QUANTITATIVE ASSESSMENT OF INSTITUTIONAL INVENTION CYCLE

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Abstract

In the present paper, the authors empirically identify institutional cycles of inventions in industrial enterprises and develop a methodology for their analysis and quantitative evaluation. The purpose of this research is to develop methods of analysing for institutional Invention cycle. These methods are based on empirical research. To identify patterns of Inventions management, we performed a series of interviews with representatives of the management team of Russian industrial enterprises. A distinctive feature of these companies is that the main type of activity is the high-tech processing of raw materials. The main type of costs of these enterprises is the transformation costs. Thus, as a result of studies, the authors proposed a model of the evolution of Inventions. The model includes the following phases: invention borrowing, invention copying, invention imitation, invention generation.

Key words: institutional cycle, invention, efficiency, resources

JEL Code: O310, O320

Introduction

Under the present conditions of globalisation, the inability to build an effective social and economic system in the absence of the development of a scientific and technical base (represented as the ability of the system to create inventions), as well as to develop the necessary infrastructure and institutions supporting its formation, is becoming increasingly apparent.

The meaning of the term “invention” has not yet been definitively established in contemporary scientific economic literature; in this context, it is of scientific interest to attempt to define the essence of the concept.

In this study, we consider the concept of invention as the generation of new scientific and technical knowledge obtained as a result of fundamental and applied research, which is then converted into production experience and intangible assets: scientific discoveries,

patents, databases, software and etc., the invention, excogitation and presentation of some idea that will permit the solution of conceivable problems.

One of the first to draw attention to the distinction between inventions and innovations was Joseph Schumpeter. In his 1912 study entitled "The Theory of Economic Development" he noted that "new discoveries and inventions are constantly replenishing the existing stock of knowledge... The function of the inventor and the general technician does not coincide with the function of the entrepreneur. As such, the entrepreneur is not the spiritual creator of new combinations" (Schumpeter, 1912). According to Schumpeter, the implementation of new combinations by entrepreneurs includes the following five cases: "1) the production of new goods or the creation of a new quality of goods, 2) the introduction of a new mode of production, 3) the development of a new market, 4) providing a new source of raw materials, 5) carrying out an appropriate reorganisation" (Eggertsson, 2001).

Thus, for Schumpeter, innovations (to the first and second case of activities of an entrepreneur) precede inventions, i.e. the creation of new discoveries and patents.

Thus, the life cycle of scientific and technological activities consistently includes three phases: inventions (new knowledge, patents) – innovation (introduction of new knowledge) – imitation (replicating the introduction of new knowledge). However, in the scientific literature to date there have been no studies that focus on an evaluation of the cycles of invention. The purpose of this study is to develop methods for analysing and quantifying institutional invention cycles based on empirical research.

Economic science and the economic analysis of the activities of economic entities follows the purpose of describing, explaining, predicting and making recommendations as to the most effective development of market-related entities (Arrow, 1994). Unlike other economic theories (especially neoclassical, abstracting from how the market works without offering an adequate explanation of how the market works), institutional economic theory shows how parts of the economic system are in practice related to the whole in terms of market relations (Tarushkin, 2004).

Institutional economics is characterised by attention to the description of the practical functioning of the economic system, observation, empirical testing of hypotheses and recommendations for improvement of business entities (Kuzminov, Bendukidze, & Yudkevich, 2006). It focuses on a study of the practical work and develops recommendations for the improvement of economic systems, which enhance the efficiency of our institutional economic theory within the theoretical research framework.

As is well known, the phenomenon of the transformation of knowledge into the primary productive force was predicted in the 1960-70s in the works of Peter Drucker and Daniel Bell (Bell, 1973). The competitive advantages of the firm began to be interpreted in relation to the ability to benefit from the electronic resources of the Internet and e-commerce, with the ability to attract and retain "knowledge workers", to create a "learning organisation" and, more rapidly than their competitors, to identify and commercialise global opportunities of technological and organisational innovations. It is no coincidence that one of the most fruitful efforts of strategic management theorists in recent years, formed on the basis of the resource approach, has been the concept of "knowledge creation company" (Nonaka, & Takeuchi, 1994), which proceeds according to the development of the intellectual capital of the firm (Teece, 2001).

The high importance of inventions in the development of modern Russian enterprises, and institutional economic theory as a basis for modelling of market processes, determine the theoretical and practical relevance of the study of institutional invention cycles.

1. Classification of Institutions for Invention

The authors of the study use the concept of inventions to develop a methodology to analyse the institutional structure of the interaction of institutions, based on the preparation of a unified multi-hierarchical system of characteristics, taking the form of an institutional atlas (Popov, & Vlasov, 2013).

The main objective criterion of the institutional atlas of knowledge generation is in terms of its applicability to describe the knowledge generation activities of business entities of different activity types. Another objective of the institutional atlas criteria consists in the necessity of evaluating the special features of the knowledge generated (Vlasov, 2010).

The place of origination was considered in terms of the first criterion of the division of invention institutions. In this case, endogenous invention institutions are institutions that coordinate and provide interaction in the internal environment of a business entity. Exogenous institutions structure and regulate the relationships of business entities with external economic agents.

In the current economic conditions of the post-industrial society, it is precisely knowledge that has become the principal economic resource in terms of ensuring the development of business entities (Vlasov, 2007). Thus, an enterprise development strategy on

the basis of the knowledge economy is the second criterion for the separation of invention institutions.

In the first place, in order to effect a division of inventions according to the development strategy of a business entity, it is necessary to first address the question of evaluating inventions; naturally, such an evaluation should be expressed in rubles (Bjørnåli, 2010). The authors consider that in this case, in contradistinction to the resource indicator, it is necessary to use a change in the capitalisation of the business as a result of the introduction of inventions, since this indicator most clearly reflects the true value of inventions in the financial statements of a business entity.

Inventions, which also depend to a large extent on the planning horizon, can be distinguished as follows: less than a year (borrowing), from 1 to 3 years of age (copying), from 3 to 5 years (imitation), and more than 5 years (generation).

We take into account the previously defined areas of study of the institutional structure of innovation systems:

1. invention institutions at the level of the enterprise
2. invention institutions at the level of research institutions and universities
3. invention institutions at the regional level

Based on the analysis of invention institutions at different economic levels, the authors propose the following typology of economic invention institutions (Table 1).

Tab. 1: Typology of Economic Invention Institutions

Types of Institutions Research Facility	Formal Institutions	Informal Institutions
industrial production enterprises	- research and development institute - institute for the improvement of technology, production and management - institute for the certification of products and services - institute for exploitation of rights to the results of intellectual activity and the means of their ascertainment - institute for the acquisition of rights to use computer programs and databases	- institute for the recruitment of workers employed in R&D - business travel institution - consulting institute - institute for the study (research) of current market conditions, information gathering - corporate hospitality institute
scientific institutions and universities	- institute of publication of monographs - institute of publication of scientific research in Russian journals - institute of publication of scientific research in Russian journals - institute of acquisition of patents - institute of participation in exhibitions	- institute of participation in conferences and symposiums - institution of business trips - institute of unrefereed publications
regional	- state institution supporting invention activities	- institution of interest in

	- institution for the development of programmes and strategies - institution of technology parks and technopolities - institution of interaction between science and business - institution of industrial integration	inventions - institution of business trips - institute of moral incentives

Source: research of the author

1.2 The Evolution of Institutions for inventions

In his monograph "Elements of Reform Theory", the academic writer V.M. Polterovich (2007) identifies several stages in the development of innovations in industrial enterprises: borrowing, i.e. the acquisition (purchase) of new knowledge; copying - the duplication of knowledge created by other companies; imitation and pioneering research and development. By analogy, we propose the following distinction of invention institutions supporting the development of the process of creating new value in industrial enterprises:

- borrowing
- copying
- imitation
- generation

To identify patterns in the process of controlling inventions, a series of group interviews were carried out with the representatives of medium-sized industrial enterprises currently operating in Ekaterinburg and the Sverdlovsk region. A distinctive feature of these companies is that the main type of activity is the transformation of raw materials, that is to say, high-tech processing resulting in the creation of new value. The primary cost type of these enterprises consists in the costs of transformation.

In terms of carrying out activities relating to inventions, 78% of surveyed companies plan to use inventions in the form of borrowing in the next year. This short planning horizon changes due to the fact that this type of invention is not developed directly by business entities, and sold on the open market, thus quickly becomes obsolete and loses its value. For the copying and imitation of inventions, the planning horizon increases by an average of 2-3 years (59% of copying inventions coincides with a planning horizon comprising of 1-3 years). The most distant planning horizon is applied when inventions are generated directly by an economic entity and have no analogues (in 81% of cases the generation of inventions has a planning horizon of more than five years) (Table 2).

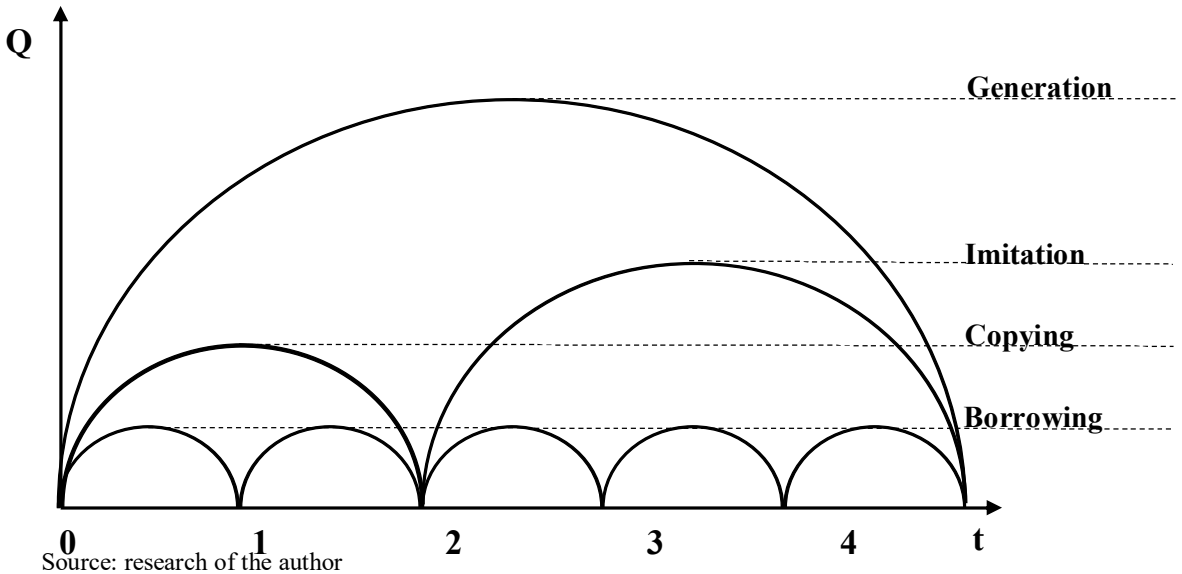
Tab. 2: The distribution of various types of inventions depends on the planning horizon

Type of Invention	Planning Horizon			
	up to 1 year	1 - 3 years	3 - 5 years	more than 5 years
Borrowing	78%	21%	6%	2%
Copying	11%	59%	12	7%
Imitation	8%	12%	56%	10%
Generation	3%	8%	28%	81%
Total	100%	100%	100%	100%

Source: research of the author

The evolution of inventions can be represented on the basis of empirical studies as follows (Fig. 1). Where: t – time; Q – production returns from inventions.

Fig.1: Schematic representation of the evolution of inventions



Source: research of the author

The results showed that in 75% of cases when changing information resources not generated by the relevant invention industries themselves, but are rather borrowed inventions (purchased on the open market); in 12% of cases, they are copied with 100% accuracy from other enterprises and only in 4% of cases is the new knowledge developed in-house, i.e. generated (Table. 3). Consequently, when changing the information resources of the enterprise, the most significant are the institutions of borrowing inventions.

Tab. 3: Distribution of types of inventions used when changing the information resources of the enterprise

Type of Invention	
Borrowing	75%
Copying	12%
Imitation	9%
Generation	4%
Total	100%

Source: research of the author

When making changes in the organisational structure, the most important in the studied companies are copying of inventions – in 38% of cases – and imitation of inventions – in 34% of cases. When changing the organisational structure, independent enterprises generate inventions in an average of 12% of cases (Table 4). Consequently, when changing the organisational-structural resources of the enterprise, the most significant are the institutions copying and imitating inventions.

Tab. 4: Distribution of types of inventions used when changing the organisational-structural resources of the enterprise

Type of Invention	
Borrowing	16%
Copying	38%
Imitation	34%
Generation	12%
Total	100%

Source: research of the author

When asked about the importance of different kinds of inventions during changes in the fixed assets of enterprises, the answers were distributed as follows: use of generation of inventions – in 77 cases out of 100; other types of inventions – in 23 cases (Table 5). That is, when you change the fixed assets of the enterprise, the most important are institutions of generating inventions.

Tab. 5. Distribution of types of inventions used when changing the fixed assets of the enterprise

Type of Invention	
Borrowing	4%
Copying	7%

Imitation	12%
Generation	77%
Total	100%

Source: research of the author

Conclusion

The theoretical research carried out on the evolution of invention institutions yielded the following theoretical results.

Firstly, the authors have contributed to the literature a typology of invention institutions – a global first.

Secondly, as a result of the research, we have been able to propose a model of the evolution of inventions. Based on empirical research, the following patterns of institutional cycles of inventions in industrial enterprises are revealed:

- The planning horizon for changes and institutional invention cycles widespread in the enterprise are interdependent: for the generation of new knowledge, a "long" time horizon is required and "long" life cycle institutions generate inventions, with the short life cycle of institutions borrowing inventions and the short life cycle of the respective inventions, bringing about the information resources of the enterprise.

- When changing the information resources of the enterprise, the most important are the institutions of borrowing inventions.

- When changing the organisational-structural resources of the enterprise, the most significant are the institutions copying and imitating inventions.

- When changing the fixed assets of the enterprise, the most important are institutions of generating inventions.

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