9] or strategic alliance (G. Griv, A. Shipilov, T. Rouli, 2014) [10]. The existing studies are generally oriented to a limited list of parties concerned. In most cases, the relevant studies are conducted in terms of the entity’s management development rather than the whole range of the enterprise’s stakeholders (I. V. Gontareva, 2011). Particularly relevant This problem becomes particularly relevant in terms of the interaction between those who represent large-scale economic and industrial systems. The regulation of such interaction allows establishing a system of business rules to determine the institutional basis of LSEIS development.

Developments aimed at presenting corporate governance in the context of institutional theory of economics are already available (Z. Y. Shershnova, 2015) [12]; however, they need to be extended towards the features of LSEIS. The basis for such an extension should be standards for architectural description (L. G. Cretu, 2014) [13] and modeling of complex systems (M. Lankhorst, 2016) [14]. These standards are generally applied with respect to technical systems and require proper development towards their adaptation to social and economic systems. The adaptation of such a tool makes it possible to develop a conceptual basis for organisational LSEIS development. Accordingly, this enables us to extend existing methodological approaches to managing LSEIS. In particular, institutionalisation and established business rules will make it appropriate to use the tools of reflective management in order to develop scenarios of interaction between LSEIS participants (R. N. Lepa, 2012) [15]. Also, it should be noted that the implementation of a new organisational development methodology will certainly go in close contact with certain transformation processes and deal with resistance to change. Taking this into consideration, it is necessary to consider the achievements of change management (J. Hayes, 2014) [16]. However, it is impossible to transmit them directly to LSEIS activities. Some adaptation is needed to the declared architectural and institutional paradigm of the organisational development of LSEIS.

3. The purpose of the article is to prove the hypothesis about the appropriateness of proceeding organisational transformation of business entities through involving enterprises in integration interaction and develop theoretical, methodological and methodical bases for institutional and architectural design of organisational development of large-scale economic and industrial systems.

4. Results

To prove the designed hypotheses and achieve the purpose of the article, it is proposed to use technology of conceptual design (A. Teslinov, 2009) [17], which provides the submission of aggregate basic concepts (displayed by using circles) and tribal relations (displayed by using arcs). The existing forms of organisational structure of LSEIS and principles to attract businesses to the integration interaction provide a basis for the scheme. The scheme shown in Figure 2 is a formalised representation of LSEIS performance. By using set-theoretical approach and checking basic concepts in figure 2 as certain sets, let us form the following cortege (in terms of (mathematical modelling):

$$LSEIS = \{A, IR, CC, ARC, TS\}$$ (1)

This cortege (1) reflects a stationary position of LSEIS in a certain period of time t. This stationary position meets the definition of LSEIS architecture in ISO 1471-2000, as «the fundamental organisation of a system that is built into its components and correlated with the principles of its design and evolution». Accordingly, we offer to consider organisational development of LSEIS as transformation or a revolution shift to a new stationary position \(LSEIS(t) \rightarrow LSEIS(t + 1)\). Focusing on architectural standards (ISO 15288 and ISO 42010) allows us to consider the development of LSEIS in the context of target and provide systems interaction. The logic of such interaction is shown in Figure 2.

Herewith, the target system will be the result of integration cooperation of enterprises within LSEIS (product or result in the output of integrated business processes). We propose to consider LSEIS to be the implementation system. In this case, characteristics and requirements of the target system form integration restrictions (in cortege (1) and they are formalised as the set \((IR)\) in Figure 2. Focusing on the conceptual model shown in Figure 2 allows us to develop the authors’ hypotheses as for institutional and architectural modeling of organisational development of LSEIS. The corresponding system of hypotheses in their connection with the concepts reflected in Figure 2 are shown in Table 3.

Some adaptation is needed to the declared architectural and institutional paradigm of the organisational development of LSEIS, not only architecture itself but also business rules of the participants are changed. These business rules define the institutional support of LSEIS performance. To formalise, it is proposed to focus on the theory of concepts of control \(CC\) in Figure 2. V. V. Radayev (Radayev, 2002) defines them as «a set of values and meanings, or certain philosophy that allows agents to interpret existing processes and interpret the actions of others» [18, 8]. Thus, the design of LSEIS involves changes in both its architectural structure and its institutional support. The model of such a change is shown in Figure 3.

Fig. 2: Conceptual model of institutional and architectural design of organisational development of large-scale economic and production system

Source: Developed by the authors

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In Figure 3 we provide conditions for the LSEIS evolutionary and revolutionary development. It should be noted that the change of LSEIS participants can be implemented not only in a revolutionary way. We can consider the development revolutionary only if the LSEIS architecture (\(ARC\)) and the concept of control (\(CC\)) has changed. Another feature seen from Figure 3 is the reflection to different ways of LSEIS’s development. These ways are defined within the scenario of LSEIS participants’ actions (\(ST\)) and within the images (\(IM_{LSEIS}\)) of the LSEIS reflexive management system.

The scheme presented in Figure 3 is based on the concept of individual enterprises’ spiral dynamics. This concept was grounded by one of the authors of the present article [19]. In Figure 3, the concept is extended by the level of LSEIS. The determination of transformation logic of business rules of LSEIS participants in conjunction with the parameters of its architectural representation. It is clear that the desire of entities to manage this relationship is an advantage of the scheme shown in Figure 3. An appropriate management mechanism must be the basis for it. Such
The article describes the implementation of the authors' hypotheses about the organisation of management development of LSEIS through working-out institutional standards of participants' interaction and transmitting such standards according to the levels of architectural representation of the integrated enterprise association. The novelty of the proposed approach is, firstly, its complexity and consideration all possible forms of organisational construction of LSEIS. Secondly, the declared focus on architectural design of LSEIS allows expanding the list of stakeholders of organisational development and establishing a system of business rules and the institutional basis of LSEIS development. Thirdly, it is in the determination of directions of adaptation of reflexive management instruments and methods of management changes to the implementation of transformational changes in institutional and architectural representation of LSEIS in development.

Accordingly, the prospects for the authors' further developments will be a practical implementation of the usage of each of these instruments under the development of management mechanism of LSEIS through appropriate methodological approaches.

<table>
<thead>
<tr>
<th>Concept Fig. 2</th>
<th>Hypothesis (H1) in terms of peculiarities of managing organisational development of LSEIS</th>
<th>No. of Relations</th>
<th>Logic of the development management mechanism of LSEIS</th>
<th>Elements of architecture</th>
<th>Terms from the multilateral systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resource</td>
<td>Hypothesis 1 (H1) = Types of resource (R1) = &lt;material, financial, labour, information, knowledge&gt;</td>
<td>4</td>
<td>Agents' actions are modelled by predicates: availability of competition to perform tasks connected with specific resource (requires competition (RS, CT1) or [requires_resource, (A, R1)])</td>
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<td>Technology</td>
<td>Hypothesis 2 (H2) = &lt;alignment of competence (RS) = (relevant, complementary, current)&gt;</td>
<td>5</td>
<td>Within the multilateral system there occurs the regulation of agents' relations. Agent has submitted as a member of some integrated agent (A, LSEIS) and is vested some power [has_authority (A, LSEIS)]</td>
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<td>Competition</td>
<td>Hypothesis 3 (H3) = List of integration restrictions for LSEIS participants (IR) = sub-contracting IR, distribution IR, information IR, financial IR, marketing IR, competitive IR</td>
<td>6</td>
<td>Reflects connections between the target system and the support system. Estimate the difference between the goal of LSEIS participants [has_goal (A, LSEIS)] and its sub-tasks [has_authority (A, SCM)]</td>
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<td>LSEIS</td>
<td>Hypothesis 4 (H4) = Characteristics of the target system (production output, given in (PR)). Interaction of LSEIS members gives us possibility to achieve goals (G(j)) which all members of LSEIS trying to achieve</td>
<td>7</td>
<td>Start of each agent activity is defined by a predicate [occurs (A, ST1)]. This predicate connects the agent's action with certain situations. The agent may be associated with resources [use (A, RS)] or product [produce (A, PR)]</td>
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<td>Integration</td>
<td>Hypothesis 5 (H5) = Establish hierarchy of roles and business rules. The roles (RL) is defined as scenarios for responding to the challenges. These scenarios take into account the level of LSEIS complexity and systems</td>
<td>8</td>
<td>Establish institutional norms ((N1) = &lt;base norms of integration support, routine &gt;), the followers of norm ((FL) = &lt;potential, real, external &gt;) and the rule for transformation of norms</td>
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<td>Restrictions</td>
<td>Hypothesis 6 (H6) = Organisation of large-scale economic and industrial systems. Kharkiv: Biznes-Inform (in Ukr.).</td>
<td>9</td>
<td>For some participant of LSEIS within their integration restrictions, definition the rights (has_right (A, IN)), liability (has_liability (A, IN)) and responsibility [has_responsibility (A, IN)] for norms' transformation</td>
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<td>Concept Control</td>
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<td>Time</td>
<td>Hypothesis 9 (H9) = As the implementation of development processes faces with organisational resistance, it is necessary to create a mechanism to manage transformational changes, agreed with the parameters of institutional and architectural representation of a large-scale economic and production system.</td>
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<td>Hypothesis 10 (H10) = Establish institutional norms ((N1) = &lt;base norms of integration support, routine &gt;), the followers of norm ((FL) = &lt;potential, real, external &gt;) and the rule for transformation of norms</td>
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<td>Image of LSEIS future</td>
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<td>Source: Developed by the authors</td>
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References


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