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## Formation of Integrating Mechanisms of Science-Intensive Enterprise Management in the Conditions of Knowledge Economy

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*On the verge of XX – XXI centuries, a whole row of changes has happened in the development of the world economical system, and the impact of those has become quite noticeable in the economic life as of separate countries, so in the general planetary scale. Now, science, having been included into the system of productive forces, has taken a special place. Earlier the influence of science over different spheres of social and economical life was rather significant, but to the end of XX century, science became the main factor of modern economy development. Intellectual capital has become determinative and taken an important place in the structure of national wealth of many countries. According to the data of the World Bank, which has made cost estimations of national endowments of different world regions, the share of intellectual capital in the structure of national wealth accounts for from 43 up to 76 % in different regions (Majburov, 2003). Proceeding from this fact, we may conclude, that the economy, based on knowledge, has taken the main position in the world. This economy foundation is an intangible value, based on non-material assets. In the conditions of economy realization, based on knowledge, success is achieved by those subjects of the market, who will manage to transfigure the character of their activity from an industrial one into an intellectual enterprise, which result will be an added value, as a form of intellectual rent revelation. In the given conditions, there appears a need in efficient models of science-intensive enterprise management on the base of their integration.*

*Keywords: economy, based on knowledge, nonmaterial assets, intellectual capital, science-intensive economy sector, knowledge management, systematic integration of innovations, economical cluster.*

### Introduction

Modern science interprets economy, based on knowledge, as a sphere, which multiply defines the efficiency of science-intensive enterprises' activity. The starting conceptions for our research work are the investigations in the sphere of knowledge management by D. Barny, A. Bolinger, and C. Wiig. They consider knowledge as the main resource of social development, economical product, the basis of subjects' modern economical

activity. The conception of informational economy, which founders are M. Castells, Y. Masuda, M. Porat, G. Stigler, T. Umesao, has been built on acceptance of the special value of information as a resource and the necessity of its processing and distribution means enhancement.

The conception of the global net-work society, created by B. Gates, G. Mince, D. Tapscott, O. Toffler, Д. Schneider, considers the process of new economical forms appearance around the

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global network capital structures, management and information, which present by themselves an interconnected complex, based on informational technologies.

Among Russian scientists, first we should distinguish the following researchers, who have made a significant contribution to development of modern conceptions of science-intensive enterprises: O. Antipova, G. Gol'dshtejn, A. Dobrynin, M. Deljagin, G. Zhuravleva, V. Inozemcev, V. Makarov, B. Mil'ner, V. Zinov. Modern system of knowledge management is built on five fundamental processes:

1. Search of new knowledge in the result of its formalization at its carriers – the subjects of inner and outer organizational chart.

2. Knowledge gathering by means of transition of inexplicit knowledge into explicit one;

3. Knowledge systematization: its classification and categorization for the purpose of its further task-oriented extraction; data cohesiveness maintenance by means of corresponding processes realization.

4. Knowledge efficient holding and authorized access.

5. Knowledge diffusion – its exchange in the process of activity and development of knowledge new spheres.

Originality of the author's approach lies in the definition of activity specifics of science-intensive enterprises from the point of view of knowledge management in the course of innovative product development, in formation of the main parameters of knowledge management in the course of innovative project realization, in the model development of system integration mechanism along with the substantiation of its role in the innovative process, as an institutional form of knowledge management. Moreover, in the given research there has been developed a methodic of knowledge management in the innovative process

on the basis of system integrator usage, there has been created a model of expert-integrators' competency and on its basis there has been developed a program of experts' training.

### Methods

The theses of system and economical analysis of science-intensive enterprises' and innovative-manufacturing complexes' activity in Russia have become the basis of the performed research. It is worth to single out the following innovative complexes among the investigated ones:

The innovative-manufacturing complex, based on MSTU named after N. Ye. Bauman, which strategic partners are CC «Jenergija», SMJV «Mashinostroenie», SSSMC (Space Centre) named after M. V. Hrunichev, CJSC «Jenergomash» and others; the innovative complex on the basis of OJSC «Zelenograd Innovative-Technological Centre», the consortium of enterprises on the basis of SMJV «Rational Mechanics» in Zheleznogorsk, the Tomsk University of Management Systems and Radio Electronics (TUMSR).

We have also used the method of expert estimations, the analysis of elementary factual and statistical data, and simulation of the system integrator activity.

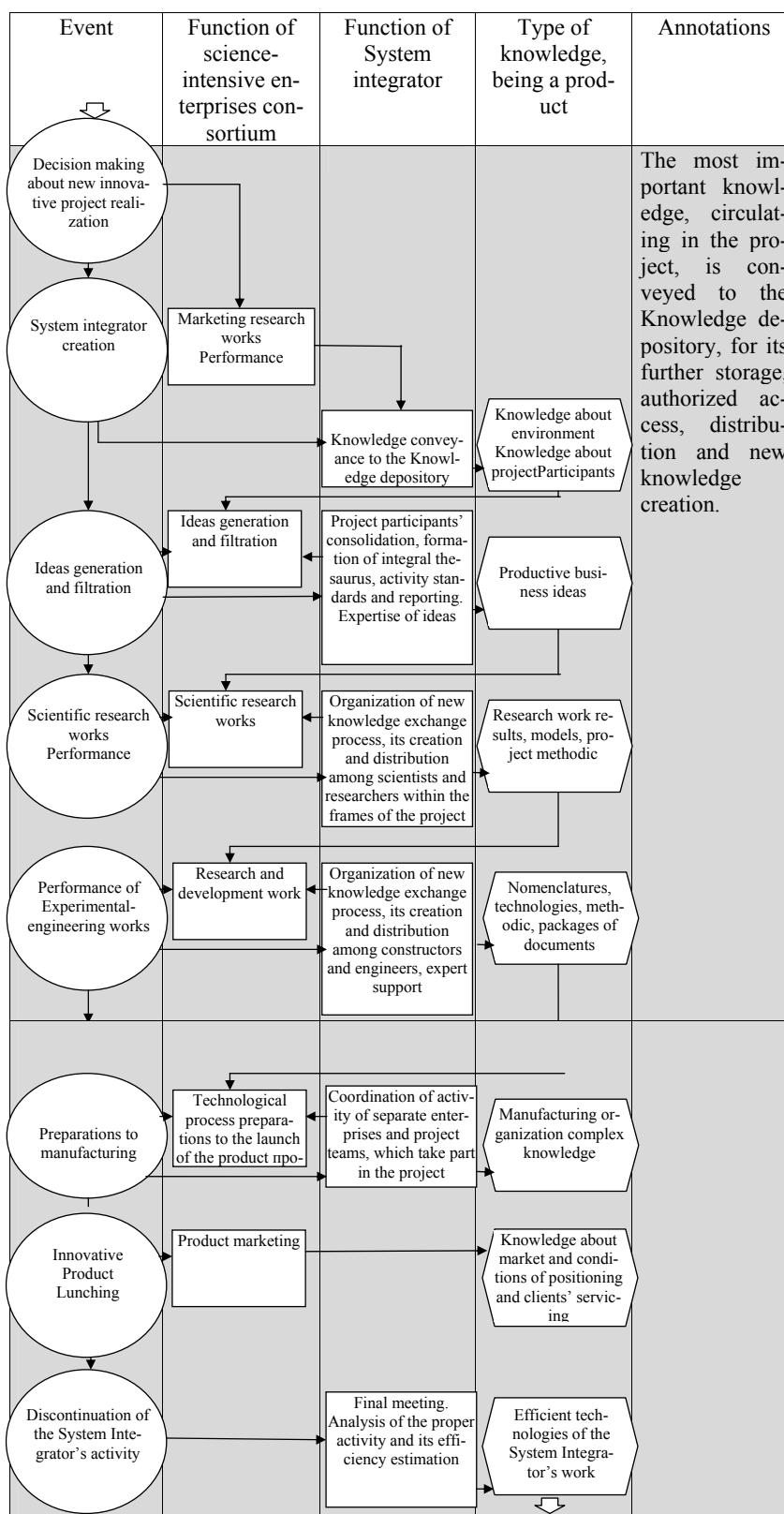
### Results

The re-formed segment of the world economy has a row of specific features, which single it out from the rest of economical society. Here, we shall underline the key peculiarities of the science-intensive enterprises' activity:

1. Sophistication of the product it-self; the product is not simply more complicated, but a big amount of high technologies is needed to be synthesized for its production;

2. Diminution of the science-intensive products' vital cycle from several years to several months. In the given conditions, the vital cycle of the product sphere knowledge also shortens, and

Table 1. Knowledge Management Model on the System Integrator Basis



that brings to a contradiction: on one hand, high technologies application allows creating a better and a longer-run product, on the other hand, – product obsolescence significantly reduces the vital cycle of the product;

3. The business competition character changes in the industry sectors, where the science-intensive enterprises' activity appears to be determinative. They refuse from the traditional price competition and damping, because of high technology markets transformation and their borders blurring. Here, we are not speaking about business competition between companies, but between coalitions and networks, and its main instrument is not a price, but a new quality, technologies, and knowledge. Moreover, cooperation of the state, the science and the business acquires a permanent character, in order to fulfill collectively the major research projects, which will allow to master new spheres and confines, to form economical clusters; and finally, coalition is a more efficient market player, than a separate company. The opt for coalition is also defined by such tendencies in the modern economy, as:

- Transition to 100 % industrial outsourcing of major high-technology producers;
- Formation of on-line service and offshore programming market;
- Logistic service development and large-scale export of technologies;
- Pullulation of TQM, MRP, CRM conceptions and unitary standards of quality in management;
- Appearance of virtual corporations.

4. It is formed a systematic character of created innovations. Innovations can be of autonomic character in the structure of traditional enterprises. However, in science-intensive enterprises, they most often use innovations in a combination, as far as they are of interpenetrating character. Innovation systematic character peculiarity consists in the fact that one can hardly codify

the innovation knowledge, and consequently it is subjected to devolution to external organizations. H. Chesebrough and D. Tispoint at this fact (Chesebrough and Tis, 2007).

5. The science-intensive economy sector differs by its higher added value. The features of non-material assets define profitability specificity of high-technological economy sector, while science-intensive enterprises base them-selves upon these features. The higher added value of science-intensive enterprises is testified by their close connection with venture capital. We can see it by the example of USA, where venture capital has appeared earlier, than in other countries and it is more widely spread. 65% of all the USA venture companies are concentrated in three USA states: California, Massachusetts and New York, i.e. in the states, which possess the highest scientific-technical potential. According to V.Zinov's data (Zinov, 2005) and some other researchers (Avdulov and Kul'kin), round about 80% of venture investments are spent for the enterprises of the science-intensive industry sector. Overall, the process of venture capital participation in science-intensive enterprises is mutually profitable. On one hand, venture capitalists support and develop the science-intensive sphere of economy, on the other hand - it itself contributes to the growth and steady development of the venture capital. Thus, in 1980 in USA, the volume of venture capital was \$4 billion, and in 1998, it reached already \$84.2 billion.

- The science-intensive enterprises' activity defines the special type of employees and managers, working for it. The most important competencies are the following:

- High intellectual level, which is expressed in ability to handle large amounts of information, to single out the most significant features and to form new methods of activity;
- Mental creativity, which presents by itself an integral characteristics, which is expressed in

ability to see one's own frames and stereotypes, to overcome them and to generate new knowledge and products;

- Tolerance to uncertainty, inner flexibility, readiness to constant changes;

- High communicative level, the skill to make business contacts, to deal with different people, to find the ways to avoid conflicts, to come to compromises;

- The ability to make decisions in conditions of informational deficit, of time pressure, taking into account the interests of different participants of the process;

- Resistance to stress, as an ability to maintain working efficiency in the conditions of external pressure, the skill to think «while going»;

- Presence of the entrepreneurial instinct, the skill to anticipate the situation development, to run the justified risk, to focus the given resources in the right time and in the right place;

- Strong will to contact with the surrounding people, to exchange knowledge, to act as a facilitator in the team-work.

On the stage of high-technological product creation and entering the market, there is a need of integration mechanism for efficient management of science-intensive organizations coalition. In our research work, we consider System Integrator as such a mechanism.

Under System Integrator, we mean structurally integral community of experts, who realize the processes of interaction of complex system parts in order to provide innovative process and system development. System Integrator creates «the field» for organizational interaction, generates external organizational networks of informational interaction, acts as an intermediate, as an accelerator and as an expert of knowledge distribution. It has to become the key link of the net, forming the innovative economical surrounding.

The useful key product of System Integrator is a coordinated activity of science-intensive enterprises' coalition, scientific research institutions, universities, project-implementation firms for the development of innovative product and its market launching. Let us single out the most important functions of System Integrator. They are:

- Consolidation of innovative process participants, formation of the integral cognitive field for product creation.

- Expertise of decisions, used knowledge and technologies.

- Management of formalization processes, knowledge reception, its exchange, spreading, and transferring within the frames of innovative process.

- Intermediary between Knowledge depository and the participants of innovative process.

- Coordination of separate teams' activity of innovative coalition on all the stages.

System Integrator carries the responsibility for maximal usage of innovative coalition participants' potential; for the quality of generated ideas and decisions; for operationality of innovative product creation processes; for the amount and the quality of formed knowledge.

Knowledge depository plays a special role in the science-intensive coalition activity. Within the frames of our research work, we call Knowledge depository a special container of knowledge, which activity is walk-through in relation to different innovative projects, performed by coalition or innovative-economical cluster.

The peculiarities of the Knowledge depository activity are:

- storage of informational bits, containing innovative projects knowledge, in electronic form of any format;

- integral system of information classification;

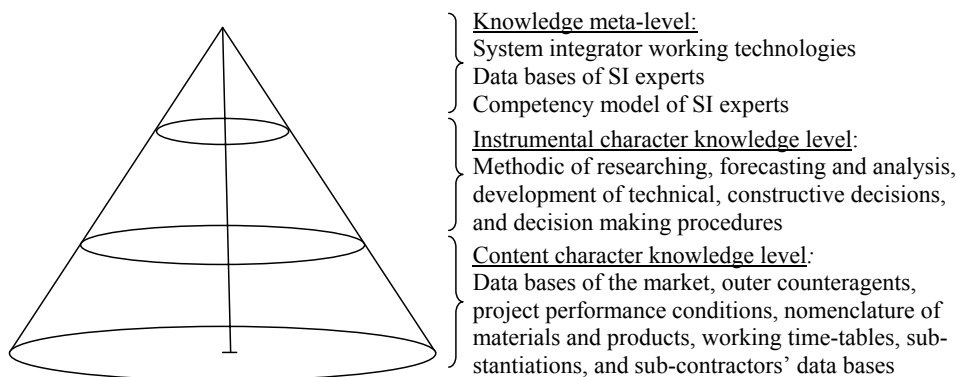


Fig. 1. Knowledge Depository Model

- common format of information distribution, storage and search (document registration form) has been worked out on the basis of Dublin Core international standard; Knowledge depository is equipped with reliable and friendly navigation systems;

- convenient organizational structure of information storage, which includes three main levels (Fig. 1):

- simple and clear interface, it is possible to set it to suit concrete needs of the innovative process participants;

- a walk-through character of working; depository does not stop its functioning when the project is finished, it works in succession or in several projects at a time, thus providing knowledge storage and distribution;

- thematic rubricator, having been developed in accordance with Russian and international standards in the sphere of information classification and systematization;

- possibility of authorized access to the informational system of any of the innovative coalition participants through any computer, which has Internet connection;

- high level of system protection and security;

- wide seeking possibilities: full-text search, seeking by document registration form fields

(name of document, author, key words, thematic heading);

- possibility of searching forms setting to suit concrete needs of the customer;

- integration with other products of the Lotus platform;

- possibility of dialogue in an on-line regime, organization of forums, conferences, consultations of the consortium participants from different cities and countries in the format of a virtual club.

The science-intensive industry is an engine of the modern economy. World annual average increase of science-intensive industrial production volumes amounted to 11% with adjustment for inflation. There at, in other manufacturing industries, this value was 2.7% [Science and Engineering Indicators]. Generally, science-intensive industry development brings to structural reorganization of all the economy, i.e. the share of the high-technological sector is constantly growing. Thus, in 1980 all the science-intensive sphere made up only 7.1% of all the world industry. Today, its share has reached 11.9%. To our mind, formation of management mechanisms of the science-intensive coalitions and clusters on the system integration basis will allow giving an additional impetus to these processes.



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