Perspectives of Innovations, Economics & Business, Volume 4, Issue 1, 2010
www.pieb.cz

THE PLACE OF TECHNOLOGY TRANSFER PROCESSES IN THE SYSTEM OF METHODS FOR RESEARCHING THE AREA OF SCIENCE -TECHNOLOGY-INNOVATION

JOANNA WISNIEWSKA, PH.D.

The Faculty of Economics and Management
University of Szczecin, Poland

JEL Classifications: O33

Key words: Science, technology, innovation, technology transfer, methodology, research.

Abstract: The growing importance and scope of technology transfer processes undertaken all over the world settles the question of the necessity for their proper identification. The multi-aspect character and complexity of these phenomena create specific problems in conducting analytic work. Although technology transfer is an element of the Science-Technology-Innovation (STI) system, it does not have a proper place in the existing methodology system of this area. The aim of this article is to point out the necessity to create a proper, complex and comprehensive methodology for researching technology transfer processes, which would contribute to better understanding of the processes themselves and at the same time enable their proper development.

ISSN: 1804-0527 (online) 1804-0519 (print) PP.18-20

Introduction

Nowadays, creating competitive potential of enterprises or national economies requires investment in knowledge and technology, obtaining of which is possible by means of developing the area of R&D or technology transfer. The fact that no entity or economy is able to create all the knowledge required makes it necessary to engage in technology transfer processes, which can precede or result from developing and implementing innovative solutions. In this regard, technology transfer becomes a part of a widely understood innovative activity, with an important place in the area of STI.

We need to observe both the multilevel character of transfer processes and the variety and changeability of forms in which they take place. Considering the character of carriers appearing in transfer, we talk about the so-called transfer of material knowledge (e.g. purchasing machinery, equipment, trading in licenses, know-how, etc.) and the exchange of non-material knowledge (e.g. co-operation within the area of R&D, personnel training, exchanging information). Whereas if you consider the planes and mechanisms of technology transfer, reference books usually talk about domestic and international transfer, or internal and external transfer.

However, in the face of globalisation processes it is becoming harder to unambiguously identify what type of technology transfer mechanism we are dealing with. More and more often they are complex, multidirectional and multilevel processes. This is connected, among other things, with gradual blurring of enterprise boundaries, which is an effect of occurrence of network organisations and gradual heading towards creating enterprises of the future, perceived as "pulsating quantum fields" (Wiśniewska, 2008). The evolution of organisational structures progresses, as Perechuda (2005) states, from atomic-analytic structures, through synthetic-process structures to virtual-fractal-network structures. Thus, unambiguously defined mechanisms and paths of knowledge transfer occur only in classic enterprises, while contemporary organisations, because of the blurring of boundaries between entities and their surroundings, start to gradually depart from this model.

Methodology of the STI system

The importance of technology transfer processes in enterprises, economy or the world is so great that it is reflected in conducted researches, analyses, and growing number of publications. They refer to various issues including the course, forms of realisation and conditioning of processes of selecting and acquiring technology as well as its transfer, application, diffusion and adaptation in the system. In this regard the issue of selecting suitable methods and measuring instruments for conducted research becomes extremely important.

As an element of the STI area, technology transfer should have its place in the proper methodology system of the area. However, what needs to be pointed out is that despite the fact that work on creating complex methodology in the STI area has been conducted all over the world for years, there is still need for development, particularly since for many groups of problems a complex, standard methodological instrumentarium has not yet been developed.

Considering the level of methodology development and the methods of collecting and analysing data, we can distinguish two groups of methods constituting the STI methodological system.

The first group includes sections with well-developed and established standard methodology. Research within this group is conducted in most countries on the basis of generally adopted international methodological recommendations. This group consists of the following statistics: R&D activity (Frascati methodology), patents, innovation (Oslo methodology), technological balance of payments (TBP), high technology products and fields (HT) and knowledge intensive services sector (KIS), indicators regarding human resources for science and technology (HRST- Canberra methodology) and bibliometric research.

Methodology concerning the issues that form the second group is still in the phase of initial development. Its indicators and data, even if available, are not fully comparable in time or in space, because of constantly changing methodology. This group consists of: statistics regarding the use of advanced

manufacturing technologies (AMT), information and communication technology (ICT), LBIO method[1], non-material investments, measurements of organisational changes and non-technological innovation in enterprises, technology foresight, analysis of public attitudes and public understanding of science and technology.

As you can see, we cannot speak on the existence of a comprehensive methodological system, but rather on the existence of many various methods developed with a view to analysing separate thematic areas. Unfortunately, attempts to classify STI statistics prove that groups of research methods created in that way do not cover the whole area of STI. For example, among many existing groups of methodological procedures used for observation within the area of STI there are no proper solutions for complex analysis of technology transfer processes. That is why the analysis of these processes is a complex task, which has been conducted so far on the basis of various procedures, sometimes with the use of data collected in research regarding other areas of STI.

Using existing methodology in technology transfer analyses

Undoubtedly, the oldest area of collecting STI data is the area of R&D and the main OECD document regarding R&D statistics is Standard Practice for Surveys of Research and Experimental Development, better known as the Frascati Manual. Unfortunately, Frascati methodology as such is not particularly useful as regards observations and analyses of technology transfer processes.

However, Oslo methodology (OECD, 2005b), which is currently a generally adopted international standard for analysing innovation in industry and services, is somewhat more useful in this area. Some of the data collected according to its requirements can be used in observing some aspects of technology transfer processes, if only considering the fact that according to assumptions innovative activity includes, among other things: purchasing knowledge in the form of patents, licenses, technical services (non-material technology), as well as acquiring material technology, i.e. innovative machinery and equipment necessary for implementing new processes or manufacturing new products. Apart from that, it should be noted that in the latest edition of the Oslo Manual particular attention is placed on the role of connections and co-operation between companies and research firms and institutions in the context of stimulating innovative activities, and as we know they are the planes of vertical and horizontal technology transfer processes.

Assuming that the patent system should be the mechanism for creating new and economically useful knowledge as well as the mechanism of its popularisation, analyses in the area of patent activity are conducted on the basis of rules compiled in the manual entitled The Measurement of Scientific and Technological Activities: Using Patent Data and Science and Technology Indicators - Patent Manual have been classified as basic statistics of the STI area. Patent statistics can be used in the development of appropriate indicators for evaluating the STI area (e.g. connections existing in this scope, diffusion of R&D work results, conformity between the structures of science, technology and economy), current development tendencies, existing economic and social potential and evaluating the national innovation system (Kozłowski, 2008). Of course, this kind of research work has its weak points, the most important of which is that its results provide information on inventiveness rather than innovation or diffusion of new technologies. However, as shown in the examples, analysis of patent data can contribute to the identification of selected areas, which can be important from the point of view of specific aspects of technology transfer, e.g. mapping technology flow between various sectors of industry.

Information collected on the basis of analysing technological balance of payments (TBP) and high-tech sectors and products can prove to be useful for the purpose of analysing chosen aspects of technology transfer. In case of TBP analysis, it is possible to acquire information on the international flow of industrial property and know-how. TBP indicators are created with a view to measuring international diffusion of technological thought in its non-material form (disembodies technology). However, it should be observed that TBP data regards international diffusion of technological thought in its non-material form only, leaving out other forms of technology transfer: import of machinery, equipment and products, the so-called reverse engineering and migration of people (employing foreign specialists, professional contacts, technical co-operation, trainings, etc.).

On the other hand, statistics regarding high-tech sectors and products are based on of two principal approaches (sector and product), which assume the presence of such characteristics as, for example, substantial share of expenditure on R&D, short life cycle of products and processes, fast diffusion of technological innovation, growing need for highly qualified personnel, etc. Considering the fact that in this case one of the basic indicators is the export value of high-tech products in relation to export as a whole, which is treated as an indicator reflecting the capacity of the economy of a given country to absorb new scientific and technological knowledge resulting from R&D activity, some aspects of this methodology can be used for diagnosing technology transfer processes observed in the macro scale.

A very specific methodology is the so-called information society methodology, which is the basis of research concentrating on measuring demand, supply and use of ICT technology. Its aim is, among other things, evaluation of the influence of ICT on economic development, the capacity of implementing and developing ICT, evaluation of the extent in which this technology is used (scope and level of diffusion) by enterprises, administrations and households. The limited objective scope, expressing itself through narrowing the scope of observation to one type of technology (ICT) makes this kind of research tools useful exclusively in case of diagnosing transfer processes of the above-mentioned technology.

Apart from mentioned procedures, widely used in many countries around the world, there are procedures of monitoring chosen aspects of the STI area, which are used in a smaller scale or left in the initial phase of development. This

[1]The LBIO method (literature-based innovation output indicators) consists in collecting information on individual innovations introduced to the market on the basis of announcements placed by enterprises in specialist, technical and commercial, press.

group includes, for example, Bogota methodology and the so-called RICYT[1] indicators, which are instruments for measuring and analysing activity in the STI area in Latin America. In this case, the so-called diffusion indicators, which are a part of this methodology, can have some significance in the observation of technology transfer processes.

In some countries (the UK, Australia, the USA), attempts have been made to conduct research in the area of science-economy technology transfer and commercialisation of scientific research. Unfortunately, these research attempts have not led to the development of comprehensive methodology either.

Technology transfer processes are specifically related to the phenomenon of internationalisation of R&D and innovation. In this case existing rules and the statistical system of R&D globalisation are insufficient to measure it in a way corresponding to its importance and novelty. So far, methodological issues regarding globalisation of R&D and technology have occupied a particular place in the OECD Handbook of Economic Globalisation Indicators, 2005.

Conclusion

STI statistics, in spite of significant attempts aiming at creating a comprehensive methodological system, is still an incompact collection of diverse areas and subjects of methodological or analytical works rather than a comprehensive, centralised discipline. Developed standards do not cover all issues appearing in the area of STI. This situation can be observed, for example, in reference to issues is connected with technology transfer processes, where previous research has been conducted on the basis of chosen elements of the existing system of monitoring innovation and not complex, specialist methodology. Certainly, the main problem here is the multidimensional character of technology transfer processes, where many aspects have few directly measurable features and create specific problems, e.g. measurement of human resources, which is an important factor as regards absorption potential, and its changes may result from conducted transfer. That is why analyses often make use of qualitative measuring instruments and methods, particularly case studies. Therefore, there is the issue of an everlasting split between statistical methods with their virtue of generality, but lack of specific accuracy, and case study methods, which offer richness of material at the cost of possibility to make generalisations.

Also important is the problem of access to suitable data, connected on the one hand with unwillingness to disclose information (the question of technology is considered an area requiring particular protection from competition) and on the other hand with aggregate character of individual categories as regards areas, in reference to which firms do not necessarily keep detailed registers.

Considering discussed aspects, it is evident that there is an urging need to start work on creating suitable, comprehensive methodological standards for the analysis of technology transfer processes, so that the undertaken research efforts could help to understand them better and develop them appropriately on the basis of obtained results.

1 RICYT (Red Iberoamericana de Indicatores de Sciencia y Tecnologia) – Ibero-American indicators used in R&D analysis.

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