System Modeling of Scientific Research Center as a Base Architecture of Knowledge Management and Innovation

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Abstract
This paper discusses the purpose of system modelling of research center and determine the architecture of knowledge management and innovation as one of the conceptual aspects of management of research center. A system of interrelated indicators is proposed to assess the effect of CPS introduction. On the example of the Department of Research and Development (R&D) within the framework of "Scientific research center", the implementation of this methodology is considered.
Keywords: Science Research Center (SRC), system modeling, modeling of lifecycle innovations, knowledge and innovation, management, research and development (R & D).

Introduction

Transition economy on an innovative path of development associated with the qualitative growth of human capital. Human capital is a combination of acquired knowledge and natural human qualities, which bring income to the individual. By innate qualities include biophysical state of health at birth, and to the formation of acquired knowledge, skills, intellectual capital, and the motivation to work. Uzbekistan was one of the first among the CIS countries went on a two-tier system in higher education. All taking place in the education system reforms promote greater involvement of students, teachers, researchers and scientists in the world educational progress, including in the academic mobility.

In June 2015 a report by a High Level Reflection Group of Directors – General[1] set out principles, short - and medium - term actions, and governance arrangements for a corporate data, information and knowledge management policy[2].

A wide variety of definitions of innovation demonstrates the dynamic and spatial development of the object on the basis of knowledge [D. Leonard-Barton, 1995]. In the opinion of T. Hegerstranda every generation of innovation is cyclical and consists of the following stages: origin, distribution, accumulation and saturation of knowledge. Studies SJ Shevchenko innovation lifecycle is divided into three periods: the incubation period distribution and the period of reducing the use of scales. Yu.P.Yakovets considers innovation life cycle, beginning with the emergence of the idea, then the cycle passes through the introduction and ends with aging.

Simulation of the life cycle of innovation

Simulation of the life cycle of innovation as the basis for system modeling, the author of the process is shown in Fig. 1.

The innovation process is a change of input in the form of knowledge and management of, demand in the market and in practice. As a result can act as objects (new or improved products, services, processes, organizational forms, innovation in the social environment of the enterprise), and system (enterprise, industry, economy).

Usually the appearance of sources of innovation are the unmet needs, practical experience and the results of research activities (fundamental and applied research). These factors can be regarded as a manifestation of the evolutionary stage of origin of the product.

A manifestation of the sources of innovation is knowledge. In the sphere of innovation are three essential pieces of knowledge:

- Marketing knowledge on demand, markets and their evolution;
- Practical knowledge, based on a synthesis of previous technical, economic and social practices;
- Scientific knowledge about the natural, material-technical and socioeconomic systems.

[1] The group, chaired by Walter Deffaa (REGIO), included 11 other Directors General and a Deputy Secretary General: M. Klingbeil (SG), A. Italianer (COMP), M. Servoz (EMPL), R. - J. Smits (RTD), R. Madelin (CNECT), V. Sucha (JRC), F. Frutuoso de Melo (DEVCO), W. Radermacher (ESTAT), I. Souka (HR), S. Quest (DIGIT), N. Calviño (BUDG) and M. Reicherts (OP).
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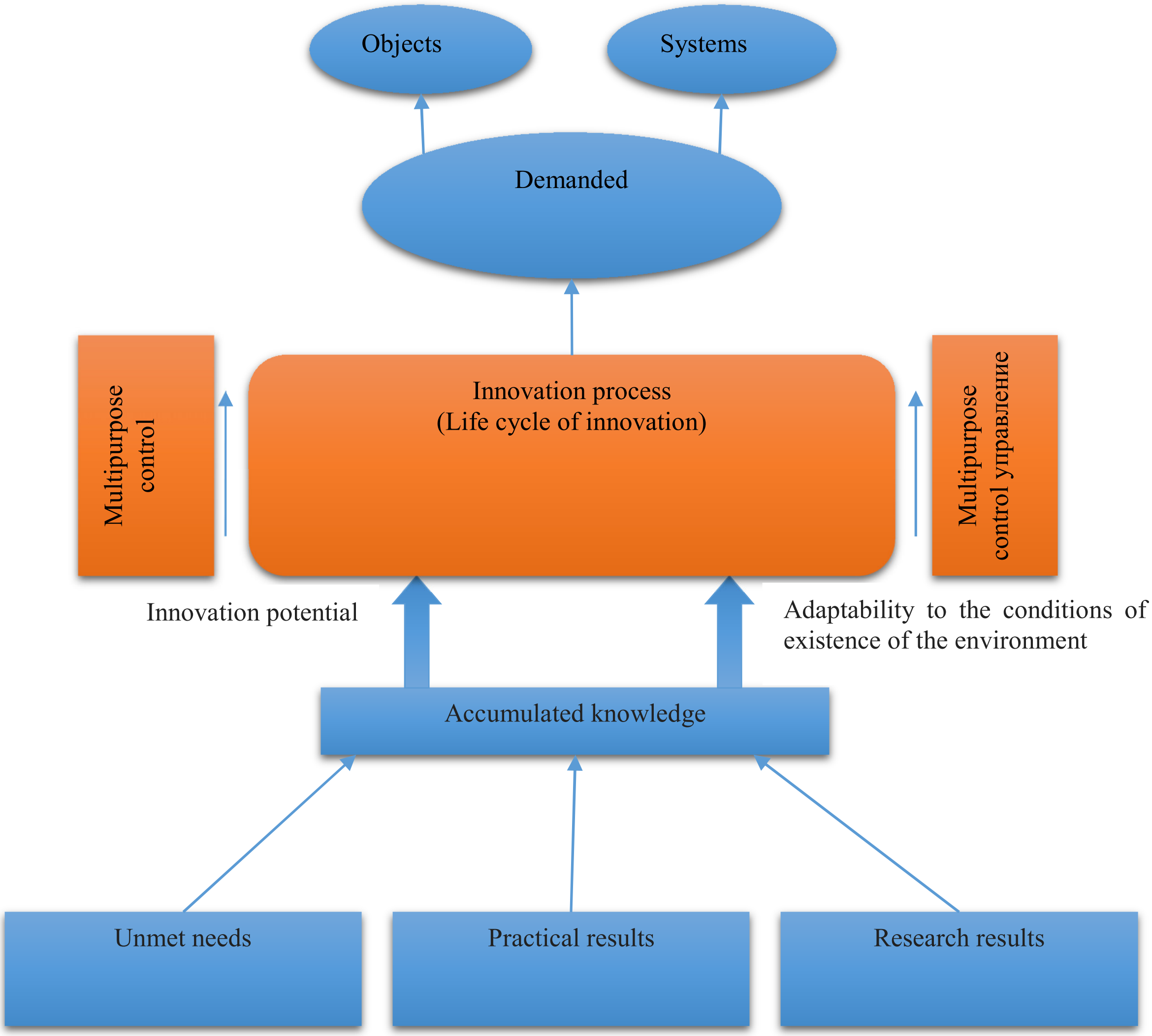


***Fig. 1.1** Modeling the life cycle of innovation (compiled by the author)*

From the completeness and reliability of knowledge the effectiveness of the innovation process depends on many things.

The progress of the innovation process is largely determined by the level of innovation center building - a collection of various types of resources required for the implementation of innovative activity (labor, financial, information, intellectual, technological, etc.).

The variable environment with limited resources, markets, and promotes the creation and development of innovative processes. Therefore, in the modeling must take into account adaptability to changes in the center of the internal and external environment. In our opinion, the life cycle model of innovation can be presented in the form of five successive stages, corresponding to certain developmental stages of the innovation process: innovation (the birth of) - an innovation (formation) - an innovation (growth) - Imitation (stability) - improvement (development).

The innovation is the result of a modern fundamental and applied research, development and experimental work in any field of activity. The primary task of the appearance of innovation is to define property rights in the knowledge and assessment of its value, that is, the transformation of knowledge into economic and administrative category. The emergence of innovations appropriate stages of the innovation process: research, development of the basic characteristics of the product, prototype creation and testing.

Once the novelty begins to be used, it becomes an innovation phase, which corresponds to the following stages: planning and pre-production, production. Ends innovation phase is determined by the appearance of innovation, moment when knowledge is completely transformed into a product, and this product has entered the market. In this case the resulting economic impact at this stage to evaluate the commercial potential of innovation.

The fourth stage - imitation noted as a stage in the evolution of innovation in the works less Frimenaa, Schumpeter, etc. In practice, the simulation is implemented in two possible ways:.

- The purchase of rights to intellectual property (copy);
- The transfer of ready-made solution for a new market (replication).

Imitation is necessary because of the limited capacity of the company to meet the demand, the availability of administrative, legal and other barriers in the process of product distribution.

To determine the place of knowledge management and innovation and the use of a total SRC control system will use the methodology of the system analysis of complex managed objects.

Define the boundaries of the complex object as a material system, a list of important terms of the research components of the system and the interaction with the external environment through the material flow. System model should reflect the most general aspects of the research object, so the basis for its development are the ordered presentation of business processes, obtained by analyzing the largest SRC Uzbekistan. At the highest level of abstraction, the main business process SRC can be collectively represented by six input conversion functions in the output material product:

1. Marketing.
2. Research.
3. experimental development.
4. Technological preparation of production.
5. The final product manufacturing and services.
6. Quality Control.

The main result of the function - the transformation of one into the other resources through the use of third. So, in the formalism of modeling standard IDEF0 function of the end product production can be represented as shown in Fig. 2.1 [A.B. Scheer, 1999, 2000]

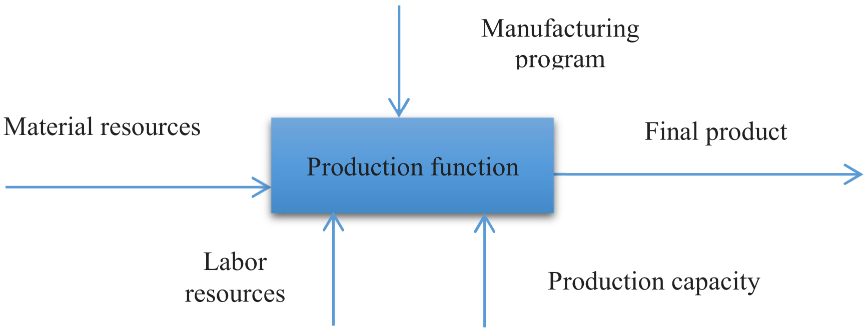


***Fig. 1.2** Example of resource conversion function*

For further modeling purposes, the following types of resources appropriate to allocate required for the release of the final product material SRC:

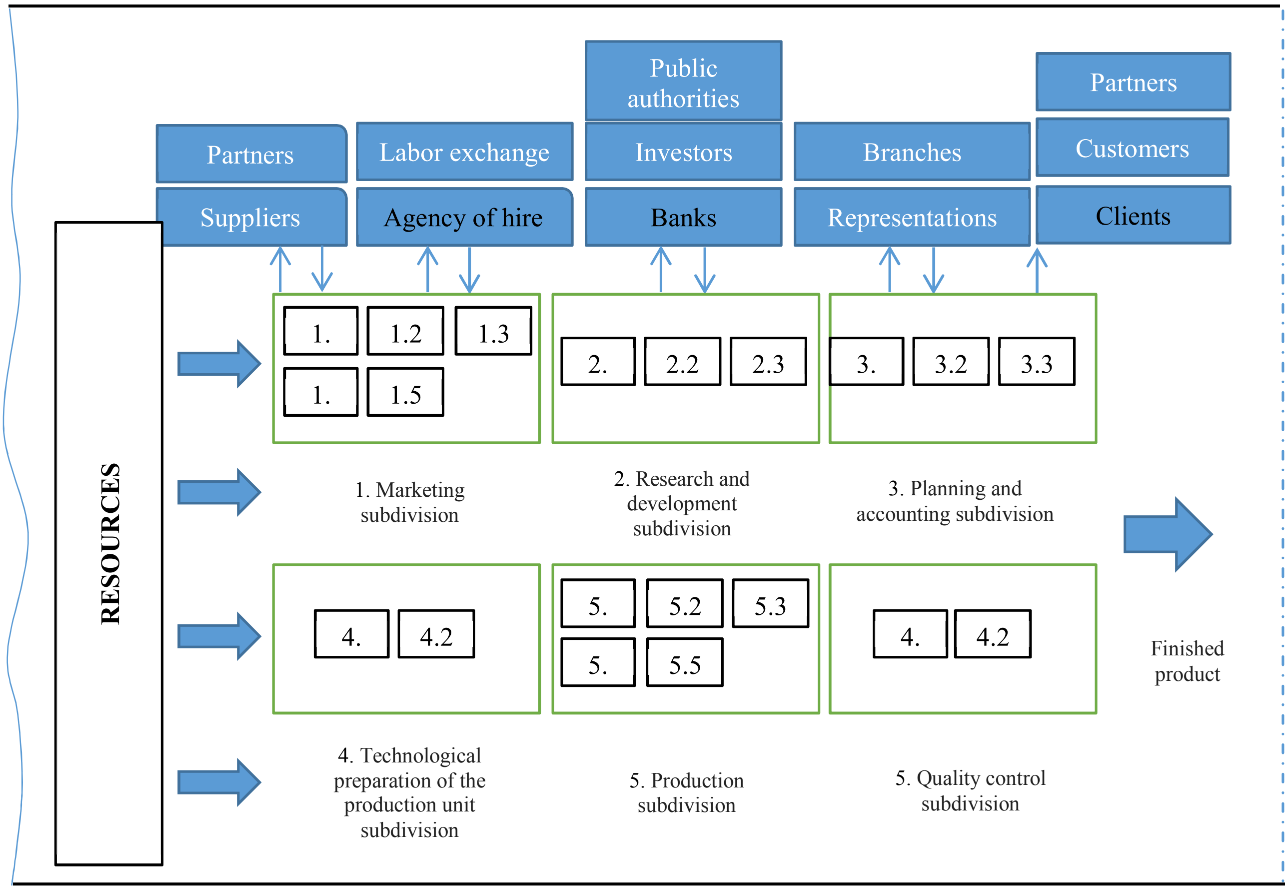
1. Material resources as a means of production and objects. In accounting terms, this basic (equipment) and working capital in terms of reserves (.
2. Energy and natural resources.
3. Employment (human) resources to ensure the final product gains at the expense of labor invested.
4. Financial resources. In accounting terms, this equity and debt and calculations.

The functions of the main business process SRC implemented in practice the relevant organizational units, which are defined in the simulation model as the components of the system. In terms of organizational structure are the main components of the SRC division. Each of the components (subunits) is decomposed into a plurality of components (departments, laboratories), which in turn can be further decomposed to the individual jobs. Thus, we can talk about multi-level nature of the description of a complex object, ie SIC multilevel model.

SRC as a material system interacts with the environment through the sharing of resources, the four above-mentioned species. The objects of the environment include:

1. Suppliers resource groups 1 and 2, the partners (SIC, as a rule, is a node in a managed supply chain).
2. Exchange of labor and employment agencies that meet the need for labor.
3. Investors and banks providing loan funds, as well as government bodies, forming the budgets of different levels through a system of taxation.
4. Own branches and representative offices (international and regional), which could potentially act as both suppliers and consumers of intermediate and final products SRC.
5. Customers and clients who use the intermediate and final products SRC.

Thus, in the first stage of modeling proposed generalized model as the SRC system (integrity), which has a specific structure (composition of ingredients) and interacting with certain objects of the environment through the sharing of resources, the four species. Graphic interpretation SIC system model as a material object is shown in Fig. 2.2.



1.1 - Department of market research (demand)
1.2 - Department of Management product range
1.3 - Sales department
1.4 - Division of demand generation and sales promotion
1.5 - service department
2.1 - Research and calculations
2.2 - Division of reliability
2.3 - Division designs
3.1 - Planning Division
3.2 - Department of dispatching
3.3 - Accounting Department
4.1 - Division of Technology Development
4.2 - Division of pilot production
5.1 - 5.5 - Workshops for the production of various types of products
6.1 - Quality Control Department
6.2 - Department of Product Certification
6.3 - The Department of Business Process certification

***Fig. 1.3** System model SRC as a material object*

To determine the management structure of the complex material object, what is a SRC, we turn to the classical control theory in which a systematic approach formulated the principle of isomorphism control structures [V.A. Wittich, 1999, 2000] The main functional modules of this structure are.:

- Information gathering and processing module on the current state of the control object (ISOD)
- The decision-making module (MNR)
- A control unit (MU).

These modules are consumers of information-nanievyh flows, based on which there is a purposeful movement in the state space of the control object. Functional feedback control system diagram shown in Fig. 1.4.

Data collection and processing and decision-making modules located in the control system feedback loop and are designed to analyze the current state of the managed object, comparing this with the desired state (synonyms normative, standard state), developing alternative control actions, their ranking and selecting the best. Control implementation module is designed for direct exposure to the object in order to adjust its current state to the desired direction.

Thus, in contrast to the material of the control object interaction components through which the material flows, the control system operates with a flow of information reflecting the state and behavior of the object material at each time point. Combining the SRC system model as a material object and the model of governance they obtain SRC system model as the multi-level managed material object. To this we add a flat system model of the third dimension, reflecting the information aspects of the object of control.

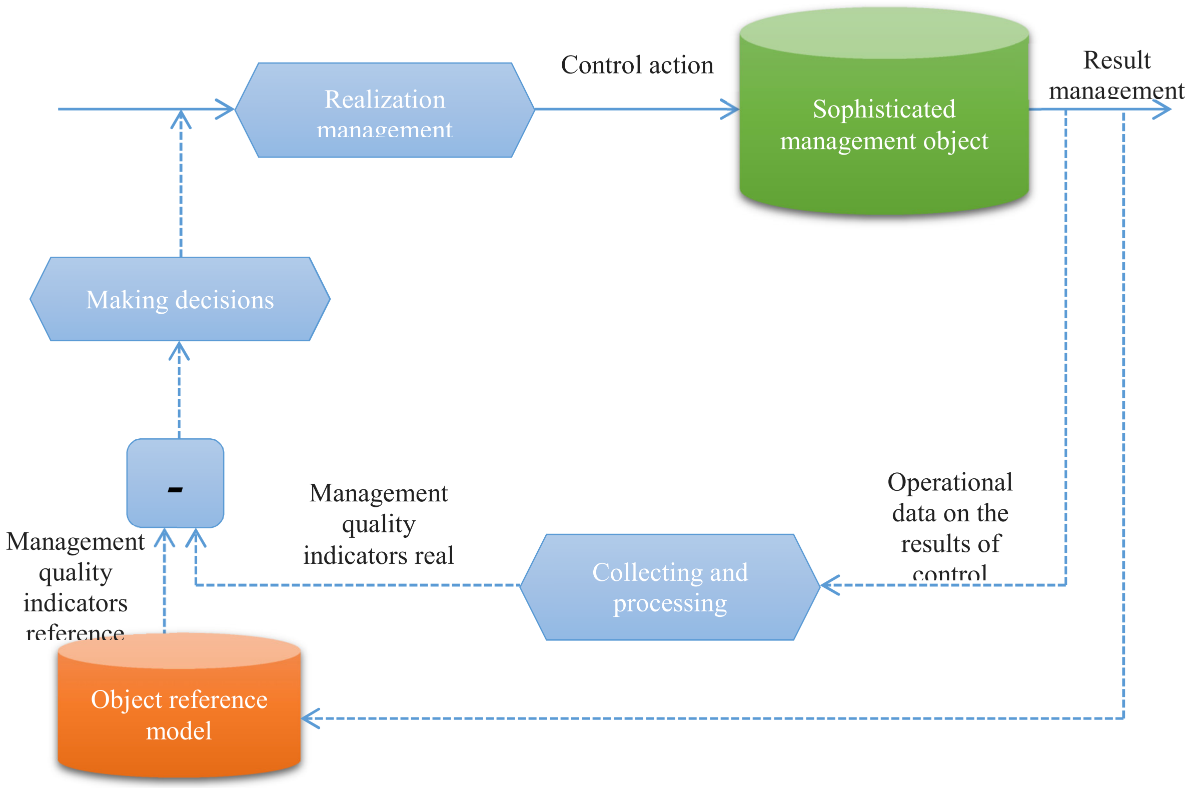


Fig. 1.4 *The classical scheme of a complex object management system*

Then summarized SRC as a complex controlled object model can be represented by a volume consisting of nested cubes of information, based on the material plane (Fig. 1.5)

The base of each of the cube as a fragment of the material plane defines system boundaries for consideration of the object (the largest cube - SRC) and its components (eg, the transport department, sales department, foundry, warehousing, market research department), with an emphasis on the material (ie. e. the objective) nature of the object of control. The third dimension of the model, the vertical axis of the information is a subjective component model and reflects the level of detail, completeness and certainty of information used for decision-making in the framework of the consideration of each component of the object. The introduction of this "virtual" areas can be considered as a set of resulting volume of data, information and knowledge, designed for targeted control over the objects as a whole through the management of its components.

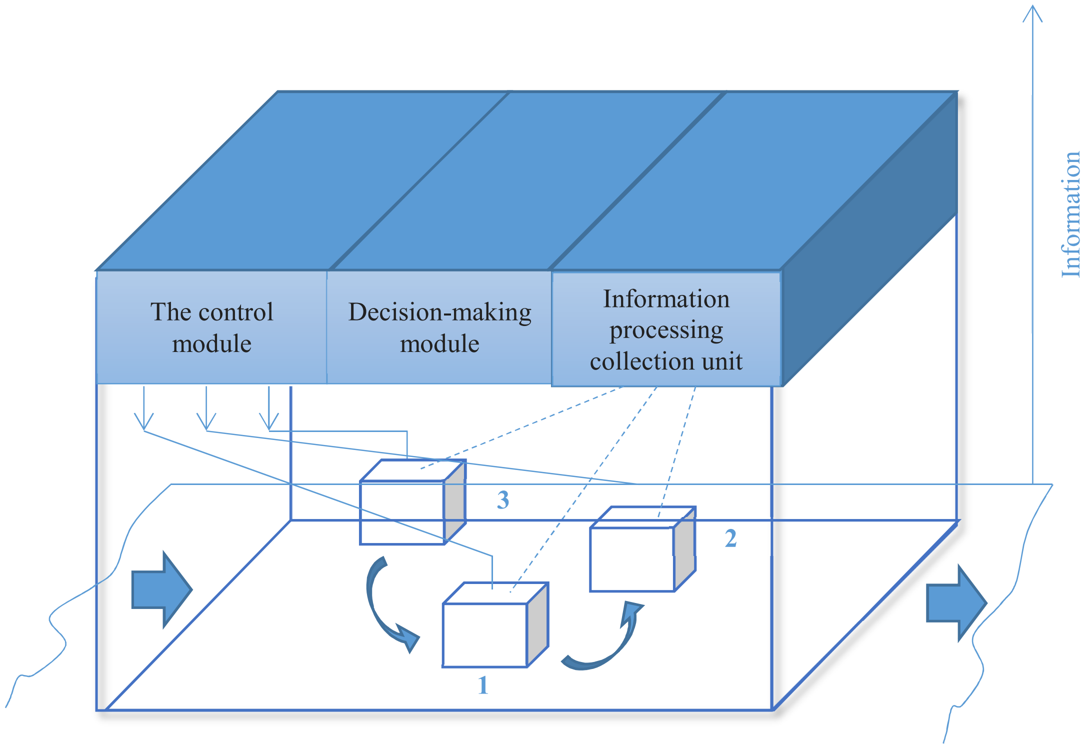


***Fig. 1.5** System model SIC as a multi-level managed object*

Thus, the SRC as a complex socio-economic object is represented in the model hierarchy volumes, each of which includes:

- A fragment of the material plane,

- Limited information znanievy volume, which takes place in the space of a purposeful change of state of the control object.

- Management system, structurally isomorphic with respect to the levels of the hierarchy and is intended to provide a purposeful behavior considered fragment volume hierarchy.

It should be noted that the smaller the volume and correspondingly closer to the plane of the material is observed component system model, the more determinate is complete and certain amount of information and knowledge used for data management purposes the object. An example of this can be controlled subsystem workplace machining area whose status is determined by the number of blanks in the input drive, the number of finished products in the output stacker, a set of processing operations, characterized by a time parameter, and schedule the launch preparations for processing.

Conclusion

Accordingly, the management of the entire object, in this model the highest volume, involves the use of aggregated information resources (indicators), abstract knowledge and decision-making under conditions of incomplete information and uncertainty.

Systemic SRC modeling as a complex managed social and economic facilities possible to determine the structure of its management system as a network of decision-making, called the Corporate Network Decision Making (CNDM). The system model takes into account not only the internal organization of the SRC, but also its external environment, since it is assumed that the SRC can be a party, involving open knowledge sharing distributed production network.

References

1. Leonard-Barton D., 1995 Wellsprings of Knowledge// Harvard Business School Press, Boston, MA.
2. Wittich V.A., 1999 Open systems management through the integration of knowledge. // Autometry, №3, p. 38-49.
3. Wittich V.A., 2000 Evolutionary management of complex systems // Proceedings of the Samara Scientific Center of the Russian Academy of Sciences - Vol 2, number 1, p. 53-65.
4. Scheer A.B., 2000 Business processes. Basic concepts. Theory. Methods. - Vest- meta. - 175 p.
5. Scheer A.B., 2000 Modeling business process - West meta. -175s.