

# Examining the Role and Place of Technology Transfer Centers in Technology Development and Transfer in the Transportation Industry

Atoosa Khorram

Master Graduate of Technology Management, Department of Management and Economic, Science and Research Branch, Islamic Azad University, Tehran, Iran,  
Email: [Atoosakhorram@yahoo.com](mailto:Atoosakhorram@yahoo.com)

Received: 17, February, 2019

Accepted: 27, May, 2019

Online Published: 19, Jun, 2019

## Abstract

Considering the importance of the transportation industry as a lifeline and important economic, social, cultural and political connection ring as well as the strategic role and sensitivity of this industry in providing services and the importance of technology as applying the science, the present review study aims to investigate the role and place of technology transfer centers in the technology development and transfer in the transportation industry. In this study, an introduction of the subject is first provided reviewing the past studies, and then the theoretical literature on variables and finally, discussion and conclusions are presented. The findings of this study indicate that technology transfer centers can cause facilitating and accelerating technology transfer in the transportation

**Keywords:** Technology Transfer Centers, Technology Development, Technology Transfer, Transportation Industry

## 1-INTRODUCTION

As the key to competing in today's business world, technology is essential for the growth of organizations. New technologies create more appropriate ways of doing things and are bringing new aspects to human activities. In this way, it will be possible for human beings to increase productivity, improve the quality of goods and services, reduce time to market new products and satisfy endless needs. As a major weapon of competition between companies, today's worldwide success is clearly dependent on utilizing technology.

In order to optimally manage technology, it is necessary to obtain as broad a picture as possible of the future horizons. One of the areas of technology management practice that requires this holistic view and foresight is technology transfer. Industrialization in today's world is deeply dependent on technology transfer, and technology transfer is the method by which the technical knowledge or machinery technology is transferred from one company to another (Belderbos & Wakasugi, 2008). There are currently few countries that need to be completely self-sufficient in terms of technology. Even advanced countries do not have to import technology. However, the need for countries like Iran to transfer technology is more pressing and critical, as technology transfer is one of the key components of development. The technology transfer approach in its importing countries should consider the proper technology selection according to their needs. In this approach, the main issue is to adapt the imported technology to the importing country requirements. This adaptation, sometimes referred to as localization, is trying to determine the nature and extent of technology dependence on the one hand and the realization of the way to overcome it by preserving cultural identity, on the other hand. Accordingly, both external data management and technology mobilization are considered (Mazurkiewicz & Poteralska, 2017).

With the rapid advancement of technology and the enormous volume of scientific and technical studies, countries around the world have been forced to develop systems for organizing technology and technical information affairs. On the other hand, the transportation industry faces a wide range of technologies in various sectors such as air, sea, land, rail and combined transport in the fields of infrastructure, equipment, fleet, operation and maintenance which are changing and transforming every day. This shows the need to establish a proper system for organizing technology-related tasks in the transportation industry. Hence, attracting advanced technologies through technology transfer to achieve the goals of the transportation industry is of great importance. Therefore, the transportation industry policymakers should strongly consider the proper management of technology in technology transfer activities. However, one of the key steps in this area is to choose the appropriate transfer method (Kastell, 2006). Then, considering the importance of this topic, the present study investigates the role and place of technology transfer centers in technology development and transfer in the transportation industry.

## 2. LITERATURE REVIEW TECHNOLOGY

The term "technology" stems from the two Greek words "Techno" meaning art or skill and "Logia" meaning science and knowledge (Caramihai et al, 2017). Technology is the knowledge used to make goods, provide services, and improve the use of limited and valuable resources. Technology is the result and consequence of the development of knowledge. Although knowledge is not information, it is based on the amount of information available. Knowledge is all that one's mind and mind has been able to acquire and understand through the mass of information (Mahboudi & Ananthan, 2010).

Technology, in today's world, is an undeniable part of the fundamentals and concepts of development, so that, according to experts, is the key driver of sustainable development, growth, and development of technology-based knowledge (Caramihai et al, 2017).

The world's leading governments and industries have realized the importance of technology and are seeking to apply science to increase efficiency and competitiveness in international markets. The importance of technology is tangible as the most important driver of economic development in the world. Technology is scientific in nature, and the question is part of its philosophy, and research and development and subsequently, discovery and invention are needed in order to answer this question (Caramihai et al, 2017).

Technology refers to all the knowledge, products, processes, tools, methods, and systems used in the creation of goods or services that comprise two hardware and software components. The software itself has three components of humanware, infoware, and orgaware and hardware are the same laboratories, workshops, measuring instruments, tools, etc. (Bozeman, 2000). Technology is the scientific application of scientific and technical achievements to respond to one or more needs (Ghebrihiweta & Motchenkova, 2017). Technology can be defined as all the knowledge, processes, tools, methods and systems used in manufacturing products and services. In simpler terms, technology is the way we do things and the means by which we achieve our goals. Technology is the practical application of knowledge and tools to help the human effort. Indeed, technology is the practical application of scientific and engineering knowledge to understand, develop, or apply service products, processes, or operations (Di Benedetto et al, 2003).

#### **Technology components**

Technology includes the following components:

- a) Hardware: the objects in which technology is embedded, including tools, machinery, and equipment, which are used to produce goods or services.
- b) Software: A set of guidelines, rules, methods, and theories for the use of machinery.
- c) Human Resources: including knowledge, skills, intellect, initiative and experience of a human or a group of human beings.
- d) Organization and management: including management systems, communications, and organizational systems.

In case that sufficient capital is provided, hardware components are often easily obtainable. According to research, the amount of hardware components available in our country is relatively large due to the ease of use, and there is no major shortage in this respect in different branches of industry. However, the important point about technology hardware components is that if they are provided without sufficient coverage of the technology software components, these capabilities will either remain idle or operate at very low efficiency (Costantini & Liberati, 2014).

### **3. TECHNOLOGY TRANSFER**

Technology transfer is referred to the process by which technology flows from one source to another which can be individuals, companies, organizations, or the wider country. Technology transfer can also occur at the international, regional, inter-industry, inter-company, and other levels. In other words, technology transfer is the process by which technology is transferred from a primary source to the technology recipient. Therefore, there is a technology transfer transaction, which may or may not be covered by a binding legal contract (Mahboudi & Ananthan, 2010).

There are two interpretations of technology transfer. In a sense, technology transfer is the application and use of technology in a place other than its original location. By definition, technology transfer is a process that flows technology from source to recipient. In other words, technology transfer means acquisition and achieving technology by the technology recipient. In this sense, mere relocation is not enough for technology transfer, and technology must in fact be transferred to the recipient so that he also becomes able to build the product or execute a process of the same quality as the assignee.

Technology transfer occurs in two types: vertical transfer and horizontal transfer, in the vertical transfer or R&D transfer, technical information and applied research findings are transferred to the development stage and engineering design and then enter the production process with the commercialization of technology. In horizontal transfer, technology moves from one level of competence in one country to the same level in another. In this case, the higher the level of technology receiver, the lower the cost of technology transfer and the more efficient its absorption (Costantini & Liberati, 2014).

Technology transfer is a process that causes shaping the technology flow from the source to the receiver. The source refers to the holder of knowledge and the recipient of such knowledge. The source can be an individual, a company, or a country (Bennett & Zhao, 2004).

Technology transfer is the application and use of technology in a place other than the original place of creation. In other words, technology transfer is the process that causes technology to flow from the source to its recipient (Bozeman, 2000).

There are various definitions for technology transfer, one of which being the most comprehensive: the interconnected chain of purposeful activities whereby the set of technology components in a place other than the primary place of technology is being exploited in ever broader economic applications (Ben Benedetto et al, 2003).

Today, with advancing technology and countries compete for it, the competition for acquiring technology has greatly expanded. So that developing countries pay enormous costs to acquire these technologies, but technology transfer follows certain principles and has its own complexities. A successful technology transfer requires:

- 1) Selecting the appropriate technology
- 2) Selecting the transfer method
- 3) Selecting the country of origin

- 4) Negotiation and Contract
- 5) Technology acquisition (Caramihai et al, 2017).

On the other hand, technology transfer is a process essential to the widespread use of technology by one or more users. Technology transfer is also a process that enables the flow of technology from one source to a recipient, in this case, the source is the owner or holder of knowledge. Whereas the recipient is the beneficiary of such knowledge. The source can be an individual, a company or a country (Ghebrihiweta & Motchenkova, 2017).

Access to technology in manufacturing firms in developing countries is only possible through technology transfer from developed countries, which is done in both vertical and horizontal ways. In vertical transmission, also known as R&D transfer, technical information and applied research findings are transferred to the development stage of engineering design and after commercializing, technology enters the production process (Caramihai et al, 2017).

Technology, in horizontal transfer, is transferred from one level of competence in one country to another with the same level of competence elsewhere. The higher the level of technology recipients, the lower the cost of technology transfer and the more efficient it will be absorbed.

In this definition, technology transfer is an interconnected chain of purposeful activities in which a set of technology components is developed and utilized in a place other than the original location, in an ever broader application (Caramihai et al. al, 2017).

Transferable components in the technology transfer process are:

- Intermediate equipment and goods
- Operating modes and methods
- Industrial design and trademarks
- Technical information, maps and plans
- Human skills
- Individual or organizational inventions and creations (Di Benedetto et al, 2003)

#### **Technology transfer methods**

Technology transfer methods are a set of activities, under predefined conditions in which the technology required by the applicant is available. The methods of technology transfer vary widely depending on the type of technology and the conditions of its recipient and provider. Among the categories introduced in the books and papers, the direct and indirect methods, internal and external, formal and informal, commercial and non-commercial, packaged and unbundled can be mentioned. In general, the most important ways in which technology is transferred are foreign direct investment, royalty transfer, joint venture, key contracts, technical assistance contracts, subcontracts, reciprocal contracts, reverse engineering, employing technical and scientific force, conferences and exhibitions, import of capital goods machinery, scientific and industrial espionage that degree of effectiveness and importance of each of these methods depends on factors such as the nature of the technology required and capacity of the recipient to learn and acquire technical knowledge (Bozeman, 2000).

There are generally different ways of transferring technology, some of which are identical in content and nature, and the only difference being in their titles. Technology transfer is a set of predefined activities in which the required technology is provided to the applicant in return for the supplier's satisfaction. Technology transfer methods are different and in some cases vary widely depending on the technology and the conditions of the transfer. Transfer methods may involve at least the engagement or effort of the recipient in methods like relying on an external source to maximize the organization's employment in ways such as integration. In this regard, they can be categorized both in formal and informal channels (Ghebrihiweta & Motchenkova, 2017).

Foreign Direct Investment (FDI): one of the most important mechanisms of technology transfer, is most applicable when the technical information is of high importance or the technology holder prefers to make the most of its benefits. This method is used by countries facing scarce resources and its main advantage is for the host country to minimize investment risks and to have access to all sources of investment country support (Bozeman, 2000).

Joint venture: This type of technology transfer is concluded by concluding a contract between the local company in the host country and its foreign counterpart. The main difference between this method and the direct investment method is that the two parties share the decision-making, control and transaction benefits, while the investor usually takes the primary control.

License Contract: the contracts whereby the licensee sells a technology license to a recipient for a specified period in return for a specified fee, usually royalty. The license agreement is one of the inexpensive sources of technology and provides the technological credibility of the recipient country. In general, countries that have more capabilities and better technology absorption use this method.

Reverse Engineering: technology transfer in this method is usually done by purchasing samples of machinery from outside and disassembling and copying it. This type of technology transfer is commonplace in industries where its components are easily accessible, such as the computer industry.

Technology acquisition through expert people: the heart of technology is human. At the technological level, as we go from the lowest level of research and development, the machine and hardware become less and less important to humans. In this case, if there is at least technological readiness in the firm or country, technology can be gained through the experience of engineers and skilled professionals in the field.

Subcontractors: There is no specific definition of subcontractors in the industrial literature, however, it can be considered a bilateral contract between two industrial units for the supply of parts, materials, and services required by one of the other. These contracts are not always straightforward but are sometimes done with one or more intermediaries. The use of subcontractors, in addition to enhancing efficiency in long-term resource efficiency, makes local industries independent.

Importing capital goods and machinery: this method plays an important role in enhancing the industrial structure and technological capability of the technology receiver country.

Strategic partnership: with several companies in which they work in a limited way for a share of the benefits. This treaty can be horizontal or vertical. In the general contract, Company A agrees to sell Company B's product in return for a share of the profits. In a horizontal partnership, the company integrates its technical production skills into a more competitive and efficient marketplace.

Outsourcing: usually used when access to product technology is not easy and the company does not require technology acquisition.

Merge: one company merges with another technology supplier, forming a new company.

Industrial Spy: despite the ethical doubts about it, using it for profitability may be a rational decision. The enormous investment and long product life cycle, coupled with advanced technologies, enables technology advancement and the survival of a company in the shadow of achieving such technologies (Bozeman, 2000).

#### **Technology Transfer Process**

Technology transfer process includes the stages of selection and acquisition, adaptation, absorption, application, diffusion and development of technology that are described below:

- a) Selection and acquisition: the basis of the whole process which is of particular importance and sensitivity.
- b) Adaptation: linking imported technology to local research and development structures, so it is an essential component in fostering technology self-sufficiency.
- c) Attraction and Analysis: Attraction and analysis is the process of examining, training, and acquiring complete knowledge of the technology acquired and all of its various components.
- d) Application and implementation: The process of utilizing the technology acquired in the production and distribution of the desired goods and services after its adaptation, absorption, and analysis.
- e) Development: a process in which technology is acquired and the knowledge and experience acquired through studies, adapting, absorbing, applying, and integrating this knowledge, experience, and skills with the data and findings of internal technology to create a new technology to make better and newer processes and products (Mahboudi & Ananthan, 2010).

#### **Barriers and Problems with Technology Transfer in Iran**

Technology transfer usually faces barriers, the most important being technology management and the educational and cultural system (Kabiri et al, 2012). There are some barriers in technology transfer in Iran that need to be considered to make this process more effective. Some of these are as follows:

- ignoring the project defined standards, technical and support standards, project maintenance and development standards

- Not use of experts' knowledge in projects in the right direction
- Lack of the technology right place among the government and people
- The need to improve R&D in companies (Mahboudi & Ananthan, 2010).

#### **4. TECHNOLOGY TRANSFER CENTER**

The following definitions are common for a technology transfer center:

- The technology transfer center is a center for collecting information on technology and resources, including appropriate technologies and successful experiences.
- Such centers could serve as a channel between manufacturers and users of technology at the domestic, regional or international level.
- The main center for developing and promoting best practices through various educational activities
- A place for systematic technology transfer activities that respond to internal needs.
- An accelerator for the promotion, use and implementation of experiences gained by domestic experts (Bennett & Zhao, 2004).

#### **Transportation Industry**

As a lifeline and an important link of economic, social, cultural and political connectivity, the strategic role and sensitivity of the transportation industry in providing services has always been a matter of concern and its adaptation to the different needs of different parts of society is one of the major goals of today's policymakers. Hence, how to effectively use technology and the flow of information in this industry is of particular importance as it is an important and underlying part of it, affecting many other societies' activities and enables countries to make the most of their potential talent today. Although the basic goals of the transport community have not changed dramatically, their technological advances have faced great revolution and enormous complexity. Keeping up with these advances as an inevitable principle of development requires the coherent knowledge, research, and planning of industry stakeholders in all its dimensions to formulate, implement, and evaluate new strategies (Ale Ebrahim et al, 2006).

Because of its prominent position in the economy, the transportation sector is one of the indicators of growth. Given that the growth and development of this sector plays an important role in shaping the evolution of other industrial, agricultural and manufacturing sectors, most economists today consider economic growth and development of all countries conditional on the development of transportation, and the industry is referred to as the centerpiece of the underlying activities necessary for the transformation of economic growth (Kastell, 2006).

On the other hand, the latest scientific and technological advances in the field of communications, telecommunications, satellite information technology and the transport society as the main economic, cultural, political and social lifelines have revolutionized. However, organizations (in general) and the transportation industry in Iran have benefited less from

this transformation and it is partly managed in the traditional way.

Given that the transport sector plays a key role in the flow of economic activity in each country, it is expected that productivity improvement in this sector can directly and indirectly lead to improved productivity in other sectors and part of the goal of economic growth in the country comes from productivity (Moradi et al, 2015). The transportation industry in Iran has long been the cornerstone of the country's strategic and climatic situation and the basis for fundamental change. Increasing the population and distribution of transport organizations on the one hand, and the need to increase speed, quality and productivity, reduce time, cost and waste of energy and accelerate the process of gaining competitive advantage in the development of the industry on the other, have made it a vital thing to create integrated systems and raised the need to rethink the industry and its affiliated organizations in the form of a comprehensive IT strategy to meet the needs of customers and meet their present and future needs (Ale Ebrahim et al, 2006 ).

## 5. DISCUSSION AND CONCLUSION

The purpose of this study was to investigate the role and place of technology transfer centers in technology development and transfer in the transportation industry. As an important industry, lifeline, and an important economic, social, cultural and political connecting link, the transportation industry has always been a focus and the strategic role and sensitivity of this industry in providing services tailored to the different needs of different sectors is one of the major goals of today's policymakers. On the other hand, technology is knowledge for making goods, providing services and improving the way of using limited and valuable resources, and technology in today's world is an integral part of the foundations and concepts of development. Therefore, the importance of technology is evident and it is essential to increase the efficiency and competitiveness of international markets and to apply science and organizations seeking technology to compete better. Technology transfer is one way of acquiring technology that enables technology to flow from one source to another. In other words, it refers to an interconnected chain of purposeful activities whereby the set of technology components is exploited in ever-broader economic applications other than the primary place of technology creation. Technology transfer centers can be used to facilitate the technology transfer process, which can serve as a channel between manufacturers and users of technology at local, regional or international levels.

On the other hand, with a wide range of technologies in the different air, sea, land, rail and combined transportation areas in the fields of infrastructure, equipment, fleet, operation and maintenance, which is changing every day, the transportation industry needs a proper system for organizing its technology-related affairs. Technology transfer centers can be used to better manage technology transfer and organization. Therefore, it can be concluded that technology transfer

centers can play a key role in technology transfer in the transportation industry.

## REFERENCES

- 1) Ale Ebrahim, N., & Golnam, A. (2006, October). Heavy Duty Fleet and Transportation in Iran the Past, the Present Condition, the future perspectives and its interaction with Economy. In FISITA 2006 World Automotive Congress, Yokohama, Japan.
- 2) Belderbos, R., Ito, B., & Wakasugi, R. (2008). Intra-firm technology transfer and R&D in foreign affiliates: Substitutes or complements? Evidence from Japanese multinational firms. *Journal of the Japanese and International Economies*, 22(3), 310-319.
- 3) Bennett, D., & Zhao, H. (2004). International technology transfer: perceptions and reality of quality and reliability. *Journal of Manufacturing Technology Management*.
- 4) Bozeman, B. (2000). Technology transfer and public policy: a review of research and theory. *Research policy*, 29(4-5), 627-655..
- 5) Caramihai, M., Tănase, N. M., & Purcărea, A. A. (2017). proposals for improving innovation and technology transfer policies in Romania. *Procedia Engineering*, 181, 984-990.
- 6) Costantini, V., & Liberati, P. (2014). Technology transfer, institutions and development. *Technological Forecasting and Social Change*, 88, 26-48.
- 7) Di Benedetto, C. A., Calantone, R. J., & Zhang, C. (2003). International technology transfer. *International Marketing Review*.
- 8) Ghebrihiwet, N., & Motchenkova, E. (2017). Relationship between FDI, foreign ownership restrictions, and technology transfer in the resources sector: A derivation approach. *Resources Policy*, 52, 320-326.
- 9) Kastell, K., Bug, S., Nazarov, A., & Jakoby, R. (2006, May). Improvements in railway communication via GSM-R. In 2006 IEEE 63rd Vehicular Technology Conference (Vol. 6, pp. 3026-3030). IEEE.
- 10) Khabiri, N., Rast, S., & Senin, A. A. (2012). Identifying main influential elements in technology transfer process: A conceptual model. *Procedia-Social and Behavioral Sciences*, 40, 417-423.
- 11) Mahboudi, M., & Ananthan, B. R. (2010). Effective Factors in Technology Transfer in the Pharmaceutical Industries of Iran: A Case Study. *IUP Journal of Knowledge Management*, 8.
- 12) Mazurkiewicz, A., & Poteralska, B. (2017). Technology transfer barriers and challenges faced by R&D organisations. *Procedia engineering*, 182, 457-465.
- 13) Moradi, A., Hejazi, S. R., & Farsi, J. Y. (2015). Sustainability in Iran's road transport sector: evaluating strategies and policies. In *Sustainable operations management* (pp. 203-222). Springer, Cham.