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STRATEGIC FRAMEWORK AND METHODOLOGICAL BASES OF TECHNOLOGICAL PACKAGE DEVELOPMENT MANAGEMENT

The article deals with the problem of technological package management. Based on the concept of integrated innovation we consider the evolutionary approach for technology package management. Directions of evaluation process of package are presented. Scheme of improving of technological package is proposed. The process of technological package development is considered in case of development of granulation equipment that includes a variety of technologies, which are incorporated into the technological package "Granulator". For technological package development the technology package lifecycle, technology map of package and technology trajectory are interrelated considered.

Keywords: innovation process, technological package, technology trajectory, development strategy, granulation technologies.

Introduction. Technological package (group of technologies or directions which gives appreciable result of its implementation) of company is aimed on developing of main activities and creating and strengthen of competitive advantages. Technological package is a system that combines the technologies included in and is characterized by synergistic effect compared with the isolated and unrelated technologies application. So modern technological development of civilization has less to do with the creation of some new technologies, but with the emergence or creation the opportunities for development of different technology groups in different technology packages. In order to maintain competitiveness, companies need to continually invest in technology projects. Thus we turn to new wide area of management optimization objectives that require the development of new and adaptation of existing instruments of technology audit and innovation management for this purpose.

Analysis of recent researches and publications shows that scientists more detail consider the growing complexity of used technologies, which limits the ability of enterprises of self-development of technologies. Also resource limitations require an organization to strategically allocate resources to a subset of possible projects [6]. To achieve the objectives of research we propose to use methodical approach for complex analysis of industry dynamics stated by us earlier [10; 12] as well as the concept of ecosystem innovation [13]. Also, we will use the approaches of international expert organizations UNIDO [8], Grand Challenges Canada [9]

and European Industrial Research Management Association [7]. The recent study [4] concerning integrated innovation process model, for example, concluded that integrated approach to managing the innovation process is attractive for many reasons. Experts of Grand Challenges Canada [9] notice that integrated innovation is coordinated application of technological, social and business innovation to develop solutions to complex challenges.

Integrated innovation approach as the main approach for technology packages analysis does not discount the singular benefits of each of types of innovation models alone, but rather highlights the powerful synergies that can be realized by aligning all three. Integrated innovation recognizes that scientific/technological innovations have a greater chance of going to scale to achieve global impact and sustainability if they are developed from the outset in conjunction with appropriate social and business innovations. Based on the relationship of technology package concept can be regarded as a rational basis for analysis in this research. We believe that the task of forming and management of technological package as a functionally related group of technologies that have system properties is a task of integrated innovation management, as technologies are developed interrelated.

On this basis, the **aim of this study** is to analyze the methodological foundations of development process of technology package based on integrated innovation approach.

Results. First of all, let's consider the theoretical base of technology package analysis. Technology package should be considered as a system and combined application of its constituent technologies has a synergistic effect compared with its application as unconnected technologies. Based on our previous studies [10; 12] we can conclude that the complexity of interactions in technology package is supported by its composition, which comprises following functional elements from inside and outside of enterprise:

- technologies, linkages between them, as well as their fundamental basis;
- information package and communications system (communications within the package and communications with the environment);
- software and hardware products;
- personnel management and training;
- support processes of technology package.

Thus, the technology package we propose to consider as a kind of system, the development of which is evolutionary. According to UNIDO recommendations [8] analysis of acceptability of technology includes an assessment of technical and economic features of technology package in context of production in national environment. Therefore, as a basic tool of technology package development we propose to consider technology transfer as part of integrated innovation approach.

We believe that areas of technology package assessment should include:

- analysis and evaluation of efficiency of production, process, equipment and services;
- technical, technological, and proposals to improve the technology;
- definition of production, cost of materials, resources, space reserves.

Based on Chris Curran general approach [5] we propose to follow such basic steps to get a handle of technology package:

1. Creating an inventory of existing technology package, because the first challenge of technology package development is to get a list of all of the different technologies which enterprise have in use. Some of the attributes of this include:

- component type (critical, supporting);
- application systems that supports it;
- number of users (products, processes, other technologies) supported;

- amount spent per year (labor + licensing + modifications (upgrades));
 - sourcing – external, internal, combined etc.
2. Mapping technologies according its stages – i.e., figure out where each technology sits in its lifecycle. There is no single classification scheme but the technology lifecycle typically is segmented into such six phases: in the lab, emerging from lab (early adopter), leading edge, state of the market, last generation, end of life.
 3. Analyzing the package and act: systemizing of data and mull over possible changes that enterprise need to work into next year’s plan.
 4. Create an organizational and economic mechanism of continuous process of reviewing and refreshing of technology package.
- Enterprises of modern sectors, especially high-tech, at the same time use a large number of technologies, distributed according to functional application, but only some of these technologies are critical in terms of specialization. Therefore, for management technology package we propose to divide into the following classes (Table 1) with appropriate management instruments (optimization object and development strategy).

Table 1 – Technology package components

Package component	Characteristics of package component	Optimization object	Development strategy
Basic technologies	Are known and are the basis of production processes and are not tools in competition	Technology	Adaptation
Key technologies	Are owned by a limited number of companies (or just one) and ensure the possibility of key competitive advantages in the market for some time	Technology package	Improvement
Trial technologies	Are at the initial stages of life cycle, but because of lack experience are not competitive tools, but there is a probability that they will move into the category of key and replace them in the package	Idea	“Elite” selection

We investigated that efficiency of high-tech industries to achieve competitiveness could also significantly increase through the use of technology corridors which are the list of mandatory requirements and limitations to technical parameters, consumer products and services that is broken down by some periods and with the increasing of requirements (Fig. 1).

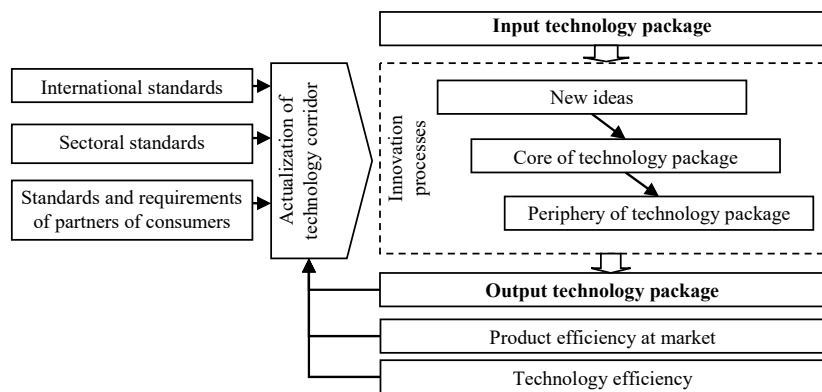


Figure 1 – Technological package development (authors’ development)

From the point of evaluation of technology and prospects of technology package as an integral object enterprise must use forward-looking techniques – roadmaps of basic technologies and technological foresight. In parallel with the receipt and processing of information is necessary foresight market analysis products and forecast of development of its innovative sectors.

Thus, we can conclude that for the purposes of technological forecasting is advisable to create a special unit with such main objectives:

- provide the capability to search and share technology information;
- provide with tools to technology portfolio analyze, make decisions about future investments and generate reports;
- enhance the ability to identify prospective technology development partners;
- provide subdivisions and top management the capability to dynamically capture information and manage technology.

The result of audit phase is to assess the current state and the formation of an “ideal” (target) technology package, which includes proposals for improving the efficiency of existing technology package and achieving competitive advantages.

At the stage of evaluation of possibility of modifications of product proposition on the basis of new technological solutions a strategy of technological development of the enterprise is developed. Forecasting is a necessary step as a effective indicator of production of high-tech start-up period from the start of pre-work before the production start.

The implementation of the proposed scheme is possible with the effective management of technology transfer, based on calculation of aggregated qualitative evaluation of integral indicator and quantitative assessment of technology using financial management tools.

Important step after technology audit and technology package conception creation stages is search of possible sources of technologies, when it is necessary to evaluate the possibility of acquiring the technology and the choice of methods of technology transfer.

The result of these phases is understanding of the vector of technological development of production system and the level of demand of innovation production. At Fig. 2 technological package development model based on the integration of new technologies in package that provide the required parameters of products (services), which in turn leads to necessity of building of new linkages between technologies in package, is shown.

Also in the analysis of areas of optimization, we offer to consider the following basic characteristics of technological package:

- level of package fragmentation, showing package readiness to practical implementation, i.e. the level of availability of all technologies (in terms of base and support technologies) that allows to realize the main purpose of creating the package and makes it possible to assess the feasibility of further existence of package;
- level of package perspective is analyzed based on technological and socio-economic foresight based on idea of package and is characterized by strategic nature of the goal of package creating;
- level of package competitiveness shows the ratio of technology innovation compared to existing national and international counterparts and efficient competitiveness of products;
- level of package autonomy, which in turn includes autonomy in terms of innovation system in national and international context, i.e. the possibility of to realize the goal of the package itself, or the necessity to attract participants at national or international level.

So as the conclusion from mentioned above we can propose the integrated scheme of technology package development (Fig. 3), based on such elements and tools:

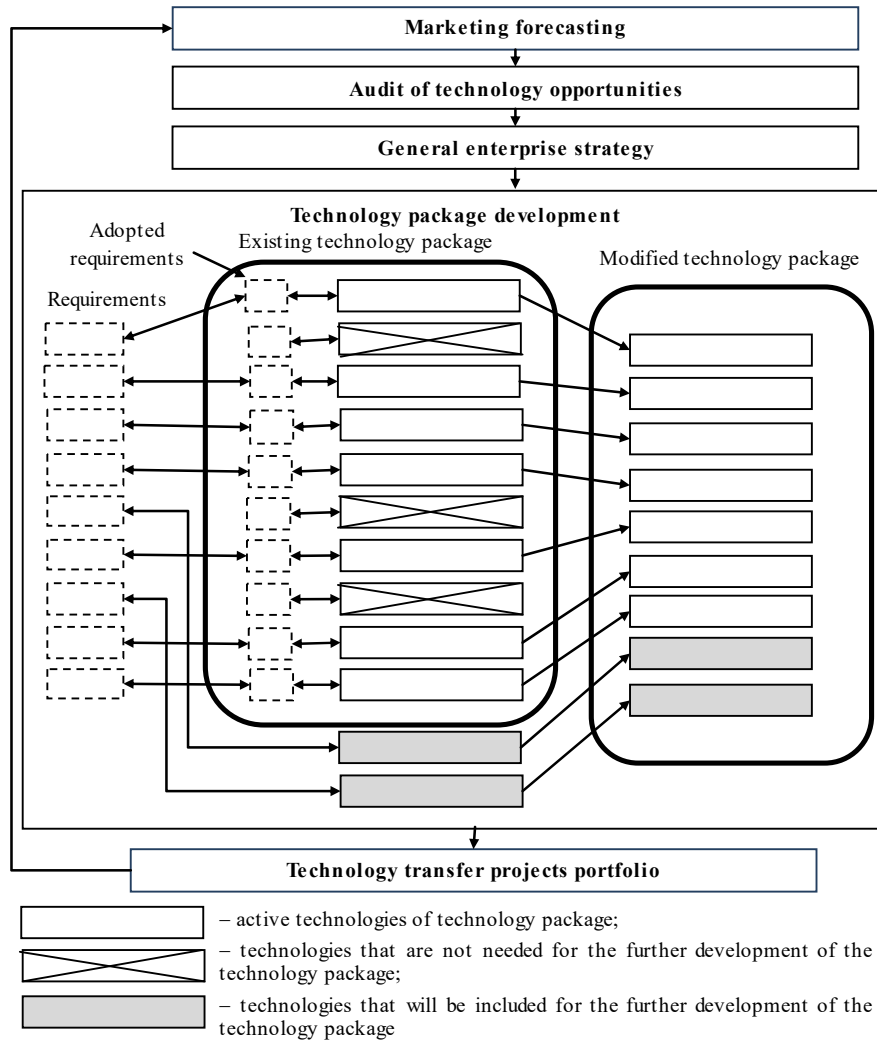


Figure 2 – Technological package development model (authors' development)

- 1) identification of technology package and classification of technologies, included into it (basic, key or trial);
- 2) considering of technology roadmapping of package;
- 3) considering of technology trajectory, based on approach proposed by European Industrial Research Management Association (EIRMA) [7].

We have considered the main aspects of technological package development in case of granulators production. In our previous researches [1; 2; 3; 14] we have shown that the granulators production includes list of technologies (materials science, chemical engineering, heat and mass transfer technologies, IT etc.), which are incorporated into the technological package "Granulator". Thus we can apply the creative symbiosis principle: integration of

several technologies simplifies system structure, thereby eliminate the limits of its evolution.

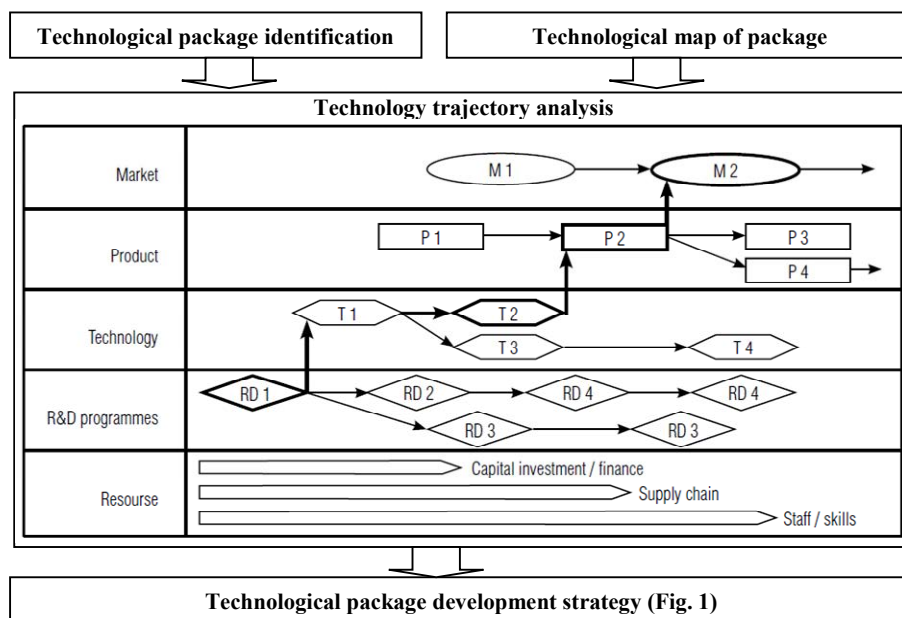


Figure 3 – General scheme of technology package development (authors’ development) (elements and links of the main technological trajectory are marked with bold)

In technological package “Granulator” lifecycle analysis, based on technology forecasting, in chemical engineering as basic technology of package (producing of granular product) as a key technology we select granulating in fluidized bed units (Fig. 4).

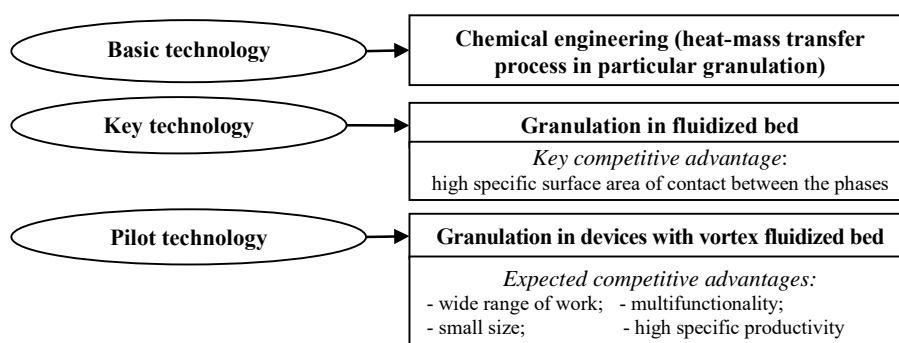


Figure 4 – Example of technology package lifecycle (authors’ development)

This technology is widely used in chemical industry, but it also requires upgrading in order to increase the productivity. Our experience suggests that as a pilot technology (technology that can replace the key in future) we’ll consider producing porous ammonium nitrate in

vortex fluidized bed which don't have listed above disadvantages and can reduce energy costs. This technology will provide to the market with industrial explosives for blasting at open and underground workings. The technology is protected by 20 patents for inventions and industrial designs, software copyright certificates.

Granulation technology development roadmap is shown in technology map (Fig. 5).

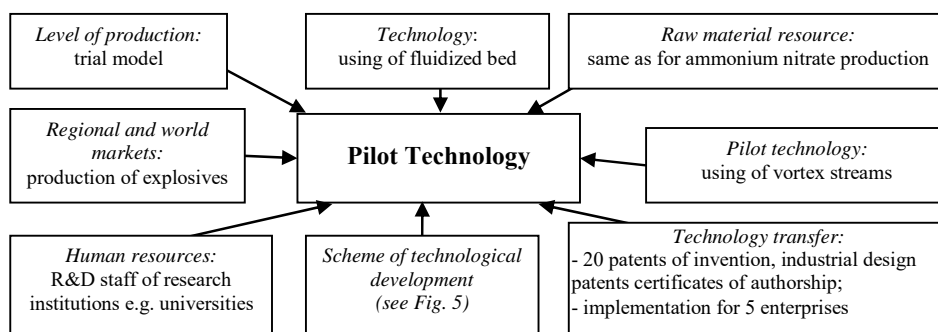


Figure 5 – Technology roadmapping of package (authors' development)

In Research Laboratory of Heat and Mass Transfer Processes of Sumy State University (Processes and Equipment of Chemical and Petroleum Refinery Department) comparative market study of different methods of producing granular products were carried out. Analysis of current market granular product manufacturers for needs of chemical, mining, pharmaceutical and food industries showed that among these granulation methods to the latest (best) applies fluid-bed granulation.

We have investigated such key product indicators of granulation systems technological trajectory analysis:

- dimensions and performance, reliability and ease of operation;
- product criterias;
- versatility – one granulator may be established to work with different performance and wide range of products;
- ecological purity – waste formation during granulation should be minimized and waste gases should not be contaminated to environment.

Based on classic presentation of technological trajectory we have made the technological trajectory of analyzed package. According it for the further development of granulation technology of porous ammonium nitrate granulation in fluidized bed technology is performed.

Conclusion and further research directions. The improvement of the technological package as complicated system is subject to the existing or predictable market demands and in accordance with available resources. In this context the area of responsibility spans the ownership of technology package roadmap, shaping package governance processes, and day-to-day management oversight of technology project package for one or more functional areas. This includes actively planning various aspects of technology package including resource availability, budget allocation and project sequencing in order to best deliver the package to our business commitments and against operational constraints. An important advantage of technological package development is project approach that implies a systematically and strategic vision of situation. In further researches we'll consider the problem of optimization

the process of roadmapping and the main technological trajectory optimization, especially multidimensional optimization (resources, R&D directions, technologies, products).

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Стратегічні аспекти та методичні основи управління розвитком технологічного пакету

У статті розглядаються проблеми управління технологічними пакетами. На основі концепції інтегрованих інновацій розглядається еволюційний підхід до управління технологічним пакетом. Представлені напрями процесу оцінювання пакета. Запропонована схема вдосконалення технологічного пакета. Процес розроблення технологічного пакета розглядається на прикладі розвитку обладнання для гранулювання, що включає в себе різні технології, об'єднані в технологічний пакет "Гранулятор". Для розвитку технологічного пакета в комплексі розглядаються життєвий цикл, технологічна карта та технологічна траєкторія пакету.

Ключові слова: інноваційний процес, технологічний пакет, технологічна траєкторія, стратегія розвитку, технології гранулювання.

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Стратегические аспекты и методические основы управления развитием технологического пакета

В статье рассматриваются проблемы управления технологическими пакетами. На основе концепции интегрированных инноваций рассматривается эволюционный подход к управлению технологическим пакетом. Представленные направления процесса оценки пакета. Предложенная схема совершенствования технологического пакета. Процесс разработки технологического пакета рассматривается на примере развития оборудования для гранулирования, которое включает в себя различные технологии, объединенные в технологический пакет "Гранулятор". Для развития технологического пакета в комплексе рассматриваются жизненный цикл, технологическая карта и технологическая траектория пакета.

Ключевые слова: инновационный процесс, технологический пакет, технологическая траектория, стратегия развития, технологии гранулирования.

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