Knowledge Transfer and Technology Commercialization – Comparative Study[1]

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Abstract:

The paper presents results of the research conducted in a form of in-depth interviews and an online survey mirroring a series of target groups: scientists and entrepreneurs in Poland, two developing EU countries (the Czech Republic and Hungary), two developed EU countries (Norway, France), USA and Canada. The aim was to gather insights concerning a model of cooperation between science and business in the process of knowledge transfer in Poland. The work involved a comparative analysis with systems identified in: developed European countries; European countries similar to the Polish stage of development of knowledge transfer; the USA and Canada. The results shows that Polish respondents underestimate the relational factors like: active entrepreneurs in initiating cooperation, responsiveness, openness, trust, and good communication skills. Good relationships between scientists and businesses should be built based on two main characteristics: activity of entrepreneurs and scientists openness for business needs. Both academics and entrepreneurs rank the existence of mutual understanding of each others' needs and commitment as essential.

Keywords

university, knowledge transfer, commercialization, innovation, entrepreneurship, Poland.

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Introduction

The subject of the publication is the knowledge and technology transfer system and it aims to provide inspiration and practical guidance to representatives of universities, companies and public administration for the creation and development of innovation networks. The rate at which new knowledge and research results are absorbed by the economy sets the pace for the acquisition of permanent competitive advantages for both enterprises and regions. In Poland, low levels of knowledge transfer and technology commercialization have been identified. Currently many institutions are supporting entrepreneurs and researchers in the conception and implementation of innovation in Poland. The number of innovation institutions is still growing (Matusiak, 2010). Although these centers have an important role to play in building competitive advantage in the economy, they are weak and fragmented. Individual cells of the system: business, science, and R & D units all operate in isolation. Their ability to provide services for innovation, especially those that are highly specialized and world-class is still unsatisfactory. The Polish system of technology transfer and commercialization is poorly prepared for the challenges of globalization and European integration (Matusiak, Guliński, 2010). In all Polish regions there is a fragmentation of the innovation system. Individual centers, HEI[2]s and R&D institutions do not know each other. They do not cooperate, but rather compete for public funds and clients. In the wider innovation network a lack of trust and cooperation between actors is one of the most important problems facing the Polish system of technology transfer and the commercialization of knowledge.

Current understanding

A lack of cooperation between the science and businesses sector, and a need for cooperation are pointed to by many authors (Kondratiuk-Nierodzińska, Grabowiecki, 2004). There are many barriers to overcome in technology transfer, mainly because research organizations and the commercial sector have different aims and norms (Nelson & Byers, 2005), time frames, language (Trzmielak, Gwarda-Gruszczyńska & M. van Geenhuizen, 2010), and culture. Another barrier can be the weak absorptive capacity of the partners (Trzmielak, 2011). One of the indicated reasons is the lack of equity funds and the high costs of innovation. The influx of EU funds has already changed a negative image of Polish research centers and companies in the area of knowledge transfer. As indicated by Gwarda-Gruszczyńska (2013) there is potential for increased cooperation. However, the Polish innovation indicators and incomes of HEIs and R&D units only change very slowly. Research results obtained by the authors confirm constantly low levels of collaboration between researchers and entrepreneurs. Four out of five surveyed entrepreneurs declared no cooperation with the scientific community.

2 HEI – Higher Education Institution

On the other hand there is constant pressure on universities to work on applicable research and to focus their teaching and research efforts on ways that have a direct impact on their local regions. Regional and national economies pressure universities to become leaders in today's global market. The challenges posed by the market, associated with optimal knowledge transfer to industry and the conversion of scientific and technical knowledge into new products and services, all force a change in research units' approaches to cooperation with companies. Application of marketing concepts in the processes of commercialization of research results is important. References to science marketing called by some authors 'science to business' marketing can be found in the innovation management and technology transfer literature rather than in the marketing literature: Jolly (1997), Etzkowitz (2002), Bok (2003), Butler and Gibson, eds (2001), Markman et al (2005), Frischmann (2005), Shankar (2008), Baaken (2009), Baaken and Plewa (2009). The Polish literature on science marketing is very thin. Only few articles about marketing of research results can be found (Jasinski (1998), Pomykalski (2001), Bialon (2012)). According to Bialon (2011) R&D organizations do not run marketing research, do not segment market and have small knowledge about the demand for new technologies. Kruk writes about the marketing of product innovation (2012). Trzmielak & Grzegorczyk (2010, 2014) write about marketing for technology transfer and commercialization and the role of relationship marketing in fostering university technology transfer and commercialization. Relationship marketing is a wide marketing concept that has been described by many authors: Reichheld & Sasser (1990), Berry (1995), Grönroos (1994,1996), Gordon (2001), Gummesson (2002), Ballantyne, Christopher & Payne (2003), Kumar & Reinartz (2006), Storbacka & Lehtinen (2001), Otto (2004). Relationship marketing is conducive to the creation of innovative ideas and that is why it could also be helpful in fostering commercialization processes at research and higher education institutions.

Methodology

The following research aims have been identified:

1. To enhance the understanding of relationships between science and business in the process of knowledge transfer in Poland,
2. To conduct comparative analysis of Poland with other countries,
3. To identify required changes in the existing cooperation models of chosen industries,
4. To develop recommendations for improved relations between universities, R&D units and companies.

Direct and indirect methods of data gathering were used in the research including direct measurement (in-depth interview) and indirect measurement (e-mail survey). Two measuring instruments were created: a questionnaire and an interview scenario. The combination of

direct and indirect methods provided both quantitative and qualitative data. First, in 2012 a series of in-depth interviews was conducted with Technology Transfer Office staff in each institution. Institutional interviews were also conducted with faculty and university top management. Institutions researched were drawn from among the 20 biggest universities in Poland. The aim was to identify barriers to, and drivers for, the knowledge transfer and university research commercialization system in Poland. Following this first step, an online survey was conducted focussing on a series of target groups: scientists and entrepreneurs (representing businesses) in a series of territories comprising: Poland, two developing EU countries (Czech Republic, Hungary), two developed EU countries (Norway, France), USA and Canada. The aim was to gather insights concerning factors for improving relationships between science and business. From April to August 2014 an online questionnaire has been sent by e-mail to 10 000 respondents from two target groups: scientists and business representatives in Poland, four EU countries and the United States.

We sampled purposefully, selecting respondents meeting chosen criteria for the study. This was a purposeful sample, in the sense it is not intended to be representative, but rather is likely to have the characteristics that we want to examine. Such sampling does not allow the results to be generalizable to the wider population but they may be generalizable at a conceptual level (Jack et al., 2008). We choose two European countries in a similar stage of development to Poland, two European well developed countries and USA to make some comparisons, to find differences and similarities and to learn lessons. The research population was created according to the criteria of institution: scientific research institution and enterprise from a chosen sector. The main interest of the scientists were in the sectors: biotechnology, information technology, energy and the environment, chemistry and food technology and new technologies. An additional criterion for the selection of companies was experience in cooperation with research centers and innovation. We used the lists and websites of research institutions, science and technology parks and technology incubators. The lists used recorded information about companies that the universities cooperate with. We also used published reports and rankings of most innovative companies. Scientist was defined as a person working in scientific research institutions (mostly high schools). A database of scientists was established on the basis of academic institutions data including universities registers, for example from the Ministry of Science and Higher Education and European Commission. The test results presented in this article, refers to the level of statistical significance below 0.05.

From the 10 000 sample we received 554 answers. The survey yielded a response rate of 5,54 %. After removing cases with missing data, the results presented here are based on a final N of 361 responses. Two out of three respondents represent business, while every second response represents Poland, every seventh East and Central Europe countries and West Europe countries 20 % of the questionnaires were submitted by American and Canadian scientists. While the views presented in this paper are imperfect representations of reality, and are not representative of, or applicable to, every academic discipline we believe that they are an important point in an ongoing discussion. That

discussion seeks to understand the building of knowledge and competence in scientific and research centers and more effective and efficient processes of knowledge transfer especially in developing countries.

Findings

We have analyzed the factors that inhibit or intensify the integration of entrepreneurs and researchers. Analysis of a cross table revealing the relationships between scientists and entrepreneurs has focused on the ranking of characteristics of good relationship. We tested characteristics in two groups: structural and relational drivers and barriers. Three structural features were identified as significant: experience in cooperation; business orientation of HEI; and presence of business incubators in the region (Fig1).

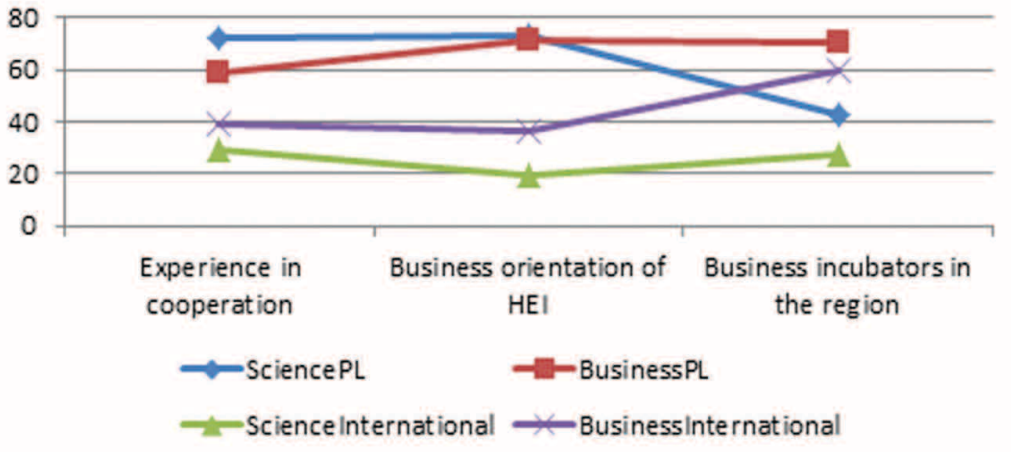

Figure 1: Factors mostly influencing the development of science-business relations (in percentage)

Source: own research

In the case of cooperation between universities and business it can be said that these activities involve interaction between individuals belonging to systems that are very different in their identity and mission. The results show that entrepreneurs, both Polish and from the other countries surveyed, envisage a greater role for business incubators in the region and their impact on the possibilities of cooperation with science than scientists themselves. It is interesting that Polish respondents attach greater importance to earlier HEI experience in cooperation and business orientation. This is particularly evident in the graph showing the international scene (Fig2). Brown and Oplatka (2010) indicate that Canada and the US deregulated the higher education market in nineteen-eighties. Canadian and US universities made efforts to gain a larger share of international research

at the end of Twentieth Century. Poland started to change its low position in the scientific research area in 2005, introducing the obligatory regulation on intellectual protection and technology transfer office creation. The importance of Polish university business orientation follows the deregulation policies gradually introduced in Poland. It is widely assumed that in the context of increasing competition higher education institutions need to improve their market approach.

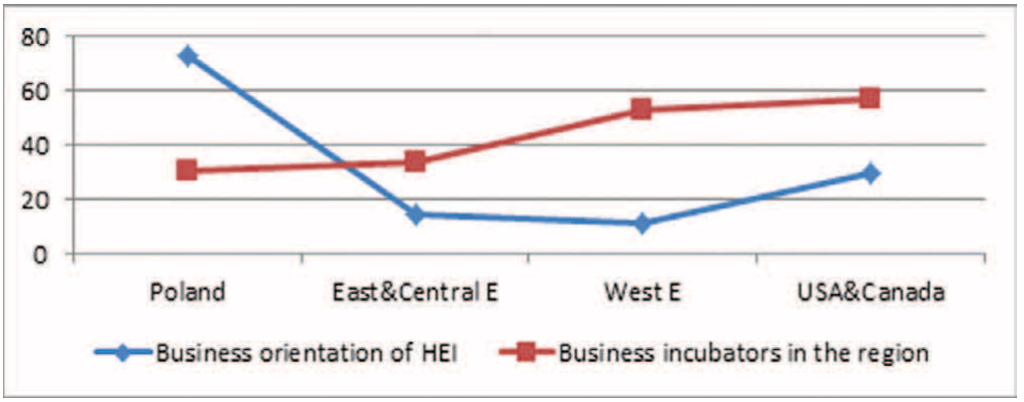

Figure 2: Factors mostly influencing the development of science-business relations – international perspective (in percentage)
Source: own research

Business incubators are also a new idea in East & Central countries. A significant growth in the number of incubators in Poland occurred at the beginning of nineteen-nineties. Their role in high-tech companies development still is small because of many barriers to start-up creation (Trzmielak,2011). Polish companies showed too little interest in technology transfer and the scale of the diffusion process for technology was too small (Jasiński, 2005). The Batavia Industrial Center (founded in 1959 by J. L. Mancuso) is recognized as the first US business incubator (Zehner, 2011). The economic impact on the region surrounding has been significant. Therefore the high influence of business incubators on science and business cooperation in the US, and by extension in Canada and Western European countries, is understandable (Matusiak, 2006).

A pretest of characteristics from the second tested group (relational drivers and barriers) suggested following relational attributes to be taken into consideration in the further quantitative research: scientist and entrepreneur activity in initiating relationship, communication, responsiveness for offer, openness for business and scientists needs, mutual trust, easy accessible and attractive offer, competence in collaboration. From the international perspective, six features were identified as being significant: active entrepreneurs in initiating cooperation; sufficient scientist responsiveness to the business

offer; sufficient entrepreneur responsiveness to scientific offers; sufficient entrepreneur openness for scientists' needs; sufficient entrepreneur trust for science; and good communication skills of scientists (Fig3).

What can be noticed is that a proportionally larger group of American and Canadian respondents in the surveyed population referred to a significant role for entrepreneurs in initiating cooperation with science and sufficient responsiveness to a scientific offer. Every second US and Canadian respondent indicated that an active entrepreneur was a crucial market player in business and science alliances. Two out of five surveyed respondents emphasized entrepreneur responsiveness for scientific offers as being sufficient for cooperation. This was three times higher a number of respondents than is seen in Poland.

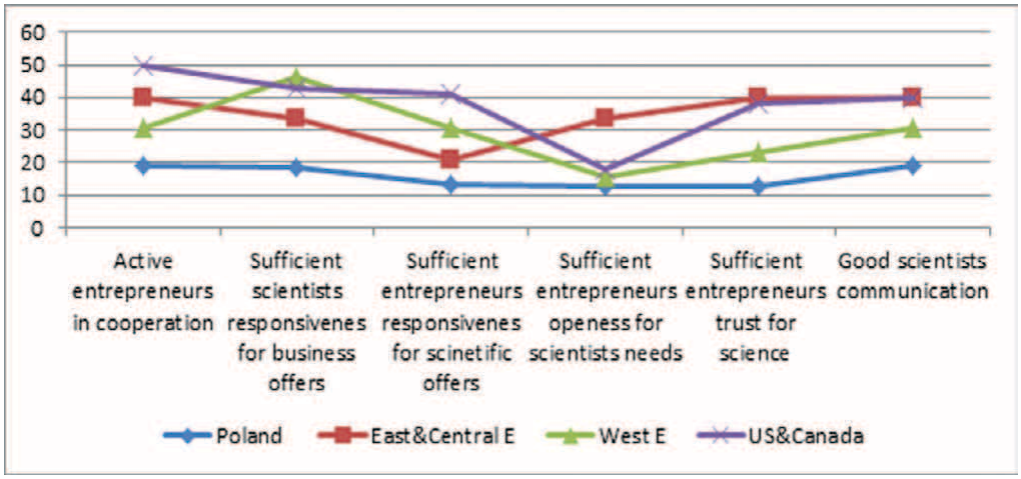

Figure 3: Essential drivers of good scientist entrepreneur relationship – international perspective (in percentage)
Source: own research

Proportionally more American and Canadian respondents confirmed the role of the six analyzed characteristic in the process of building good relationships than is seen for Polish, East Central European and Western European scientists and businessmen. Thus, the results show that respondents from developed countries (noting higher innovation rates) rate relational drivers as "essential". The results shows that Polish respondents underestimate the relational factors and their responses vary considerably from the reports of scientists and entrepreneurs from other countries.

Furthermore, the dependence between scientists, entrepreneurs and relationship drivers has been analyzed. We found the following four characteristics to be statistically significant for both target groups: activity of entrepreneurs; good communication skills

of scientists; sufficient scientist openness for cooperation; and accessible entrepreneurs offer for scientists (Fig. 4). The first two attributes were indicated in the previous analysis (Fig.3). They confirm that entrepreneur activity can be a critical factor in building good relationship between science and business.

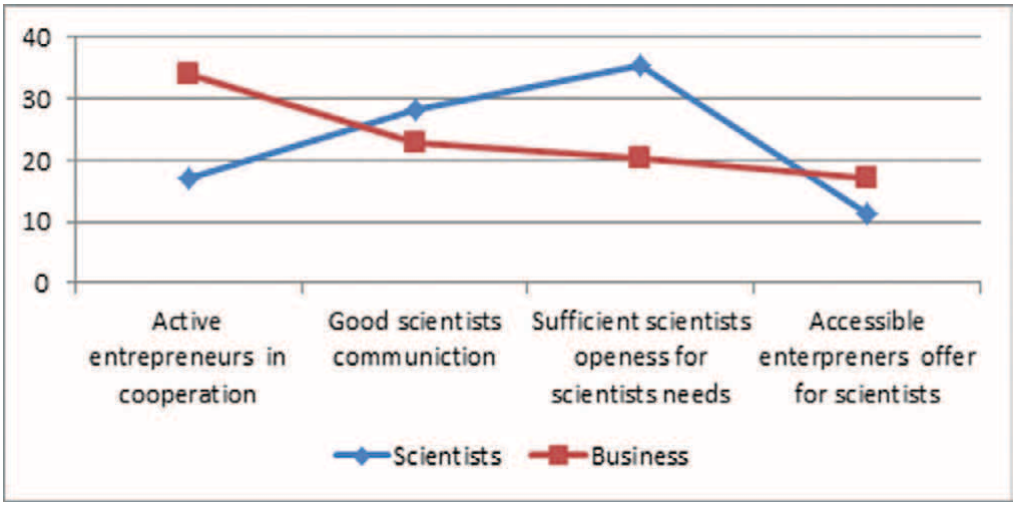

Figure 4: Essential relational drivers – perspective of entrepreneurs and scientists (in percentage)

Source: own research

Every third entrepreneur surveyed declared that in their opinion active entrepreneurs play a fundamental role in science and business cooperation. There were twice as many indications as those made by scientists. On the other hand, scientists indicated 'sufficient scientist openness to business offer' as essential (Fig. 4). Summarizing this part it can be stated that good relationships between scientists and businesses would be built based on two main characteristics: activity of entrepreneurs and scientists openness for business needs.

Finally, respondents were asked to rank characteristics of good relationships in the context of knowledge transfer and technology commercialization. The results show that both academics and entrepreneurs rank the existence of mutual understanding of each others' needs and commitment as essential drivers (statistically significant at the 5 % level or better). The feature "understanding each other' needs" has been reported mostly by respondents in the United States when "commitment" was most important for Polish respondents. Half of respondents rank the first feature as the first and second position on the ranking scale. Therefore it can be stated, following Statt's [1997] theoretical research on psychological approach, that the central dilemma for university organizations is that successful cooperation is likely to motivate entrepreneurs to be active in cooperation and encourage scientists to be open for business needs to work with.

The authors of the study identified following relational barriers, the analysis showed statistical significance (below 0.05):

- passive attitude of scientists to cooperation with enterprises,
- lack of openness of researchers to the business needs,
- no reaction of scientists to offers from businesses,
- low communication skills of researchers,
- lack of implications of scientific results in business activities.

The features presented are only a proposal for further discussion. Interesting observation came when considering perception of quality of research services offered by scientific institutions. Foreign respondents in both groups: scientists and entrepreneurs indicated similar perception of research quality (Fig.5) 19,2 % of scientists and 14,9 % of business representatives indicated that the quality of research offered by scientific organizations on market was very high and only few of them (0 % of scientists and 1,4 % of business representatives) think it to be of very low quality.

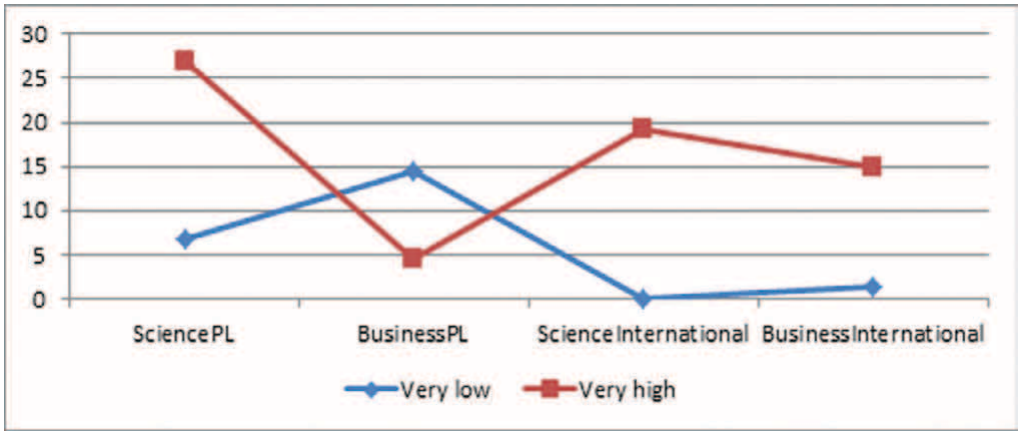

Figure 5: Perceived quality of research services offered by scientific institutions on market?
Source: own research

It looks like scientists perceive the quality of scientific services offered by HEIs slightly better than business representatives. The tendency can be seen also in Poland but the differences among both groups of respondents are much bigger. There is a considerable difference in group of polish entrepreneurs. Nearly 15 % of them perceive the quality of research offered by Polish scientific institutions as very low and only 4,5 % of business respondents from Poland indicated very high quality. Poor perceived quality may be one of the barriers of cooperation. It's important to mention the real quality of the research offered by particular institutions has not been studied, just the respondents perception of situation.

So, it can be noticed that:

- entrepreneurs perceive the quality of research offered by HEIs lower than scientists,
- the differences in perception of research quality among both groups: scientists and entrepreneurs are especially big in Poland,
- Polish entrepreneurs perceive the quality of scientific research offered by Polish HEIs as very low.

From a branding theory perspective consumers (here entrepreneurs as a university target group) may have difficulty forming their quality evaluations and may end up basing them on considerations other than their own experience. Thus, if there is a gap between reality and perception for different stakeholders then research universities should employ a range of brand elements to enhance brand recall and signalling. They should design corporate communication programs and communicate strong organizational associations. Other researchers have identified number of dimensions influencing perceived service quality: tangibles, reliability, responsiveness, competence, trustworthiness, empathy, courtesy and communication (Keller, 2008). For sure research universities and institutions need more integrated marketing communication to build image, awareness and trust among different groups of stakeholders.

According to Bennetzen–Moller (2013) the technology transfer activity of universities requires a special marketing approach – different even from business-to-business model. The university as knowledge creator has specificities that cannot be captured with sufficient precision through the marketing models applied to business models. Jasinski presented the whole concept of the marketing of R&D and innovation and was writing about marketing communication of scientific achievements as an element of public innovation policy (1998b) and communication with society (2010). He found out that the experience gained by public organizations and institutions with science marketing addressed to the business sector in Poland is so poor that science-to-business marketing is still in its infancy (2014).

Conclusions

Cooperation between companies and scientists can bring a significant increase in research leading to the introduction of new products. More ambitious research aims, higher risk, and more complex networks of interactions create specificity of the university-business relationships. In the context of the specific nature of these relationships all elements building mutual trust, commitment, and understanding of each other needs will positively influence the development of relations between the academy and business. The research shows that respondents from developed countries (with higher innovation rates) regard relational drivers as essential. Polish respondents underestimate the relational factors

and their responses vary considerably from the reports of scientists and entrepreneurs from other countries. They concentrate more on legal and transactional mechanisms of cooperation. The research also shows that entrepreneurs perceive the quality of research offered by HEIs lower than scientists do. Most Polish entrepreneurs perceive the quality of scientific research offered by Polish HEIs as being very low. Other researchers (Tomaszewski, 2014) found that innovation cooperation between universities and industrial companies is most probable when the HEI is connected with the Polish Academy of Sciences (the most trusted research institution in Poland). It confirms the existing crisis of trust to public research universities in Poland. In the context of technology transfer and commercialization there is a strong need to rebuild the image of Polish science among different groups of stakeholders, especially entrepreneurs. The research results also show that good relationship between science and business should be built on two main characteristics: activity of business representative and scientist's openness for business needs.

References:

Baaken T. and C. Plewa: Key Success Factors in Research Commercialization, in Hosni YA et al. (eds): Management of Technology: New Directions in Technology Transfer, Washington-Amsterdam, 2004.

Baaken T.: Science-to-Business Marketing and Partnering, in Merten W (ed): Wissenschaftsmarketing – Dialoge gestalten, Bonn, 2009.

Ballantyne D., M. Christopher, A. Payne: Relationship marketing: looking back, looking forward, "Marketing Theory" 3(1), 2003.

Bennetzen, M. V., Moller, L. S.: Technology transfer: Bridging academic research and society – a communicative approach, 'Journal of Commercial Biotechnology', 19, 2, 2013, pp. 11–16.

Berry L.L.: Relationship Marketing of Services – Growing Interest, Emerging Perspectives, 'Journal of the Academy of Marketing Science', 23 (4),1995.

Bialon, L.: Marketing badan naukowych, [in] Jasinski A. H. and Ciborowski R. (eds): Ekonomika i zarzadzanie innowacjami w warunkach zrownowazonego rozwoju, Wydawnictwo Uniwersytetu w Bialymstoku, Bialystok, 2012.

Bialon, L.: Wsparcie marketingowe, [in] Jasinski A. H. (ed): Zarzadzanie wynikami badan, 2011.

Bok D.: Universities in the Market Place: The Commercialization of Higher Education, Princeton University Press, New Jersey, 2003.

Butler J. S. and Gibson D. V., eds (2001): Global Perspectives on Technology Transfer and Commercialization: Building Innovative Ecosystems, Edward Elgar Publishing, Cheltenham.

Davey T., V. Galán-Muros, A. Meerman, T. Kusio: The State of University-Business Cooperation in Poland, Science-to-Business Marketing Research Centre, Apprimo 2013.

Etzkowitz H.: MIT and the Rise of Entrepreneurial Science, Routledge, London, 2002.

Frischmann B. M.: Commercializing university research system in economic perspective: A view from the demand side, [in:] Univesrity entrepreneurship and technology transfer, ed. G. D. Libecap, Emerald, 2005, p. 155–186.

Gordon I.H.: Relacje z klientem, Marketing partnerski, PWE, Warszawa 2001.

Greene P. G. , M. Rice: The experience in the United States: a university perspective, [in:] Global Perspectives on Technology Transfer and Commercialization. Building Innovative Ecosystems, ed. J. Butler, D. V. Gibson, Edward Eldar, Cheltenham 2011, p. 364- 381.

Grönroos, Ch.: From Marketing Mix to Relationship Marketing: Towards a Paradigm Shift in Marketing "Asia-Australian Marketing Journal", 2 (1), 1994, s.9–29, publikowane ponownie w: Management Decision, 35 (4) 1997, s. 322–339.

Grönroos, Ch.: Relationship marketing: strategic and tactical implications, 'Management Decisions', 34(3), 1996.

Grzegorczyk, M.: Budowanie relacji w procesach komercjalizacji innowacji naukowych, Marketing i Rynek (8/2014), Polskie Wydawnictwo Ekonomiczne S.A., pp. 249–252.

Gummesson, E.: Total Relationship Marketing, Rethinking Marketing Management: From 4ps to 30Rs, Butterworth-Heinemann, Oxford, 2002.

Gwarda – Gruszczyńska E.: Modele procesu komercjalizacji nowych technologii w przedsiębiorstwach. Uwarunkowania wyboru – kluczowe obszary decyzyjne, Wydawnictwo Uniwersytetu Łódzkiego, Lodz, 2013.

Hemsley-Brown J.V. , I. Oplatka: Market Orientation in Universities: A comparative study of two national higher education systems, International Journal of Educational Management 2010, Vol. 24, Issue 3, pp. 204–220.

Jasinski A H: Innowacje techniczne a dzialalnosc marketingowa, Wydawnictwo WSPiZ, 1998.

Jasinski A. H.: Science needs good public relations: Experiences from Poland, 'Indian Journal of Science Communication', No 2, pp. 17–22, 2003

Jasinski A. H.: Science Communication with Society: A Marketing Approach, [in] Jasinski A. H. (ed): Innovation in the Polish Economy in Transition: Selected Economic and Managerial Issues, Wydawnictwo Uniwersytetu w Bialymstoku, Bialystok 2010.

Jasinski A.H.: A public science product needs proper marketing: Polish experiences and challenges, Proceedings of the 13th International Science-to-Business Marketing Conference "Cross Organizational Value Creation", Winterthur, 2014, pp. 103–118

Jasiński A.H.: Barriers in Technical Transfer in the Investment Market. Management Faculty, University of Warsaw, Warsaw 2005.

Jolly V K: Commercializing New Technologies, Harvard Business Press, Boston, 1997.

Keller K.L.: Building, Measuring, and Managing Brand Equity, Pearson Education, New Jersey, 2008.

Kondratiuk-Nierodzińska M., Grabowiecki J.: Wstępna analiza w zakresie innowacyjności Województwa Podlaskiego, Raport z zadania 4 projektu, Regionalna Strategia Innowacji Województwa Podlaskiego, Białystok, 2004.

Kozmetsky G., F. Williams, V. Williams: New wealth. Commercialization of science and technology for business and economic development, Praeger, Westpoint, 2004.

Kruk M.: Zarzadzanie i marketing nowego produktu, in Jasinski A H and Ciborowski R (eds): Ekonomika i zarzadzanie innowacjami w warunkach zrownowazonego rozwoju , Wydawnictwo Uniwersytetu w Bialymstoku, Bialystok, 2012.

Kumar V., W.J. Reinartz: Customer Relationship Management. A Databased Approach, John Wiley & Sons, 2006.

Matusiak K. B. , Development of commercial support systems– indicators, policy and institutions. Institute for Sustainable Technologies Press, Radom – Łódź 2006.

Matusiak K.B., Guliński J. (ed.): Rekomendacje zmian w polskim systemie transferu technologii i komercjalizacji wiedzy, PARP, Warszawa 2010.

Matusiak K.B.: Inkubatory Technologiczne [w:] K.B. Matusiak (ed.) Ośrodki innowacji i przedsiębiorczości w Polsce. Raport 2010, Lodz/Warszawa 2010.

Nelson A., Thomas Byers: Organizational modularity and intra-university relationships between entrepreneurship education and technology transfer, Advances in the Study of Entrepreneurship, Innovation & Economic Growth, 2005/8/11, Vol.16, pp.275–311.

Otto J., Marketing relacji. Koncepcja i stosowanie, C.H. Beck, Warszawa 2004.

Pomykalski, A.: Zarzadzanie innowacjami, PWN, Warszawa-Lodz, 2001.

Reichheld F.F., W.E Sasser.: Zero defections: quality comes to service, "Harvard Business Review", 68, 1990.

Sedláček J., Obecné trendy, [in:] Nadnárodni spelečnosti v České Republice II, red. L. Blažek, Masarykova Univerzita Ekonomicko-Správni Faculta, Brno 2011.

Shankar V.: The Evolution of Markets: Innovation Adoption, Diffusion, Market Growth, New Product Entry and Competitors, in Shane S (ed): Handbook of Technology and Innovation, 2008.

Storbacka K., J. R Lehtinen.: Sztuka Budowania Trwałych Związków z Klientami Customer Relationship Management, Oficyna Ekonomiczna, Kraków, 2001.

Tomaszewski M., Factors shaping innovation cooperation between companies and research and development institutions exempliefied by the case of south-western Poland, in: Innovations and Knowledge Commercialization, Cooperative Resources, Integrated Science and Business, ed. D.Trzmielak, University of Lodz Press, Lodz, 2014, pp.155–172.

Trzmielak D. : Komercjalizacja wiedzy i technologii – determinanty i strategie, Wydawnictwo Uniwersytetu Lodzkiego, Lodz, 2013.

Trzmielak D.: Technology transfer and the development of New technology-based firms: Polish perspectives and case study on nanotechnology, [in:] Global Perspectives on Technology Transfer and Commercialization, red. J. S. Butler, D. V. Gibson, Edward Eldar, Northampton, 2011, p. 239–269.

Trzmielak D., E. Gwarda-Gruszczyńska and M. van Geenhuizen: Technology initiatives, university – industry collaboration in emerging economies: Opportunities and threats in the global market, in: Energy and Innovation: Structural Change and Policy Implications, ed. Marina van Geenhuizen, William Nuttall, David Gibson, Elin Oftedal, Purdue University Press, 2010, ss. 285–310.

Trzmielak D., M.Grzegorczyk: Technology marketing – the use of relationship marketing principles in the process of international commercialization, in: Rozvoj marketingu v teórii a praxi Marketing Development in Theory and Practice ed. Jozef Striss, EDIS – Vydavateľstvo Žilinskej Univerzity, 2010, s. 227–233.

Trzmielak D., M. Grzegorczyk: Relationship barriers and drivers of knowledge transfer and technology, commercialization – a Polish and international research study, Proceedings of ISPIM Americas Innovation Forum 2014, Montreal, Canada on 5–8 October 2014.8 October 2014.

Zehner W.B.: Successful Science Parks – Research to Riches [w:] Zarządzanie innowacją. Aspekty komunikacji, finansowania, badania rynku, psychologicznych uwarunkowań, polityki innowacyjnej i infrastruktury, ed. Dariusz M. Trzmielaka, J. Żurawska, Wyższa Szkoła Zarządzania i Administracji w Opolu, Opole 2011.