

The role of public-private partnership for effective technology transfer

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An effective technology transfer and the role of cooperation between the public and private sectors take a significant place in the modern development of economies based on knowledge. The rapid development of technology and innovation are the main features of this new content in their society. Economic changes due to innovation provoke important changes in policies and are significantly affected by the level of investments to sectors such as education and social science.

Innovative development is determined by the relationship between public and private sectors that ensures different degrees of competitiveness in vast areas of knowledge. In order to address global challenges that affect strongly social-economic development, different models of collaboration from the traditional ones are needed. Such is the PPP.

This article aims to analyze the different levels of development of public-private partnership and highlight its role in the implementation of technology transfer through introduction and implementation of new and / or more - custom models.

Keywords: Technology transfer, public-private partnership, public-private partnership, policies, effective models

Introduction

The modern world has a specific characteristic - a global development which covers all spheres - economic, political, social and cultural processes of society. Globalization in recent years of the XX and the beginning of XXI centuries led to the emergence of a new type of institutional features in the country in which the centerpiece is knowledge transfer and public-private policies aimed at guaranteeing better and higher quality of life.

The most common global challenges can be defined in the following areas:

1. Conservation of Energy
2. Waste Management
3. Education and Training
4. Medicine and Life extension
5. Security and Counter-Terrorism
6. New technologies and Global communications
7. Integrated Information Environment
8. Transfer of population
9. Sharing knowledge
10. Sustainable development.

The latter could largely be attributed to some of the global challenges set by UNESCO:

1. Education for the XXI century - development of quality education worldwide
2. Knowledge-based society - sharing knowledge and information through ICT for development of a stable economy
3. General living environment - preserving the diversity of life and natural resources
4. Science for a Sustainable Future - creating knowledge and understanding through science.

Global challenges and their areas of intervention are diverse and largely reversed in relation to the organizational structures of different types - public and / or private, as well as various administrative and economic conditions. In the early XXI century, the Lisbon strategy requests to address the challenges facing European society. It aims to create a market-based innovation-friendly environment for transfer of knowledge, technology and the creation of a new type of interdependence and cooperation and not of least importance - a sharp rise in investment in knowledge as a bridge between the public and private sectors. Europe can become the most competitive economy through implementation of these objectives.

In many cases, however, globalization is important in more than one aspect. In some cases globalization could be seen as a good basis for technological progress, increased trade and competitiveness, increased absorption of resources from different sources, shared common policies, etc. In others, however, globalization is perceived as a prerequisite for the dominance of certain economies over the less developed, and also as a threat for sharp distinction between rich and poor, etc. This is one of the reasons why the modern world increasingly focuses on the role of national and multinational public-private partnerships as a means of innovative development and access to knowledge, including on basis of effective transfer of technology, which is an opportunity to achieve assurance, economic growth, intellectual property protection and guarantees for innovative research activities.

Technology transfer and the necessary conditions for implementation

The term “technology transfer” has different definitions in scientific literature, but also in everyday life. In most cases, the search for a specific definition redirects to the definition of technology. Technology transfer is the transfer of knowledge and experience to meet the local conditions of effective use and distribution within individual countries (Chung, 2001). According to James Baranson, technology transfer is a transfer of knowledge that gives an opportunity to a company to produce a product or provide a service (Baranson, 1970). According to Hoffman and Girvan, technology transfer should be seen in terms of achieving three main objectives: first, introduction of a new technology by investing in new products, improvement of existing techniques and generation of a new knowledge (Hoffman and Girvan, 1990).

Technology transfer could also be seen as transfer of scientific and technical information from the fundamental science through application and development in the fields of manufacturing and services. Generally, the transfer of technology may be carried out under three conditions: (1) the method must have a source, (2) technologies must be manufactured or fabricated, (3) the technologies should be applied or used in some socially or economically beneficial ways.

Technology transfer, as seen through the prism of modern society under globalization conditions, is primarily a means to encourage and support developing countries in order to accelerate the acquisition of knowledge and experience by using new types of products and / or services to enable more effective and rapid development of the economy.

Challenges that technology transfer is facing are:

- growing pressure from competition
- high quality requirements
- requirements for manufacturers to protect the environment
- a need for additional investments
- a need for planning activities
- a threat of bankruptcy and losing qualified personnel.

In order to create conditions for the implementation of technology transfer in an economic environment, favorable conditions are needed, which are based on cooperation and sharing of ideas and successful implementation of innovative solutions in the production, management and services, development of new initiatives to increase business productivity cooperation and working with stakeholders. A better training is also quite significant for the implementation of technology transfer - to ensure the development and sharing of human resources and ideas between researchers and corporate structures, ending with marketing a new product. Last but not least, a condition for the development of technology transfer is the existence of an innovation potential of companies and framework conditions for increasing competitiveness.

Effective university-industry relationship is essential for transfer of knowledge and innovation from university to industry. On one hand, scientists should collaborate with the industry, and on the other - industries can be a source of funding for research and innovation at the university, and sometimes - a source of ideas. Results of research carried out by universities should be transferred to the industry and integrated with its activities including products and services, thus making available new types of products and services to intervene on the standard and quality of life and society.

For this interconnection, an important condition for technology transfer is also the public-private partnership. It is used to:

- identify effective technologies
- build capacity and infrastructure for technology transfer
- select the potential risks
- ensure return of investment
- ensure implementation of production / technology
- allow for various forms of dissemination of knowledge in the broadest sense - licensing, know-how, etc.

Public-private partnership models

Public-private partnerships as a new type of relationship is the ability of the public sector to use the experience of the private sector, with the latter providing the services traditionally characteristic of the public sector. PPP schemes are introduced for the first time in the UK in 1992 as called "Private finance initiative" which removes the rule that restricts the use of private capital to finance public assets (Leahy, 2005).

The main types of PPP range from the simplest ways of involving the private sector in public structures to more complex forms of PPP in transferring more risk from the public to the private partner. The main models, which are handled by the European Commission, are:

- *Service agreements* such as agreements between a public agency and a private sector, specifically adapted for simple, short-term operational requirements. This is a very limited form of PPP where the private partner busy, operates and maintains a facility for a short period of time. Responsibility for managing and investing in the project remains in the public sector, which bears the financial and residual risks, but benefits from the technical expertise of the private operator and saves money without transferring control over the

quality of the final products. Service agreements are often used for services in collecting toll taxes, supply and maintenance of vehicles and other technical activities.

- *Operation and control agreements* - arrangements under which the responsibility for operation and management of the facility is transferred to the private sector. Duration is generally short, but it is possible to arrange longer periods. The private partner is paid on a flat rate or based on accomplished initiatives with premiums relating to specific performance targets. The public sector bears the investment and financial risk. This type of agreement leads to significant benefits in terms of efficiency and investment in more sophisticated technologies because the private sector has a strong interest in improving the quality of services in order to reduce both the total cost and the risk to search for a service ordering the operational phase. This type of arrangement can also be used to stimulate a wider private sector participation in the subsequent phases.

- With *lease agreements*, the private partner buys income streams, generated by publicly-owned facilities in exchange for fixed lease payments and the obligation to operate and maintain the facility. Because of the fact that the commercial and demand risks of the service are transferred to the private sector, the private partner's interest is to achieve operational efficiency. The private partner benefits only if it can reduce operating costs by achieving the expected service levels. On the other hand, the public partner bears the risk associated with network expansion (construction) and participates with equity and finances. Leasing is particularly suitable for infrastructures that ensure independent revenue streams, as is the case with public transportation. More complex leasing schemes as BBO (stock exchanges and stock operations), "lease-develop-exploits" (LDO) or lease for finishing services (WAA) pose a greater risk for development in the private sector and thus reduce the burden on the public partner.

- The *operation "turnkey" or Build - Operate - Transfer (BOT)* is an integrated type of partnership in which the private partner assumes responsibility for the design, construction and operation of the facility. The combination of these individual responsibilities for a single unit promotes the extraction of greater efficiency benefits and eliminates the important responsibility for funding support from the public budget. This integrated scheme requires that the private operator takes into account the cost of operating the facility during the design phase and operation and thus promote better planning and management of the service itself. Here again, the public partner bears the financial risk: despite what can be seen in other types of PPP, the public partner yields its control of important phases of the lifecycle of the facility. Since ownership of the facility as a whole remains public, the specifications of the quality of the final products is vital to achieving the desired results. The BOT scheme is considered to be particularly suitable for projects in water and waste sectors and can be reduced to a few variations: BOOT (build, own, operate, transfer), BROT (build, rent, operate, transfer), BLOT (build, lease, operate, transfer), BTO (build, transfer, operate) to the specific needs of the project.

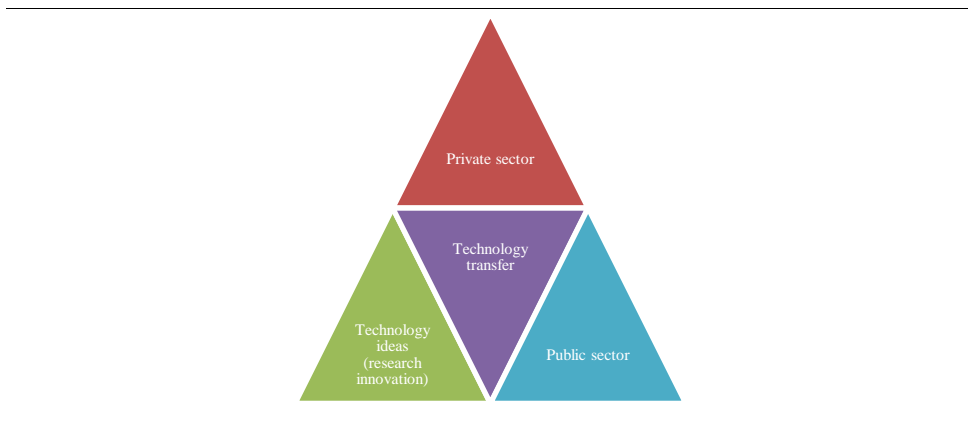
- With the *outline Design-Build Finance-Operate (DBFO)*, the private partner designs a service or a facility as required by the public participant, provides and finances construction/development of the facility/service after the design phase, and finally operates the facility. At the end of the PPP agreement, the service or facility can be left back to the public sector under the original PPP agreement, otherwise the agreement is renegotiated. DBFO is the most complicated type of a PPP since it ensures effectiveness of accomplishment and operation of the previous models, but at the same time provides new sources of capital. The most commonly used model is a DBFO concession where the private investor designs, finances, builds and operates facilities generating revenue in exchange for the right to collect revenue for a specific period of time, usually 25-30 years. Ownership of the facility remains in the hands of the public sector. This model is particularly suitable for road projects, water and waste, mainly for services, where user changes can be applied. Conversely, under the so-named "private divestiture", the facility is partially or wholly sold to the private sector, while the government retains only a regulatory role to protect consumers from monopolistic prices and restrictions on finished

products. The transfer may also be partial if the government retains ownership of a portion of the facility to ensure a certain standard of service while transferring a significant portion of the total cost to the private partner. The DBFO model can be mitigated or adapted in various ways in order to meet the characteristics of the provided services.

Public-private partnership effect on the development of technology transfer. A possible model

The public-private partnership is a key element of European innovation policies with close coordination of public research, technology transfer, private innovative companies and appropriate policy frameworks. There is a building of industrial networks, technology platforms and initiatives which consist of long-term relationships between knowledge generators, consumers and suppliers of goods and services with a variety of options and other mediator units. This model of partnership usually stipulates the development of research joint-ventures with equal distribution of costs and return of investments, information and knowledge sharing. Such a model can lead to development of technologies or practices from the private sector in public scientific structures and, as a result, a reliable institutional capacity is built or increased.

FIGURE. 1 TRIANGLE OF TECHNOLOGY TRANSFER



During 2007-2013, the European Commission focuses on the development of a society based on knowledge and creates a so-called triangle of knowledge - education, research and innovation. This triangle needs a favorable environment for development, which may be legal, investment, economic and organizational. With the development of investment and organizational environment, an increasingly important role is given to PPPs. In the new programming period 2014-2020, the trend of increasing the importance of PPPs as a key factor for competitive development of the base element - technology transfer.

One of the ambitions of the European Union is to provide a simple and effective access to financing, a greater diversity of funding sources and to minimize the risk of their usage. Investments, as a key factor for more and better research and innovation through increasing the value of inputs, strongly influence the effect of science and innovation activities.

In this line of reasoning, a second type of triangle may be suggested, one that has an impact on the development of social and economic climate in modern society - business (private sector), public sector and scientific technological solutions (Figure 1).

Scientific and technological solutions are the element through which a progressive

economic development is achieved, as long as they can be used timely and effectively. Public bodies are the catalyst for strategic development - supporting the development of science, creating conditions, regulatory environment and necessary mediators.

The private sector provides added value by implementing technology transfer based on cooperation measures which ensure the effectiveness of the technological base.

The overall innovation process (application of technological solutions) is in the middle of an interaction between the private and public sectors for implementing effective technology transfer.

Unlike the traditional model for delivery of public services, the development of schemes for the implementation of PPPs offers several new moments for accomplishment:

- *PPP - outcome oriented* - the public sector aims to improve the quality of public services and guidance to its final result. The means and ways to achieve this task are delegated to the private sector partner who can also offer innovative solutions. The main responsibility of the public sector is to develop the necessary standards and quality of services of the product or service provided by the private sector. It is advisable to keep an open dialogue partners by which achieving the desired result is alleviated significantly.
- *Cash transfers from the public sector in achieving the desired service from the private sector* - provision of the desired product or service should be with the target volume and quality. Failure or revocation of the output specification has a negative financial effect for the private partner. No matter that this is only a leading fiscal element, the system of a constant exchange of information on progress of the process and feedback from the private sector plays a very positive role.
- *A comprehensive approach in design, development and operation* - in assessing the fulfillment of a public-private partnership, the value of the means to achieve the end result is not being compared, but the cost of delivery of the final product or service. Delegation of powers on one side without any dialogue can create limitations or difficulties in conveying the outcome.

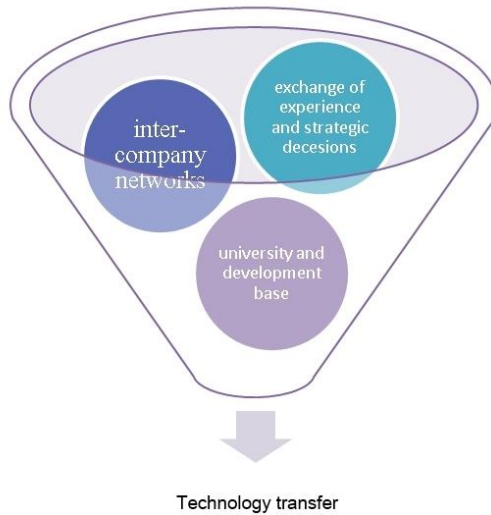
Broadly speaking, technology transfer requires feedback from stakeholders - public sector, private sector, consumers and the market. In this regard, a successful PPP model and implementation of technology transfer could be considered as follows:

- Financial contribution of the private sector (industry) and the public sector - sharing of expenses. In the case of a research laboratory which will develop/design a product or service that the consumer agency will identify and the public sector will monitor the system performance.

In the context of a public-private partnership, the effective transfer of technology is dependent on a functional model of the Triple Helix - university, industry and government. Namely the model of the triple helix is the basis for forming a supportive infrastructure of innovative/technological solution through networking between different actors in the process was carried out. "With increased overlapping of communications, networks and organizations between spirals" the "triple helix" model becomes a complex system (Etzkowitz and Leydesdorff, 2000). The "triple helix" model focuses on the progress of technological developments and solutions and their institutional environment which gradually changes the environment for research and development (Leydesdorff, 2000).

The university has an active position in the application of knowledge to use and in the expansion of contribution in the creation of academic knowledge. The private sector is favorable to increase their level of technology involved in the field of learning and knowledge sharing. The government has a role of social entrepreneur and a venture capitalist, which is in addition to the traditional regulatory role in determining the investment rules and benefits of public interest (Etzkowitz, 2003).

FIGURE 2. INTERACTION PROCESS FOR REALIZATION OF TECHNOLOGY TRANSFER



The model allows:

- Interaction between the university and development bases, exchange of experience and strategic decisions by the public sector and efficient use of tools in the public sector to increase the budget and profitability of business, also ensuring links between the university and industrial environments.
- Cross-company projects with the support of the government and the potential of research teams and laboratories;
- Research projects financed by the state and under a mandatory condition for use in private/industrial sector in order to regain investments;
- High-tech science projects that are supported by the government and create conditions for inter-company networks for distribution of products/services in different countries/regions.

It should be noted though that PPP models have their strengths and weaknesses too. A PPP does not provide "quick results" and should be used only when appropriate and there are clear benefits and advantages that can be proved. PPP structures need to be adapted to the sectors and the project context, and the desired effect and benefits will influence the selection and design of PPPs.

The role of PPPs for effective technology transfer has primarily secondary role as the use of a model helps to eliminate volatility and risk from: poor infrastructure environment, lack of standards and quality processes, frequent cases of reluctance to change and introduction of innovative solutions, and finally - a long and cumbersome development (Figure 2).

Conclusion

In the modern development of society and economy as a whole, a growing need could be seen for connecting new research knowledge and turning it into new products and

technologies by industry and public-private partnership provides the necessary resources for investment. In any economy, technology transfer is driven by government policies and depends on the role of government, academic and industrial societies for building of a culture of cooperation for effective use of technology. That is why a continuous development of public-private partnership is needed in the direction of flexible policies, competitive business and research activities, ensuring implementation and return of investment. This can be achieved through establishment of bilateral arrangements between the public and private sectors and academia, which are the basis for effective technology transfer needed to economy growth and development of society as a whole.

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