

Представлена концепція інформаційного забезпечення діяльності інтегрованих об'єднань підприємств. Визначено систему гіпотез та теоретичних положень щодо консолідації інформації для менеджменту великомасштабних економіко-виробничих систем. Процес організації розкрито з використанням методології структурного аналізу та моделювання. Формалізація змісту процесів консолідації, заснована на концентричній теоретико-множинній моделі, обумовила особливості підпорядкування контурів консолідації інформації принципам рефлексивного управління

Ключові слова: консолідація інформації, великомасштабна економіко-виробнича система, рефлексивне управління, теоретико-множинний підхід

Представлена концепция информационной поддержки деятельности интегрированных объединений предприятий. Определена система гипотез и теоретических положений по консолидации информации для менеджмента крупномасштабных экономико-производственных систем. Процесс организации описан с использованием методологии структурного анализа и моделирования. Создание на основе концентрической теоретико-множественной модели формализованного описания процесса консолидации определило особенности подчинения этого процесса принципам рефлексивного управления

Ключевые слова: консолидация информации, крупномасштабная экономико-производственная система, рефлексивное управление, теоретико-множественный подход

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DEVELOPMENT OF INFORMATION CONSOLIDATION SYSTEM IN THE REFLECTIVE MANAGEMENT OF LARGE-SCALE ECONOMIC AND PRODUCTION SYSTEMS

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1. Introduction

In today's world of increasing speed and unpredictability of changes in conditions of economic activity of national enterprises, the need for formation of adequate informational support of companies' management is becoming even more relevant. It is the importance of information for management decision-making that enhances the value of innovations, devoted to improvement of processes of informational and analytical support for managing an enterprise. Formation of such support should take into account a number of trends of development in the global economic system. First, these are the trends of extension of information-communication technologies and development of knowledge economy. Second, this is the intensification of integration processes, corporatization, and the emergence of various associations of enterprises. Taking this into account, the relevance of this study is in the creation of a conceptual basis for increasing the value of information for decision-makers. This information will be preliminarily processed and linked to strategic scenarios of development of integrated associations of enterprises.

2. Literature review and problem statement

Speaking of association of enterprises, it is essential to consider a diversity of approaches both to the creation of such associations and to their classification or typology. Vast majority of researchers focus either on corporative enterprises [1, 2], or on studying cooperating relationships between independent enterprises [3, 4], particularly when they form extensive logistics networks to create value [3] or strategic alliances [4], or on the clustering-network formations [5]. Each of the authors of these papers identifies somewhat differently queries to a subsystem of information management of enterprises. Accordingly, to unify such queries, it is necessary to achieve uniformity in the representation of all types of enterprise associations. This can be accomplished using innovations [6], which introduce the concept of large-scale economic and production systems (LEPS). By LEPS, the author of article [6] implies "a certain integrated totality of entities that represent various forms of capital. These entities are related to each other by financial-economic and productive- technological connections". Appropriateness of focusing on LEPS is proved by developments [7], which examine the issue of ex-

tension of “business- ecosystems”, and proposals [8], concerning the relevance of formation of “corporative networks”. The authors of paper [7] imply by “business-ecosystem” a creation of joint platforms of business agents, which allow groups of enterprises to improve their own competitiveness. In turn, the authors [8] reduce understanding of “a corporative network” to an association of independent businesses that coordinate their activities through a system of contracts. Thus, the condition for emergence of LEPS, business ecosystems and corporative networks is involvement in joint business activity, based on soft (contractual) or hard (ownership) managerial and organizational relations.

The main challenge for a system of informational support of LEPS management is to overcome opportunistic behavior and asymmetry of information in an integrated formation, coordination of formats of registration of data and ontology of knowledge, used by LEPS management. It is clear that decision-making under conditions of business associations requires consolidation of information and knowledge, available in various strategic business units (SBU), which are separated in the structure of LEPS. A part of information queries can be satisfied by consolidated financial reporting. However, this reporting is mainly associated with investment decisions and provides the so-called “retrospective” information about activities of an enterprise in the LEPS structure. Thus, consolidation of information for management of associations of enterprises should be considered from the point of view, different from consolidation of financial reporting. Similarly, the condition can be applied to an individual enterprise, not integrated in the LEPS structure. Thus, subsequently, we will define the essence of concepts “information consolidation” and “consolidated information”.

Here, we emphasize the existence of several approaches to the definition of the essence of concepts “information consolidation” and “consolidated information”. The first group of interpretations considers consolidated information as the information “collected in one location”. In this case, it is more appropriate to talk about the concept of “data consolidation”, which in [9] is defined as “management of integration processes and data exchange between different production systems”. Common definitions of information consolidation also include: “summarizing records for report preparation” [10]; “the process of information accumulation and structuring” [11]; “obtaining of systematically integrated information resources from various sources” [12]; “organization of management of sets of strategic corporative information” [13]. In this context, it is appropriate to take into consideration the proposal, contained in paper [14], in terms of the need to divide consolidation into physical and logical. Physical consolidation involves physical collection of information and its carriers in a particular location. Logical consolidation is reduced to organization of an easy access to distributed information.

The second approach somewhat expands comprehension of the concept of “information consolidation”. In this case, emphasis is made on representation of consolidation as a means of solving the problem of insufficient completeness of information when making decisions. Representatives of this approach [15, 16] stress the need to overcome the lack of information due to various generalizations and prediction calculations. Within this approach, for example, information consolidation can be considered in the context of formation of information-analytical models and indicator panels for them. An example of this is innovations [15], which present

the process of generalization of accounting information for formation of analytical decision support panels. It is possible to develop proposals [15] on formation of information support of management by focusing on a system of balanced score card (Balanced Score Card, BSC) [16]. In this respect, an illustration can be paper [17], in which BSC is identified with information system of strategic management.

In this case, control over operative aspects of a enterprise’s activity will be exercised with the use of the monitoring system.

However, these approaches to definition of the essence of information consolidation processes still focus on retrospective information. Accordingly, these approaches do not take into account complex horizontal and hierarchical relationships between enterprises comprising LEPS. That is why it is necessary to develop the concept of information consolidation in terms of adaptation to LEPS conditions.

3. The aim and objectives of the study

The goal of present work is to develop theoretical and methodological foundations for the organization of information consolidation contours for management of a large-scale economic and production system. In this case, development of these foundations must take into account specific features of architectural organization of LEPS and approaches to development and coordination of managerial decisions.

To accomplish the set goal, the following tasks were to be solved:

- to develop a scheme of a subject-area of information consolidation and to substantiate a system of hypotheses and theoretical provisions on organization of the process of information consolidation for large-scale economic and production systems;
- to present a model of the course of the process of information consolidation organization using methodology of structural analysis and modeling;
- to substantiate the essence of consolidation processes using concentric theoretical-multiple model, providing for subordination of information consolidation contours to principles of reflective management.

4. Materials and methods of research into preconditions of the organization of information consolidation for management of large-scale economic and production systems

The above specified differentiation of processes of consolidation between logical and physical requires provision of differentiation between methods and approaches to organization of information support of LEPS management. We suggest that such a differentiation should be based of proposals [18] regarding existence of two approaches to organization of information support of management. They are document-centered (provides reference point to documents as integral objects) and data-centered (operates with schemes of data recording, obtained in different notations and integrated between themselves) approaches. Thus, when defining the essence of consolidated information and organization of the system of collecting such information, we propose to be guided by the matrix, shown in Fig 1.

Approach to organization of information support of management	A. Data-centered approach	Formation of local data warehouses within architecture of information system of enterprise	Reference point to processing electronic documents and operative information for converting them to knowledge
	B. Document-centered approach	Regulation of keeping nomenclatures and business archives at enterprise	Formation of summarized nomenclatures of events for systematization of existing archives
		X. Physical consolidation as information accumulation in a definite location	Y. Logical consolidation with unified access to information and knowledge
Kind of consolidation			

Fig. 1. Definition matrix of the essence of concept “information consolidation”

Thus, approaches that reduce information consolidation to its collection in one location (corresponds to segment BX of the matrix, shown in Fig. 1), or are focused on overcoming problems of information incompleteness (correspond to segment AX and BY of the matrix, shown in Fig. 1) require a certain extension. On the whole, when determining comprehension of consolidated information, it is necessary to take into account requirements to it in terms of the latest conceptions of management. Here, we will note that for the majority of modern conceptions of management, it is appropriate to define the essence of consolidated information in the framework of segment AY of the scheme, shown in Fig. 1.

Thus, in the course of formation of the system of consolidated information (SCI), it is necessary to focus on the third approach, which reduces all consolidation processes to formation of open knowledge, which is used by decision makers. The first interpretation of information consolidation through open knowledge was quite extensively considered in [19]. The authors examined information consolidation as open knowledge, in relation to which specialized actions, such as processing, selection, analysis, restructuring, reformatting, etc. were applied. The need for these actions is explained by re-orientation of acquired knowledge for serving the most basic decision, problems and information needs of a specific clientele or social groups. Otherwise, consumers of this knowledge are not able to address it effectively and rationally due to inaccessibility in a derivative form and distribution in many documents. This interpretation is in line with a whole array of research in the area of “Business intelligence” [20, 21], which operates with methods and tools for transforming of unprocessed information into a convenient form. By a convenient form, we imply a possibility “to provide the enterprise management with necessary information for preventive business decision making” [20] or to make information suitable for “making optimum decisions” [21].

However, the vast majority of scholars operate only with the concept of information and information systems and do not explore banking accounting as the main source of formation of information for enterprise’s management. In this case, just within accounting methodology, it is possible to separate some approaches to understanding the process of providing information for management of a enterprise. Research into strategic management accounting occupies the main place among similar studies. In addition to developments in the area of strategic accounting, the approach to definition of consolidated information through open knowledge is closely connected with innovations [22], dedicated to definition of information synergy. The author of paper [22] reduces such synergy just to “combination and integration of theoretical, methodological and organizational components of formation and provision of the whole spectrum of information into a

single system”. In case of extension of this interpretation through features of preventiveness of information formation, it is possible to obtain the essence of the concept of “information consolidation”. Nevertheless, we consider it appropriate to extend such understanding of the concept of “consolidated information” with achievements of reflective approach to management organization. Reflective approach is particularly relevant under conditions of LEPS. Reflection in this case is seen through “encouragement of a controlled subject to make desired decisions” [23] and “making manipulative decisions” [24].

5. Results of research into parameters and approaches to information consolidation for management of large-scale economic and production systems

We propose to incorporate all the above-mentioned requirements for formation of system of consolidated information (SCI) with the use of theoretical-multiple approach. Within this approach, the components of SCI are described through a totality of sets. A similar approach has already been used to substantiate the structure of accounting-analytical support of costs management of enterprises [25]. Here, it is proposed to extend this innovation in terms of coverage of the whole spectrum of information, necessary for LEPS management. When improving the existing model, it is also necessary to consider emergence of the declared earlier synergy of accounting information that will also emerge between different levels of hierarchical representation of LEPS.

In addition, to develop existing proposals, we will use innovations [26], which employ a concentric model of sets to describe mental space of environment of a particular project or a program. As far as consolidation process is concerned, we propose to introduce four contexts of adding content to a system of information collection, processing, and usage. The first context will be determined by external surrounding of LEPS (we mean the environment of indirect influence for LEPS and all its stakeholders, such as consumers and competitors). The structure of consolidated information for given context is determined by set {ENV}. The second context determines the environment of direct influence, containing stakeholders of an enterprise and those entities, with which an enterprise started integration interaction {STH}. The third one is connected with participation in extended logistic networks, which involve several entities. In this study, this context will be defined as a large-scale economic and production system and will be modeled by set {LEPS}. The last, the fourth context, will correspond to the level of an individual enterprise (EN) or a strategic business unit (SBU) as a part of the integrated business structure. To represent it, we introduce set {EN}. Here, we will pay attention to the fact that the mentioned sets are “nested” in one another, and on the whole, determine the spatial sample of CIS. This sample is assigned through the following tuple:

$$SCI = \langle ENV, STH, LEPS, EN \rangle. \tag{1}$$

Subsequently, we will determine a content sample of the information consolidation system. The sets, which

will form a content sample of SCI, are included in each set, presented in the tuple. It is on the whole in line with innovations [26], regarding description of different levels of a project surrounding with the same totality of sets. To determine a list of sets, we will use the model of formation of contours of information consolidation for management of individual entities and associations of enterprises, shown in Fig. 2. This model was based on the methodology for conceptual design [27], which involves presentation of the totality of basic concepts (represented with the use of circles) and generic relations (represented with the use of arcs).

We will note that the action of organizational mechanisms is additionally presented in the conceptual model, shown in Fig. 2. These mechanisms provide for transformation of constituents of tuples (1) and (2) in SCI. It should be particularly noted that the scheme, presented in Fig. 2, is focused on application of REA-concept as the basis for formation of the system of consolidated information. This concept examines activity of economic entities (Agents) in terms of correlation of available resources (Resource) and in the context of certain events (Events). Accounting is kept in the context of existing entities. In the case of LEPS, existence of such resources and competences in separate

entities serves as the basis for generation of business rules of integrational interaction.

These rules form the space of institutionalization of interaction that is described in detail by authors [28]. Accordingly, the system of consolidation of accounting information must provide for support of implementation of such business rules. Therefore, the content sample of the information consolidation system with the use of the multiple-theoretical approach and the concepts, shown in Fig. 2, implies a separation of the following sets:

- {SRC} – the set of sources of origin of consolidated information;
- {CT} – the set of tools and formalized procedures for consolidation of accounting-analytical information for its transformation into open knowledge;
- {CI} – the set of revealing the kinds of consolidated information;
- {SUP} – the supportive component of operation of consolidation system;
- {DW} – the set of data warehouses, which contains results of operation of information consolidation system;
- {RP} – the set of strategic and operative points of reference for operation of an enterprise's management system or integrated business structure;

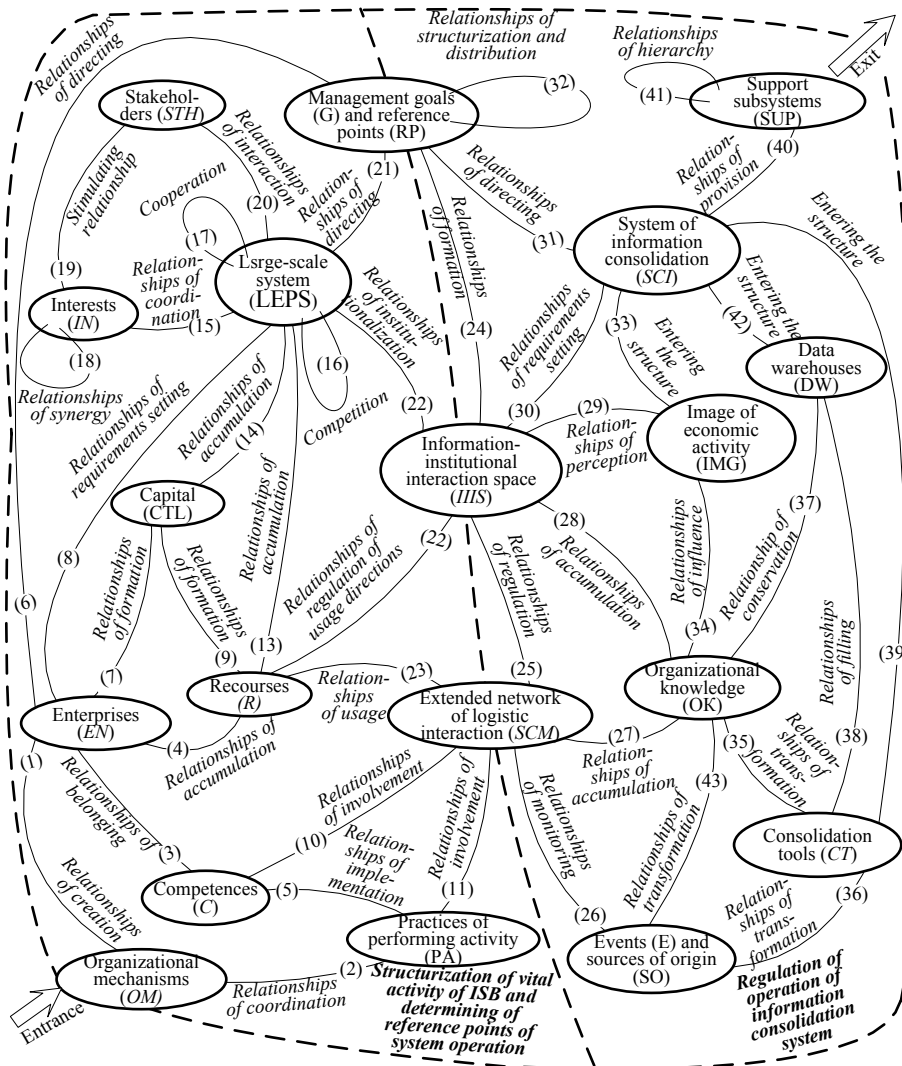


Fig. 2. Conceptual model of the formation of contours of information consolidation system

Under this allocation, the information consolidation system is defined as the following tuple that just contains consolidated information and different types of operation support of SCI:

$$SCI = \langle SRC, CT, CI, SUP, DW, RP \rangle. \quad (2)$$

In the case of uniting of tuples, represented by formulae (1) and (2), we obtain a concentric theoretic-multiple model of the system of consolidation of accounting information for

management of enterprises and integrated associations. Separation of levels of this model is shown in Table 1.

As we can see in Table 1, the sets, presented in it, characterize particular concepts from the conceptual model of information consolidation, shown in Fig. 2. Analysis of relationships between the concepts, shown in Fig. 2, allowed us to formulate a system of hypotheses regarding implementation of the system of consolidated information (SCI), shown in Table 2.

Table 1

Concentric theoretic-multiple model of the system of consolidation of accounting information (SCI)

Spatial sample Content sample		SCI = <ENV, STH, LEPS, EN>			
		Environment of direct influence	Level of direct influence of stakeholders	Large-scale economic and production system	Enterprises and strategic business-units
		{ENV}	{STH}	{LEPS}	{EN}
Sources of information origin; (SRC)		{SRC ^{ENV} }	{SRC ^{STH} }	{SRC ^{LEPS} }	{SRC ^{EN} }
		SRC = <SRC ^{ENV} , SRC ^{STH} , SRC ^{LEPS} , SRC ^{EN} >			
Tools and procedures of consolidation (CT)		{CT ^{CE} }	{CT ^{STH} }	{CT ^{LEPS} }	{CT ^{EN} }
		CT = <CT ^{ENV} , CT ^{STH} , CT ^{LEPS} , CT ^{EN} >			
Kinds of consolidated information (CI)		{CI ^{ENV} }	{CI ^{STH} }	{CI ^{LEPS} }	{CI ^{EN} }
		CI = <CI ^{ENV} , CI ^{STH} , CI ^{LEPS} , CI ^{EN} >			
Supportive sub-systems (SUP)		{SUP ^{ENV} }	{SUP ^{STH} }	{SUP ^{LEPS} }	{SUP ^{EN} }
		SUP = <SUP ^{ENV} , SUP ^{STH} , SUP ^{LEPS} , SUP ^{EN} >			
Warehouses of consolidated information (DW)		{DW ^{ENV} }	{DW ^{STH} }	{DW ^{LEPS} }	{DW ^{EN} }
		DW = <DW ^{ENV} , DW ^{STH} , DW ^{LEPS} , DW ^{EN} >			
Management reference points (RP)		{RP ^{ENV} }	{RP ^{STH} }	{RP ^{LEPS} }	{RP ^{EN} }
		RP = <RP ^{ENV} , RP ^{STH} , RP ^{LEPS} , RP ^{EN} >			
SCI = <SRC, CT, KI, SUP, DW, RP>					

Table 2

Revealing the logic of process of organization of accounting information consolidation for management of enterprises and their integrated associations

Concept	Put forward hypotheses (H), regarding peculiarities of information consolidation for management system		Conceptual provisions (CP) of formation and usage of system of consolidated information		No. of relationships	Stage of IMP
CT STH	H ₁	Information queries for management constitute a complex non-formalized system	CP ₁	Basis for formation of SCI is identification of interests of all stakeholders, interested in consolidated information	1, 15, 18, 19, 20	IMP ₁
LEPS IIRS R	H ₂	Information consolidation under conditions of association of companies has its own characteristics associated with differences in institutional structure	CP ₂	Organization of SCI for LEPS has to consider models of LEPS organization and provide for maximum of integration potential	8, 22, 16, 17	
C EN SCM	H ₃	To take into account dynamics of environment, information must be of preventive nature and support adaptability of processes	CP ₃	It is necessary to provide for strategy criterion and expand a list of indicators, which will embrace all components of business processes, which involve participants of LEPS	5, 10, 11, 22, 23, 25	IMP ₂
SCI E SO	H ₄	There is a mismatch between economic and accounting reality (different variants of representation and interpretation of events)	CP ₄	SCI operation has to take into account logic of reflective management for overcoming information asymmetry and opportunistic behaviour	26, 29, 30, 33, 36	
G RP	H ₅	Because goals and strategic reference points of enterprise's development determine requirements to information structure, they should be involved in SCI structure	CP ₅	SCI acts as a tool for interaction institutionalization and formalization of rules of implementation of strategic objectives for such interaction of reference points	6, 21, 31, 32, 24	IMP ₃
SUP	H ₆	Operation of SCI requires organization of proper support of operation of this system	CP ₆	It is necessary to distribute requirements for organization of SCI operation throughout all levels of LEPS hierarchy	40, 41	IMP ₄
CT, DW	H ₇	LEPS and its participants select approach to SCI formation independently, but taking into account institutional requirements for vital activity of association of enterprises as a whole	CP ₇	SCI implies coordination of tools and approaches to consolidation with stakeholders, along with organization of knowledge diffusion and protection	35, 37, 38, 39	
OK IMG	H ₈	When making decisions, management must take into account parameters of «accounting choices» regarding representation of a particular operation	CP ₈	It is necessary to adapt accounting to possibility of formalization of business rules. Accounting representation must meet accepted rules	27, 28, 34, 43	IMP ₅
EN CTL	H ₉	Representation of economic reality for a enterprise essentially depends of the type of activity a enterprise is involved in	CP ₉	Organization of the process of information consolidation must take into account specific features of LEPS belonging to a particular industry	2, 3, 4, 7	

The main feature of Table 2 is that each of the proposed hypotheses substantiates a corresponding provision regarding refining of SCI content and correlates with a specific stage of organization of SCI implementation and usage (IMP). In this case, SCI formation is based on specification of content of the concepts, shown in Fig. 2 and expansion of description of the sets, shown in Table. 1. For this purpose, first of all, we will determine the content of sources, which will constitute the basis for information consolidation. It is clear that the basis for information system of enterprises is financial accounting. Under conditions of LEPS and SCI, the list of these sources must go beyond financial accounting system. Considering this, we propose to include in their structure information that is generated in the systems of financial ($\{SRC_{FA}\}$), management ($\{SRC_{MA}\}$) and strategic ($\{SRC_{SA}\}$) accounting. Information sources will include management and integrated reports ($\{SRC_{RP}\}$). In addition, information sources will include the data, produced by the system of monitoring of internal and external environment ($\{SRC_{ENV}\}$) and parameters of controlling system ($\{SRC_{CS}\}$). In this case, $\{SRC_{CS}\}$ will contain not indicators (they are formed within other sets), but rather dimensions of deviations from reference points, set in the system of operative and strategic control. Accordingly, information sources for SCI are formalized by the following tuple:

$$SRC = \langle SRC_{FA}, SRC_{MA}, SRC_{SA}, SRC_{RP}, SRC_{ENV}, SRC_{CS} \rangle. \quad (3)$$

Some explanations should be made regarding the relationship between the sets, presented in Table 1. Thus, for example, the components of the system of environment monitoring will include certain characteristics that require an appropriate level of management. The relationships between these parameters correspond to the logic of cascading indices for BSC. That is, for each level from the spatial sample of SCI (Table 1), its own indicators, which do not repeat each other, are separated. To improve the quality of consolidated information, it is possible to provide for succession of indicators, when indicators of each subordinate level specify and specify those of a higher level. This requirement is formalized in the following way:

$$SRC_{ENV} = \langle SRC_{FA}^{ENV}, SRC_{FA}^{STH}, SRC_{FA}^{LEPS}, SRC_{FA}^{EN} \rangle. \quad (4)$$

The next element of tuple (2) includes the tools, with the help of which information is consolidated (logic of using such tools is modeled by representation of $CT: SRC \rightarrow CI$). It is proposed to include in the structure of such tools: optimization methods ($\{CT_{OM}\}$); imitation models ($\{CT_{IM}\}$); cognitive models ($\{CT_{CM}\}$); decision trees ($\{CT_{DT}\}$), neural networks and machine learning methods ($\{CT_{NN}\}$); semantic networks ($\{CT_{SN}\}$); prediction methods ($\{CT_{PM}\}$), etc. These components of set $\{CT\}$ make up only a reference and inexhaustible tool list. The content of this set, which is determined with tuple (5), is completely defined by knowledge and interests of decision makers.

$$CT = \langle CT_{OM}, CT_{IM}, CT_{CM}, CT_{DT}, CT_{NN}, CT_{SN}, CT_{PM} \rangle. \quad (5)$$

As a result of operation of tools, declared in tuple (5), consolidated information is formed. According to the accepted above interpretation, this information is treated

as open knowledge (entire list of knowledge of enterprise, beyond allocation by classification features, is reduced to set $\{CI_{BY}\}$). However, such an approach should be expanded. To do this, the structure of consolidated information involves:

- $\{CI_{SC}\}$ – possible scenarios of development of events;
- $\{CI_{RS}\}$ – enumeration of responses of management to challenges;
- $\{CI_{BR}\}$ – business rules, accepted by management;
- $\{CI_{CC}\}$ – enumeration of institutional concepts of control;
- $\{CI_{SA}\}$ – results of conducted strategic analysis of activity of economic entities, etc.

In a generalized form, the content of consolidated information is revealed by the following tuple:

$$CI = \langle CI_{BY}, CI_{SC}, CI_{RS}, CI_{CC}, CI_{SA} \rangle. \quad (6)$$

It is clear that the consolidated information must be recorded in some way. That is, application of the tools from tuple (5) leads not just to formation of consolidated information ($CT: SRC \rightarrow CI$), but rather to entering of such information to appropriate storage systems. The best solution here is the concept of subject-oriented Data Warehouse, which in turn provides a variety of implementation options. A detailed consideration of these options goes beyond the purpose of this study. As an example, we will take hierarchical ($\{DW_{HR}\}$), network ($\{DW_{NW}\}$) and relational ($\{DW_{RL}\}$) data warehouses. It is clear that selection of approach to storage of consolidated information depends on the type of information and sources it is generated ($SRC: CI \rightarrow DW$). In this case, tuple (7) structuring also corresponds to the hierarchy, shown in Table. 1.

$$DW = \langle DW_{HR}, DW_{NW}, DW_{RL} \rangle. \quad (7)$$

Sets (3)–(7) reveal content characteristics of the information consolidation system. However, an efficient operation of a consolidation system is possible only in case of existence of various regulations. These regulations in totality make up support subsystems for SCI. In general form, as a part of this support subsystem, we propose to separate organizational regulations ($\{SUP_{OR}\}$), which will determine parameters of relationship between different levels of hierarchy, shown in Table 1. It is also essential to provide technological ($\{SUP_{TH}\}$), social ($\{SUP_{SC}\}$), economic ($\{SUP_{EC}\}$) and ergonomic ($\{SUP_{ER}\}$) support of SCI operation. In addition, with regard to allocation of data warehouses as a part of SCI, it is appropriate to separate components of program support ($\{SUP_{PS}\}$), which would provide registration of consolidated information and regulate access to consolidated knowledge. In a generalized form, a support subsystem is reduced to the following tuple:

$$SUP = \langle SUP_{OR}, SUP_{TH}, SUP_{SC}, SUP_{EC}, SUP_{ER}, SUP_{PS} \rangle. \quad (8)$$

As the last element of tuple (2), a set of reference points for the management system operation was separated. This set was introduced to SCI with consideration that these reference points would determine queries to a subsystem of management information support, which in the case of the present study was transformed into SCI. First of all, we propose to use objectives (a tree of objectives) of functioning of particular enterprises and LEPS as a whole (is assigned by

set $\{RP_G\}$) as reference points. Secondly, it is necessary to provide for availability of a system of motivational complexes $\{RO_{MC}\}$. The content of set $\{RP_{MC}\}$ has to contribute both to accomplishment of set goals and to promotion of improvement of reliability of consolidated information. The logic of goal setting and using of motivational complexes is largely determined by the chosen business model of an enterprise, which is introduced to SCI through set $\{OM_{BM}\}$.

Appropriateness of introduction of this set is also explained by selection of integrated reporting (set $\{SRC_{RP}\}$) among information sources, which is formed with a focus on strategy and a business model of an enterprise. As reference points, it is also relevant to use strategic alternatives, chosen by an enterprise. To enhance effectiveness of such formalization, we will introduce set $\{BSC\}$ and acquire the following form of the corresponding tuple:

$$RP = \langle RP_G, RP_{MC}, RP_{BM}, BSC \rangle. \tag{9}$$

Extension of the concept of formation of integrated reporting as the reporting, which focuses on the factors of creation of worth and a business model of an enterprise, updates the problem of content definition of the structure of elements of set $\{OM_{BM}\}$. Here, the most valuable are proposals [29], considering determining of this business model components. As components of a business model, we separate: selected segments of consumers; specifics of rendered services; principles of loyalty and costs management; parameters of financial flows; parameters of interaction with stakeholders; rules of filling of marketing-mix strategies; key competences and resources.

Since the balanced indicator system itself contains a cascading tool and implies existence of a hierarchy, an independent representation of BSC model was introduced into tuple (9). In this case, as it was emphasized in [25], the sets of key factors of an enterprise's success ($\{KSF\}$) and of key performance indicators ($\{KPI\}$) will be distinguished as the main elements in the structure of $\{BSC\}$. However, to reveal target orientation, it is possible to introduce non-formalized set $\{SM\}$, which will contain Strategic Maps at various decomposition levels (in the hierarchy, shown in Table 1). $\{SM\}$ elements will provide maximum formalization of management reference points for tuple (10). Achievement of these reference points is provided by the system of strategic measures, which is assigned through elements of $\{SA\}$:

$$BSC = \langle KSF, KPI, SM, SA \rangle. \tag{10}$$

Representation of the system of consolidated information, marked by sets (1)–(10), determines the list of stages for its implementation. In a general form, these stages were declared in Table 2. Content filling of these stages, performed in terms of the methodology of structural analysis and design, is displayed in Fig. 3.

The block diagram, shown in Fig. 3, is the top level of the model of organization of information consolidation. This block diagram only determines the logics of organization of information support of LEPS management. The model, accordingly marked in Fig. 3, requires expansion and representation in the context of organization of implementation and use of the information consolidation system.

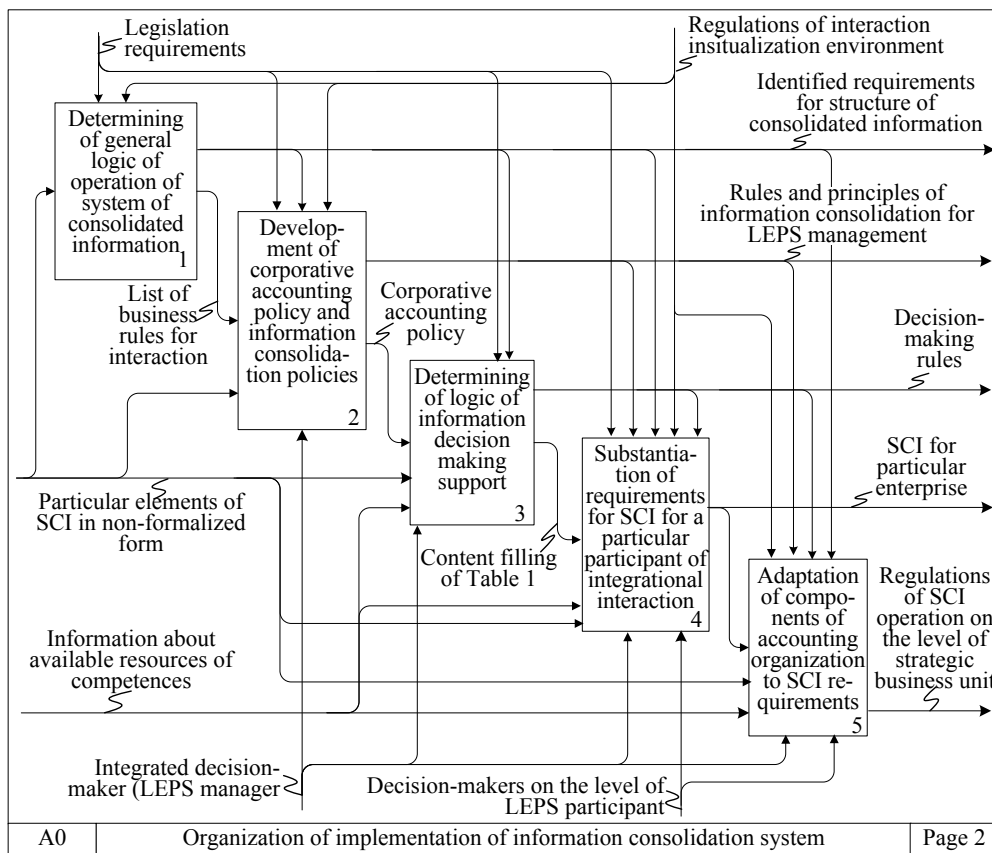


Fig. 3. Block diagram of the process of organization of information consolidation

6. Discussion of results of formation of theoretical-multiple model of accounting information consolidation system

In the context of determining of content adding at the stages, presented in Fig. 3, two approaches should be emphasized. The first is the traditional approach, which corresponds to segments AX, BX and BY of the matrix, presented in Fig. 1. It comes down to determining of the structure of accounting procedures that will generate data (fill set {SRC}) and of tools, which perform data processing. The second approach (corresponds to segments AX and AY), takes into account the ability of enterprises to influence information, perceived by stakeholders (in the framework of implementation of the principles of reflective management). In addition to direct influence, “an accounting option” is also possible, when an enterprise chooses one or another way of representation of economic reality. This assertion is based on a detailed substantiation of the concept “accounting reality” in paper [30].

Accordingly, to develop these proposals, information consolidation processes should be correlated with the concept of accounting interpretation of a certain fact of economic activity or assets, equity and liabilities, existing at an enterprise. In this case, book-keeping interpretation of accounting information will determine attractors (defined by using the elements of set {RP}) of an enterprise development. In the terminology of reflective management, it will form an image of such an attractor or an image of its promising business model. All possible images are determined within set {IMG}. At the content level, this set acts as correlation of management reference points and consolidated information in the vision of a particular decision maker:

$$IMG=CI \cup RP.$$

(11)

We propose to give a formalized representation of the image of a promising business model in the form of set {IMG_{EN-EN}}. This set is treated as an image of an attractor of enterprise’s development in perception of a enterprise (a enterprise’s intention). It is clear that LEPS will have its our vision when it comes to attractors of its development. This vision is assigned by set {IMG_{LEPS-LEPS}}. In this case, in the course of development planning, LEPS will have a certain vision of a desired business model of a enterprise ({IMG_{EN-LEPS}}). Similarly, a enterprise creates its own image of existence as a part of an integrated association of enterprises ({IMG_{LEPS-ИД}}). Thus, the purpose of LEPS management is to approach the assigned images of development attractors.

As a result, consolidated vision of a promising business model of LEPS and of enterprises, incorporated in it, was registered in the SCI. In this case, it is possible to propose succession and subordination of business models similarly to cascading procedures in BSC concept. It is clear that depending on the strength of integrational limitations and institutionalization of LEPS operation, business model parameters will be coordinated through the construction of a compromise area. However, all participants of this process will be eager to influence decision making process of other entities through a system of reflective influences.

The author’s option of this system of influences with determining of the reflection rank (RR) is shown in Fig. 4. We will pay attention to the fact that in this scheme, reflection is limited to the rank on level 2 (RR=2). Here, we support the opinion of a number of researchers [23, 24] that further increase in a reflection rank subtly affects the model but considerably complicates perception of the model.

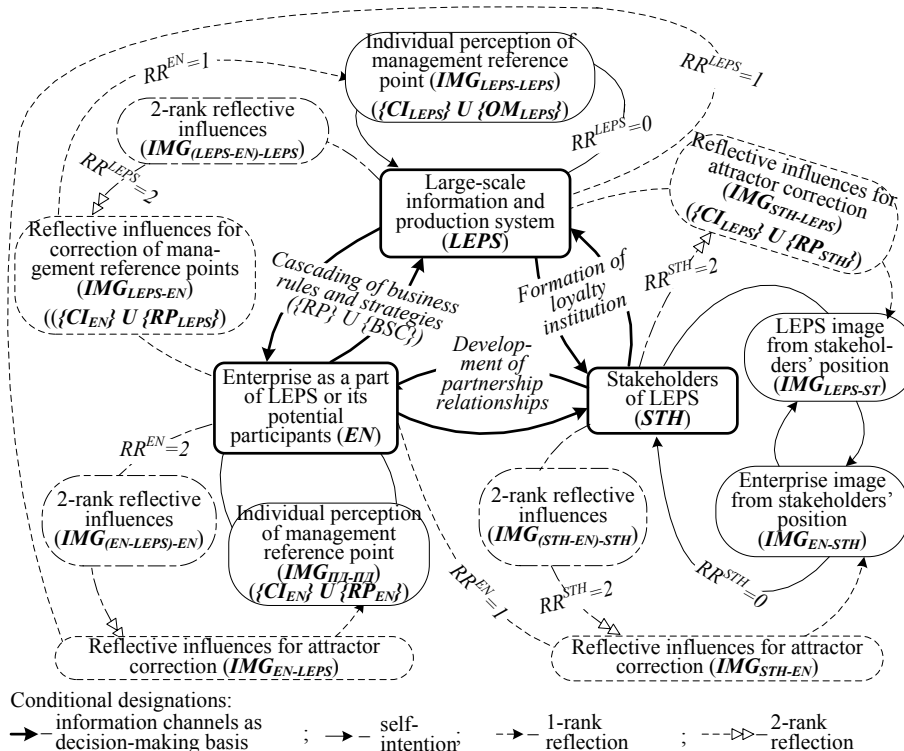


Fig. 4. Reflection perception in the course of formation of information consolidation system in terms of levels of integrational interaction of LEPS participants

Thus, approaching of images of attractors, shown in Fig. 4, can be based on a wide range of methods of reflective management from “information dissemination” to “distraction” and changes in the rules of decision-making.

7. Conclusions

1. Developed conceptual basis for the organization of information support for LEPS management takes into account principles of knowledge economy and relies on information consolidation tools. The use of technology of conceptual design allowed us to develop a scheme of subject-area of information consolidation. The advantage of this scheme is application of principles of reflective management of integrated association of enterprises. Employing the concepts of this subject-area made it possible to substantiate a system of hypotheses regarding construction of the information consolidation system for meet the needs of management of large-scale economic and production systems.

2. To prove the hypotheses that were put forward and to create conditions for practical implementation of obtained results, we developed a set of conceptual provisions regarding organization of consolidated information. The advantage of this development is coordination of given provisions with the stages of organization of the information consolidation system. The succession of such stages is presented with the use of methodology of structural analysis and modeling.

3. For the formalized representation of the essence of consolidation processes, we used the concentric theoretical-multiple approach. Application of this approach allowed us to represent the hierarchy of satisfaction of information needs of LEPS. It was also proved that formation of such information needs should take into account the principles of reflective management. To do this, we represented the block diagram of revealing mutual reflective influences of LEPS participants, which models two levels of reflective interaction.

However, it is necessary to carry out subsequent research in order to determine the specific measures for implementation of these reflective influences and substantiation of the relevant features of information consolidation.

References

1. Aniskin, Yu. P. Korporativnoe upravlenie innovatsionnym razvitiem [Text]: monografiya / Yu. P. Aniskin; Yu. P. Aniskin (Ed.). – Moscow: Omega-L, 2007. – 411 p.
2. Bokovets, V. V. Teoretyko-metodychni zasady upravlinnia korporatsiyamy [Text]: monografiya / V. V. Bokovets. – Kyiv: Kondor, 2015. – 204 p.
3. Popkova, E. G. Integration and Clustering for Sustainable Economic Growth [Text] / E. G. Popkova, V. E. Sukhova, A. F. Rogachev, Y. G. Tyurina, O. A. Boris, V. N. Parakhina // Contributions to Economics. – New York: Springer, 2017. – 578 p. doi: 10.1007/978-3-319-45462-7
4. Griv, G. Preimushchestvo setey. Kak izvlech' maksimal'nyu pol'zu iz al'yansov i partnerskih otnosheniy [Text] / G. Griv, A. Shipilov, T. Rouli. – Moscow: Al'pina, 2014. – 259 p.
5. Rekord, S. I. Razvitie promyshlenno-innovatsionnykh klasterov v Evrope: ehvoluyuciya i sovremennaya diskussiya [Text]: monografiya / S. I. Rekord. – Sankt-Peterburg: Izd-vo SPbGUEHF, 2010. – 109 p.
6. Kizim, N. A. Organizatsiya krupnomasshtabnykh ehkonomiko-proizvodstvennykh sistem [Text]: monografiya / N. A. Kizim. – Kharkiv: Biznes-Inform, 2000. – 108 p.
7. Graca, P. Performance indicators for collaborative business ecosystems – Literature review and trends [Text] / P. Graca, L. M. Camarinha-Matos // Technological Forecasting and Social Change. – 2017. – Vol. 116. – P. 237–255. doi: 10.1016/j.techfore.2016.10.012
8. Andres, B. A decision support system for the collaborative selection of strategies in enterprise networks [Text] / B. Andres, R. Pöller // Decision Support Systems. – 2016. – Vol. 91. – P. 113–123. doi: 10.1016/j.dss.2016.08.005
9. Treitiak, V. V. Development of technology for consolidation and synchronization of data of industrial-purpose integrated automated systems [Text] / V. V. Treitiak // Eastern-European Journal of Enterprise Technologies. – 2015. – Vol. 6, Issue 2 (78). – P. 17–22. doi: 10.15587/1729-4061.2015.55923
10. Cirstea, A. The Need for Public Sector Consolidated Financial Statements [Text] / A. Cirstea // Procedia Economics and Finance. – 2014. – Vol. 15. – P. 1289–1296. doi: 10.1016/s2212-5671(14)00590-5
11. Zviglyanich, S. N. Pokazateli kachestva konsolidirovannoy informatsionnoy sistemy [Text] / S. N. Zviglyanich, V. L. Petrov // Systemy obrobky informatsiy. – 2012. – Issue 7 (105). – P. 75–78.
12. Nych, L. Ya. Effectiveness evaluation of search in information systems with consolidated information [Text] / L. Ya. Nych, R. M. Kaminskyj, N. B. Shakhovska // Radio Electronics, Computer Science, Control. – 2016. – Issue 2. – P. 103–109. doi: 10.15588/1607-3274-2016-2-13
13. Ogiela, L. Advanced techniques for knowledge management and access to strategic information [Text] / L. Ogiela // International Journal of Information Management. – 2015. – Vol. 35, Issue 2. – P. 154–159. doi: 10.1016/j.ijinfomgt.2014.11.006
14. Bezverkhyi, K. V. Klyasifikatsiya oblikovo-zvitnoi informatsiy [Text] / K. V. Bezverkhyi // Aktualni problemy ekonomiky. – 2013. – Issue 9. – P. 206–212.
15. Grinchak, A. Development of information technology for operational control of agricultural production [Text] / A. Grinchak, O. Davletkhanova, Y. Mykolaichuk // Eastern-European Journal of Enterprise Technologies. – 2016. – Vol. 2, Issue 2 (80). – P. 36–44. doi: 10.15587/1729-4061.2016.65476

16. Kaplan, R. S. Sbalansirovannaya sistema pokazateley. Ot strategiy k dejstviiyu [Text] / R. S. Kaplan, D. P. Norton. – 3-e izd. ispr. i dop. – Moscow: Olimp-Biznes, 2017. – 320 p.
17. Kadarova, J. Balanced Scorecard as an Issue Taught in the Field of Industrial Engineering [Text] / J. Kadarova, M. Durkacova, L. Kalafusova // *Procedia – Social and Behavioral Sciences*. – 2014. – Vol. 143. – P. 174–179. doi: 10.1016/j.sbspro.2014.07.382
18. Levenchuk, A. Sistemnoizhenernoe myshlenie [Electronic resource] / A. Levenchuk // *TechInvestLab*. – 2015. – Available at: http://techinvestlab.ru/files/systems_engineering_thinking/systems_engineering_thinking_2015.pdf
19. Kosilo, N. S. Konsolidaciya informaciy o deyatelnosti organizaciy: sistemologicheskij verbal'nyi podhod [Text] / N. S. Kosilo, D. B. El'chaninov, O. N. Guca // *Visnyk NTU «KhPI»*. – 2015. – Issue 62. – P. 64–69.
20. Bert, B. *Business Analysis for Business Intelligence* [Text] / B. Bert. – London: CRC Press, 2012. – 388 p. doi: 10.1201/b13096
21. Jallow, A. K. An enterprise architecture framework for electronic requirements information management [Text] / A. K. Jallow, P. Demian, C. J. Anumba, A. N. Baldwin // *International Journal of Information Management*. – 2017. – Vol. 37, Issue 5. – P. 455–472. doi: 10.1016/j.ijinfomgt.2017.04.005
22. Kuznetsova, S. A. Synerhetychnyi rozvytok bukhholderskoho obliku dlia stanovlennia «ekonomiky znan» v Ukraini [Text]: monohrafiya / S. A. Kuznetsova. – Melitopol: TOV «Vydavnychyi budynok MMD», 2010. – 148 p.
23. Mal'chik, M. V. Refleksivnoe upravlenie konkurentosposobnost'yu predpriyatij [Text]: monohrafiya / M. V. Mal'chik. – Doneck-Rovno: CHP Lapsyuk V. A., 2010. – 216 p.
24. Lepa, R. N. Modeli refleksivnogo upravleniya v ehkonomike [Text]: monohrafiya / R. N. Lepa. – Doneck: Institut ehkonomiki promyshlennosti, 2012. – 380 p.
25. Pylypenko, A. A. Formuvannia oblikovo-analitychnoho zabezpechennia upravlinnia vytratamy pidpriemstv ta yikh obiednan [Text]: monohrafiya / A. A. Pylypenko, I. P. Dzobko, O. V. Pysarchuk. – Kharkiv: Vyd. KhNEU, 2011. – 344 p.
26. Verenyh, O. Development and implementation of formalized model of mental space of project or program environment [Text] / O. Verenyh // *Eastern-European Journal of Enterprise Technologies*. – 2016. – Vol. 2, Issue 3 (80). – P. 21–31. doi: 10.15587/1729-4061.2016.65635
27. Teslinov, A. *Konceptual'noe proektirovanie slozhnyh resheniy* [Text] / A. Teslinov. – Sankt-Peterburg: Piter, 2009. – 288 p.
28. Ivanov, Yu. B. Intehratsiynyi rozvytok subiektiv hospodariuvannia: teoretychne obruntuvannia ta orhanizatsiya upravlinnia [Text]: monohrafiya / Yu. B. Ivanov, A. A. Pylypenko. – Khariv: VD Inzhnek, 2012. – 400 p.
29. Osterwalder, A. *Business Model Generation* [Text] / A. Osterwalder, Y. Pigneur. – New Jersey: John Wiley & Sons, Inc., 2010. – 288 p.
30. Lehenchuk, S. F. Bukholderska realnist yak obiekt instytutsiynykh doslidzhen [Text] / S. F. Lehenchuk // *Menedzhment ta pidpriemnytstvo v Ukraini: etapy stanovlennia i problemy rozvytku*. – 2014. – Issue 794. – P. 188–200.