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ANTECEDENTS OF SCIENTISTS' ENGAGEMENT IN COOPERATION WITH INDUSTRY

Introduction

The interest in university-industry connections has been the subject of many studies [Mansfield, 1991; Kimberly et al., 1997, Nelson et al., 2002; Laursen, Salter, 2004; Este, Patel, 2007; Brimble, Doner, 2007; Segarra-Blasco, Carod, 2008; Tether, Tajar, 2008]. Contrasting views on the role of universities in this process and the desired relationship between universities and businesses presented in these articles. Researchers of the triple helix model [Etzkowitz, Leydesdorff, 1995; Etzkowitz et al., 2000] argue that academia should be tightly integrated with industrial companies to maximize knowledge capitalization. This perspective is expressed in the entrepreneurial university model, which focuses on the commercialization of academic knowledge in the form of patents, licensing, industry cooperation and the creation of spin-off companies. While commercialization is a primary mode of knowledge transfer from science to business, numerous other engagement channels exist through which scientists can interact with companies. As many researchers have already noted, the links between universities and industry cover a much wider spectrum of activities than the commercialization of intellectual property rights [Mansfield, Lee, 1996; Schartinger et al., 2001; Agrawal, Henderson, 2002; Cohen et al., 2002; Mowery, Sampat, 2005]. In particular, Cohen et al. [2002] highlighted that for most industries, patents and licenses are less important as channels for communicating public research than publications, conferences, informal interactions, and consultations. Schartinger et al. [2002] have shown that patents and licenses represent a low proportion of public-private collaborative activities compared to other formal agreements such as

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contract studies or joint research agreements. Agrawal and Henderson, using data on MIT academics, confirm these findings, showing that patents account for only about 10% of all knowledge transfer activities [Agrawal, Henderson, 2002]. Hence there is a lot of empirical evidence to suggest that the knowledge transfer process between academia and industry operates through various channels, including staff mobility, informal contacts, consulting, joint projects, and research contracts. As a result, patents and spin-offs play a limited role in this process [Faulkner, Senker, 2011; Arundel, Geuna, 2004]. One reason for this is that only a small part of the interaction between academia and industry is motivated by the prospect of directly realized commercial products. As Mansfield and Lee [1996] contend, industry-supported academic research and development rarely produces specific inventions or products. Instead, the primary goals of such collaborative research and development is to acquire up-to-date knowledge, access students and faculty, and find solutions to specific problems. The range and variety of interactions that scientists can undertake with enterprises go beyond mere commercialization-related activities. This has piqued researchers' interest in various forms of cooperation currently defined by academic commitment [Perkmann et al., 2021].

This article focuses on the concept of academic engagement as knowledge-oriented interactions between academic researchers and partners outside of the university. This is distinguished as an activity beyond teaching and commercialization [Perkmann et al., 2013, 2021]. There exists a research gap in the literature related to the insufficient identification of the range of factors that determine the scientists' engagement in cooperations with enterprises. Moreover, the wide range of different activities that can be classified as forms of academic involvement has not been thoroughly described in existing literature. The aim of the article is to consolidate knowledge about the nature of academic engagement, its various manifestations, and to identify both individual and contextual factors affecting such engagement. In particular, an attempt was made to answer the following questions: How is academic engagement defined in the literature? In what forms does it present itself? What are the determinants of academic involvement? The author provides a critical overview of the literature on research scientists' collaboration with industry, focusing particularly on antecedents of such behavior. To structure the review, the author develops a framework for analysis that takes into account individual attributes of scientists along with organizational and institutional characteristics that affect their industry engagement.

1. Literature review

1.1. The essence and forms of academic engagement

The term "academic engagement" is relatively new in literature on the subject. Previously (up until around 2010), terms such as "industry-university relations" or "university-industry interactions" were used to refer to the involvement of researchers in relations with enterprises[1]. More or less since 2011, the interest in the topic of academic engagement has notably increased in English-language literature. This concept has yet to found a direct literal equivalent in Polish literature. Academic engagement encompasses a diverse range of linkages, and is not solely confined to the transfer of intellectual property [Perkmann et al., 2021].

The first conceptualization of this concept was introduced by M. Perkmann and colleagues. They posited that academic engagement involves knowledge-oriented interactions by scientists with entities outside the academic sector, distinct from teaching and commercialization activities [Perkmann et al., 2013]. According to these authors, such interactions include, inter alia, joint research with businesses, contract research, consulting, and other informal activities such as consulting, networking with industry professionals [Perkmann et al., 2013; Perkmann et al., 2021]. The development of the academic engagement concept met the suggestions emphasized in the literature. Most researchers attention primarily focus on commercialization channels [Azoulay et al., 2009; Thursby, Thursby, 2002], ignoring other important forms of relationship that can be made at the interface between these two important sectors [D'Este, Patel, 2007; Perkmann, Walsh, 2007; Ramos-Vielba et al., 2016; Olmos-Peñuela et al., 2014].

In the opinion of various researchers, the involvement of scientists, when compared to commercialization or academic entrepreneurship, is understood and practiced more widely across various disciplines. It also holds greater economic importance for universities or enterprises [Perkman et al., 2013; Cohen et al., 2002; Hughes, Kitson, 2012]. Moreover, academic engagement tends to be more "informal" compared to formal collaborative processes or joint university-enterprise research [Ponomariov, Broadman, 2007]. Ponomariov and Broadman point out that such informal contacts become a prelude to more formal relationships in the future [Powell, Grodal, 2006; Cohen et al., 2002].

[1] Phrases – "university-industry interactions" or "relations" were used in publications, e.g.: [Bozeman, Gaughan, 2007; Gaughan et al. 2007; Perkmann, Walsh, 2007].

In the English-language literature on the subject, there are only a few definitions of the term "academic engagement". The most frequently cited ones are listed in the table below (Table 1).

Table 1. Review of selected definitions of academic engagement

No	Author(s)	Definitions
1	Cohen et al., 2002	Inter-organizational examples of collaboration involving mainly person-to-person contacts.
2	Schartinger et al., 2002	Interactions linking universities and other organizations, especially companies.
3	Link et al., 2007	Informal technology transfer, although most interactions are formalized through contracts.
4	Perkmann et al., 2013	The type of university-industry relationship that can take many forms such as collaborative research, contract research, and consulting. It is practiced by more scientists than commercialization.
5	Perkmann et al., 2021	Knowledge-oriented interactions by academic researchers with external partners, distinct from teaching and commercialization.

Source: own study based on: [Cohen et al., 2002; Schartinger et al., 2002; Link et al., 2007; Perkmann et al., 2013; Perkmann et al., 2021].

The definitions presented in the table reveal that researchers approach the topic from different perspectives. This suggests that the concept in its early stages of development and encompasses a number of relations/initiatives/interactions at the university-enterprise interface. The first attempts to measure academic involvement were made by Gaughan and Bozeman [2007], who defined it as industrial involvement. As these researchers have noted in other previous studies, the most important source of R&D information for private companies is informal interactions with university researchers and engineers [Cohen et al., 2002]. Given the frequent citations of informal interactions as important sources of R&D information, and their potential to foster an "innovation climate" it's possible that they bolster and even increase the probability of other types of interactions, such as collaborative research.

Perkmann et al. [2013] distinguish between academic engagement and commercialization mainly due to the goal: commercialization focuses on obtaining financial benefits by the researcher, while academic engagement is carried out with the intention of achieving a greater number of goals. There are also important links between the two activities. In fact, commercialization is often a follow-up, whether intended or not, of an academic commitment. In other words, academic commitment often precedes commercialization and can therefore be considered as an input to the latter [Perkmann et al., 2013]. There are many different activities that allow scientists to be involved in the transfer of new technology or knowledge. Some of these activities are more formal than others [Bekkers et al., 2008; Lockett et al., 2003].

Resent research by scientists [e.g. Abreu, Grinevich, 2013; Caldera, Debande, 2010; Cohen et al., 2002; D'Este, Patel, 2007; Schartinger et al., 2001] emphasizes that most industries and universities, less formal and non-commercial activities are just as important as formal contracts. Studies have shown that involving researchers in these less formal activities provides important economic and social value for both academic and industrial partners. Audretsch et al. [2012] emphasize the importance of informal relationships, concluding that there's a pressing need for more focus and further research on informal cooperation and knowledge transfer.

Recent literature findings indicate that the current scale and impact of scientists' external involvement in cooperation with the business sector is underestimated and involves many more interactions (i.e. research and development contracts, consulting, staff exchange, joint supervision for graduate students) than just the effects of commercialization [Iorio et al., 2017].

After an in-depth review of the literature, there are many activities that can be used to express the involvement of scientists in cooperation with enterprises (Table 2).

Table 2. Different types of academic engagement presented in the literature

No.	Interaction/form of involvement	Author(s)
1	Participation in a conference organized by the industrial sector	Abreau et al., 2002; Tartari, Salter, 2015; Tartari et al., 2002; Fuentes, Dutrenit, 2012; Muscio, Pozalli, 2013; D'Este, Patel, 2005
2	Participation in industry sponsored meetings	Tartari, Salter, 2015; Tartari et al., 2014; Muscio, Pozalli, 2013; D'Este, Patel, 2005
3	Joint contract research (original research carried out by universities)	Tartari, Salter, 2015; Tartari et al., 2002; Iorio et al., 2017; Molas-Gallart et al., 2002; Abreau et al., 2002; Olmos-Peñuela et al., 2014; Fuentes, Dutrenit, 2012; Arvantis et al., 2008; Muscio, Pozalli, 2013; D'Este, Patel, 2005
4	Joint research agreements (joint research undertaken by both partners)	Abreau et al., 2002; Tartari, Salter, 2015; Tartari et al., 2002; Iorio et al., 2017; Molas-Gallart et al., 2002; Olmos-Peñuela et al., 2014; De Fuentes, Dutrenit, 2012; Arvantis et al., 2008; Muscio, Pozalli, 2013; D'Este, Patel, 2005
5	Consulting agreement	Abreau et al., 2002; Tartari, Salter, 2015, Tartari et al., 2002; Bozeman, Gaughan, 2004; Iorio et al., 2017; Olmos-Peñuela et al., 2014; Grimpe, Fier, 2010; De Fuentes, Dutrenit, 2012; Muscio, Pozalli, 2013; D'Este, Patel, 2005
6	Postgraduate studies for enterprises	Tartari, Salter, 2015; Tartari et al., 2002; Muscio, Pozalli, 2013
7	Training for company employees	Abreau et al., 2002; Tartari, Salter, 2015, Tartari et al., 2002; Iorio et al., 2017; Molas-Gallart et al., 2002; Olmos-Peñuela et al., 2014; De Fuentes, Dutrenit, 2012; Muscio, Pozalli, 2013; D'Este, Patel, 2005

cont. Table 2

No.	Interaction/form of involvement	Author(s)
8	Creation of research infrastructure (with company funds, e.g. new laboratory on campus)	Abreau et al., 2002; Tartari, Salter, 2015; Tartari et al., 2002; Arvantis et al., 2008; Muscio, Pozalli, 2013; D'Este, Patel, 2005
9	Providing information on research to private companies	Bozeman, Gaughan, 2004; Ponomariov, Boardman, 2007; De Fuentes, Dutrenit, 2012
10	Contact with people from the enterprise sector asking about their research or research interests	Bozeman, Gaughan, 2004; Ponomariov, Boardman, 2007
11	Assistance in hiring doctoral students or doctors to work in industry	Bozeman, Gaughan, 2004; Ponomariov, Boardman, 2007; De Fuentes, Dutrenit, 2012
12	Development of a report / expert opinion on solving a problem in the enterprise	Arvantis et al., 2008
13	Experience in working in a company as an owner, partner or employee	Bozeman, Gaughan, 2004; Ponomariov, Boardman, 2007
14	Direct cooperation with employees from the enterprise that resulted in the patent or copyright	Bozeman, Gaughan, 2004; Ponomariov, Boardman, 2007; Iorio et al., 2017; Arvantis et al., 2008
15	Collaboration directly with employees from the enterprise in order to transfer or commercialize technology	Bozeman, Gaughan, 2004; Ponomariov, Boardman, 2007; Iorio et al., 2017; Grimpe, Fier, 2010; Arvantis et al., 2008
16	Co-authorship of an article with employees from enterprises, which was published in a scientific journal	Abreau et al., 2002; Bozeman, Gaughan, 2004; Ponomariov, Boardman, 2007; Molas-Gallart et al., 2002; Grimpe, Fier, 2010; De Fuentes, Dutrenit, 2012
17	Other informal relations (e.g. telephone, e-mail consultation on solving a problem in the enterprise)	Abreau et al., 2002; Iorio et al., 2017
18	Using non-academic literature	Iorio et al., 2017
19	Participation in corporate events	Iorio et al., 2017
20	Joint supervision of a doctoral student; implementation doctorates	Iorio et al., 2017; Arvantis et al., 2008; D'Este, Patel, 2005
21	Using the technical infrastructure of the enterprise	Iorio et al., 2017
22	Spin-off (owner, partner or employee)	Iorio et al., 2017; Molas-Gallar et al., 2002; De Fuentes, Dutrenit, 2012; Muscio, Pozalli, 2013; D'Este, Patel, 2005
23	Networks	Abreau et al., 2002; De Fuentes, Dutrenit, 2012; Muscio, Pozalli, 2013
24	Staff mobility	Olmos et al., 2014; De Fuentes, Dutrenit, 2012

Source: own study based on: [Iorio et al., 2017; Abreau et al., 2002; Tartari, Salter, 2015; Tartari et al., 2002; De Fuentes, Dutrenit, 2012; Muscio, Pozalli, 2013; D'Este, Patel, 2005; Molas-Gallar et al., 2002; Bozeman, Gaughan, 2004; Ponomariov, Boardman, 2007; Olmos-Peñuela et al., 2014; Grimpe, Fier, 2010].

As indicated by the researchers, the activities contained in the table refer to many different activities by means of which it is possible to generate added value for both scientists and companies cooperating with them. D'Este and Patel investigated the knowledge transfer mechanisms by which scientists in the UK interact with businesses and the factors that influence engagement in a variety of interactions.

They discover that researchers interact using a wide variety of channels and are more likely to engage in most channels such as consultancy and contract research, joint research or training than patenting or spin-out activities [D'Este, Patel, 2007]. In turn, Gripme and Hussinger state that most of the existing research has focused on formal university technology transfer mechanisms, i.e. those that embody or directly lead to legal effects such as a patent, license or license agreement. Research has found that informal contacts improve the quality of formal contacts or that formal contracts are accompanied by an informal relationship related to the transferred technology. Their research in over 2,000 German companies confirms this complementary relationship [Gripme, Hussinger, 2008].

1.2. Conditions for the involvement of scientists in cooperation with enterprises

1.2.1. Individual characteristics of scientists

The literature on the subject provides examples of individual researchers' characteristics, which predispose these people to cooperate with enterprises to a greater extent [Perkmann et al., 2013, 2021; Feldy et al., 2014; Abreu, Grinevich, 2013; D'Este, Patel, 2007; D'Este, Perkmann, 2011]. Among the analyzed features, the following can be indicated: age of the scientist, seniority, gender, experience in cooperation with enterprises, academic degree, type of discipline represented by the researcher, scientific productivity [D'Este, Perkmann, 2011; D'Este, Patel, 2007; Bekkers et al., 2007; Boardman, Ponomariov, 2009; Feldy et al., 2014].

The age of scientists (biological) still has an ambiguous effect on the willingness to engage in collaboration. One British study shows a positive relationship while others, from a later period, demonstrate a non-linear effect with the youngest and oldest subgroups that show a lower range of involvement than middle-aged researchers [Abreu, Grinevich, 2013].

A study by Haeussler and Colyvas [2011] cited evidence that senior life scientists in Germany and the UK are more likely to engage in a variety of commercial activities, including not only patenting and licensing, but also consulting and setting up a business than their younger colleagues [Haeussler, Colyvas, 2011]. One study for Italy shows no effect [Iorio et al., 2017], while others for the same country and similar disciplines show only weakly significant negative effects [Tartari, Breschi, 2012].

On the other hand, the status / position of a researcher (how high a person is in the academic hierarchy) is more strongly related to academic commitment, for example in Italy and Great Britain [Abreu, Grinevich, 2013; Lawson et al., 2019; Tartari, Breschi, 2012].

Lawson et al. [2019], as a result of research by scientists from Great Britain, show that engagement is caused by prior engagement, with repeatability rates of up to 94% depending on the type of activity.

Research shows that a researcher's experience in working in a company has a positive impact on academic engagement [Tartari et al., 2014]. On the other hand, the direction and strength of the impact of the researcher's experience (characterized by seniority and the title or academic degree) on his willingness to engage in cooperation with enterprises was not clearly defined in the literature [Feldy et al., 2014]. On the one hand, it is indicated that researchers are more open to entering into new relations with the business sector [D'Este, Patel, 2007], on the other hand, it appears that older researchers more often cooperate with enterprises thanks to the contacts they have developed over the years [Landry et al., 2005].

In research conducted by Boardman [2009], Bozeman, Gaughan [2007]; D'Este, Perkmann [2011]; Haeussler, Colyvas [2011], seniority is positively linked to collaboration, given that engagement is often fueled by personal contacts, more experienced researchers are likely to have larger networks, enabling them to find potential partners in the private sector.

Earlier experiences with industry positively influences the attitudes of scientists towards involvement in cooperation [D'Este, Patel, 2007].

The research from various scholars emphasizes that starting cooperation with enterprises is influenced by the scientific discipline in which scientist works. Evidence predominantly suggests that, due to the their applied nature, technical and engineering sciences play the main role in the process of technology transfer [Bekkers et al., 2008; Bozeman, Gaughan, 2007; Lee, Bozeman, 2005; Ponomariow, 2008].

Research shows that gender is also a factor that differentiates scientists' willingness to cooperate. It is assumed that men and women should cooperate with enterprises as often, however, most studies show that men dominate in this area [Tartari, Salter, 2015; Azagra-Caro, 2007; Abreu, Grinevich, 2017].

The research by Bekkers, Freitas [2008], Haeussler, Colyvas [2011] also shows that the research productivity of a researcher is positively related to academic commitment. In other words, successful scientists are also the ones most involved in projects with industry. A similar situation concerns the complementarity between government and industry grants received and the willingness of scientists to cooperate. The researchers implementing the grants are more credible to business representatives and will be willing to cooperate with such scientists [Perkmann et al., 2013].

1.2.2. Organizational conditions (institution employing the researcher)

The readiness and willingness of scientists to cooperate with enterprises is also determined by the conditions created by their home university [Giulani, Arza, 2008].

The personal involvement of the university/department is considered crucial to the process of transferring knowledge and technology from university to enterprises [Thursby, Thursby, 2003, 2004]. As indicated by Di Gregorio and Shane [2003] colleges differ in the degree to which their researchers collaborate with industry as a consequence of commercially oriented university research.

The quality level of the university or the scientist's home department is one of the most important determinants at the organizational level [Perkmann et al., 2013]. Scientists from leading universities with high research potential have a better chance of cooperating with enterprises. In addition, institutional support in the form of training or awards can increase commitment [Perkmann et al., 2013]. Carayol [2003] notes that commercial partners are more willing to cooperate with more recognizable scientific units, especially in high-risk projects. Moreover, if a scientist belongs to a research center operating at a university, he or she is more likely to be involved in cooperation. In other studies, it was noticed that the high level of scientist's involvement in research projects coincides with the high level of scientific activity of the individual [Feldy et al., 2014]. The presence of a technology transfer unit at a university usually has a positive impact on the willingness of scientists to cooperate [Arvanitis et al., 2008]. One study finds that universities' entrepreneurial communication and culture in Sweden and Germany influences commercialization but has little effect on academic engagement [Huyghe, Knockaert, 2015]. As Perkmann and colleagues found after in-depth literature analyzes, investigating the impact of organizational factors on academic engagement (i.e., factors that constitute a de facto characteristic of the so-called academic ecosystem) requires further research because they have been relatively neglected in previous research or because research has produced contradictory or inconclusive results [Perkmann et al., 2021].

1.2.3. Institutional and legal conditions

At the institutional and legal level, the literature indicates the economic and social impact generated by university-industry cooperation at the regional and national levels, as well as the growing importance of policy changes that maximize the effectiveness of interactions between both sectors [Filippetti, Savona, 2017]. The institutional and legal context that may influence the behavior of scientists in the area of willingness to cooperate with the business sector relates mainly to specific national regulations and public policies. In terms of the role of national policies, it is difficult to make any comparative conclusions. Most research focuses on North America and European countries including the UK, Spain, Germany and Sweden, while little is known about other geographic contexts. At least it seems that among these countries there are no major differences in terms of the determinants of academic involvement [Grimpe, Fier, 2010; Haeussler, Colyvas, 2011]. Research on academic

engagement rarely made reference to the role of the institutional environment and national policies, in part because it enjoyed less policy-makers' attention than, for example, commercialization [Perkmann et al., 2013].

1.2.4. Other conditions

Scientists' decision to engage in cooperation is also influenced by the social context and their perceptions regarding the potential costs and benefits of such cooperation [Powell et al., 2011]. Research indicates that scientists are strongly inspired by the attitudes and behaviors of their university colleagues, as well as by local social norms and the attitude of local leaders [Tartari et al., 2014].

Some researchers have explored how the local context, in which scientists operate, affects their commitment and willingness to commercialize research results [Stuart, Ding, 2006; Feldman, 2008]. Stuart and Ding [2006] observed that when universities and faculty peers are more involved with private companies, individual scientists are more likely to pursue similar collaborations [Stuart, Ding, 2006]. Feldy et al. [2014] demonstrated that the extent of cooperation an also be influenced by an institution's focus, as defined by various regulations. Interestingly, they found that research institutes, rather than universities, offer the greatest potential in this aspect [Feldy et al., 2014].

There are numerous studies suggesting that involvement in industry increases the inventive capacity of scientists, as measured by patents either pending or obtained [Perkmann, 2021]. Lawson [2013] found that British scientists with a significant portion of their funding from the industry tend to file more patents. [Lawson, 2013]. Goel and Göktepe-Hultén [2013] found that both collaboration and consultancy have a positive impact on patenting, with the scale of industrial collaboration being greater [Goel, Göktepe-Hultén, 2013]. Another interesting research thread that can be considered in the case of the determinants of academic engagement is the issue of trust between cooperating entities. While trust has been thoroughly examined in the context of innovation collaboration among industrial firms, its evolution when academics engage in cooperation with enterprises has been explored in only a limited number of studies [Hemmert et al., 2016].

2. The effects of academic engagement

Academic involvement may influence various activities of the scientist within the university. Collaborative projects often bring new, academic valuable insights and ideas, even if they are rarely used and do not lead directly to the publication of results [Lee, 2000; Perkmann, Walsh, 2009].

Numerous studies suggest that involvement in industry increases the inventive capacity of scientists, as measured by patents pending or obtained [Perkmann et al., 2021]. Also Goel and Göktepe-Hultén [2013] found that both collaborative research and advising have a positive impact on patenting, with the scale of industrial collaboration being greater. The impact of the involvement of scientists in cooperation with industry on didactics is not clear. The only exception is Lin and Bozeman [2006], who observe that collaborative scientists support students more [Lin, Bozeman, 2006]. When analyzing the impact of commercialization efforts, there is relative agreement that academic inventors publish more and better quality publications than their non-patenting colleagues [Agrawal, Henderson, 2002]. While academic engagement may not directly influence the trajectory of researchers' careers, it is believed to enhance their prestige and reputation [Owen-Smith, Powell, 2001]. Some researchers see the negative impact of academic involvement on the research topics undertaken by academic scientists. On their part, there is concern that engagement with industry is shifting researchers' agendas towards applied research at the expense of long-term basic research [Perkmann et al., 2013].

When comparing the outcomes of scientists' individual participation in commercialization to those of academic engagement, several conclusions can be drawn. First, while participation in commercialization appears to have a positive impact on researcher productivity, the effects of academic commitment remain ambiguous. Second, neither commercialization nor academic commitment appear to shift the focus of academics towards more applied research. Third, there is no evidence that both types of interaction lead to increased secrecy and reduced the open communication of research [Perkmann et al., 2003].

Conclusions

This article introduces a fresh perspective to the literature by analyzing the range of determinants associated with academic engagement. In particular, attempts were made to answer the following questions: What is academic engagement? In what form can it express itself? What are the conditions for this engagement? In this article, the author adopts a multi-level approach to explore the various factors that influence scientists' collaboration with enterprises. As indicated in the article, there is no single definition of academic engagement. For many researchers closely tied to this topic, academic engagement refers to knowledge-oriented interactions undertaken by academic researchers and external partners distinct from teaching and commercialization activities [Perkmann et al., 2021]. The review of the determinants of academic involvement shows that it is a phenomenon determined by many factors: individual, on the part of the scientist, but also institutional or organizational.

The conducted literature review confirms and justifies the key observations in this area, namely that: 1) academic engagement is complementary to more formal relations between scientists and enterprises, 2) academic engagement is practiced by scientists having certain individual characteristics and motivations, 3) scientifically productive entities are more willing to engage than other scientists, 4) academic engagement is positively correlated with mobilizing funds and resources for research and development.

The first limitation of this article is that the concept of academic engagement has not been as well defined in the literature as, for example, commercialization has been. This lack of research in earlier literature makes comparisons with many previous studies impossible. Moreover, few studies offer international comparative analyzes, as most of the literature focuses on the United States or selected European countries. Relatively few studies concern other parts of the world, which means that specific regional, institutional, and individual factors may differ across the global spectrum. Another limitation is the tendency of researchers to focus intensely on the conditions of cooperation from the perspective of an individual researcher, while ignoring the broader context in which the researcher operates. In fact, only a few researchers analyze the determinants of academic involvement from the perspective of enterprises: their tendency to form relationships with scientists and the underlying motivations for such relationships. A limited amount of information is currently available regarding the role of faculty's psychological support in promoting academic engagement. Further research is required to ascertain whether and how university infrastructure and targeted policies effectively promote cross-sector collaboration. Moreover, although the majority of research is centered on the precise sciences, it's crucial to explore the validity of this phenomenon in other fields, including the social sciences and humanities. Additionally, studies in this domain should delve into the implications of such involvement on pivotal academic pursuits, notably instructional activities, as these could serve as conduits for transferring the influence of such engagement.

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ANTECEDENTS OF SCIENTISTS' ENGAGEMENT IN COOPERATION WITH INDUSTRY

Abstract

The purpose of this article is to identify the conditions for the involvement of scientists in cooperation with enterprises based on a literature review. The precursors of the subject, M. Perkmann et al., indicate that the involvement of scientists refers to the knowledge-oriented interactions they undertake with organizations outside the science sector, distinct from teaching and commercialization [Perkmann et al., 2021]. According to the quoted authors, such interactions include joint research with enterprises, contract research, consulting and more informal activities such as consulting, training, networking with business practitioners. The development of the concept of academic involvement met the suggestions

emphasized in the literature that most of the attention of researchers focuses primarily on commercialization channels, ignoring other important forms of relations that can be made at the junction of these two important sectors [Azoulay et al., 2009; Thursby, Thursby, 2002]. The article identifies individual characteristics of scientists, as well as analyzes the organizational and institutional context, and other conditions affecting the cooperation between scientists and enterprises.

Keywords: academic engagement, academic entrepreneurship, university-industry relations

JEL classification codes: I23, L24, L26

CZYNNIKI WARUNKUJĄCE ZAANGAŻOWANIE NAUKOWCÓW WE WSPÓŁPRACĘ Z PRZEMYSŁEM

Streszczenie

Celem artykułu jest identyfikacja czynników warunkujących zaangażowanie naukowców we współpracę z przemysłem dokonana na podstawie przeglądu literatury. Prekursorzy tematu, M. Perkmann i współpracownicy, wskazują, że zaangażowanie naukowców odnosi się do zorientowanych na wiedzę interakcji, jakie podejmują z organizacjami spoza sektora nauki, a są odrębne od nauczania i komercjalizacji [Perkmann i in., 2021]. Według cytowanych autorów interakcje te obejmują wspólne badania z przedsiębiorstwami, badania kontraktowe, doradztwo oraz działania bardziej nieformalne, takie jak doradztwo, szkolenia, networking z praktykami biznesu. Opracowanie koncepcji zaangażowania akademickiego wyszło naprzeciw podkreślanym w literaturze sugestiom, że większość uwagi badaczy skupiona jest na formalnych kanałach komercjalizacji, ignorując inne ważne formy relacji, jakie mogą zachodzić na styku tych dwóch ważnych sektorów [Azoulay i in., 2009; Thursday, Thursday, 2002]. W artykule zidentyfikowano indywidualne cechy współpracujących naukowców, a także dokonano analizy kontekstu organizacyjno-instytucjonalnego, prawnego i innych uwarunkowań warunkujących podejmowanie relacji z przedsiębiorstwami.

Słowa kluczowe: zaangażowanie akademickie, przedsiębiorczość akademicka, relacje uczelnia-przemysł

Kody klasyfikacji JEL: I23, L24, L26