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PRINCIPLES AND RISKS OF PROJECT MANAGEMENT IN THE FIELD OF NANOTECHNOLOGY

The article provides for the preconditions for the transition to a complex project management, covering all stages of the life cycle of innovative nanotechnologies in the field of nanotechnology. Structural relationships between nanotechnology routes are described, and the problem of control over the complexity of these relations is described. At the same time, the principles of project management in the field of nanotechnology are presented, which reflect the nature of these projects, their structure, other factors that determine participants and the specificity of managerial tasks. After defining the main features and perspectives of nanotechnology as a new technology, the document provides general risks associated with the use of nanotechnology and lack of risk management processes, as well as recommendations for governments, industries, international organizations and other stakeholders. The purpose of the research – The importance of nanoindustry in the country's economy and the existence of a number of issues in this area require the elaboration of effective solutions for their effective solution to the transformation of the Nano-industrial complex of Kazakhstan. This article outlines one of the possible ways of transition to project management as an integrated management concept, which eliminates the problem of compatibility between the elements of the nanotechnology structure.

Key words: project management, nanotechnology projects, principles of nanotechnology projects, risks of nanotechnological projects.

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Нанотехнология саласындағы жобаларды басқару қағидалары мен тәуекелдері

Мақалада нанотехнологиялар саласындағы инновациялық нанотауарлардың өмірлік циклінің барлық сатыларын қамтитын кешенді жобаларды басқаруға көшудің алғышарттары қарастырылған. Нанотехнология бағыттары арасындағы құрылымдық қарым-қатынастар көрсетіліп, көрсетілген қатынастардың күрделілігін ескере отырып, бақылау мәселесін қалыптастыру сипатталған. Сонымен қатар, нанотехнология саласындағы жобаларды басқару принциптері ұсынылады, олар осы жобалардың сипатын, олардың құрылымын, қатысушыларды құруға және басқарушылық тапсырмалардың ерекшелігін анықтайтын басқа да факторларды көрсетеді. Нанотехнологияның негізгі сипаттамалары мен перспективаларын жаңа технология ретінде анықтағаннан кейін, құжатта нанотехнологияның қолданылуы мен тәуекелдерді басқару процесінің жетіспеушілігімен байланысты жалпы тәуекелдер, сондай-ақ үкіметтерге, салаларға, халықаралық ұйымдарға және басқа да мүдделі тұлғаларға ұсынымдар берілген. Зерттеу мақсаты - Ел экономикасында наноиндустрияның маңыздылығы және осы саладағы бірқатар мәселелердің болуы Қазақстанның наноөнеркәсіптік кешенін жаңа деңгейге көшіру мақсатында оларды тиімді шешудің тиімді шешімдерін әзірлеуді талап етеді. Осы мақалада наноиндустрия құрылымының элементтері арасындағы өзара іс-қимылдың үйлесімділік проблемасын жоюды қамтамасыз ете-

тін интеграцияланған басқару тұжырымдамасы ретінде жобаны басқаруға көшудің ықтимал тәсілдерінің бірі көрсетілген.

Түйін сөздер: жобаларды басқару, нанотехнологиялық жобалар, нанотехнологиялық жобалар қағидалары, нанотехнологиялық жобалар тәуекелдері.

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Принципы и риски управления нанотехнологическими проектами

В статье представлены предпосылки перехода к комплексному управлению проектами, охватывающие все этапы жизненного цикла инновационных нанопродуктов в области нанотехнологий. Описаны структурные взаимосвязи между маршрутами нанотехнологий и описана проблема управления сложностью этих отношений. В то же время представлены принципы управления проектами в области нанотехнологий, которые отражают характер этих проектов, их структуру, другие факторы, определяющие участников, и специфику управленческих задач. После определения основных характеристик и перспектив новой технологии применяются к документу и общие риски, связанные с отсутствием процесса управления рисками, а также правительств, промышленности, международных организаций и других заинтересованных сторон. Цель исследования – важность наноиндустрии в экономике страны и наличие ряда вопросов в этой области требуют эффективных разработок для решения проблемы трансформации нанопромышленного комплекса Казахстана. В этой статье описывается один из возможных путей перехода к управлению проектами как концепция интегрированного управления, которая устраняет проблему совместимости элементов наноструктуры.

Ключевые слова: управление проектами, проекты нанотехнологий, принципы проектов нанотехнологий, риски нанотехнологических проектов.

Introduction

Today, interest in nanotechnology is very high. Issues related to different aspects of this field are discussed in Kazakhstan and international symposiums, conferences, seminars. There is no specific law regulating nanotechnology issues in Kazakhstan, but there are a number of identified programs (eg, the Concept of Innovative Development of the Republic of Kazakhstan until 2020, the State Program of Forced Industrial and Innovative Development of the Republic of Kazakhstan for 2010-2014 (modified), which states that Kazakhstan's industrial-innovative policy "should meet the fundamental requirements of the Third Industrial Revolution."

Examples of other successful projects and programs in the field of nanoscopy, nanotechnology and nanoengineering can be summarized. However, despite the obvious achievements in these areas, Kazakhstan remains behind the world leaders in the field of nanoindustry, such as USA, Japan and the European Union. One of the main reasons for this lagging is the ineffectiveness of the mechanisms used to switch from basic and applied research to production organization. Establishment of technoparks, business incubators, business reactors and other innovative institutes that are constantly growing. However, the main objective of these institutions is to support innovative projects at the initial stage, and from that point of view, the problems of transition to mass production remain open (Ukaz Prezidenta, 2013).

In our opinion, one of the ways to solve problems in the industry is to use project management in the implementation of projects in the field of nanotechnology. Project management is used at all stages of innovative production, ranging from research to ready-made nanotechnology profits (Bowman DM, 2006: 38p). This approach requires the development of a new method of project management that is characterized by the nature of the nanotechnology industry, not just its structure and properties, but also with the dynamics of the system. Any methodology requires the formation of the underlying principles and timely prevention of the risks involved.

Materials and methods

The methodological sequence of the study is presented in the article as follows. Initially, projects

and programs in the field of nanoindustry on the basis of the method of generalization of the studied data. As a result, the reasons for lagging behind world leaders have been revealed, which is the ineffectiveness of the mechanisms used to move from basic and applied research to a production organization. Then, ways of solving problems in the industry are considered. Statistical analysis is the tool of analysis. The result of the research is the definition of the principles of project management in nanotechnology.

Literature review

Nanotechnology projects are essentially a sign of vigilance that all have the benefit of the national economy that brings them to the forefront of positive emotions (Gregory R, 1995: 223p).

Nanotechnology projects enter the group of strategic projects focusing on the development of scientific and technical potential, providing the global competitiveness of Kazakhstan in the most important technological areas. In the preceding decade, the country's economic competitiveness and high degree of national security will boost progress in nanotechnology, 1T, new materials and biotechnologies (Forrest D., 2007: 25p). When the basic effect is achieved, it is possible to access the revealed technologies in interdisciplinary regions (Meshalkin V. P., 2012: 54p).

For effective management of projects in any sphere of activity, it is necessary to enforce the specifications of the specific field. How to solve this problem, the problem of nanotechnology in the field can be switched to the traditional management techniques, used by the management of the project, and the whole process of innovation of innovation (Abbot KW, 2006: 36p).

The cycle, which includes a complete lifecycle project in nanotechnology, includes fundamental research, application development, production technology, marketing technology, production and realizations, finance for new research scores (Johnson B.B, 2007: 48p)

Each of the studied stages is directed to the management of the problem, requiring the use of own methods and tools (Cross F.B, 1996: 925p). The realizations of the project management will provide for the co-operation of the decision-makers to meet the needs of the unit (Gwinn M.R., 2006: 182p). Creating a structured context can be based on a systematic approach to research projects, including complex systems, including organizational, economic and technical subsystems (Driesen D.D., 2005: 95p). In accordance with the systematic approach to the complex research of similar systems, you can use the modeling (Breggin L.K., 2006: 329p). Multiplayer modes can also be used with the base system controller if the model is enabled and required by the process controller.

Taksim image, the principles of understanding that are being taught in the process of nanotechnology in the field of project management, are based on the notion of effective implementation of the effective system of project management in the area of observation (Breggin L.K., 2006: 329p).

Proved analysis of the specifications of the project in the field of nanotechnology, represented in the work (Babich A., 2003: 184p), allowed to formulated the principals, represented further.

Results and discussions

A) The principle of the evolving character project. Most projects in the field of nanotechnology emit the developmental character.

An irreducible project – the project at the moment of the initialization of the finite touches, making it clear that it is the end of the process (Austin C., 2004: 21p). In the case of similar projects, it is possible to tell about terminals, characterizing the expiration of the defined stage of the project. Moment detection of terminal terminals in development projects adds many factors, in the first seeing the effectiveness of the predecessor operations and externally processed. For projects involving nanoindustry, the high-end system of terminals involves the highest degree of research and competitiveness amongst the countries and private companies in the field of innovation. Getting acquainted with the patenting part of a key decision maker may limit the ability to explore other possibilities in developing other projects (Hodge G.A., 2007: 36p).

By default, the management of the nanotechnology in the field of software can not be implemented with either a static or dynamic system, but it is possible to change only the parameters, but not the structure. The theoretical knowledge of the project in the form of a similar system of forming is discussed with the help of the methods. Majority of the methods are attributed to expertise and qualitative subjectivity. The process of structuring the frameworks of the project management process is the actual task, requiring the development of new methods of decision-making. Principle of equality of values, resources, risk and structure of the project. With the help of nanotechnology in the field of non-management of projects, the risks and resources are

characterized as unsatisfactory. Undeterminedness of risk is not just the result of their formation, but also the lack of information, which is not the case. What is the source of the resources that are manifested by the unbalanced nature of the human resource, playing the most important role in the field of nanotechnology. Any change in the list of transcribed components will be added to the structure of the project, ie. and subsequent relationships with different types of interactions (Sarkisov P. D., 2013: 35p.). These projects are in line with the management of the project, with the willingness to engage in joint ventures and mutual funds, resources and risks.

B) Principle of Prioritizing Optimization of the Present Characteristic Project. The main task of the project is to find the most effective and effective utilization of resources for the purpose of bringing life cycles to the life cycle of the whole cycle, with internal and external contexts. Multiplication, which is defined by the task, includes material, financial, personal, intellectual and time resources. It is evidently the search for a global extreme of kernel functions in many applications for slab projects that are associated with the problem. There are many mathematical methods that are used in project management, and search for local extremes to search for resources by looking at the status of all other resources in a resource free manner. The lifelong cycle of projects in the nanosurgical studio encompasses a list of the most commonly used stadiums, each of which is based on different types of stages and substeps, and is part of the project. To be honest, for projects that have a long life cycle, the first outcome of the plan will be to exploit the effective use of time resources (Abbot KW, 2006: 36p).

Looking at the details of the project will help you to understand how to optimize the time frames of the project in terms of resource limitations. Principle of continuous process of planning and monitoring. The principle follows from the principle of the developing character of the project. Management of the dynamic system is impossible without the organization of continuous monitoring of the project implementation and planning on the basis of the external analysis of the parameters and the parameters of the projected outsourcing. While doing so, be sure that the process of monitoring and planning is resource-intensive, which promotes the demanding methodology of their organization.

C) The principle of potential development. Exquisite projects, many of which are related to nanotechnology in the field of projecting, are the result of the use of the resulting results obtained in the process of their realizations. As a result, the effectiveness of data projects will be evaluated on the basis of the criterion, drawing out the effects, forming the potential project. Fundamental potentials of projects are complemented by innovation in the intellectual resources of their implementation (Environmental Defense, (2007). At the time of the first plan, you will be able to find out what resources are available for, and how to use them for different purposes, such as the project, and the next generation of innovations in the cycle of innovations.

Thus, to assess the potential of the project, it is necessary to develop the following tasks: Appraisal of intellectual property resources; discovery of promising feeds; analyze possible use of intelligent resources in the frames of embedded embedded objects. The principles of interconnection of projects and their interconnected phenomena. The fundamental and applied research in the field of nanotechnology leads to the fact that the different projects, realizing in this sphere, have a multiplicity of points of interconnection, in the volume and in the interval between (Johnson B.B, 2007: 48p). The maintenance of the effective interoperability between the projects is driven by the development of the infrastructure of the nanoindustry. In Kazakhstan, the national nanotechnological network, which is part of the coordination of activity in the field of nanotechnology.

At present, the functioning of the national network is reduced to filling out the databases created within the framework of the infrastructure projects of the program “Development of Nanoscience and Nanotechnologies in the Republic of Kazakhstan for 2010-2012”, developed by the Ministry of Education and Science of the Republic of Kazakhstan. The information stored in these databases is necessary as the initial parameters for making many decisions on project management in the field of nanotechnology.

To date, most participants do not have access to viewing this information, which significantly limits the possibilities of project management.

D) The principle of coherence of interests of all participants. The composition of participants in nanotechnology projects is very heterogeneous. It is possible to single out research organizations that create fundamental and applied solutions, innovative institutes engaged in the commercialization of scientific developments, manufacturing enterprises that organize the output of products, higher educational institutions that provide human resources for nanotechnology, investment institutions that provide financing, and public services that support development nanotechnology (Forrest D., 2007: 25p).

To ensure effective project management, it is necessary to develop such a motivation system for participants, which would ensure the coherence of their interests in the implementation of projects. For this, the management system should be as transparent as possible, and the principles of its operation are clear to all participants. In this regard, the use of methods and tools to support decision-making, based on the analysis of objective data, characterizing various aspects of the project. The principle of ensuring a coherent transformation of project models in the process of its transition between stages. This principle is based on the system-wide principle of the modeling of complex systems and the requirement to improve the objectivity of management, which is a consequence of the principle of coherence of interests of participants. At the same time, the principle determines the need to transform the models used in the management process, when the project moves between stages, because in the process of such a transition, a significant transformation of the project objectives is possible, entailing many changes. A special role here is assigned to the consistency of the transformation necessary to ensure the balance of the many models that serve as the basis for the management system.

E) The principle of minimizing the total number of control actions. The project in the field of nanotechnology is a complex management object. At first glance, the management of such an object requires the introduction of a large number of control actions and controlled parameters. At the same time, it is known that the complication of the system entails a decrease in its reliability and resistance to disturbing effects (Ackerman B.A, 1985: 37p).

Thus, to ensure the sustainability of the project management system in the field of nanotechnology, while maintaining the required level of controllability of the object, it is necessary to reduce the number of control actions to the lowest possible level. With a decrease in the number of control actions, the number of parameters to be controlled is reduced, since the control must be not only stable, but also economical, i.e. using the minimum amount of resources. This principle describes the requirements for the total number of control actions in a single control loop, and their distribution within the contour may differ for projects of various types. Therefore, the actual task is to develop a classification of projects from this point of view.

Risks in projects in the field of nanotechnology. The International Council for Risk Management (IRGC) has determined the difference in management between requirements related to nano-, not micro- / macro-technologies. New attributes of nanotechnology require different routes for risk assessment, and now innovations in the field of nanotechnology are ahead of policy and regulatory environment. In a shorter period, the management gap is significant for those passive nanostructures that are currently in production and have a high level of impact; and is especially important for several "active" nanoscale structures and nanosystems that we can expect in the market in the near future (Gregory R, 1995: 223p). Active nanoscale structures and nanosystems can influence not only human health and the environment, but also aspects of social lifestyle, human identity and cultural values. The main recommendations of the report concern selected nanotechnology applications with a higher risk level, short-term and long-term problems and global nanotechnology management models. Active nanoscale structures and nanosystems can influence not only human health and the environment, but also aspects of social lifestyle, human identity and cultural values.

A risk assessment is a definition of the risks associated with exposure to a person or environment of a hazardous substance, and the number of risks depends on the specific properties of the substance (Cross F.B, 1996: 925p).

The purpose of risk management is to identify and manage significant risks. It consists of several key stages, with feedback through the monitoring and monitoring process. Risk management overlaps with other management processes in most projects, which are usually performed as part of normal project management (Gwinn M.R., 2006: 182p).

We offer a 8-step model of risk management in nanotechnology in related projects and believe that these considerations can significantly control the hazardous effects of materials in the workplace and the environment (Fig 1).

Step 1: Basic knowledge of the work is necessary to conduct an adequate assessment. Therefore, staff in the workplace, with extensive knowledge in this area, should always be involved.

Consultations between managers and staff are useful for assessing and helping to provide information on the substances used, how the work is done, on the impact of nanomaterials and commitment to quality control.

Project managers can conduct evaluations themselves by working in a small workplace, or you may need to set up a team in a larger workplace. The evaluation team should be able to understand information in protocols and labels, check working conditions and forecast potential problems. They

also need to interact effectively with staff and potential stakeholders to make the right conclusions about risks and risks, and finally accurately report the results (Baram M.S., 1984: 201p).

Step 2: In order to be able to conduct a thorough risk assessment, divide the work into sections, subsections and tasks or process units in accordance with the Work Breakdown Structure (WBS) (Driesen D.D., 2005: 95p). Step 3: Determine all the nanoparticles that are used or will be used, or will be produced in each working device and in the process. The nanoparticle can be obtained in the form of powder, liquid, gel, vapor, dust, fog or smoke in the workplace (Breggin L.K., 2006: 329p).

Step 4: Determine the type of nanoparticle. Nanoparticles can be found in several forms, such as, for example, engineered insoluble nanoparticles in a matrix for more dangerous forms, such as free nanoparticles.

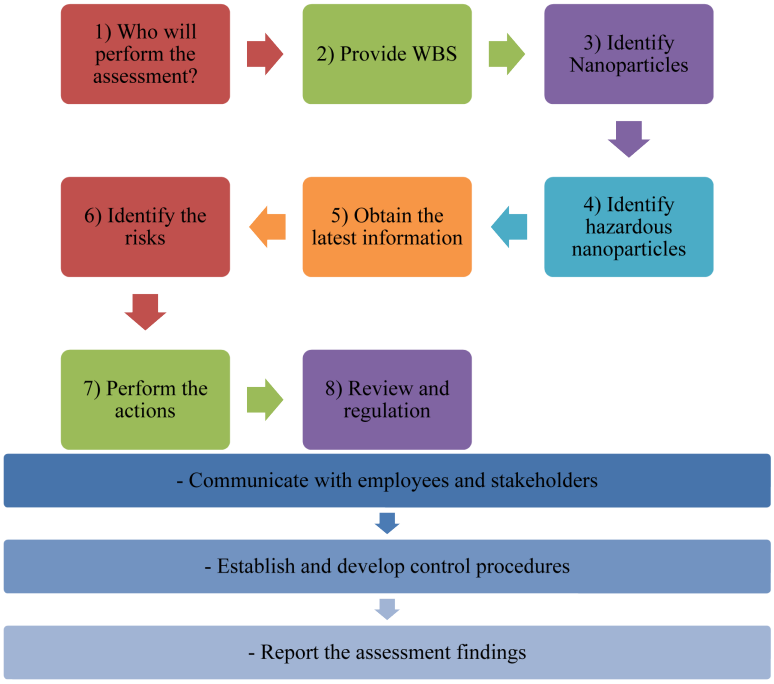

Figure 1 – 8-step model of risk management in nanotechnology projects [Breggin L.K., 2006: 329p., Florini K., 2006: 53p., Colvin V.L., 2003: 21p]

Step 5: The supplier must provide information on nanomaterials. However, for most nanomaterials, Material Safety Data Sheets (MSDS) are not available, so you will need to obtain adequate information from other sources, such as textbooks, standards, technical reference sources, scientific articles, reports, trade journals, online online databases or experience.

Step 6: How dangerous nanoparticles are released into the work area? Are people exposed to hazardous nanoparticles through breathing, skin, ingestion, or eye contact? The "walk" will check the information about each of the working blocks. It is important to talk to employees anywhere and ensure that all people exposed to nanomaterials are covered. If a new task is planned, a process or work unit, but not yet in operation, an evaluation is required.

Step 7: Significant risks include serious health effects in the workplace (ETC Group, 2003), for example, by inhaling nanoparticles or working with highly toxic nanoparticles (eg, nanobased antitumor drugs).

Step 8: Review and regulation of evaluation is required if:

There should be significant changes in project, work, material, process or control procedures

Poisoning associated with nanoparticles

Inadequate control procedures reported

New data on the risk of nanoparticles

In these situations, the use of a new or improved management method is reasonable.

Nanotechnology risk management – policy recommendations. This is a summary of the policy recommendations contained in the White Paper and

the Brief Policy, published in 2006 (Friends of the Earth (Australia), 2007):

Improved knowledge base

Standardize the nomenclature, measuring and control systems

Better understanding of risk

Improve communication

Understand all the consequences

Strengthening risk management structures and processes

Identify gaps and remedies

Development of voluntary systems

It is necessary to take proactive and coordinated measures for possible events, when nanotechnology applications will cause irreversible and significant damage

Encouraging communication and stakeholder participation

Distinguish passive and active nanomaterials and products

Improve communication strategies

Engage in the public and participate

Provide broad social benefits and

Stakeholder involvement in setting priorities

Financing of the public good

Reducing barriers to developing countries

Economic planning to reduce adverse impacts

Cooperation between stakeholders and countries

Conclusion

The high importance of the sphere of nanotechnology in the country's economy and the presence of a number of problems in this area require the development of effective solutions for their overcoming with the aim of transition of nanotechnology of Kazakhstan to a new level.

In the present paper it is shown that one of the possible approaches is the transition to project management as a concept of integrated management that ensures the elimination of the problem of coherence of interaction between the elements of the structure of nanotechnology.

The use of this approach is advisable for the following reasons:

complexity of structural interrelations in nanotechnology due to the presence of complex interindustry interactions;

close interconnection of fundamental and applied research, technology and engineering; the possibility of the emergence of new structural elements (in science, technology and applications);

the need to integrate the interests of a heterogeneous membership;

the long cycle of innovation reproduction, which determines the priority of time management; a high level of system dynamics in the field of nanoindustry.

It is shown that the transition to project management should be carried out on the basis of the principles listed in the work, taking into account the specifics:

1) nanotechnology,

2) projects implemented in this field and

3) project management tasks and methods for their solution in relation to the object under consideration (White paper on nanotechnology risk governance, 2006).

It seems that the transition to project management, based on the principles discussed, will significantly improve the efficiency of processes occurring in this area and overcome the backlog of our country from the leaders in the production of innovative nano products.

In addition, this article proposes a 8-step qualitative model of risk management for project managers in the field of nanotechnology. The exposure of hazardous nanoparticles can be prevented by limiting exposure. These steps allow project managers to identify significant risks on a systematic basis.

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