

**Urszula WNUK**

Institute for Sustainable Technologies – National Research Institute, Radom  
urszula.wnuk@itee.radom.pl

## **THE HUMAN COMPONENT AS A BARRIER TO SUCCESSFUL EXECUTION OF TECHNOLOGY TRANSFER PROCESSES**

### **Key words**

Technology transfer, human component, technology transfer barriers.

### **Abstract**

The intensification of globalisation processes and the development of information societies have led to the increased demand for technologies, which help organisations build and maintain their competitive advantage, both on the national and international market. The transfer of technologies is beneficial for both research organisations commercialising their intellectual property, and companies in which research results are implemented. As a result of technology transfer, novel technological, process and system solutions are brought to the market, which stimulates the development of better, consumer-oriented products and services. The advantages the technology transfer brings to the R&D and business sectors, therefore, directly contribute to the improved level of a country's innovation performance and competitiveness.

As technology transfer is a process that involves interaction between two or more entities, it has to be analysed in a broader socio-technical context, and the importance of the human component cannot be overlooked.

The intention of this paper is to explore the role of the human component in the technology transfer process, and identify human-related factors that can

hinder the transfer of technology from the transferor (the author of technology) to the transferee (the technology beneficiary) representing different market sectors, i.e. the R&D sector and the industry. The analyses concern the transfer of technologies from Polish R&D units, both academic and non-academic.

## **Introduction**

Technology transfer is defined as the movement of knowledge and its assets from one organisation to another to add value to their operations, and as a result boost their competitiveness [1, 2, 3, 4, 5]. It encompasses a complicated process involving the complexity of technology, interactions between the transferor and the beneficiary, and the transferor's capability of teaching, and the acquirer ability to learn [6]. Therefore, the effectiveness of moving innovations from one entity to another depends not only on the nature of the technology transferred (i.e. its complexity, maturity and codification) [7] and the cost-effectiveness of the process [7, 8, 9], but also on numerous human-related factors [7, 8, 10]. Thus, it has to be analysed in a broader socio-technical context. In this context, the role of the human capital needs to be stressed, because it is a central prerequisite for innovation activity [11] and influences the development, dissemination, acquisition, and integration of a new technology. Human-related factors influencing the effectiveness of a technology transfer process can fall into the following three categories:

- Organisation and management (e.g. timeliness [8], effective knowledge and technology management [7, 12], clear business processes ensuring better organisation of the transfer process and helping to comply with the regulatory standards required by the society [13]);
- Personnel capabilities (e.g. tacit and explicit knowledge and the ability to disseminate it, transferor's competencies and the capability of teaching and the absorptive capacity of the transferee [6]); and,
- Social capital (e.g. social ties (i.e. formal and informal networks for cooperation), trust relations, value systems) [7, 14, 15, 16, 17, 18].

The above listed elements of human resources can have a positive or negative influence on the effectiveness of a technology transfer project. In this article, the author focuses on the latter case and shows how human-related factors can in fact hamper the smooth execution of the transfer project and impede the effective implementation of its results in practice.

## **1. Organisation and management**

Research organisations and businesses vary in terms of work organisation and standardised operational procedures, and these differences may interfere

with the successful execution of the technology transfer process. The human-related organisation and management barriers are listed in Table 1.

Table 1. Human-related factors behind unsuccessful organisation and management of technology transfer

- 
- Schedule delays,
  - Unclear division of responsibilities for the execution of the transfer project,
  - Focus on the outputs of the transfer process not its outcomes,
  - Application of inefficient structures and strategies for the management of knowledge (i.e. transfer units, IP protection rules),
  - Lack of clear transfer procedures and regulations,
  - Too much bureaucracy,
  - Stiffness and inflexibility of work organisation and standardised operational procedures.
- 

Source: Author based on [19, 20, 21, 22, 23, 24].

Enterprises often have structural and organisational advantages, including ease of communication and speed of decision-making: whereas, the organisation of work at research units is governed by a lot of red tape and the structure of their management is stiff and inflexible. When approaching a research organisation, businesses frequently face this wall of bureaucracy and their enquiries are not treated with urgency. This fear that the stringent deadlines will not be met is also present during the technology transfer process. R&D organisations often do not realise that businesses operate in a very hostile environment of market changeability and competition, and that the time factor plays a crucial role for their success.

Additionally, while entrepreneurs basically are interested in two major things, i.e. (1) how much they have to spend on the technology, and (2) how much profit its implementation will generate, R&D units often are incapable of providing them with estimations and costs within very stringent deadlines.

Despite third mission<sup>1</sup> assigned to them, Polish universities still are viewed as “ivory towers” in which science is done only for the pursuit of knowledge, and which are difficult to be approached by the practically minded. This attitude stems from the fact that Polish academia is still focused mainly on teaching and basic research, and there still is little interest in commercialisation of its results. Many Polish universities established special technology transfer units; however, there usually are more than one such organisations functioning within their structure (e.g. business incubators and technology transfer offices (TTOs)), as a result of which their responsibilities frequently overlap. When it comes to

---

<sup>1</sup> Traditional two missions are teaching and research. The third mission concerns greater involvement with the society and commercialization of research results for the benefit of the country.

Polish PROs,<sup>2</sup> the technology transfer requires the high involvement of individual researchers at all its stages, since TTOs are still rare.

## 2. Personnel capabilities

The focus of a technology transfer process is the dissemination of expertise regarding scientific and innovative practice to individual organisations to help them manage the challenges of using that knowledge and/or its products to create change within their work settings [25]. Therefore, it requires certain skills and abilities from both the technology transferor and its beneficiary, which are presented in Table 2.

Table 2. Personnel capabilities required in a technology transfer process

Transferor (R&D unit)	Transferee (enterprise)
<ul style="list-style-type: none"> <li>– Technical skills and competence</li> <li>– Competence in the field of innovation commercialisation (e.g. how to protect IP, what mechanisms of technology transfer to us, skills in marketing of innovations, skills in negotiations etc.)</li> <li>– Openness to the market needs</li> <li>– Ability to teach (e.g. clear manuals, simple language of training)</li> </ul>	<ul style="list-style-type: none"> <li>– Technical skills and competence</li> <li>– Ability to adapt technology management tools and strategies to rapidly changing technologies</li> <li>– Openness to innovations</li> <li>– Ability to learn (e.g. how to operate and maintain a new machine, etc.)</li> </ul>

Source: Author based on [6, 19, 20, 23, 26].

The dissemination of knowledge and the transfer of its tangible assets may be impeded by the lack of the above listed personnel capabilities.

Businesses frequently report a shortage of a qualified personnel and technological weaknesses, such as the lack of technical and competence skills to implement and manage complex technologies. They also exhibit a lack of knowledge or interest in new technologies, or they are not familiar with the activity of R&D organisations. Therefore businesses unwillingly turn to R&D organisations when in need of a specialist equipment or services.

Research organisations often lack competence in the effective execution of the technology transfer process. They inefficiently promote the results of their research and lack knowledge of commercialisation procedures, mechanisms, and structures.

The ability to teach and learn are the components of broader interactions between the transferor and the transferee, and therefore constitute one of the attributes of the social capital described in detail in the next section of the article.

<sup>2</sup> Public Research Organization of non-academic character.

### 3. Social capital

Social capital is the product of social interactions. It encompasses many aspects of a social context, such as social ties, trusting relations, and value systems that facilitate actions of individuals [27]. It is a network of relationships that form a valuable source of resources. As technology transfer relies heavily on direct contacts and serendipity to create links between research and its potential applications [12], its success depends on the quality of the links between the technology transferor (i.e. the R&D unit) and its beneficiary (i.e. industry).

As Autio and Laamanen state [16], technology transfer is an intentional and goal-oriented interaction between two or more social entities; therefore, communication and interaction abilities between the stakeholders of the technology transfer are crucial for the effective execution of this process. However, successful cooperation of the business and the R&D sector and the creation of linkages between them can be hampered by numerous social capital barriers (Table 3), which can take the form of cultural, trust, and motivation issues.

Table 3. Social capital barriers to technology transfer

Cultural	Trust	Motivation
<ul style="list-style-type: none"> <li>– Language barriers (i.e. language of science vs. language of business)</li> <li>– Different value systems, priorities and expectations (i.e. focus on intangible benefits vs. focus on tangible benefits)</li> </ul>	<ul style="list-style-type: none"> <li>– Secrecy</li> <li>– Suspiciousness</li> </ul>	<ul style="list-style-type: none"> <li>– Different reasons for cooperation</li> <li>– Individual goals over shared goals</li> <li>– Lack of motivation to transfer research results</li> </ul>

Source: Author based on [6, 7, 12, 13, 14, 15, 18, 24].

The potential communication difficulty in technology transfer processes is widely studied in literature, and various reasons for its occurrence are quoted [7, 14, 15, 18, 19, 20, 21, 22, 23, 28, 29]. Scholars active in the field of technology transfer usually treat cultural difference as the main human-related factor behind communication breakdown between the representatives of the R&D and the business sector.

Culture is reflected in values, norms, and practices. However, business and scientific culture significantly vary in terms of value systems, priorities, expectations, and language, which all form a set of barriers to successful communication and execution of joint projects, including technology transfer projects. R&D organisations disseminate the results of their research in usually complicated, scientific jargon, which is incomprehensible for someone not familiar with it. The application of different value systems results in conflicts of interest

between the science and the business sector. R&D organisations are interested in having the results of their work published and disseminated to the public. Enterprises, on the other hand, are often more secretive about the outcomes of research in the search for competitive advantage and ultimately profit. These fundamental differences of opinion are often reconciled in research agreements, but this remains a major and a quite difficult to overcome barrier to technology transfer. Therefore, culture differences are behind the technology transfer stakeholders' inability to develop shared goals and alliances and one of the greatest barriers to the success of the technology transfer process.

Trust is another attribute of social capital, and trust issues may significantly impede the execution of the transfer process. The transfer of technologies from the R&D sector to industry is generally a low-trust environment. Businesses are often sceptical towards new technologies developed at PROs or universities or towards the ability of research organisations to stick to deadlines, or rise to their requirements [20, 23], and are more likely to implement solutions by global conglomerates or well-known companies. Researchers, on the other hand, are afraid to trust companies with the results of their research. They are afraid that the outcomes of their work can be copied by the business or shared without the consent of the R&D organisation, and their value purposefully lowered by the enterprise interested in their purchase.

Motivation factors can also negatively influence the success of a technology transfer process. Scientists and researchers still lack entrepreneurial drive and there are too few incentives that would encourage them to transfer the results of their R&D activity. Entrepreneurs enter a technology transfer project because they are interested in increased cost savings that the application of a technology may bring them. R&D institutions treat the transfer of technologies as a process that, when ending with a successful industrial application, will yield additional income for the execution of future research, but most of all will boost their prestige and competitiveness. The business is therefore more focused on the outcomes of the technology transfer process (i.e. long-term economic, social and operational benefits), while PROs and universities still pay more attention to the outputs of this process (i.e. number of publications, patents, licenses, start-up or spin-off companies) [20, 23, 24].

### **Summary and conclusions**

Despite being a costly and a lengthy process whose outcomes are often uncertain, the transfer of research results is extremely beneficial to organisations participating in it, and it plays a key role in the economic development of the country at the same time. Therefore, overcoming barriers to its success should be a priority.

When it comes to the success of the technology transfer project, along with financial, technical and organisational factors, it is the human capital, expressed particularly in the organisation and management of work, personnel capabilities as well as interpersonal skills needed to create human ties, and understanding and trust on both sides of the partnership that count the most.

Previous collaboration experience, personal connections, and informal communications are beneficial, but formal ties between the research organisation and industry should also be established. These can be achieved through the creation of networks of cooperation or the development of IT platforms for knowledge and technology dissemination and building close ties with the industry sector, which facilitates the establishment of long-term relations and stimulates the joint execution of future R&D projects, including technology transfer.

For technology transfer to function properly, the organisations involved in this process should endeavour to build a culture of mutual trust through effective communication between the technology transferor and its beneficiary. Establishment of trust between the stakeholders of the technology transfer process can help build long-term collaborations, enhance communication efficiency, and as a result, facilitate teaching and learning interactions between the stakeholders, which leads to fruitful knowledge and experience exchange leading to effective implementation of research results in industry. Long-term cooperation addresses the miscellany of stakeholder values, priorities and expectations, and helps overcome organisation barriers in R&D projects. Over time, researchers and business people will develop better joint understanding and common language, which also helps them to overcome cultural barriers. Therefore, it is beneficial for enterprises to be involved in the execution of a R&D project from the start, because it will facilitate future transfer of its results, as the adoption of more open models of cooperation facilitates collaborative knowledge and experience sharing which has positive effects on inter-organisation communication and relationships.

*Scientific work executed within the Strategic Programme “Innovative Systems of Technical Support for Sustainable Development of Economy” within Innovative Economy Operational Programme.*

## References

1. Rogers E.M. (ed.): Inducing technological change for economic growth and development. East Lansing, MI, Michigan University Press, 1972.

2. Johnson S.D., Gatz E.F., Hicks D., Expanding the Content Base of Technology Education: Technology Transfer as a Topic of Study, *Journal of Technology Education* Vol. 8, No. 2, Spring 1997.
3. Matusiak K.B. (red.): *Innowacje i transfer technologii. Słownik pojęć*, wydanie III zaktualizowane, Polska Agencja Rozwoju Przedsiębiorczości, Warszawa 2011, pp. 301–303.
4. Poznańska K., Łobjeiko S., Brdulak J., Chinowska K.: *Systemy wspierania innowacji i transferu technologii w krajach UE i w Polsce*, Polska Agencja Rozwoju Przedsiębiorczości, Warszawa 2003, p. 42.
5. Mazurkiewicz A., *Modelowanie transformacji wiedzy do praktyki w budowie i eksploatacji maszyn*, *Studia i Rozprawy*, Instytut Technologii Eksploatacji, Radom – Poznań 1999.
6. Lee A.H.I., Wang W-M., Lin T-Y.: An evaluation framework for technology transfer of new equipment in high technology industry, *Technological Forecasting and Social Change* 77(2010), pp. 135–150.
7. Lin B.W, Berg D.: Effects of cultural difference on technology transfer projects: and empirical study of Taiwanese manufacturing companies, *International Journal of Project Management* 19 (2001), pp. 287–293.
8. Might R.J., Fischer W.A.: The role of structural factors in determining Project management success, *IEEE Transactions on engineering Management* 32 (1985), pp. 71–77.
9. Bućko J.: Ocena finansowa i drogi wzrostu efektywności projektów innowacyjnych [in] Bućko J., Ruta R., Rosmańska E., *Zarządzanie projektami innowacyjnymi*, ITeE-PIB, 2006, pp. 33–52.
10. Wnuk U.: Legal Regulations and Governmental Initiatives Fostering Research Results Commercialisation, *Maintenance Problems* 3/2010.
11. Romer P.: Endogenous technological change, *Journal of Political Economy*, Vol. 98(5) pt. 2, 1990, <http://pages.stern.nyu.edu/~promer/Endogenous.pdf> [accessed: 13.02.2014].
12. Hargadon A.: Brokers of innovation: lessons from the past, *Focus*, Vol. 8 No. 1, 2004.
13. Harris D., Harris F.: Evaluating the transfer of technology between application domains: a critical evaluation of the human component in the system, *Technology in Society* 26 (2004), pp. 551–565.
14. Evald M.R., Klyver K., Svendsen S.G.: The Changing Importance of the Strength of Ties Through the Entrepreneurial Process, *Journal of Enterprising Culture*, Vol. 14 (1) (2006), pp 1–26.
15. Kedia B.L., Bhagat R.S.: Cultural constraints on transfer of technology across nations: implications for research in international and comparative management, *Academy of Management Review* 13(1988) pp. 559–571.



16. Autio A., Lemanen T.: Measurement and Evaluation of Technology Transfer, *International Journal of Technology Management*, Vol. 10 (1995), pp. 643–664.
17. Anatan L.: Managing technology transfer through university-industry collaboration, [https://www.academia.edu/2650413/Managing\\_Technology\\_Transfer\\_Through\\_University-Industry\\_Collaboration\\_A\\_Literature\\_Review](https://www.academia.edu/2650413/Managing_Technology_Transfer_Through_University-Industry_Collaboration_A_Literature_Review) [accessed 10.02.2014].
18. Abidin R., Hasnan N., Abdullah C.S., Mohtar S., Zulhumadi F.: Relationship between Social Capital and Technology Transfer Performance: A Study on Companies in Technology Park, *Journal of Southeast Asian Research*, Vol. 2013, [https://www.academia.edu/4929477/Relationship\\_between\\_Social\\_Capital\\_and\\_Technology\\_Transfer\\_Performance\\_A\\_Study\\_on\\_Companies\\_in\\_Technology\\_Park](https://www.academia.edu/4929477/Relationship_between_Social_Capital_and_Technology_Transfer_Performance_A_Study_on_Companies_in_Technology_Park) [accessed 10.02.2014].
19. Trzmielak D.: Problemy komercjalizacji technologii w Polsce i na świecie – analiza wyników badań, *Zeszyty Naukowe (642) Ekonomiczne Problemy Usług (64)*, 2011, pp. 59–78.
20. Matusiak K.B., Guliński J.L Kierunki doskonalenia systemu transferu technologii i komercjalizacji wiedzy w Polsce. Zadania dla rządu i administracji centralnej, *Zeszyty Naukowe Uniwersytetu Szczecińskiego (642) Ekonomiczne Problemy Usług (64)*, 2011.
21. Stawasz E.: Główne obszary sił motorycznych i napięć w systemie transferu i komercjalizacji technologii w Polsce, *Zeszyty Naukowe Uniwersytetu Szczecińskiego (642) Ekonomiczne Problemy Usług (64)*, 2011.
22. Jasinski A.H.: Barriers for technology transfer: the case of a country in transition, *Journal of Technology Management in China*, Vol. 4 Issue 2 (2009), pp. 119–131.
23. Matusiak K.B., Guliński J., System transferu technologii i komercjalizacji wiedzy w Polsce – Siły motoryczne i bariery, *Polska Agencja Rozwoju Przedsiębiorczości*, Poznań – Łódź – Wrocław – Warszawa, May 2010.
24. West D.M.: Improving University Technology Transfer and Commercialization, *Issues in Technology Innovation*, Number 20, December 2012, [http://www.insidepolitics.org/brookingsreports/University\\_Tech\\_Transfer.pdf](http://www.insidepolitics.org/brookingsreports/University_Tech_Transfer.pdf) [09.02.2014].
25. Backer T.E.: The failure of success: challenges of disseminating effective substance abuse prevention Programmes, *Journal of Community Psychology*, Vol. 28, No. 3, (2000) 363–373, p. 364.
26. Matusiak K.B., Guliński J. (eds.): Rekomendacje zmian w polskim systemie transferu technologii i komercjalizacji wiedzy, *Polska Agencja Rozwoju Przedsiębiorczości*, Warszawa, September 2010.
27. Tsai W., Ghoshal S.: Social capital and value creation: the role of intra-firm networks, *Academy of Management Journal* 41: 464–476, 1998.

28. Wright R., How to get the most from university relationships, MIT Sloan Management Review, Vol. 49, No. 3 (2008), [http://viewswire.eiu.com/report\\_dl.asp?mode=fi&fi=843254469.PDF](http://viewswire.eiu.com/report_dl.asp?mode=fi&fi=843254469.PDF) [accessed 07.02.2014].
29. Malik K.: Aiding the technology manager: a conceptual model for intra-firm technology transfer, *Technovation*, 22(7) 2002, pp. 427–436.

## **Czynnik ludzki jako bariera skutecznej realizacji procesu transferu technologii**

### **Słowa kluczowe**

Transfer technologii, czynnik ludzki, bariery.

### **Streszczenie**

Wraz z intensyfikacją procesów globalizacyjnych i rozwojem społeczeństw informacyjnych znacząco wzrasta zapotrzebowanie na nowe technologie, które pozwalają organizacjom budować i utrzymywać przewagę konkurencyjną zarówno na rynku krajowym, jak i na rynkach międzynarodowych. Wiedza i tworzone na jej bazie innowacje odgrywają istotną rolę w kreowaniu wartości dodanej przedsiębiorstw oraz jednostek naukowo-badawczych i tym samym przyczyniają się do wzrostu konkurencyjności i innowacyjności krajów. Ze względu na fakt, że transfer technologii jest procesem polegającym na interakcji między dwoma (lub więcej) podmiotami, musi on być analizowany w szerszym kontekście społeczno-technicznym, co oznacza, że rola czynnika ludzkiego nie może zostać pominięta.

Celem artykułu jest zaprezentowanie roli czynnika ludzkiego w procesie transferu technologii. W pracy skoncentrowano się na negatywnym wpływie tego czynnika na efektywność procesu transferu technologii pomiędzy polskim sektorem nauki i biznesu.