

**KNOWLEDGE AND TECHNOLOGY TRANSFER AS DRIVING
FORCE FOR SOCIAL INNOVATIONS****Šimelytė A., Tvaronavičienė M., Holmen R. B.,
Burinskas A., Razminienė K.***

Abstract: Knowledge and technology transfer are defined as driving force for new business models, innovations and economic development. The aim of the paper is to carry out detailed literature analysis in order to create new framework of technology and knowledge transfer that contributes to social innovation. To explore the level of investigation and latest trends of the topic, the article provides bibliometric analysis on knowledge and technology transfer. The information is obtained from Web of Science for the period of 1990 to 2021. VOSviewer has been used for citation analysis, co-authorship and bibliographic de-coupling. More than 5,000 articles have been found with the keywords technology transfer and knowledge transfer in the database WoS indexed at six well-established citation indexes. For the bibliometric analysis, 308 articles in the fields of economics and business management have been used. Results of this review integrates concept of social innovation into theory of knowledge-based of firms. Furthermore, it composes the model of new knowledge and technology transfer that leads to social innovations. Thereby, our article contributes to theory of knowledge-based of firms and the concept of social innovation.

Key words: knowledge transfer, technology transfer, innovation, social innovation, FDI spill-over, absorptive capacity, bibliometric analysis

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Introduction

Rapidly evolving new technologies and innovation have changed the world, business, science and habits of people within very short time. Thus, the vast number of articles on technology transfer: traditional models of technology transfer (Bozeman, 2000; Agrawal & Cockburn, 2003; Siegel & Phan, 2005; O'Shea et al., 2005; Guan et al. 2006; Lopez-Cruz & Obregon, 2015; Villani et al., 2017;

* **Agnė Šimelytė** Assoc. Prof. Dr., Vilnius Gediminas Technical University (Vilnius Tech), Faculty Faculty of Business Management, Lithuania **Manuela Tvaronavičienė** Prof. Dr., Vilnius Gediminas Technical University (Vilnius Tech), Faculty Faculty of Business Management, Lithuania **Rasmus Bøgh Holmen** Dr., Institute of Transport Economics, Norway **Arūnas Burinskas** Dr., Vilnius Gediminas Technical University (Vilnius Tech), Faculty Faculty of Business Management, Lithuania **Kristina Razminienė** Dr., Vilnius Gediminas Technical University (Vilnius Tech), Faculty Faculty of Business Management, Lithuania

✉ corresponding author: agne.simelyte@vilniustech.lt

✉ manuela.tvaronaviciene@vilniustech.lt; rbh@toi.no; arunas.burinskas@vilniustech.lt; kristina.razminiene@vilniustech.lt

Hilkevics & Hilkevics, 2017; Scarra & Piccaluga, 2020), knowledge-based theory of firms (Szulanski, 2000; Marz et al., 2006; Balboni et al., 2017; Martin, 2019; Scarra & Piccaluga, 2020; Pangarso et al., 2020; Alkhazali et al., 2021; Mura & Hajduová, 2021), innovation (Howells, 2006; Bacon et al., 2019; Cibák et al., 2021), FDI spillovers (Glass & Saggi, 1998; Gupta & Govindarajan, 2000; Yokota & Tomohara, 2010; Havranek & Iršova, 2011; Jude, 2016; Mehmmod et al., 2021) has been published for the last thirty years. The concepts of technology transfer and knowledge transfer are integrated into other multidisciplinary theories and fields of study such as business management (Szulanski et al., 2016), economics (Martin, 2019; Scarra & Piccaluga, 2020; El Idrissi et al., 2020), engineering (Al-Abidi et al., 2012), medicine (Ringsted et al., 2011), computer science (Dearing, 2009), environmental studies (Ahmad et al., 2020; Nassar & Tvaronavičienė, 2021), and the others. Such integration and analysis in various fields of study, proves that technology and knowledge transfer is a significant tool for development of the field. Increasing number of articles in technology and knowledge transfer demonstrates the importance of technological development. Scientific literature provides numbers of articles dedicated to innovation, technology transfer, knowledge transfer or absorptive capacity, however, most articles concentrate on technology or knowledge transfer from advanced economy to emerging or less developed host country. Thus, literature on technology and knowledge transfer is still fragmented and lacks complex point of view towards integrated technology and knowledge transfer including transferring channels, especially from advanced economy to advanced economy.

The article addresses the concepts of technology and knowledge transfer, which result to social innovation, focusing on its different streams of research and carrying out critical review of the topic. The aim of the paper is to create new framework of technology and knowledge transfer that contributes social innovation. In order to implement aim of the paper, content analysis of scientific literature and bibliometric analysis of technology and knowledge transfer concepts are carried out. Bibliometric analysis identifies main authors, countries and journals that investigate this topic. In addition, maps and visual elements such as co-citation, bibliographic coupling and co-authoring will be used.

For the methodological purposes the article is divided into three parts. The first part is devoted to the critical literature review on innovation and knowledge transfer. The second part of the article explains the methodology of bibliometric analysis. The third part presents result and discussion of the bibliometric analysis including the most influencing articles and authors of the field, and clustering keywords.

Literature review

Basic of innovation.

Innovation means creating something new or something old in a new way. In line with OECD's (2018) Oslo manual for innovation measurement, national statistical bureaus commonly distinguish between four types of innovation. These are:

product innovation (i.e. quality improvements of goods), process innovation (i.e. improved production or distribution processes), organizational innovation (i.e. new methods for internal organization or new ways of handling external relations) and marketing innovation (i.e. product promotion or new product wrapping). Another common dimension applied for classification of innovations involves incremental and radical innovations. Incremental innovations occur gradually, providing people and organizations some to adjust to the new products or technologies. On the contrary, radical innovations are innovations that appears suddenly with substantial implications for the concerned markets. Under radical innovation, outsiders may even adapt to new technologies faster due to less substitution towards earlier generations of technologies (i.e. leapfrogging confer Fudenberg et al., 1983).

The concept of innovation has been devoted much attention in the research literature from at least the 1800s. In his pioneering contribution, Tarde (1890) proposes that the innovation-decision process for each individual and the technology diffusion follows a 'S-curve'. The term S-curve reflects the notation of a curve resembling the letter S lying flat (as popularized by Rogers, 1964). The innovation curve of Tarde begins with new knowledge, advances to formation of attitudes and further to the decision to adopt or reject. Next follows implementation and use, before the curve ends with confirmation of the decision. The turnover among firms in the phases between basic research and commercialization of a new products or technologies is known as the 'Valley of Death' (Ford et al., 2007; Beard et al., 2009). Since the 1950s, innovation has to an increasingly extent been formalized in economic models. In 1956, the foundation of neoclassical growth theory was laid down by Solow (1956) and Swan (1956) (independently of each other), involving of an aggregated production function, a depreciation function and a utility function depending on consumption. In the model, utility over time is maximized by picking the investment share of income that yields the highest steady state consumption level with a constant growth rate. Yet, the forces behind economic growth were not modelled in the Solow-Swan model. Endogenous growth theory addresses this weakness, involving a progressive problem shift in theory on economic growth rather than a revolution (Lakatos, 1970). This tradition implies that technology improvements are at least partly a result of knowledge investments and do not completely fall like 'manna from heaven', implying that economic growth is caused by endogenous rather than exogenous forces (Ramsey, 1928; Koopmans, 1963; Cass, 1965). Economists of the endogenous growth model tradition have argued that that knowledge has cumulative and combinatorial properties of knowledge generation represent a particularly important mechanism in economic growth (Romer, 1990; Weitzman, 1998; Aghion & Howitt, 2000). Cumulative aspects of knowledge have inter alia been assessed in context of product varieties (Grossman & Helpman, 1991) or new product qualities (Nelson & Winter 1982; Aghion & Howitt 1992).

Innovation is an important contributor to technical progress and thereby productivity growth, either occurring through an isolated activity (e.g. research and

development confer Griliches, 1979) or as an integrated part of the production theory (e.g. learning by doing confer Arrow, 1971). Whereas innovation regards the creation of something new, technical progress regards improvement of implemented technologies. Johansen (1972) introduces the distinction between embodied technical progress (i.e. improved technologies exploited by fixed capital or intermediates) and disembodied technical progress (i.e. increased output for a given amount of unchanged inputs). Whereas embodied spillovers are caused by suppliers' inability to appropriate the full benefits from the products, disembodied spillovers constitute pure externalities (Scherer, 1984). Invention potential has been subject two alternative main hypotheses. The 'standing on shoulders' argument suggests that the invention potential increases over time, as more knowledge becomes available to build further. The 'fishing out' argument do on the other hand suggests that the invention potential decreases over time, as fewer inventions are left to realize. We refer to Jones (1995) and Jones & Williams (1998) for a formalization of these arguments into Romer's (1990) endogenous growth model. In the heterodox schools of economics and other social sciences, Schumpeter (1976) has been a pioneer within endogenous growth theory and the field of innovation. Schumpeter explains economic growth as a consequence of innovation of new products and technologies with subsequent creative destruction of old products and technologies. Schumpeter also stresses that high reward in terms of large market shares for successful innovations could also contribute to switching the competition from a price setting to an innovation setting. Cohen and Levinthal (1990) and Zahra and George (2002) address firms' ability to recognize, assimilate and commercialize the value of new information.

Reviewed theories of innovation.

Technology transfer makes outstanding impact on increasing effectiveness and development. Especially, technological transfer from advanced economies is vital for less developed countries as economies of these countries mostly is dependent on low-tech. For example, Martin (2019) and Ginevičius et al. (2021) prove the existence of strong link between technology transfer and economic development. Technology transfer from large company to other smaller ones indirectly stimulates both supply and demand (Agrawal & Cockburn, 2003). In general, transfer of technology or knowledge is defined as movement of "know-how", technology, technical knowledge from one place to another (Guan et al. 2006). For example, transfer of "know-how" from foreign capital company to the domestic one (Jude, 2016), from MNCs to the universities of the host country (Hong et al., 2010), from universities, laboratories or public institutions (Bekkers et al., 2008; Villani et al., 2017) to domestic companies (Howells, 2006), or even technology and knowledge transfer within the organization (Calero-Medina & Noyons, 2008). Lopez-Cruz & Obregon (2015) set a part technology and knowledge definitions. Technology is described as tools, techniques, materials, power source which is developed by humans. Meanwhile, knowledge is a human act which is based on personal thoughts, abilities and experience. Hence, knowledge should not be understood as

information and data (Lopez-Cruz & Obregon, 2015). Additionally, the broader definition is provided by anthropologists, who argue that technology transfer in some way, influences culture and habits. By nature, knowledge is non-rival and partially excludable, making it a mixture of a public and club good. As innovation involves by definition concerns development of new knowledge, it may involve classical latent challenges related to public goods such as free-riding and underfunding. Imitation of others can for some agents constitute a more beneficial strategy than being a technological leader, since it requires less investment in knowledge (e.g. as illustrated in the model of Basu & Weil, (1998)). Careful literature analysis of the most cited articles in technology and knowledge transfer has indicated several streams of research: traditional models of technology transfer (Scarra & Piccaluga, 2020), knowledge-based theory (Balboni et al., 2017), organizational transfer (Marz et al., 2006), absorptive capacity (Zahra & George, 2002; Calero-Medina & Noyons, 2008; Apriliyanti & Alona, 2017), organizational innovation (Peris-Ortiz, & Hervas-Oliver, 2014; Gallego et al., 2012; Birkshaw, 2008), social innovation (Alteena et al., 2015), channels of technology transfer which include: technology transfer based on institutional – business cooperation (Bekkers et al., 2008; Villanni et al., 2017), and FDI spill-overs (Glass & Saggi, 1998; Aitken & Harrison, 1999; Fetscherin et al., 2010; Havrenek & Iršova, 2011; Jude, 2016; Wang & Kafouros, 2020).

Traditional models of technology transfer.

The technological innovation, its application has recently been extended towards public sector innovation, universities, healthcare and even social enterprises. Scarra and Piccaluga (2020) define three ways of technology transfer, such as transfer through procurement, transfer through joint development projects, and transfer through patents. Traditional technology transfer models composed by appropriability, dissemination and communication (Lopez-Cruz & Obregon, 2015). Technology transfer which results in technological innovation is the best transferred and absorbed in the partnership networks or as it defined in small world of strategic technological alliances (Verspagen & Duysters, 2004). Traditional point of view towards technology transfer is limited in the context of social innovation. Since it refers to designing technologies that is based on functional logic which might be performed without any reference to the society (Nogami et al., 2017). Thus, technology transfer essentially refers to the movement of “know-how” in high-tech, technological processes or tools, techniques or materials.

Knowledge-based theory of firms

Knowledge-based theory of firms is founded on idea that knowledge is vital resource for existence of a company (Balboni, et al., 2017). Knowledge leads to innovation when it is shared and utilized in collaborative network. Grant (1996) defines four main characteristics of utilization knowledge that are necessary to create added value for a firm: transferability, knowledge potential for aggregation, appropriability, and specialization in knowledge acquisition. Szulanski et al. (2016) describe two knowledge transfer models: “front-loading” and “back-loading”. For

example, “back-loading” is more used in initiation or implementation phases. The authors state that impact of “back-loading” or “front-loading” depend on knowledge transfer difficulty and on relationship between donor and knowledge recipient. Lopez-Cruz and Obregon (2015) support knowledge-based theory and claim that innovation is desirable outcome of knowledge transfer. Traditionally, an innovation refers to technology, modernity, IT, or high-tech in general (Nogami et al., 2017). On the other hand, an innovation is determined as a development of new product, service, production process, organizational structures, administrative system (Aravind, 2014), practices, strategies, and performance (Sempere-Rippol, 2014). Thus, in most of the studies, knowledge transfer refers as an outcome to technological innovation (Bacon et al., 2019; Nogami et al., 2017). Gallego et al. (2012) claim that before implementing technological innovation, organizational or management innovation supposed to be employed. Organizational (management) innovation improves ability of organization to absorb new information and adopt technological innovation. In addition, organizational or management innovation may become as a tool for successful adoption of technological innovation. Controversial definitions of organizational innovation are provided in the scientific literature as well which brings misunderstandings in the concepts of innovation. Some researchers (Lam, 2005) include both technological and non-technological innovations into definition of organizational innovation while the others (Peris-Ortiz & Hervas-Oliver, 2014) describe organizational innovation only as non-technological innovations. Non-technological innovations might be divided into organizational as management innovations, administrative or even marketing innovation. Thus, based on innovation definition, management innovation might be described as all new activities to the company, processes, strategies, or even new business models which are the result of transferred knowledge. Such new business models or strategies might refer even to social innovations.

The foundation of social innovations.

Another relevant literature explores social and economic innovation in developing new business models that solve social problems and create social and economic value (Saji, 2016; Martinez et al., 2017; Aksoy et al., 2019; Gasparin et al. 2020). Social entrepreneurship and social enterprises have emerged in the way how local and civil society responded to societal challenges (such as an unemployment, greying of Europe, sustainable growth and social exclusion or waves of immigration) by developing new social responsibilities in new engaging forms and social economy. Even more, Martinez et al., (2017) claim that social innovation emerges when technological and organizational innovations fail to satisfy needs of society such as reducing poverty, solving climate change problems etc. At the same time, social innovation might to fulfil the gap of public goods supply failure (Gasparin et al., 2020). Social innovation, similarly to technological and organizational innovation, may involve development of new products, services, technological principals, production processes with the purpose to solve social problems in the society. In strategy of Europe 2020 it is pointed out that social

innovation is one of the approaches to achieve its aims. In some European countries 75% of social enterprises devote their activities to solve problems relating to environment (sustainable growth), economic, social and community development and social service delivery (inclusive growth), and training and education (smart growth). For example, Nordic countries have much longer history of implementing social innovations and social entrepreneurship compared to the neighbouring north region such as the Baltic states. In Nordic research proves the evidence that early forms of social enterprises act as a driver for innovations in development of industry, agriculture or communities. Although, in order to transfer knowledge for developing social innovations, various initiatives as programmes, hub, centres, partnerships, networks between partners are established (Milley & Szijarto, 2020), firms very often tend to adopt social innovations through non-formal processes or interaction. Thus, it becomes challenging and difficult even to measure the volume of social innovations or impact of social innovation on sustainable economic growth in the region while using traditional indicators such as R&D, patents (Martinez et al., 2017), profitability customer satisfaction, increased effectiveness, or market share. Even more, knowledge transfer that contributes social innovation requires mixed – model for evaluation its impact as three players participate in successful development of social innovation

Theory of organizational transfer

This theory is based on organization's ability to learn or in other words organizational learning. Organizations face with difficulties of knowledge transfer or even ability to use transferred knowledge to create innovations (Marz et al., 2006). Argote, and Miron-Spektor (2011) highlight that organizations ability to create innovations depend on organization's experience. Another concept in this area is to understand how companies absorb innovative ideas. The concept *absorptive capacity* is a part of organizational transfer theory. Based on the concept of Cohen & Levinthal (1990), absorptive capacity is crucial for a firm in order to create innovations. Absorptive capacity is ability of a firm to recognize new tendencies while analysing external information, absorb, empower and commercialize it. It is noticeable that the number of articles analysing, measuring, and re-conceptualizing absorptive capacity increases rapidly. For example, Zahra and George (2002) split absorptive capacity of a firm into unrealized and realized absorptive capacity which might have different impact on competitive advantage of a firm. Wang and Ahmed (2007), the same as Zahra and George (2002), define firm's capabilities as firm's ability to recreate and renew its materials and intellectual capital, reintegrate, upgrade own capabilities in respect to external changes and to manage to increase or sustain own competitive advantage. Furthermore, high absorptive capability has positive impact on success of technology and knowledge transfer between donor and recipient (Wang et al., 2020). Marz et al. (2006) find that some of organizations strengthen own research and development activities while the others manage to use external information, imitate and learn from competitors. Calero-Medina and Noyons (2008) notice that

absorptive capacity is the subject of research from psychological cognition and learning theories to economics and innovation development, and competition. Tavani et al. (2018), while examining interlinkages between collaboration within innovation networks and two innovation dimensions, find positive effect of collaborative networks on process and product innovations only if absorptive capacity exists. Hence, the differences in partners' absorptive capacity may influence the diffusion of knowledge in social innovation joint projects (Lascaux, 2019). Literature provides five streams of absorptive capability such as organizational learning, knowledge transfer, dynamic capability, and micro-foundations (Apriliyanti & Alon, 2017). Thus, absorptive capacity as multidimensional construct is integrated into different theories of technology and knowledge transfer as well.

Channels of technology and knowledge transfer.

Another stream of research on technology and knowledge transfer, which tries to answer the question how technologies and knowledge that contribute to innovation including social innovations are transfer.

Technology transfer based on institutional – business cooperation.

Most of technology and knowledge transfer studies are devoted to analyse business – university cooperation (e.g. Pertuz et al., 2021). Such high-level interest in university-business cooperation is based on point of view that effective absorption of transferred knowledge from university becomes a part of business strategic perspective as business company gains competitive advantage. Villani et al. (2017) suggest that intermediary institutions such as, university incubators, technology transfer offices, research centres or clusters might improve technology and knowledge transfer from universities to business companies. Howells (2006) claim that intermediaries also would help to transfer technologies from large to small firms. The main purpose of intermediary organizations is to identify potential partners. However, effectiveness of knowledge transfer from public laboratories, research centres or universities highly depend on recipient absorptive capacity. In most cases companies operating in high-tech industries tend to collaborate with research centres and universities (Martin, 2019). D'Este and Patel (2007) discover that university researchers collaborate as consultants, or join contract projects or joint projects. Thus, university research has great potential in collaboration with business companies, especially large corporation which are willing to keep innovatory leadership and to ensure high incomes (Grimaldi et al., 2011).

FDI spill-overs.

Hymer's (1977) dissertation on FDI has created new understanding of movement of international capital and put the background for the present studies in technology and knowledge transfer through FDI. Researchers focus on determinant of FDI or impact of FDI on the host country. FDI may have both positive and negative impact on host economy. Some authors address how relatively poor countries may inherit production and consumption of products abandoned by the country where they were originally developed (Gershenkron, 1962; Vernon, 1966). In today's

global economy, multinational enterprises and foreign direct investments may stimulate economic growth through trade, knowledge transfers and sharing of common resources and value chains (e.g. Xu, 2000; Dinopoulos & Segerstrom, 2010; for multinational enterprises and Borensztein, et al., (1998) and Azman-Saini, et al., Law (2010) for foreign direct investments). Investigating entry and exit costs, Scarpetta et al. (2002) find that they are particularly harmful in markets characterized by product innovation and expansion. In addition, due to transferring technologies and know-how, FDI boost economic growth by increasing productivity and competition between domestic and foreign capital companies (Fetscherin et al., 2010). Scientific literature describes several channels of technology transfer through FDI such as imitation, labour mobility, vertical linkages or even increased competition (Havranek & Iršova, 2011; Jude 2016). Jude (2016) claim that domestic firms less benefit from foreign competition or imitation than from horizontal knowledge diffusion. Fetscherin et al., (2010) notice that intensity of FDI spill-overs differ, or even not all FDI tend to generate technology transfer. Meanwhile, the intensity and direction of horizontal FDI spill overs mainly depends on absorptive capacity of domestic firms as well. Inward FDI may encourage domestic research and development activities and become a driving force for imitation, adoption of know-how. Yokota and Tomohara (2010) state that less developed countries with low-skilled labour force benefit from FDI spill-overs only in low-tech. Meanwhile, less developed countries with relatively high-skilled labour force benefit from technology transfer through FDI in high-tech. Furthermore, technology transfer through FDI full fills technological gap in less developed country and promotes its absorptive capability (Glass & Saggi, 1998). Recent study of Wang and Kafourous (2020) indicates that geographical dispersion has significant impact on FDI spill-over for business groups. Additionally, it has been found that business groups more benefit from FDI spill-overs through affiliates with service and marketing departments. Although, theories of FDI has been evolving for more than 50 years; however, conventionally, it is expected that FDI flows would be directed from advanced economy to emerging economy or less developed one. Even more, lot of studies are dedicated to analyse China's phenomenon (Hong et al., 2010; Blanc-Brude et al., 2014), thus, there is a lack of studies on other regions. Moreover, the situation has changed and more and more MNCs defined as globally born companies expand from emerging countries such as China to the advanced economies. Still, tendencies of FDI flows form advanced economy to other advanced economy are not explored enough.

Proposition of knowledge and technology transfer framework that contributes to social innovations.

Scientific literature has revealed importance of technology and knowledge transfer, their interlinkages with innovation. At the same time, analysis of scientific studies provides some gaps in existing theories of technology and knowledge transfer which leads the development of new integrated knowledge and technology transfer framework that contribute to social innovations including channels of technology,

confer figure 1. The framework is compiled of five main boxes. The first box is dedicated to identify knowledge transfer channels. Based on the scientific literature, business companies, universities, labs, hub, technological centres play role of knowledge transfer channels. Both foreign capital and domestic companies may participate in knowledge transfer, either as single knowledge or technology donor (social investor) or as a part of network. Meanwhile, hubs and technological centres are involved as intermediaries. In addition, all these payers may be integrated into single network to transfer knowledge or technology which result either technological or organizational innovations such as social innovations. First box has linkages with other two boxes: success factors and social innovator. At the same time, both knowledge transfer channels and social innovator are connected by success factors. Success factors are composed of absorptive capacity, geographical distance and cultural compatibility. Scientific literature provides vast articles on absorptive capacity that emphasize its relevance and importance in the process of identifying new opportunities, absorbing new information, ability to use it in creating innovations. Even more, successful distribution of outcomes from innovative products or processes, especially obtained in R&D highly depends on compatibility of absorptive capacity between partners. Lascaux (2019) describe four possible combinations of absorptive capacity among networking partners.

1. High relative absorptive capacity and low absorptive gap. This means that absorptive capacity is similar between partners and low differences. Such combination would lead to balance in collaboration and output of innovations would be implemented and successful.
2. High absorptive capacity and high absorptive capacity gap. In this case both partners are able to identify new opportunities, use information and share it for the development of joint project. However, it might be difficult to combine and use information for creating innovative initiatives for solving social problems.
3. Low relative absorptive capacity and high absorptive gap. In this case, partnership would recognize limited transferable information, ability to use it and create innovations
4. Low relative absorptive capacity and low absorptive capacity gap. Partners have similarities in transferring knowledge and absorbing new information in order to create innovation. This situation is alike in the case of high relative absorptive capacity and low absorptive capacity gap, however, the quality of distribution of innovative outcomes might be lower as well.

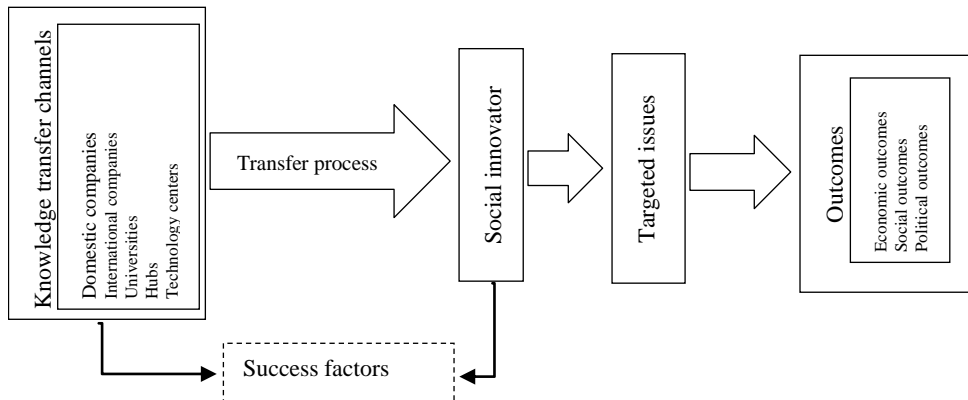


Figure 1: Proposition of new knowledge and technology transfer framework that contributes to social innovations including channels of technology transfer

Source: composed by the authors

The other component of success factors box is geographical distance. This component is more important when social innovation is created due FDI spillovers. On the other hand, cultural compatibility and similarities in cultural identity becomes more even more important than geographical distance.

The other box is social innovator which refers to both profit and non-profit organizations. Meanwhile, scientific literature pays more attention on social innovation of non-profit organizations.

Next box is dedicated to targeted issues which would describe main problem that social innovator tries to solve. For example, demographical problems, climate change, poverty, drugs abuse etc. This box supposed to describe also the factors that creates the problem. For example, poverty might be influenced by low wages, lack of housing, inaccessibility of education, illiteracy, corruption in the country, high inflation, shortage of some product, or difficult situation in economy in general, etc. The other box is dedicated to outcomes. Based on targeted issues, social, economic and political outcomes are expected. As social innovation solves problems for society, the outcomes always supposed to be classified in these three groups. Since, social innovation solves social problems, but it still has impact on economics. Even more, every social innovation requires funding, thus economic outcomes might refer to improved situation in the country, increased incomes of vulnerable groups, etc. In order words, it might be stated that economic outcomes are relevant to financial payback of funded social innovation. Meanwhile, political outcomes are associated to political changes towards the problem which is solved by social innovator. Thus, understanding interaction among knowledge transfer channels and social innovator while solving problems for society, might help to develop or improve policy, or implement to initiatives, or stimulate social innovations particular sector.

Based on the structure of proposed new knowledge and technology transfer model that contributes to social innovations including channels of technology.

Methodology

In 1969 Pritchard has introduced bibliometric analysis. Presently, it is widely used in various research fields. For example, database www.sciencedirect.com provides 2,669 articles with the keyword bibliometric analysis including papers in the fields such as finance (Tandon, et al. 2021), logistics (Moldabekova et. al., 2020), absorptive capacity (Calero-Medina & Noyons, 2008; Apriliyanti & Alon, 2017), foreign direct investment (Fetsherin et. al., 2010; Dzikowski, 2018), inclusive innovation (Mortazavi et al., 2021), and open innovation (Gao et al. 2020), technology and knowledge transfer (Scarra & Piccaluga, 2020), sustainability (Charlier, 2003), sustainable entrepreneurship (Moya-Clemente et al., 2021) and the others. The purpose of bibliographic coupling is to distinguish important citation nodes in the network of research individual publications (Glänzel & Czerwon, 1996). Thus, bibliometric analysis would provide key concepts and development of new paths in technology and knowledge field during all the period. Calero-Medina & Noyons (2008) claim that citation analysis identifies peculiarities of the research field, main concepts and the changes of paradigms. Additionally, bibliometric co-citation analysis shows connection among articles and research topics by providing number of article citation, co-citation by the other articles and distinguishes streams of the research field (Apriliyanti & Alon, 2017). For the methodological purposes, Montazavi et al. (2021) divide bibliometric analysis into three stages. The first stage is devoted to retrieve the “core literature”. Second phase is devoted to the review of “core literature” and the third phase covers bibliometric analysis. The article employs quantitative analysis of the literature. For quantitative analysis the article applies bibliometric co-citation, coupling and mapping keywords. In order to carry out bibliometric analysis, Web of Science data base has been used indexed at SCI-EXPANDED (Sciences Citation Index Expanded), SSCI (Social Sciences Citation Index), A&HCI (Art and Humanities Citation Index), CPCI-S (Conference Proceedings Citation Index – Sciences), CPCI-SSH (Conference Proceeding Citation Index – Social Sciences and Humanities) and ESCI (Emerging Sources Citation Index). The research covers period of 1990 to 2021. The topic containing “technology” provided more than 75,000 articles with in the last 30 years in various disciplines. Later, into the search of TS keywords “technology”, “technology transfer” and “knowledge transfer” has reduced number of articles to 5623. After including topic of “FDI spill-over” and removing all other research fields except economics and business management, the database of 308 articles has been created and used for bibliometric analysis. The software VOSviewer has been used for citation analysis, co-authorship, bibliographic coupling. Finally, the article outlines main concepts on, technology and knowledge transfer with the impact of FDI which contributes to social innovation.

Results

The number of articles on technology and knowledge transfer and has been constantly growing every year (figure 2) which makes more than 75,000 in all fields of sciences. However, the most of the articles has been written in social sciences: management (33%), followed by business (20%) and economics (10%), engineering industrial (6.5%), the lowest number of articles associated with technology transfer and knowledge transfer has been published in the field of materials science multidisciplinary (1.5%).

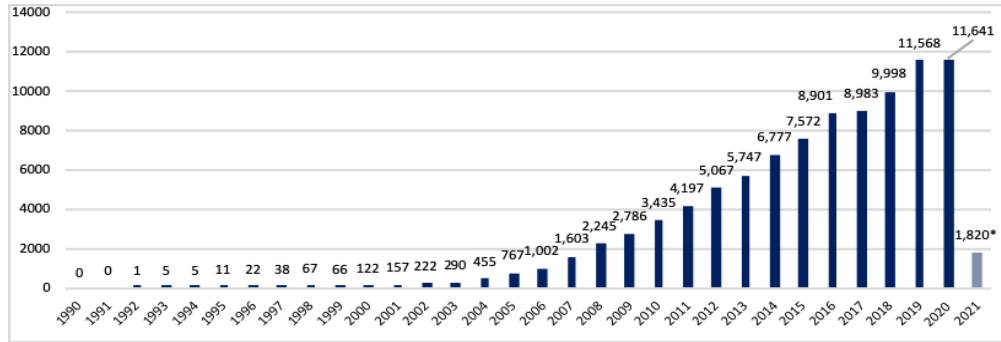


Figure 2: Annual number of publications on knowledge and technology transfer in all fields of studies
Source: composed by the authors. * Up to April 2021.

Although, the bibliometric analysis covers the period of 1990-2021, the first article in WoS has been indicated in the year of 1992 which has been written by Grossman & Helpman (1992). The article has been cited 146 times during the period of 1992-2021 which makes 4.71 times per year. The annual average citation per item in management, business and economics is 29.2 times since 1992.

The research has indicated 10 the most influencing journals in knowledge transfer and technology transfer fields of study (table 1). These journals are: “Research Policy”, “Academy of Management Review”, “Journal of International Business Studies”, “Strategic Management Journal”, “Organization Science”, “Administrative Science Quarterly”, “Technovation”, “Journal of Technology Transfer”, “Academy of Management Journal”, and “International Journal of Management Reviews”.

Table 1. The most influencing journals in the study fields of knowledge transfer and technology transfer (composed by the authors)

Title	TC	AC	Impact factor	Five-year impact factor
<i>Research Policy</i>	11,560	16.9	5.35	7.92
<i>Academy of Management Review</i>	7,718	42.4	8.413	12.44
<i>Journal of International Business Studies</i>	4,881	13.6	3.953	4.373
<i>Strategic Management Journal</i>	4,356	13.4	5.572	

<i>Organization Science</i>	3,647	15.6	2.790	4.975
<i>Administrative Science Quarterly</i>	3,625	58.7	8.304	5.887
<i>Technovation</i>	2,394	10.9	5.729	6.925
<i>Journal of Technology Transfer</i>	2,265	15.1	4.147	4.632
<i>Academy of Management Journal</i>	2,230	17.8	7.571	11.853
<i>International Journal of Management Reviews</i>	2,149	28.6	8.631	9.896

Note: TC- total number of citations, AC - average number of citations

The most cited scientific articles (table 2) show the importance of absorptive capacity. Even more the most cited article analyses absorptive capacity. The other articles identify the role of university in transferring knowledge or technologies to industry.

Table 2. Ten the most cited scientific articles on knowledge and technology transfer
 (composed by the authors)

Title	Leading author	Source Title	Year	TC	AC
Absorptive capacity: A review, reconceptualization, and extension	Zahra, S. A.	Academy of Management Review	2002	4,397	219.85
The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits	Hansen, MT	Administrative Science Quarterly	1999	2,828	122.96
Do domestic firms benefit from direct foreign investment? Evidence from Venezuela	Aitken, B. J.	American Economic Review	1999	1,386	60.26
The reification of absorptive capacity: A critical review and rejuvenation of the construct	Lane, P. J.	Academy of Management Review	2006	1,258	78.63
Absorptive capacity, learning, and performance in international joint ventures	Lane, P.J.	Strategic Management Journal	2001	1,036	49.33
Intermediation and the role of intermediaries in innovation	Howells, J.	Research Policy	2006	849	53.06
Academic engagement and commercialisation: A review of the literature on university-industry relations	Perkmann, M.	Research Policy	2013	841	93.44
Dynamic capabilities: A review and research agenda	Wang, C.	International Journal of Management Reviews	2007	818	54.53
The knowledge spillover theory of entrepreneurship	Acs, Z.	Small Business Economics	2013	766	85.11
University-industry linkages in the UK: What are the factors underlying the variety of interactions with industry?	D'Este, P.	Research Policy	2007	694	46.27

Note: TC- total number of citations, AC- average number of citations

Such high average citation number of Administrative Science Quarterly in the field of technology and knowledge transfer, has been influenced by highly cited articles written by Hansen (1999), Fleming et al., (2007), and Xiao (2007) (Table 1). Studies of Zahra & George (2002), Lane, et al., (2006), and Dhanaraj et al. (2006) have made greatest impact on average annual citation of Academy of Management Review in technology and knowledge field. Further graphical analysis, as shown in figure 3, clarifies relationships between publications by indicating main researchers.

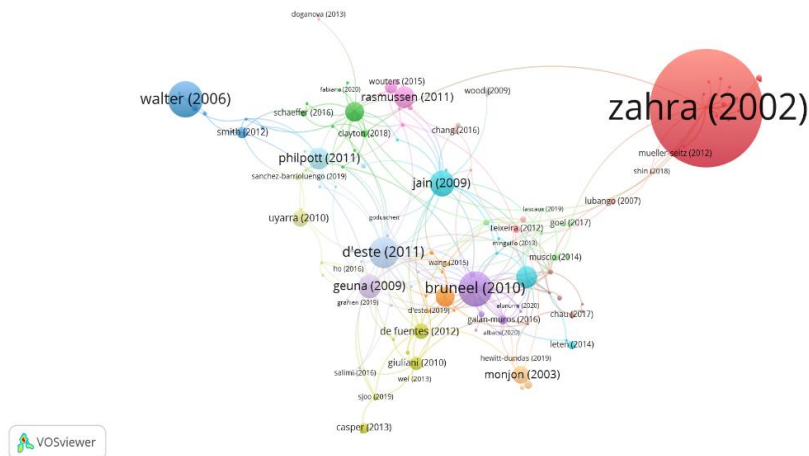


Figure 3: Bibliographic coupling of the authors
Source: composed by the authors

Noteworthy, the article by Zahra & George (2002) is the most cited in the field with the total citation number 4,397 and average annual citation number 219.85 times. Scientific articles of Aitken & Harrison (1999) and Antras (2005) with total citation number of 1,386 times made significant impact on average citation number of “American Economic Review” in the field of knowledge and technology transfer. These findings reflect on high standing of these journals in the communities of scholars in technology transfer, knowledge transfer and innovation science fields. The most cited paper is written by Zahra (2002) which has been cited more than 4,000 times. The size of nodes indicates the significance and prestige of the paper. Based on the colour of nodes it may be identified the main clusters, which provide systemized tendencies and similar point of view in the study field of knowledge and technology transfer.

The analysis of co-occurrence of keywords associated with knowledge and technology transfer in figure 4 indicate that three clusters exist in analysed number of papers. For visual analysis the repeated words or abbreviation with similar meaning have been removed. The leading and outstanding keyword of the first cluster is “technology transfer” which occurred 153 times with 75 links and the total link strength 974. Links attribute indicates the number of co-occurred links of

a given keyword with other keywords. The strength of total link attribute identifies the total strength of the co-occurrence links of a given keyword with other keywords.

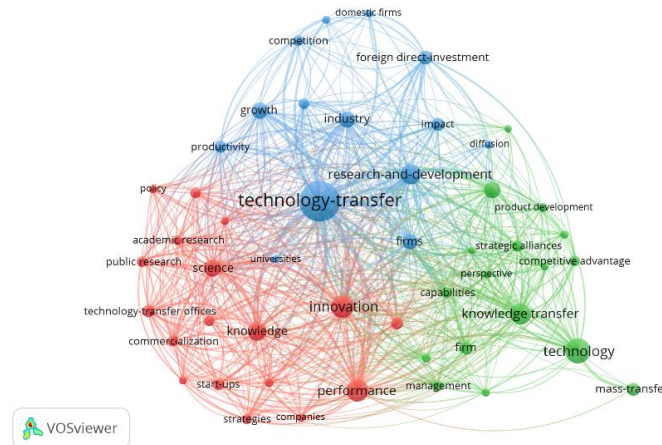


Figure 4: Co-occurrence of keywords associated to technology transfer and knowledge
 Source: composed by the authors

Keyword “knowledge” occurred 81 times and most of the articles including this keyword were published in 2014 with average citation of 96 times. In this cluster similarly cited is keyword “entrepreneurial orientation”. Although “entrepreneurial orientation” has 30 links and occurred 5 times, it has been average cited of 94 times. The third cluster contains two leading keywords “technology” and “knowledge-transfer”. “Technology” occurred 28 times with the 59 links and total links strength of 200, while average citation is 30.9. “Knowledge-transfer” occurred 55 times with total links strength of 121 and average citation is 84.5. Most of the articles including keywords “technology” and knowledge-transfer” have been published in 2015 and 2016 respectively. Analysis of co-occurrence of keyword associated to technology transfer and knowledge has indicated main paths of research in this field of study. It might be concluded that first cluster refers to technology transfer in industry which increases productivity and competition with an impact of FDI spill-overs. The second cluster is technology transfer based on institutional – business cooperation. The third cluster explains absorptive capacity theory. Meanwhile, “social innovation” has not occurred among the keywords which are the most associated to technology and knowledge transfer. Thus, it proves that scientific literature on technology and knowledge transfer which results in social innovation is fragmented. Thus, it requires further research that would extent theory of knowledge transfer and fulfil the gap of the literature that refers to technology and knowledge transfer that becomes driving force to social innovation. Even more, more detailed research would assist in measuring impact of social innovation on social, economic and political outcomes.

Discussion and concluding remarks

Technology and knowledge transfer are multidisciplinary as both are object in different field of studies. The interest of research in technology and transfer is growing every year. The huge number of articles in WoS proves that. Bibliometric analysis has revealed several levels of technology and knowledge transfer: within organization (based on organizational learning theory), from large domestic company to the SMEs, university – business collaboration and from foreign capital company to the domestic ones as the result of FDI spill-overs. Meanwhile, analysis of scientific literature identifies some gaps which is needed to fill in. First of all, there is no single framework which would explain interactions among participants, define the problems which supposed to solved and at the same time show the outcomes. Secondly, there is a lack of studies on knowledge and technology transfer that contribute to social innovations in education, health services, social services and labour market; and the third is that literature mainly focuses on knowledge or technology transfer from advanced to emerging markets.

The novelty of the article is based on developed new framework for knowledge and technology transfer that contributes to social innovations including channels of technology. The framework integrates knowledge transfer channels or in other words potential participant in network for creating social innovation. In order successfully transfer knowledge that would contribute to social innovation, success factors are introduced in the framework. Special attention is paid to absorptive capacity as compatibility of absorptive capacity between partners has remarkable impact on creating and adopting innovations. Proposed framework involves both targeted issues and desirable outcomes. Both targeted issues and outcomes have direct interlinkages with social innovator. Proposed framework might be used for understanding the how transferred technology and knowledge contributes to social innovation in neighbouring geographical regions when both partners are from advanced economies.

For future research on collaboration between foreign and domestic capital companies in neighbouring geographical area might explore the following research questions:

RQ1. What are aims and objectives for social innovation development?

RQ2. How network for developing social innovation has been created? How partners plan own actions, defines mutual aims and objectives?

RQ3. How partners and other stakeholders communicate? What are their roles, financial requirements?

RQ4. What are the challenges in sharing knowledge, preparing joint projects? Are both partners in network and other stakeholders satisfied with the results of innovative outcomes?

RQ5. How targeted issues have been solved, what social initiatives have been introduced to reach expected outcomes?

The framework may also be further developed, for instance by exploring the influence of older seminal contributions over time and the linkages to literature on

related topics (such as economic growth, entrepreneurship, organizational development, performance enhancement and productivity).

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TRANSFER WIEDZY I TECHNOLOGII SIŁĄ NAPĘDOWĄ INNOWACJI SPOŁECZNYCH

Streszczenie: Transfer wiedzy i technologii definiowany jest jako siła napędowa nowych modeli biznesowych, innowacji i rozwoju gospodarczego. Celem artykułu jest przeprowadzenie szczegółowej analizy literatury w celu stworzenia nowych ram transferu technologii i wiedzy przyczyniających się do innowacji społecznych. Aby zbadać poziom badań i najnowsze trendy w tym temacie, artykuł zawiera analizę bibliometryczną dotyczącą transferu wiedzy i technologii. Informacje pochodzą z Web of Science za okres 1990-2021. VOSviewer został wykorzystany do analizy cytowań, współautorstwa i rozpręgnięcia bibliograficznego. W bazie danych WoS odnaleziono ponad 5000 artykułów ze słowami kluczowymi transfer technologii i transfer wiedzy, zindeksowanych według sześciu uznanych indeksów cytowań. Do analizy bibliometrycznej wykorzystano 308 artykułów z dziedziny ekonomii i zarządzania przedsiębiorstwem. Wyniki tego przeglądu integrują koncepcję innowacji społecznych z teorią firm opartych na wiedzy. Ponadto tworzy model transferu nowej wiedzy i technologii, który prowadzi do innowacji społecznych. Tym samym nasz artykuł wpisuje się w teorię firm opartych na wiedzy oraz koncepcję innowacji społecznych.

Słowa kluczowe: transfer wiedzy, transfer technologii, innowacje, innowacje społeczne, FDI spillover, chłonność, analiza bibliometryczna

知识和技术转移成为社会创新的驱动力

摘要:知识和技术转移被定义为新商业模式、创新和经济发展的驱动力。本文的目的是进行详细的文献分析,以创建有助于社会创新的技术和知识转移的新框架。为探讨该课题的研究水平和最新趋势,本文提供了知识和技术转移的文献计量分析。1990年至2021年期间的信息来自Web of Science。VOSviewer已被用于引文分析、合着和书目解耦。在WoS数据库中发现了5,000多篇以技术转移和知识转移为关键词的文章,并被六个完善的引文索引编入索引。对于文献计量分析,使用了经济和企业管理领域的308篇文章。这篇综述的结果将社会创新的概念整合到了企业知识基础理论中。此外,它构成了导致社会创新的新知识和技术转移模型。因此,我们的文章对企业知识基础理论和社会创新概念有所贡献。

关键词:知识转移, 技术转移, 创新, 社会创新, FDI溢出, 吸收能力, 文献计量分析