

Scientific and methodic bases of high technologies international transfer potential analyzing in metallurgy



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Abstract

The article deals with theoretic bases of international technology transfer and suggests scientific and methodic bases to determine its potential with reference to technological package conception. Methodic of international technology transfer effects estimation is suggested.

Keywords: EFFECT, INTERNATIONAL INNOVATION COOPERATION, TECHNOLOGY TRANSFER, INNOVATION SYSTEM

1. Introduction

The transition to usage of high technologies and corresponding equipment is an important part of technological revolution in metallurgy at the present stage. The demand for metals is constantly growing because they are used in all sectors of the economy. However some metals produced in small quantities and are necessary in new industry sectors, which requires using of high technology.

Considering the technological gap in metallurgical technologies international technology transfer provides commercial use of research and investigations

at the international level and innovations introduction with purpose to increase industry competitiveness and keeping of sustainable development principles. International technology transfer is characterized by various types of technologies and great number of its trans-border transfer motives and channels. Thus, the task of identification of most effective ways to use and technology transfer and transfer of technology constituents is very actual.

Analysis of the international technology transfer is a wider part of policy analysis, science and technique study and technologies estimation. In the stated

approaches social nature of science and technique is mentioned, that becomes the base of state control. These approaches are focused on social and cultural product of science and technique through analysis of discourse and practices in various relevant social groups. Our previous research (Prokopenko, 2014) suggested to observe international technology transfer as a channel of various innovative system interconnection.

The aim of this article is to analyze theoretic and methodic bases in study of the international technology transfer potential.

2. General approach for technology transfer analysis

Realizing of technology as a complex of knowledge, which may be used to produce goods and service from economic resources, or scientific methods to achieve practical aims in economy, it gives ability to define new criteria of technology transfer analysis.

According to the basic scientific and methodic approach, knowledge is a “flow”, and that’s why it may be given as an object, since the transfer process makes significant contribution into the knowledge formation process. Knowledge is a result of information interpretation in this case. That’s why while optimizing complicated technological systems based on technology transfer we propose to use evolutionary models to abide dialectics principles and systematic approach.

Analogically with the ecological complementarity principle in the innovation system all components included into it are interdependent and functionally correspond each other. If one part of this system falls out, all elements, connected with it will be excluded and system will be functionally changed. Introduction of the new element to the system changes the state of connected elements and leads to shortening in number and less competitive elements disappearing.

Accordingly, any technology, particularly high technology, is an integral dynamic system, which includes:

- 1) means, operations and procedures, rules, standards, samples and norms of technological activity, technological process control, which are necessary for it:

- 2) information and knowledge,

- 3) energetic, primary, staff and other resources,

- 4) set of its economic, social, ecological and other results (effects), which impact and change social and natural environment of the proper system functioning in some way.

As to the high technologies they have two tendencies, preconditioned by the technology structure,

which generally consists of:

- 1) cores of technology;

- 2) technology support networks.

On the one side it is automation (closeness) tendency, which is caused by their competitive nature and provision through low technologies complex. On the other side it is globalization trend, international supporting network systems, eternal and unoriginated by its nature (e.g. space industry technologies).

Part of the technology, for example, software, may be independent technology, or part of the technologies support net, which may be individual technology. Some technologies support nets create hyper-nets through interconnection. Tagarov B.Zh. (2013) supposes that technology analysis is necessary in order to reveal important constituents of technology through hyper-network, which compete and work with it.

High technology is any technological core, which impacts the whole architecture (structure and organization) of technology support network components. This technology changes qualitative character of tasks, its conduct, interconnections, material, energetic and informational flows. It allows not only to solve tasks in other way, but to solve various tasks.

Owing to these features, we suggest to analyze innovative systems, firstly, at the national level, to estimate possibilities to use technologies.

Taking into account hightegration (high-tech integration) and sustainability tendencies of international scientific and technical relations – relations, appearing between international economic relations subjects concerning innovation achievements rational use, get special value in the context of international interconnection. These relations can be shown in the following general forms:

- 1) international scientific and technical relations, i.e short-term relations between subjects of the international economic relations concerning innovations;

- 2) international scientific and technical collaboration – formation of long scientific and technical ties between world economy agents;

- 3) international scientific and technical integration – process of convergence and coordination in the innovative development strategies.

During mentioned processes, international networks are formed, where knowledge is transferred.

3. Technology transfer effects estimation

Transfer of scientific activity results and innovations support infrastructure development and can be described by function, characterizing innovative potential of the economic system, i.e. readiness degree to achieve innovative targets. Therefore, according to logistic approach, incoming resource (technologies)

is transferred stage by stage to final product (productive or technological innovation). Movement can be conducted with different speed and to be followed by various expenses level. That's why, it is reasonably to describe efficiency of the system work (crossing capacity) by the functional index, which defines innovative technologies transfer efficiency.

However, mentioned index depends not only on accepting innovative system. We suggest to present generally international technology transfer potential (P) in the following way:

$$P = P_t \times P_d \times P_a \times P_e \quad (1)$$

where P_t – potential of technology transfer; P_d – potential, describing peculiarities of the innovative system – donor system; P_a – potential, describing peculiarities of the accepting innovative system; P_e – potential, describing technology adaptation degree in enterprise.

Potential of innovation system is formed by the following components (Gorbachova, 2013): potential of system architecture; potential of system resources; potential of system interconnections; potential of system environment (frame conditions).

Considering possible estimation tools, suggested by authors (Maksimenko, 2009) formula (1) can be written in following way:

$$P = N^{\text{innov}} (P_t \times P_d \times P_a \times P_e) \quad (2)$$

where N^{innov} – neural network function to estimate innovative potential, based on the analysis of factors selection and its interconnection.

Analyzing abilities of innovative system we can point out that new technologies investigation (development) includes the following stages:

- improvement of traditional technologies through evolutionary accumulation of new knowledge from the previous stage;
- principle revolutionary break, creation of the new technology, paradigm change, new knowledge appearing;
- wide extension of new knowledge through existing technologies radical improvement.

The mixed (synergetic) approach is able to provide independence on further borrowing of technological decisions, development of technological processes and the whole producing cycle.

Besides high technologies transfer effect (E) is to be observed in the international section considering production realization and creation of tying products on its basis:

$$E = \sum_{l=1}^L D_j + \sum_{m=1}^M A_m + \sum_{k=1}^K T_k, \quad (3)$$

where D_j – effect after production realization, based on primary technology, A_m – effect of additional goods creation in the adjoining sectors, T_k – effect after technologies implementation, created on the basis of primary one (profit of the future producing cycle), L, A, T – number of main, tying production and technologies-followers accordingly.

At the current stage of the innovative development, country is able to propose limited set of groundbreaking technologies. Therefore, technological processes development level, which are fundamental of separate enterprises (e.g. electronics), determines ability to the groundbreaking technological development.

Enterprises, oriented to the domestic market, usually follow the pass of the least resistance and wish to use the combining production scheme, minimizing investments to master and introduce new technologies. More progressive practice to extend business within existing competence is various combination of 3 components:

1. New equipment purchase, new technological abilities and personnel mastering;
2. Including of components production technologies to the existing technological way, earlier than purchased ones from external sources;
3. Extension of production line.

Main approach to solve this task presupposes to analyze expenses dynamics by the comparing technologies variants. This analysis is conducted by the following algorithm:

- 1) data collection, which describe total and current varying expenses dynamics for comparing technologies use;
- 2) functional smoothing (approximation) of the expenses trends by comparing variants of the technological portfolio;
- 3) graphical expression of the expenses smoothing trends and establishment of the principle reasonability to transfer to new technology on their analysis base;
- 4) solving of equation systems, which express various expenses dynamics, and as a result four moments of time coordinates are established. They limit time interval of the effective change in technology:
 - 1 – moment of the earliest possible effective transfer of new technology;
 - 2 – moment of latest possible start effective transfer of new technology;
 - 3 – moment of earliest possible finish effective transfer of new technology;
 - 4 – moment of latest finish effective transfer of new technology.

The investigated model is based on four controlling factors, which form environment of the technology transfer system. It is provision with financial resources f ; quality of infrastructure q ; competition k (principle of competitive excluding) and level of state interference into system g . Innovative system state is described by scalar value of time $x(t)$, which depends on the mentioned factors. Function (t) will be called quality of the system. Its value is integral factor:

$$x(t) = \sum_j f_j x_j(t), \quad (4)$$

where f_j – factors weight $x_j(t)$, i.e. its contribution into integral factor, $x_j(t)$ – factors, used while estimating technologies.

As a result the system dynamics is described by differential equation. It is determined with only four constituents of the technological package (basic technology, key and additional technologies, basic infrastructure). Decomposition and new constituent increase factor of degree for unit.

4. Conclusions

Development of technology transfer may be step on the way for developing countries to restructure economy and its re-orientation to innovative development. Role of technology transfer potential estimations for making decisions is very high. Technology transfer mechanism creates conditions both at legislative and organizational levels to use scientific

and research potential in economy. Technology transfer also allows to improve both positions and structure of countries presence at international market without any administrative impact on national economy and private sector goods and service production structure, but market approach to transfer of progressive scientific investigations for producing process.

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