

# **A Review of Information Technology Transfer Process, Its Topicality, and Related Models**

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*Abstract. The purpose of the research to provide an overview of technology transfer process to potential readers. The topicality of this issue in the world and the state of Latvian research works with the related topic was analyzed and presented in the paper. The author reviewed experiences of colleagues from other universities for identification main concepts used in this field and existing difficulties to perform technology transfer. The anticipated outcome of this review is the identification of information technology transfer model that could be used for transferring research results from Academia to Business Sector.*

*Keywords: Review, Information Technology Transfer, Technology Transfer Model.*

## **I. INTRODUCTION**

Nowadays the basis of technology is most commonly comprised of two large groups: a group of information technology and a group of information and communication technology which are based on the use of computers with the aim of processing, receiving, storing, reflecting and transferring information. The goal of information technology is to produce the information meant for making decisions by reducing labour-intensive processes of information resource use.

A lot of the success is directly dependent on a technological solution which could solve the problem more quickly by saving time, money and energy. The life cycle of any kind of information technology begins with its development and continues with transferring the results to the end user. The entrepreneurs of Latvia often cannot afford to invest their money and time in developing new solutions and conducting experiments. In the meantime, plenty of the already developed prototypes remain within university premises and are not passed onto the public. This is because scientists and technology developers are working on the quality and the progress of the technology, meanwhile the transfer process is not well-considered. Therefore, it is crucial to comprehend the process of the technology transfer, particularly from the perspective of the university that holds the role of the manufacturer of the technology and the role of the potential originator of the transfer.

The origins of technology transfer date back to the 1950s. Based on the literature analysis, it was concluded that scientists do not strictly distinguish between the concepts of technology transfer and

knowledge transfer and this can be discovered through context. In a number of scientific articles and journals the technology and knowledge transfer carry similar meanings in terms of definitions and one definition can be replaced with the other. When summarizing the given definitions [1] - [12] the technology or knowledge transfer can be interpreted as the process of information transfer from the supplier to the recipient. Generally, this process includes at least two participants that would supply the information, knowledge, technology or experience and would anticipate a number of stages.

## **II. MATERIALS AND METHODS**

Based on the study aim this research proposal investigates the following questions:

Question 1: What are key terms and concepts in technology transfer?

Question 2: Is there a relationship between “technology transfer process” and “knowledge transfer process”?

Question 3: What is the existing state of technology transfer in the world?

Question 4: What is the role of Latvia in the subject of technology transfer?

Question 5: What are the various models used in technology transfer?

Question 6: What are the most important factors that influence the technology transfer process?

Question 7: What is the future direction of technology transfer for further study?

The aim of this study is to give an overview of the field of technology transfer and show the current state of scientific research regarding this topic. For this

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purpose, a literature review and bibliometric analyse [13] of the scientific articles published between 1960 and 2016 years indexed in Thomson Reuters' Web of Science (WoS) [14] and Elsevier's Scopus [15] was conducted.

### III. RESULTS AND DISCUSSION

The number of scientific researches related to technology or knowledge transfer is increasing worldwide every year. To reflect this trend, the bibliometric evaluation method was used [13]. The quantitative analysis was based on the data from the Thomson Reuters' Web of Science [14] and Elsevier's Scopus [15] internationally available databases. It should be pointed out that Elsevier's Scopus contains records of more than 21,000 journals, 86,000 e-books and 6,8 million conference materials as well as 27 million patents, but the Web of Science database contains the most important scientific information on more than 12,000 journals in more than 250 disciplines, offering the bibliographic and citation information, summaries and other information regarding the articles.

The information for the data analysis was compiled for the period from 1960 until the end of 2016 where the technology or knowledge transfer definitions are mentioned in several literary sources. The phrases "technology transfer" and "knowledge transfer" were selected for data processing. The results are reflected in Figure 1 which reflects the topicality of the themes in both databases.

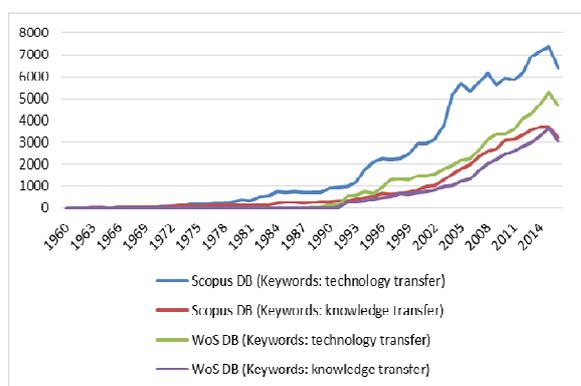


Fig. 1. The technology and knowledge transfer trends within the SCOPUS and Web of Science databases.

As can be seen, starting from 1985 there is a worldwide tendency to pay the most attention to the particular topic. Over the past decade only the SCOPUS and Web of Science databases have annually published about 15,592 scientific papers on average relating to the technology and knowledge transfer and the number of publications is increasing every year.

In terms of information technology, which is based on the use of computers, the information in the field of computer science alone has been collected over the past decade for further data analysis. The

phrase "technology transfer" was selected for data processing and the filter "computer science industry" was applied for any searches done. Table 1 summarizes the results.

Table 1. The number of publications within the SCOPUS and Web of Science databases by keywords "technology transfer" in the computer science sector.

Year	WoS	SCOPUS	Total
2006	331	897	1228
2007	387	1261	1648
2008	470	1548	2018
2009	498	1488	1986
2010	308	1395	1703
2011	288	1261	1549
2012	385	1218	1603
2013	420	1221	1641
2014	477	1239	1716
2015	608	1516	2124
2016	322	1548	1870
<b>Total</b>	<b>4494</b>	<b>14592</b>	<b>19086</b>

The bibliometric analysis showed that the theme in relation to the information technology transfer is topical and only the WoS and SCOPUS databases publish around 1,700 articles related to this issue annually. It is important to point out that most researches done in this area have been published by authors from China, the USA and Germany. Unfortunately, the scientists of Latvia still do not pay enough attention to this issue. Only 18 articles by Latvian scientists can be found for the period from 2006 to 2016 within both databases. The total number of publication during this period is reflected in Table 2.

Table 2. The number of publications by countries for the period from 2006 to 2016 within SCOPUS and WoS databases.

Country	Scopus DB 2006-2016	WoS DB 2006-2016	Total
China	2940	969	3909
US	2575	795	3370
Germany	965	278	1243
Japan	776	178	954
United Kingdom	704	169	873
India	690	261	951
Italy	609	170	779
South Korea	555	192	747
Taiwan	457	170	627
...	...	...	...
Lithuania	38	10	48
Estonia	15	9	24
Latvia	11	7	18

In terms of technology transfer models that are used around the world it must be concluded that there is no single model which can be used and some researchers use different approaches and their experience varies significantly. A lot of new approaches related to technology transfer appear every day and this is influenced by many factors: the aims and the technology transfer policy, the industry

needs, the technology quality, the engagement of funding, the government support and other factors. A number of publications were selected in order to compare the models and the scientific experience in the field of technology transfer. The results of the research were summarized in Table 3.

Table 3.  
Technology transfer models.

Source	Type of Technology	Participants involved in the process	Difficulties to perform technology transfer	Solution
[16]	Information	1. College 2. Industrial partner 3. Third person	Lack of interaction of participants	1. Cooperation Technology Transfer in four programs: • Mediator • Direct transfer • Sharing ideas • The joint venture 2. The meetings twice a year
[17]	Selected lean manufacturing tools and techniques	1. Japanese automotive industry 2. UK local companies 3. Change agents	1. Time 2. Management	Quality control and Time-based competition Based on abstraction level of the transfer process and whether it is driven by supply or demand.
[18]	Aviation security technologies	1. Developer 2. End-user	Poor understanding of the private capital, unrealistic expectations of business innovation research grants, lack of understanding of university best practices.	TECHNOGY TRANSITION-TRANSFERCOMMERCIALIZATION MODEL that includes requirements development, assessment and evaluation, certification, qualification and approval to end-user application.
[19]	Research findings	1. Researcher 2. Practionier	1. Management 2. Size 3. Complexity 4. Stakeholder involvement 5. Criticality 6. Uncertainty	Risk assessment
[20]	Tools, products, methods, techniques, models, frameworks and others that enable or support the creation of software intensive products or services	1. Researchers 2. Practioniers	Lack of interaction between center and company	1. Open (Ended) Debate 2. Conclusions in specific post-conference reports
[21]	Research projects in Software Engineering	1. Academy 2. Industry	Reliability and feasibility of technologies, their applicability to industrial settings	Theory and set of hypotheses extracted from an exploratory survey with industrial and academic partners
[22]	Electric machinery	1. Producer 2. User	Readiness of its human ware	The measurement model based on characteristic of a person that have causal relationship with work achievement
[23]	Research results	1. Academy 2. Industry	Low perception of usefulness	Technology transfer maturity evaluating model based on Requirements Traceability
[24]	Innovation	1. Scientific research institutes 2. Local governments Enterprises	Lack of interaction between actors	Academy-locality cooperation patterns
[25]	IT & ICT technologies	1. Owners, developers, innovators 2. Users	Communication barriers	STAR (Communication) Model for technology transfer

By summarizing multiple sources it can be concluded that a number of technology transfer models include the following common parts:

- the transfer object;
- two or more participants involved in the technology transfer process;
- the interaction between the participants;
- the transfer method which involves a number of steps;
- the environmental factors influencing the technology transfer process.

In addition, several sources indicate that the technology/knowledge transfer is directly related to the concept of innovation. Many research papers [26] – [31] use terms such as “knowledge innovation”, “technology innovation”, “new knowledge”, “new technology” in the context of technology/knowledge transfer. According to the definition from the Merriam-Webster dictionary [32], the “innovation” concept is to be understood as something new to the market and the synonyms to the technology transfer are substantial.

#### IV. CONCLUSION

As a result of the research it was concluded that the technology transfer is a topical theme worldwide and the number of scientific researches is only increasing annually. Most of the researches and the technology transfer models have been offered by the scientists from China, the USA and Germany. In Latvia the technology transfer process has not entirely been studied yet and, as a result, the scientists hardly ever communicate with the industry and everyone works separately. Based on the key concepts of the technology transfer, the foreign experience and the best practices, it has been decided to develop a new information technology transfer model and a way of its practical application, taking into account the environmental factors and the conditions within the Latvian market.

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