

KNOWLEDGE-BASED INTER-ORGANIZATIONAL COOPERATION OF UNIVERSITIES AND BUSINESSES IN THE CHEMICAL SECTOR

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Purpose: In this paper, the authors analyze the importance of knowledge in modern socio-economic relations. The main objective of this paper is to show the prospects for development of knowledge-based inter-organizational cooperation between universities and companies in the chemical sector.

Design/methodology/approach: The authors recognized that it is reasonable to adopt the research strategy of methodological pluralism. Therefore, the study used an integrated research approach, which included both direct interpretive and positivist research procedures. This required qualitative and quantitative research. Literature studies include Polish and foreign publications.

Findings: As a conclusion for the results of the study, it should be stated that the value derived from knowledge positively influences the establishment and subsequent strengthening of the ties between universities and companies. This knowledge (in particular, solutions in the area of digital technologies that focus on monitoring and automation of processes, data integration, and big data analytics, as well as data protection and cybersecurity) can be applied in the process of formation of long-term relationships between universities and companies. In addition, as demonstrated in the article, inter-organizational cooperation between a university and a chemical company requires ensuring symmetry in the partners' structures and management methods, as well as overcoming differences in their organizational cultures. Other conditions that should be taken into account in order to successfully shape long-term relationships are organizational proximity, cognitive proximity, institutional proximity, and social proximity.

Originality/value: The added value of the article is to show the prospects for the development of inter-organizational cooperation and to determine the importance of the impact of knowledge on the cooperation of universities and chemical enterprises.

Keywords: inter-organizational cooperation, interaction, relations, knowledge.

Category of the paper: Research paper.

1. Introduction

The new economic environment requires a proper interpretation and understanding of social and economic processes that are becoming less predictable and more dynamic. Therefore, learning, which enables the development of available knowledge resources, is becoming one of the key business processes, and knowledge itself is gaining importance as the most desirable resource, a competency, and a value that is essential to growth. The growing interest in acquiring and using knowledge and, at the same time, in the learning process is causing companies to open up to new areas of innovation (Hussain, Haseeb et al., 2021; Ginevičius, Nazarko et al., 2021).

The broad scope of the issues analyzed in this paper leads the authors to ask: How does knowledge foster inter-organizational cooperation between universities and companies in the chemical sector? It also inspires them to identify the main research problem, which is to determine the importance of the impact of knowledge on inter-organizational cooperation between universities and companies in the chemical sector.

The main objective of this paper is to show the prospects for development of knowledge-based inter-organizational cooperation between universities and companies in the chemical sector. The main objective presented in this way encourages the verification of the main research hypothesis: the knowledge of universities has a stimulating (positive) effect on the propensity of companies to establish and maintain multi-dimensional inter-organizational cooperation.

2. Knowledge orientation as a requirement of the contemporary times

In the context of constant change and globalization of the economy (Kowalczyk, Nogalski, 2007) building and strengthening a competitive advantage based on knowledge are becoming the only effective way for organizations not only to survive, but also to grow in these difficult conditions. This is one of the premises that explain the growing demand for knowledge. Another important premise is the rapid development of information and communication technologies, which leads to an increasing demand for science, technology, and knowledge (Boguski, 2009), and a search for their sources among modern chemical sector companies.

Although knowledge has always been treated as one of the key factors in economic development (Michalski, 2020), today the increasing turbulence and lability of the environment, the strong market pressures, and the impermanence of competitive advantages make the importance of knowledge even greater (Gąsowska, 2011). This is a special market opportunity for those organizations that build their competitive advantage on knowledge.

Such organizations, but also their environment, including their stakeholders, are increasingly affected by the rapid pace of social, economic, and technological change, and now also by the multi-dimensional consequences of the COVID-19 pandemic that has continued since 2020. Technologies and products are aging faster and faster and are being pushed out of the market by better solutions. The bisociation of digital technology and new communication tools (such as mobile telephony and the Internet) with new economic trends (globalization, privatization, deregulation, trade liberalization, investment in renewable energy sources, and growing social inequalities) is producing consequences that are difficult to predict and require organizational transformations, as well as a complex reconfiguration of economic systems. It is likely that by the end of the 21st century, about 70% of the currently existing jobs will no longer exist due to automation and robotization based on such technologies as artificial intelligence and machine learning. New specialized jobs, new categories of goods and services, and new complex models of economic activity will emerge (Kafel, 2013).

In the future, organizations will take liquidity, volatility, complexity, and multifacetedness for granted (Rajiani, Bačík et al., 2018). Multi-dimensional variability will be widely accepted. The importance of knowledge as a catalyst for innovative technological solutions will increase even more. Innovations will create the need for further, even more innovative solutions, thus triggering an ever-increasing demand for knowledge (Poznańska, 2016). This new reality will require proper interpretation and development of adaptability in organizations. In order to benefit from the changes that will shape the economy of the future, organizations will have to continuously learn and skillfully use their own and external resources of knowledge (Zawiła-Niedźwiecki, 2014).

The phenomenon of knowledge has many definitions and approaches, which are discussed in management and quality sciences. Knowledge should be objective and universal (Sułkowski, 2013). As an intangible resource, it is not easy to capture and measure, which makes it even more difficult to manage in organizations. In the most common approach, knowledge is a combination of data and information, supplemented by expert opinions, skills, and experience (Chaffey, Wood, 2004), which facilitate the decision-making processes in organizations. Data are objective source facts, without a context or an interpretation, that are unprocessed and do not allow drawing conclusions (Gierszewska, 2011). When data is interpreted and given a certain meaning and context, information is created (Jemielniak, 2012), which is used in various spheres of management in organizations. Of particular importance for the development of organizations are those categories that are above knowledge, i.e. wisdom, intelligence, and thinking (Skyrme, 2000), understood as the ability and capacity to acquire, obtain, and create knowledge, and to learn through skillful transformation of data and information (Grudzewski, Hejduk, 2004). Thus, it can be said that knowledge is a form of effective use of information in the activities of an organization (Drucker, 1999) and in solving its problems (Applehans, Globe et al., 1999) that uses the competencies and skills of the organization and its personnel, as well as their creative or imitative abilities. Knowledge is accumulated in people's

minds (Dolińska, 2010), but also in documents, procedures, processes, organizational practices and standards (Davenport, Prusak, 1998), and in repositories and data collections, both traditional or electronic. Knowledge is a liquid combination of formed experience, values, contextual information and inferences that provide a framework for evaluating and absorbing new experiences and information. Awareness of knowledge or access to knowledge can prove to be a source of competitive advantage for an organization.

The dominant vision in the literature is that of knowledge derived from logical behaviorism and a continuum (Jashapara, 2004) extending between tacit knowledge (“I know how”), anchored in people’s minds and experiences and manifested in practical actions, and explicit knowledge (“I know what”), imaged in sets of data and facts (Polanyi, 2009; Ryle, 2009). Other important aspects of the perception of knowledge are “knowing why” - with regard to the relations between phenomena and processes, and “knowing who” - with regard to the individuals who know “what,” “why,” and “how” (Hargreaves, 2000). More and more organizations are choosing to collaborate with other organizations to optimize the process of transformation of tacit knowledge into explicit knowledge (Nonaka, 2000) and enlarging its resources, including through the joint creation of new knowledge.

An organization’s approach to knowledge determines how it manages it. A growing number of organizations that are aware of their own limitations with regard to knowledge seek to establish relations that enable them to better leverage external knowledge for competitive advantage (Fox, 2021). P.F. Drucker claims that there are no organizations without knowledge, and instead there are only those that mismanage it (Drucker, 1999). Management of knowledge is an important multi-layered subsystem of organizational management (Zawiła-Niedźwiecki, 2014), but its development requires a certain degree of maturity in organizational and inter-organizational learning, which can be defined as a search for, and use and dissemination of, knowledge. Knowledge management in an organization can develop when it becomes aware of the importance of knowledge as an asset that will allow it to generate wealth (Bukowitz, Williams, 2000) and takes steps in that direction.

Knowledge is now becoming the dominant resource and distinctive competency of many organizations. Some believe that the growth and complexity of knowledge are dangerous, but there is a growing awareness among others that access to expanded knowledge resources can benefit their development (Probst, Raub et al., 2002). Therefore, organizations constantly strive to improve the efficiency of knowledge utilization through learning, which is determined by technological changes and organizational culture, among other factors. Technological advances can inspire changes in market offerings, but also affect the learning process itself, for example by enabling access to electronic knowledge bases and accelerating knowledge transfer. This is particularly important at the time of the emerging new post-pandemic reality and the dynamic development of virtual communication, which also contributes to changes in organizational culture. Organizational culture can be defined as knowledge, shared to a various extent by members of an organization, that is expressed in actions and words. An analysis of

the impact of organizational culture on the effectiveness of management in an organization largely concerns specifically of the organization's approach to knowledge. According to Ł. Sułkowski, the development of knowledge management shifts the focus from the values and norms upheld by an organization to its cognition and knowledge. The cultural approach requires searching for new ways of understanding organizations and business life, which naturally links organizational culture also to knowledge management (Sułkowski, 2008).

Effective knowledge management in an organization is closely linked to the development of human capital, including key competencies and creativity (Poznańska, 2018), which lead to improvements within the organization in such areas as interpersonal communication and research (Zawiła-Niedźwiecki, 2014). With the ability to think creatively and use knowledge, an organization can operate on a higher level, e.g. implement innovations (Fiddler, 2002), and ultimately improve its image in the environment and strengthen its impact on other organizations, such as its competitors. Therefore, many organizations strive to build a competitive advantage based on knowledge, while carefully analyzing signals from the environment so as to avoid and prevent mistakes and losses. Skillful use of knowledge in an organization in response to changes in its environment enables flexible and smooth transformation and rapid adjustments (Penc, 2004).

Change is one of the distinguishing features of the current time and a path for the development of any organization (Osbert-Pociecha, 2011). In order to achieve its survival, which is a natural objective, an organization must respond to, and adapt to, and even anticipate change (Kotelska, Lis, 2022). Change is a disruption to any state of equilibrium an organization is in (Sarayreh, Khudair et al., 2013). A response to change requires demonstrating the ability to adapt quickly, as well as flexibility and innovation (Heckmann, Steger et al., 2016). As a result, the organization reconfigures, integrates, and expands its internal and external resources and competencies. In the past, change occurred quite infrequently in the lives of organizations. Nowadays, the complexity, unpredictability, and turbulence of the environment cause all organizations to be subject to the impact of many factors that trigger changes and contribute to their irreversible transformation in the long term (Czop, 2016). Thus, changes in organizations are the consequence of a realized need to respond to a disturbance that throws the organization out of balance and an opportunity to use the organization's existing capabilities, e.g. to adapt or act proactively (Klarner, Probst, 2007).

Modern organizations should be able to face the challenges involved in operating in a knowledge-based economy, i.e. to adapt to the objective conditions prevailing nowadays and the changes imposed by the environment, but also to anticipate them and actively shape their environment. The strategic resource that enables such measures is knowledge (Penc-Pietrzak, 2016), which is the basis for the existence, functioning, and development of any organization (Dolińska, 2010,) individuals, and communities (Dahlman, Anderson, 2000), as well as the entire global socio-economic system (Szczepańska-Woszczyzna, Muras et al., 2021; Szczepańska-Woszczyzna, Dacko-Pikiewicz et al., 2015). In the era of the knowledge-based

economy, all organizations are very dependent on technology and information processing. The rapidly developing new information- and technology-based paradigm requires multi-dimensional creation, condensation, and implementation of knowledge (Brett, 2002), which becomes the root cause of business success or failure. At the same time, the increase in its importance in global processes, not only technological, but also social, has resulted in a change in organizations' approach to resource structure, i.e. placing greater emphasis on the development of intangible resources.

Modern requirements placed on organizations by the knowledge-based economy cause a change in the approach to the structure of resources, which is manifested in the increased importance of intangible resources and the development of inter-organizational links (Mikuła, 2007). This allows the consolidation and complementary use of the available resources, as well as the creation of network organizations that compete with each other (Mikuła, 2007; Moszkowicz, 2002), but are also willing to cooperate in certain areas (e.g. cooperation). The ability to collaborate makes it easier for organizations to respond to today's socio-economic changes and to adapt to the turbulent environment in which they operate.

The ability of organizational learning (Penc-Pietrzak, 2016) and learning from organizational change management (Penc, 2004) is responsible for the proper use, development, or renewal of an organization's resources. Organizational learning not only makes it possible to respond in a flexible manner to changes occurring in the environment (Rutka, 1996), but also facing encourages new challenges, such as innovation. In a knowledge-based economy, where more and more organizations acquire the ability to learn, in addition to the competencies needed to use knowledge appropriately, sourcing valuable and useful knowledge from the best sources is also becoming a strategic skill. One can distinguish sources of knowledge based on four barriers to its creation: the environment, the interior of the organization, the present, and the future. According to this approach, the environment imports knowledge, the interior of an organization implements and integrates that knowledge, the present determines how joint problem-solving is possible, and the future relies on experimentation (Strojny, 2000). To overcome these barriers, organizations need to develop core competencies.

Knowledge creation within an organization is based on the use of relatively easily accessible sources. These include sources of unclassified knowledge, i.e. organizational documents (procedures, regulations, instructions), archives, and data from information systems that contain information on contracts, customers, purchases, etc. Within an organization, it is also very important to use sources of tacit knowledge, which can come from managers and owners, but also - to the greatest extent - from employees. A large role in this case is played by the organizational culture and the value system on which it is founded. However, this value system must not reduce managers, employees, and their creative tasks to a function of resources and means leading to the achievement of the organization's economic and market goals (Sulkowski, 2011), but should treat them as partners in the acquisition and development of knowledge that

supports the achievement of the goals of the organization and its stakeholders. Building so-called experience-sharing communities not only allows employees to exchange knowledge, but also increases their personal happiness and job satisfaction (Chen, Baird et al., 2019).

Sources of external tacit knowledge include external experts and scientists, business partners, customers, and competitors. External sources of explicit knowledge used by organizations include materials available at trade fairs, exhibitions, and conferences, the content of websites and databases, and academic publications. Organizations should have multiple types of knowledge coming from different sources (Michna, 2017), and then should use it in the most appropriate way for themselves, including for defining strategic management elements such as mission, vision, goals, plans, and strategies (Liao, Fei et al., 2008). External knowledge (both explicit and tacit) can be obtained from a variety of stakeholders. Their particular role is to share experiences, transfer knowledge from the outside to the organization, but often also to transfer knowledge from the organization to the outside, especially within consortia, partnerships, and alliances. The most important added value from such collaboration is an expansion of the ability to use different types of knowledge for organizational needs and to equalize knowledge in the intra- and inter-organizational dimensions (Nonaka, Takeuchi, 2000).

The choice of knowledge sources depends on many factors, including their cost. In general, the cost of acquiring knowledge from internal sources is lower than the cost of acquiring knowledge from the outside, so the choice depends on the financial capacity of the organization. Due to the rapid development of information technology, the cost of search for external knowledge has decreased and the efficiency of the process of its absorption has increased. As a result, companies with the same financial capabilities (Poznańska, 2016) can acquire more knowledge in a more efficient manner (Majewska-Bator, Bator, 2011). The search for external knowledge often stems from the development of so-called open innovation. The concept of open innovation, as opposed to the creation of innovations in a closed model, is paradigm of innovation activities of modern enterprises that is rapidly gaining importance (Sopińska, 2017; Michałek, Pachucki, 2020). According to this approach, in order to create innovation, organizations should use both external and internal ideas, inspirations, and technologies (Poznańska, 2012). Intentional inflow and outflow of knowledge, i.e. knowledge transfer in both directions, is the most effective approach to the use of knowledge and accelerates innovation (Chesbrough, Garman, 2010; Lis, Ratajczak, 2014). K. Laursen and A. Salter based their approach to the management of open innovation on a strategy that involves a search for external knowledge. They distinguished two parameters of the knowledge search process: the breadth and the depth of the search for knowledge outside the company's boundaries (Laursen, Salter, 2006). The relationship between these two parameters is explained in Table 1.

Table 1.*The process of search for external knowledge in synthetic terms*

Dimensions of the knowledge-searching process	Measure	Description of the measure
The breadth of the search for knowledge	The number of knowledge sources used by an organization	The greater the number of sources of external knowledge, the greater the breadth of the search for knowledge outside the organization's boundaries.
The depth of the search for knowledge, i.e. the intensity of the search for knowledge in various sources	The degree of relevance of knowledge from external sources	The greater the relevance of knowledge from external sources, the greater the depth of the search for knowledge outside the organization's boundaries.

Source: prepared by the authors based on Greco, Grimaldi, Cricelli, 2016, pp. 501-516; Bohdanowicz, Dziurski, 2020, p. 216.

The strategy of a broad search for knowledge outside the company's boundaries is more prevalent than the strategy of a deep search for external knowledge. Most organizations search for knowledge from a wide variety of sources, but they do not do it very intensively. Both the broad and the deep search for external knowledge is costly and, due to the limited nature of resources, requires choices (Bohdanowicz, Dziurski, 2020). There is generally a negative correlation between the breadth of the search for external knowledge and its depth. For this reason, organizations strive to optimize the number of knowledge sources used and the extent to which they are used, as well as the cost of their acquisition. P. Dziurski notes that individual organizations that offer external knowledge compete for the interest of those who express demand for knowledge, especially when knowledge transfer can be a source of revenue (Bohdanowicz, Dziurski, 2020). Such behavior is on the rise in the case of universities and other research units that compete for cooperation with companies.

Studies show that Polish companies that implement open innovation are characterized by a small breadth of search for external knowledge (Sopińska, Dziurski, 2018; Poznańska, Szczepańska-Woszczyzna et al., 2022). In 2019, as many as 47.54% of the surveyed companies sought external knowledge from only one type of partner, 38.52% from two, 12.39% from three, and only 1.64% from four. These partners included customers, scientific and research institutions, and suppliers. At the same time, Polish companies were characterized by a small depth of search for external knowledge. A large group of companies (14.75%) did not make intensive use of knowledge available from various sources, i.e. these companies sought external knowledge, but their actions were very superficial (their depth of search for external knowledge was 0). A half of the surveyed companies intensively sought external knowledge from only one source, while 27.05% of the companies sought it from two sources, 7.38% from three sources, and 0.82% from four sources.

The findings of this study confirm that companies only superficially seek external knowledge from customers, while being much more likely to seek it from suppliers and scientific and research institutions (small depth of search for external knowledge). Of particular importance for companies, however, is cooperation with research and development institutions, which gives them access to knowledge characterized by a high degree of novelty. While this

knowledge is also relatively easy to access, it can be difficult to understand, process, and use. Despite the fact that companies cooperate less often with scientific entities than with customers, it is scientific entities that inspire them to search for external knowledge (Bohdanowicz, Dziurski, 2020). Research confirms (De Wit-de Vries, Dolfsma et al., 2019; Kobarg, Stumpf-Wollersheim et al., 2018) that providing companies with access to knowledge is a significant challenge for research entities, as the reported demand for knowledge opens up a wide range of opportunities to offer it in many forms.

3. Determinants of the development of companies in the chemical sector in a knowledge-based economy

Nowadays it is difficult to be self-sufficient, (Lynch, 1993) and the ability to assess the environment in terms of its direct or indirect impact is becoming strategically important. The tendency to cooperate with the environment is a natural aspiration of any modern organization that constitutes an open system (Kozłowski, Piotrowski, 2004) that interacts with elements outside it, primarily its stakeholders. These are individuals and groups that are influenced by or significantly influence the organizations (Freeman, 2010), with whom the organization has both unilateral and reciprocal relationships (Kozłowski, Jemielniak, 2009). The key to improving an organization's performance is an understanding of its environment and the relationships it has with its stakeholders. Suppliers that provide the organization with the resources it needs to operate and the customers who purchase its products occupy a strategic place among them (Freeman, Harrison et al., 2018). The exchange between an organization and its stakeholders can involve providing each other with goods or services, as well as resources that are of interest to each party. If such an exchange brings expected benefits and satisfaction to each party, in the long-term it can build mutual trust and attachment (Dacko-Pikiewicz, 2019; Dacko-Pikiewicz, 2022). The value of a specific offering is determined as a result of the relationship that exists between many entities cooperating in different conditions and making resources available to each other.

One of the resources most desired by modern organizations is knowledge. This is fostered by the paradigm of knowledge-based economy whereby many modern organizations are building their competitive advantage by sharing knowledge with each other and jointly using the available external knowledge, as well as through individual, group, organizational, and inter-organizational learning. This is one of the most important reasons for the development of various forms of inter-organizational cooperation.

Inter-organizational cooperation is a relationship between two or more organizations that develops as a result of the evolution of their mutual relations and is beneficial to each party (van Winkelen, 2010; Berlin, Carlström, 2011). This includes both resultant benefits, such as improved access to knowledge, but also inter-organizational cooperation as a value in its own right, requiring each party to provide the capabilities, competencies, and knowledge necessary to create specific interpersonal and inter-organizational relationships (Sitko-Lutek, Pawłowska, 2008; Lis, Kotelska, 2022). Inter-organizational cooperation is based on specific, more or less formal relationships between partners. These organizations, which are independent of each other in terms of their decision-making processes, may or may not follow the recommendations of other partners; however, proper coordination between them is necessary to give their cooperation the right direction.

A key attribute of inter-organizational cooperation is collaboration (Kale, Dyer et al., 2002), whereby partners pursue convergent goals and objectives in the same or different ways. This can take the form of full cooperation or cooperation only in certain areas. Inter-organizational cooperation can develop either as bilateral relationships between two organizations or as network relationships, such as consortia, alliances, networks, or clusters. Collaboration can vary in terms of the scope of activity of the parties (from passive, one-way use of knowledge to active co-creation) and the type of knowledge transferred (explicit or implicit) (Olszewski, 2020). The larger the number of cooperating organizations, the better the results that can be obtained in terms of sharing information, knowledge, and experience, or in terms of synergistic use of joint capabilities and resources (Szczepańska-Woszczyzna, 2020). At the same time, the larger the number of cooperating organizations, the harder it is to synchronize the decision-making processes, identify the common interests, reach compromises regarding risk distribution, and share the costs and benefits of activities carried out together (Payan, 2007; Michałek, Pachucki, 2021). Inter-organizational cooperation is justified only if the partners are convinced that its benefits outweigh the costs due to, for example, the time it requires.

Inter-organizational cooperation can develop between organizations with very similar or very different characteristics (Lundberg, Andresen, 2012) in the private, public, as well as non-governmental sectors (Kožuch, Sienkiewicz-Małyjurek, 2015), or between various sectors. Not only the area of cooperation, but also its dynamics, goals, scope, and legal form can vary to a large extent. Asymmetries in the structures and management methods of cooperating organizations, (Kaiser, 2011; Young, Denize, 2008), as well as differences in their organizational cultures have a significant impact on both the course and the results of joint activities. In practice, this can mean that despite each party's efforts, the differences between organizations make it much more difficult for them to work together. Companies that intuitively act in the spirit of rivalry start cooperation only if they are convinced that by doing so they will strengthen their competitiveness, which is a condition for surviving in the market (Kožuch, 2011). NGOs, on the other hand, mostly carry out social missions aimed at specific stakeholder

groups. They seek to obtain the resources they require to achieve their goals or to implement certain values, and view interaction as a mechanism that facilitates achieving the desired outcomes. Compared to organizations in the commercial and non-governmental sectors, public organizations are much more prone to authoritarianism and formalization, while autonomy of action and decision-making in them is limited, and competitive pressures are virtually non-existent (Kearney, Hisrich et al., 2009). Public organizations find it most difficult to engage in cooperation, which by its nature requires a certain amount of flexibility and adaptability.

Cooperation is a riskier form of doing business than operating independently (Czakon, 2007), so inter-organizational cooperation is not easy. A number of factors can be identified that contribute to the high level of uncertainty in such relationships, such as periodicity of operation, divergence of interests, difficulty in comprehending organizational affiliations, dispersion of activities, and lack of competencies for cooperation (Sokołowska, 2005). In extreme cases, involvement in inter-organizational cooperation can result in loss of knowledge due to its overly broad and deep transfer, or to uncontrolled and unwanted knowledge spillover effects. In the case of large asymmetry of tacit knowledge, those who have its largest resources may choose to act independently (Coff, 2010). Another possible problem associated with inter-organizational cooperation is dependence on other partners. Therefore, the price for the uncertainty associated with cooperation must be its high value to the organization, outweighing the benefits of individual action.

Various forms of interaction, such as networks and clusters, can lead to an increase in the knowledge resources in cooperating organizations. They open up new opportunities for collaborative learning and managing the existing knowledge, which ceases to be an individual resource of an organization and, to the extent acceptable to all cooperating organizations, becomes a shared resource. In order to be able to use such accumulated knowledge, it is necessary to implement a process of inter-organizational learning.

A fairly common and flexible form of inter-organizational cooperation is various forms of alliances. These are formalized or informalized inter-organizational relationships of undetermined duration, most often associated with a process of mutual compensation of resources and capabilities of any number of partners. Alliance participants strive to achieve common goals, including by compensating for their own weaknesses with the use of others' resources, including knowledge (Probst, Büchel, 1997). Alliances are most often established to observe, learn, and internationalize the partners' *know-how* (Parise, Sasson, 2002), while the cooperating organizations show a strong commitment to generating core competencies (Harbison, Pekar Jr., 1998), as well as to mutual and collaborative learning. In this cooperation, the similarity and complementarity of the partners, the common skills, and the unique knowledge of each of them play an important role. Alliances can lead to a reduction in uncertainty and an increase in the flexibility of operations (Macias, 2013); among other things, they make it easier to bear the ever-increasing cost of access to knowledge, but also, due to their different learning speeds, the partners may use the shared knowledge available to the alliance

in an unequal manner (Pietruszka-Ortyl, 2007). Certainly, in the process of collaborative learning, awareness of the elusiveness of knowledge and its constant obsolescence is desirable, as is the ability to adapt the activities of the collaborating organizations to the inter-organizational learning model developed jointly. Modern motivations for entering into alliances most often relate to the competitiveness of organizations, i.e. the desire to acquire technology or unique capabilities, share costs and risks in the process of joint research, learn from partners, adapt quickly to new conditions as a result of intensive knowledge transfer (Hamel, Doz, 1989), and benefit from the intellectual capital of partners (Skrzypek, 2015). The knowledge-based alliances defined in the literature (Probst, Raub et al., 2002) involve the cooperation of organizations to achieve the maximum learning effect through the adoption of a specific philosophy of interaction assuming that (Pietruszka-Ortyl, 2007):

- learning is the overarching goal of the alliance and every participant is aware of it,
- the philosophy of human resource management in the cooperating organizations is in line with the assumptions of the process of joint organizational learning of all members of the alliance,
- the cooperating organizations have the financial and material resources necessary for the process of collaborative organizational learning and have appointed to participate in the process their representatives with the appropriate talents, competencies, and skills that make it possible to maximize the learning effect,
- each of the cooperating organizations has thoroughly assessed its learning capabilities and is constantly improving them, e.g. builds an organizational climate conducive to learning, provides its representatives with the best conditions for cooperation with partners, and minimizes barriers to the learning process, such as those arising from cultural differences.

The strategic role of knowledge in the modern world encourages organizations to search for it and develop it in various forms of inter-organizational cooperation. The aforementioned knowledge-based alliance is just one such form. The entities engaged in inter-organizational cooperation are primarily those that are interested in better access to knowledge and its more efficient use, including businesses. It is also an attractive area of activity for organizations that offer knowledge to others as their key product, as well as organizations that use knowledge to self-improve and grow so effectively that others want to learn from them. Such organizations include universities. Many intermediate variants are also possible when organizations with knowledge to offer are themselves simultaneously seeking knowledge and are able to exchange their resources, or learn together, synergistically leveraging the capabilities of all partners.

The activities of universities are commonly associated with the production and release of knowledge (Breznitz, 2014). Accordingly, a modern university pursues three missions: education, scientific and research activities, and the creation of mutual relations with their environment. The third mission is to serve the purpose of greater involvement of academic institutions in social development processes at various levels, including economic and social

(Leja, 2015). In practice, the quality and usefulness of academic knowledge to the environment, as well as the way it is offered, including marketing preparation (Olearnik, Pluta-Olearnik, 2015) and the attractiveness of the university as a partner in various forms of inter-organizational cooperation, can vary to a large extent. It is worth noting that inter-organizational cooperation with regard to universities should mean not only transferring knowledge to the outside, but also drawing knowledge from the outside, which, in practice, means a continuous exchange of knowledge: in the spirit of academic entrepreneurship (on a market basis) (Poznańska, 2014) or through activities related to the social responsibility of science (on a non-profit basis) (Jasiński, 2015). In addition to the typically educational knowledge transfer processes (university teacher - student relationship), universities carry out basic research, but also commercial processes of knowledge exchange, including by jointly conducting research and using its results in relations between universities and companies. Moreover, socially oriented knowledge exchange processes take place there - in relations with local governments or non-governmental organizations.

According to A.H. Jasiński, universities should be seen as modern institutions operating in a market environment, i.e. in a business environment, among other things. The confluence of many factors has forced modern universities to turn to cooperation with their external environment, including, in particular, involvement in activities aimed to modernize the economy and develop cooperation with businesses. Inter-organizational cooperation can thus be developed by universities in many spatial dimensions¹ and in different markets:

- in the market for services (educational, research, consulting and expert, or design services),
- in the market for goods related to the use of so-called science infrastructure (e.g. conference rooms, laboratories, as well as recreational, accommodation, and catering infrastructure),
- in the market for external funds (e.g. participation in competitions for various types of grant funds for projects they perform),
- in the labor market (graduate education², activities of academic career offices, human resource processes for teaching, research, and administrative staff of universities engaged on the basis of various employment models),
- in the market for social services (including non-profit activities, charity, and volunteerism).

¹ It can be a local, regional, national, or international dimension.

² The role of universities in the development of professional and general competencies is discussed, among others, by: Borowiecki, Kusio, 2016, pp. 71-90; Motoyama, Mayer, 2017, pp. 787-804.

In terms of entities, the supply side in each of the aforementioned markets can be represented not only by universities, but also by all other entities that are able to provide the aforementioned services³. This market is becoming increasingly competitive and some forms of inter-organizational cooperation, such as between universities, are also developing there more and more clearly. In general, however, competition for users and buyers of university's offerings representing the demand side (students, businessmen, social partners), but also for resources, e.g. funds for operations, best specialists, and most effective advertising, prevails.

The demand side of the market in which universities operate is made up of diverse stakeholders, whose role in the environment of the academic sector is increasing (Popławski, Forkiewicz et al., 2014) while giving impetus to the creation of new knowledge that is useful to them (Wawak, 2019), as a product to be exchanged with these stakeholders. According to A.H. Jasiński, knowledge should be created not only for the stakeholders, but also with their increasing participation, so that they are not just buyers of the services provided by universities, but also their co-creators (Jasiński, 2015). This is therefore a rationale for the development of inter-organizational cooperation between the demand and supply sides of the higher-education market. The effectiveness of these activities requires the university not only to ensure an appropriate quality and availability of knowledge, and its effective transfer, but also adequate marketing preparation, among other things to create various forms of inter-organizational cooperation with the customers buying the universities' services. As emphasized, the university's entrepreneurial orientation greatly facilitates agreement with stakeholders from the business sector (De Wit-de Vries, Dolfsma, 2019) and minimizes the cultural barriers to such cooperation. According to M. Kwiek, never before have universities faced the changing pressures from their major stakeholders for so long. Therefore, higher education institutions should respond no longer only to the changing expectations of the state, but also to the new needs of students, employers, and businesses operating in the regions where they are located (Kwiek, 2011).

The particular need to intensify the process of collective learning of representatives of science and business in "learning regions" is pointed out, among other publications, by the OECD report (Ischinger, Puukka, 2009). Spatial (geographic) proximity is one of the most important criteria for selecting partners for inter-organizational cooperation. Some studies even indicate that cooperation between universities and companies tends to be local, as knowledge flows make it necessary to establish networks and maintain direct contact. Spatial proximity facilitates the transfer academic knowledge that is complex and difficult to codify (Crescenzi,

³ While in the market for higher education (educational) services, one can speak of direct competition only between universities (except for the market for training services), in the market for research or expert services, for example, universities have strong and a lot more numerous competitors: experts providing so-called professional services, consulting firms, law firms, commercial laboratories, and research and scientific institutes. According to another approach, the competitive environment of universities also includes, for example, non-profit organizations, among others due to the fact that they compete with universities for funding for social activities (e.g. grants from local governments) - see: Pluta-Olearnik, 2015, pp. 127-135.

Filippetti et al., 2017). Companies with a low capacity to absorb knowledge make greater use of local knowledge, while companies with a high capacity to absorb knowledge and globally connected companies use knowledge from outside their regions. Obtaining knowledge locally also depends on the extent to which local sources are able to provide knowledge that is in line with the information needs of the recipient. Universities whose offerings can meet the needs of companies seeking local knowledge find many potential partners for knowledge exchange in the immediate area. Universities that specialize in narrow areas of research certainly have to take a different path to reach potentially interested companies with their knowledge. Inter-organizational cooperation between universities and companies is also fostered by organizational proximity, i.e. the degree of similarity between their operating conditions, (Boschma, 2005), and cognitive proximity, i.e. access to similar reference knowledge bases and similar knowledge absorption capacity.

Cognitive proximity involves knowledge shared (Cramton, 2001) by the partners, which is particularly important when conducting research together. The more efficiently organizations communicate, the more similar reference knowledge they have. Cognitive proximity has a positive impact on the speed and accuracy of communication, but also determines its scope (Nooteboom, 2000). The cognitive dimension of proximity is correlated with the learning process much more than geographic or organizational proximity (e.g. collaborative learning to ensure the development of smart specialization of the region) (Orlando, Verba et al., 2019). Institutional proximity, understood as the degree of similarity in institutional conditions, can also be an important catalyst for the process of shared learning, but it is not beneficial in every situation. The greater the institutional proximity, the better the conditions for knowledge transfer and interactive learning; however, excessive institutional proximity can create barriers to efficient operation and introduce certain routines (Czakon, 2010). In the case of cooperation between universities and companies, diversity of experience can be a far greater advantage than institutional proximity. Social proximity, on the other hand, is an invariably important factor. Social relations are the natural environment for the development of economic interactions. Social and economic structures influence each other through the interpenetration of human relationships, similarities, and common activities and experiences. The greater the social proximity, the more efficient the learning, as demonstrated, for example, by communities of practice (Molina-Morales, Martínez-Fernández, 2010). However, the literature also points to the dangers of elimination of opportunistic behaviors from cooperation (Karpacz, 2014), and of unchanging functioning in a closed set of relationships, which limits the inclination and ability to go beyond established behavioral patterns (Oerlemans, Meeus, 2005).

A special determinant of inter-organizational cooperation between companies in the chemical sector and universities is the aforementioned ability to absorb knowledge. It is defined as the ability to recognize new external information, assimilate it, and use it for specific purposes, including business ones (Lane, Lubatkin, 1998). From the point of view of an organization that acquires external knowledge, inter-organizational cooperation is

dependent, among other things, on the recognition of the value of the partner's knowledge and the possibilities of its acquisition, assimilation, processing, and use. In an inter-organizational setting, the ability to absorb external knowledge depends on the type of knowledge to be absorbed and the similarities between the cooperating organizations in terms of organizational structures and conditions (Lis, 2017). This view alludes to the importance of organizational proximity in inter-organizational cooperation. In the context of knowledge absorption, it is worth focusing on the partner who shares knowledge. Whether the partner is willing to disclose its knowledge and share it is an important determinant of the effectiveness of the learning process of the recipient of that knowledge. Positive behavior of the provider of knowledge that supports the recipient's learning increases the effectiveness of inter-organizational learning. Therefore, a greater degree of transparency in knowledge transfer promotes improved learning outcomes for the knowledge recipient. An organization that is highly open to learning is more persistent in learning than an organization characterized by limited openness. It is not easy for the former to give up the opportunity to learn even when frustrations and challenges arise (Nogalski, Karpacz et al., 2014). The essence of effective cooperation between companies in the chemical industry and universities is therefore to ensure as much openness to collaborative learning as possible in the organizations.

4. Methodology of the research process

The research methodology in general indicates how to build a theory, while in specific terms it defines a detailed research procedure for the objects studied by a specific discipline. Therefore, the areas of interest of methodology include research methods, according to which certain patterns of individual research activities are carried out (Stachak, 2006; Sosenko, 2008; Apanowicz, 2000).

The research process began with an in-depth study of domestic and foreign literature in the science of management and quality. A search of the literature made it possible to identify the research area, recognize the scope of the subject matter, determine the definitions relevant to the topic under consideration, as well as acquire and consolidate information on knowledge management, relationship management, interorganizational cooperation, and collaboration.

Therefore, it would not be possible to achieve the main objective of the study without developing an appropriate research procedure. Accordingly, the authors reviewed methodological approaches, as well as research methods and techniques to help solve the research problem posed. They recognized that in pursuit of in-depth and comprehensive results on how universities in Poland form long-term relationships with businesses, it is reasonable to adopt the research strategy of methodological pluralism. Therefore, the study used an integrated research approach, which included both direct interpretive and positivist research procedures.

This required qualitative and quantitative research, as well as the development of various research tools (IDI, FGI, and CATI interview questionnaires). Also indicated are statistical analysis methods (including the factor method and the structural equation modeling method) and their applications, which can help managers make important decisions on establishing and strengthening ties with other business entities.

5. Relationships between universities and companies in the chemical sector in light of the results of quantitative research

According to the authors' earlier findings, the relationship between a university and chemical sector companies should be formed on the basis of value, the sources of which include the knowledge offered by universities. According to F.E. Webster, the basis of the marketing activities of an organization (including a university) is the process of defining, developing, and delivering value to clients (university's stakeholders) (Webster, 2002). Therefore, it is worth taking a closer look at how the respondents perceive the cooperation between companies and universities, what the source of value for companies cooperating with universities is, and how the existing relations between these entities are evaluated.

As part of a CATI interview with representatives of 350 chemical sector companies cooperating with universities, the respondents were asked to evaluate nine statements regarding their perceptions of the activities of universities. The averaged opinions of the respondents divided into those concerning micro (black line), small (red line), medium (blue line), and large companies (green line) are shown in Figure 1. Very importantly for the process of formation of long-term relations between universities and companies, for each of the statements (with one exception, where the average was 4.5), the average on the seven-point scale was between two categories: "I rather agree" (5) and "I agree" (6), which indicates that the level of acceptance of the presented beliefs is high (see Fig. 1).

The information presented in Figure 1 shows that the opinions of respondents representing micro, small, medium, and large companies do not differ significantly. Statements on a broadly defined involvement of universities in activities for the benefit of their environment, as well as the quality of education they offered, were rated the highest. The issue that raised the greatest concern was the causal power of universities, understood as their impact on the socio-economic development of their municipalities, cities, and regions.

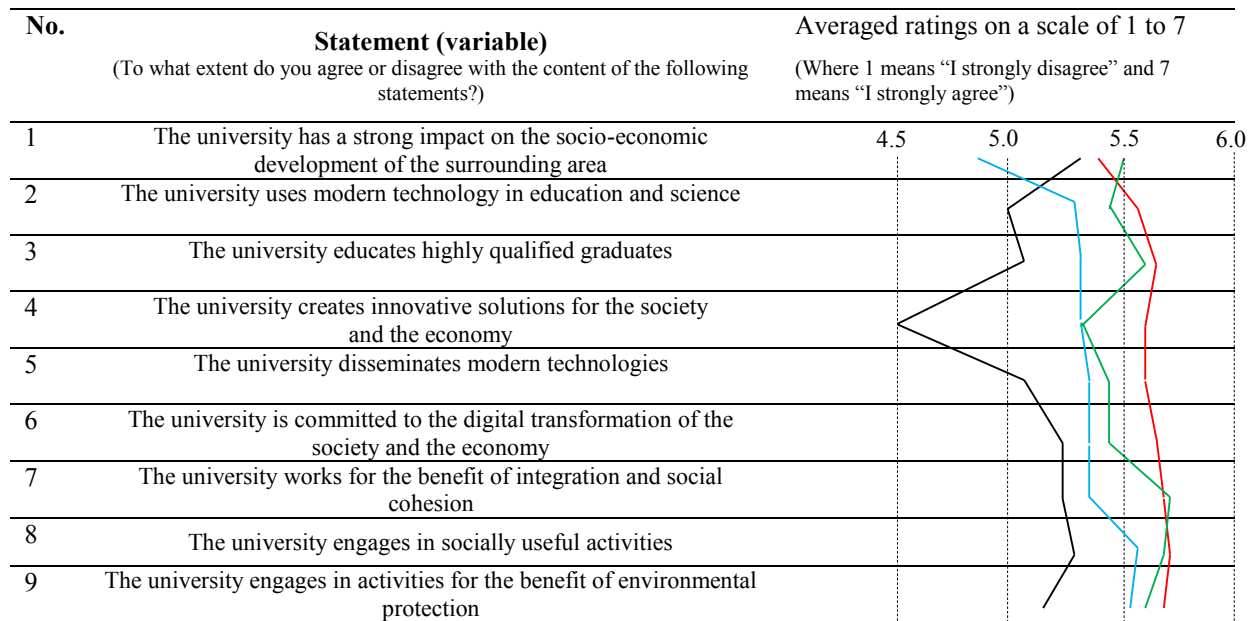


Figure 1. Perceptions of universities among the surveyed representatives of companies that cooperate with universities (black line - micro, red line - small, blue line - medium, and green line - large companies)

Source: own research.

On the other hand, Figure 2 shows the average score concerning the strength of the relationships that exist between universities and chemical sector companies on a five-point scale (where 1 means that the relationships between a university(-ies) and companies are very weak, while 5 means that they are very strong). The white bars in Figure 3, on the other hand, indicate the company's desire to further strengthen its relationship with a university(-ies) (based on a specific form of cooperation) in the future (where 1 means that strengthening of the relationship is highly undesirable and 5 means that it is highly desirable).

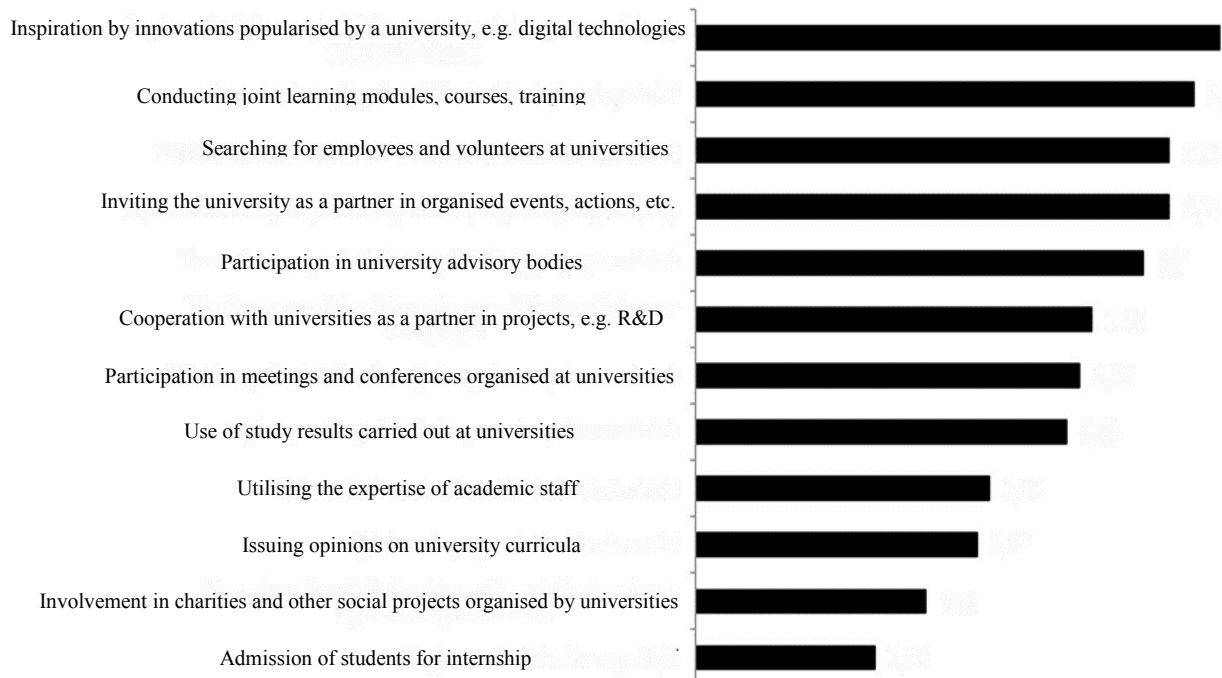


Figure 2. Relationships between companies and universities as assessed by the surveyed entities.

Source: own research.

The averaged opinions presented in Fig. 2 indicate that the strongest relationships were observed among those surveyed companies that undertake the following forms of cooperation with universities:

- getting inspired by innovations that are disseminated by the university, such as new digital technologies,
- conducting joint educational modules, courses, and training,
- searching for employees or volunteers at universities,
- inviting a university to be a partner in events, campaigns, etc. organized by the company; and
- participation in advisory bodies operating at universities.

In contrast, the weakest relationships with universities were noted among the companies involved in charitable and other social activities organized by universities, as well as those providing internship programs for students.

An in-depth analysis of the collected material additionally demonstrated that a half of the respondents rated the relationships of their chemical sector companies with universities as strong, a similar group rated them as neutral or ambivalent, while only 3% of the respondents declared weak relationships. The overall average on a scale of 1 to 5 was 3.49, which means that the declared strength of the relationships with universities was between the ambivalent (3) and moderately positive (4) response categories. Of note is the fact that the opinions obtained are slightly polarized, which means a predominance of moderate opinions over extreme ones (positive or negative). Based on the data, it can also be concluded that the strength of the relationships is positively influenced by the size of the organization (the number of employees), the length of the cooperation period, and the number of universities with which the company cooperates.

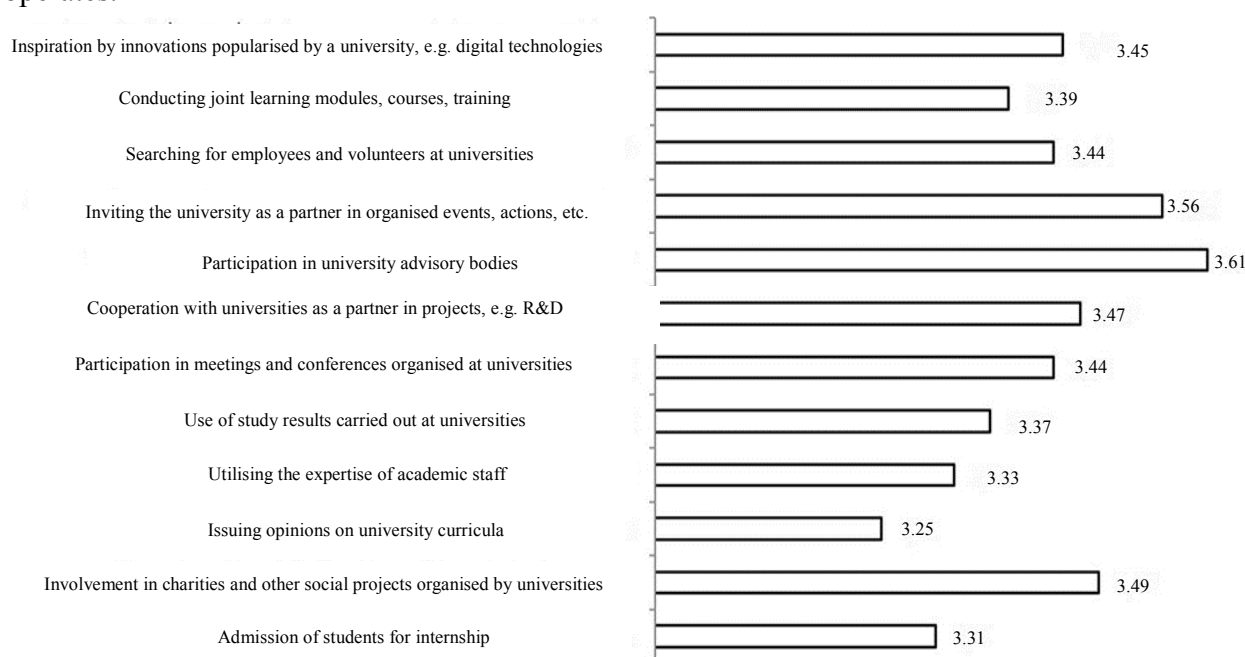


Figure 3. Willingness to further strengthen the company's relationship with a university(-ies).

Source: own research.

The data presented in Fig. 3 shows that the entities that are most interested in strengthening their relationships with universities are those that are involved in advanced forms of cooperation with universities: they participate in advisory bodies operating at universities (score of 3.61) and invite universities as partners in projects, campaigns, etc. they organize (3.56). An in-depth analysis of the collected data additionally shows that nearly 66% of the respondents wanted their relationships with universities to be “neither strong nor weak” in the next few years, while 30% expected stronger ties (mostly moderately strong). Increasing the strength of the relationships was primarily expected by those representatives of companies who rated their existing relationships as strong (52% in this group, the average rating was 3.6), cooperate with 2-3 universities (45%), and had maintained relationships with universities for 4-5 years (38%).

The representatives of the surveyed chemical sector companies were also asked whether they were satisfied with their previous cooperation with universities; the distribution of the responses given by representatives of micro, small, medium, and large companies is shown in Table 2.

Table 2.

Degree of satisfaction of the representatives of the surveyed companies with the cooperation with a university(-ies)

No.	How satisfied are you with your company's cooperation with a university(-ies)?	Company									
		Micro N = 15		Small N = 195		Medium N = 105		Large N = 35		Total N = 350	
		lb	%	lb	%	lb	%	lb	%	lb	%
1	very satisfied (5)	5	33.3	89	45.6	30	28.6	19	54.3	143	40.9
2	rather satisfied (4)	8	53.3	94	48.2	66	62.9	15	42.9	183	52.3
3	neither satisfied nor dissatisfied (3)	2	13.3	11	5.6	7	6.7	1	2.9	21	6.0
4	rather dissatisfied (2)	0	0.0	1	0.5	1	1.0	0	0.0	2	0.6
5	very dissatisfied (1)	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
6	I don't know/It's hard to tell	0	0.0	0	0.0	1	1.0	0	0.0	1	0.3
7	SATISFIED (4+5)	13	86.7	183	93.8	96	91.4	34	97.1	326	93.1
8	DISSATISFIED (1+2)	0	0.0	1	0.5	1	1.0	0	0.0	2	0.6
Total		15	100.0	195	100.0	105	100.0	35	100.0	350	100.0
Arithmetic average		4.2		4.39		4.2		4.51		4.34	

Source: own research.

The data compiled in Table 2 shows that the degree of satisfaction of chemical sector companies with cooperation with universities is high (the answer “very satisfied” and “rather satisfied” was selected by a total of 93.2% of the respondents, of which 40.9% indicated the highest possible rating (5 on a scale from 1 to 5, where 1 means “very dissatisfied” and 5 means “very satisfied”). Interestingly, a significantly higher degree of satisfaction (98%) was noted in the group of companies involved in more advanced forms of cooperation with universities, such as conducting joint educational modules, courses, or training. The vast majority of the respondents believed that the benefits of cooperation between their companies and universities were shared by both parties in equal proportions (Table 3). This opinion was most common among the representatives of small companies with 10-49 employees (88.2%). Eight percent of the respondents believed that the beneficiaries of cooperation between companies and

universities were primarily companies; most of those respondents declared maintaining strong relationships with universities (11%) and expected to strengthen these relationships in the next few years (12%).

Table 3.

The party that benefits more from cooperation between universities and companies

No.	Who benefits more from cooperation between universities and companies?	Company									
		Micro N = 15		Small N = 195		Medium N = 105		Large N = 35		Total N = 350	
		lb	%	lb	%	lb	%	lb	%	lb	%
1	universities	0	0	3	1.5	4	3.8	3	8.6	10	2.9
2	companies	1	6.7	14	7.2	8	7.6	5	14.3	28	8.0
3	both parties equally	13	86.7	172	88.2	84	80.0	27	77.1	296	84.6
4	I don't know/It's hard to tell	1	6.7	6	3.1	9	8.6	0	0.0	16	4.6
Total		15	100.0	195	100.0	105	100.0	35	100.0	350	100.0

Source: own research.

The respondents were then asked about universities' resources that were most desirable to chemical sector companies. The averaged respondents' opinions, expressed on a scale of 1 to 7 (where 1 means "very undesirable resources" and 7 means "very desirable resources") are shown in Figure 4.

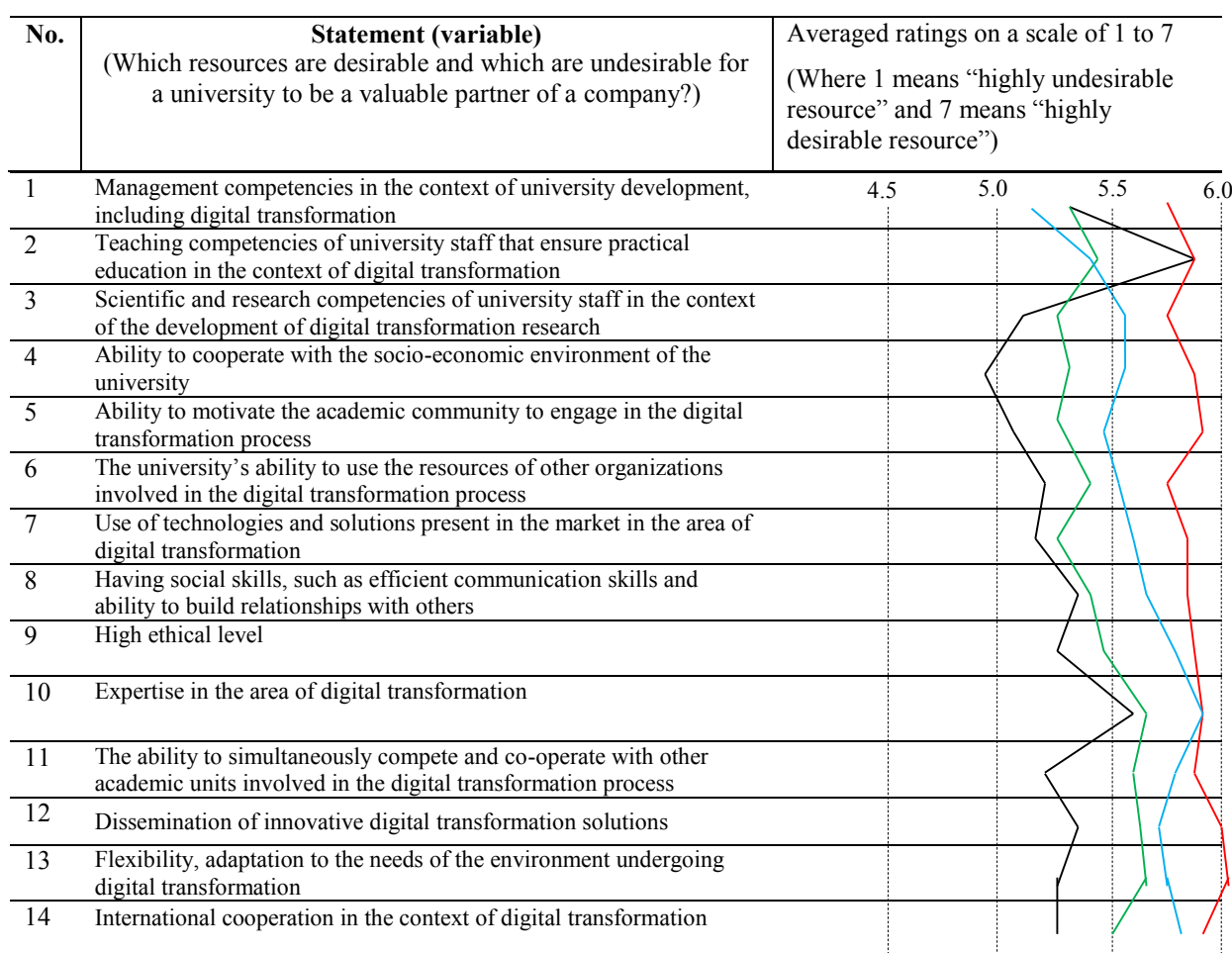


Figure 4. The desirable resources of universities (black line - micro, red line - small, blue line - medium, and green line - large companies). Source: own research.

The respondents most often considered as desirable universities' resources related to scientific knowledge and broadly defined social skills, as well as relationship-building skills. The top places in the ranking were occupied by both issues related to the universities' expertise and competencies, as well as certain characteristics of the so-called organizational culture, such as flexibility and openness to change. Once again, the opinions of representatives of micro, small, medium, and large companies did not differ significantly.

6. The impact of knowledge on establishing and strengthening the link between universities and chemical sector companies

Before starting to determine the impact that knowledge (of which universities in Poland are a "transmitter") has on the propensity of chemical sector companies to establish and strengthen their ties with universities, it was necessary to define the components of those technologies that are the most important in the process of formation of long-term relationships. These components, in the form of appropriately selected statements, would be used to study the relationships between universities and companies.

Table 4.

Arrangement of the factor loads for the variables concerning the propensity of companies to establish and strengthen their ties with universities

Method of identifying factors - principal components. Rotation method - Varimax with Kaiser normalization.

a. The rotation reached convergence in 3 iterations.

Statement (variable)	Factor	
	1 Strengthening ties	2 Establishing ties
I would like to create joint international projects with selected universities	0.810	
I would like to create joint research and development projects with selected universities	0.781	0.398
I would like to have an influence on the educational offer, fields of study, and curricula of selected universities	0.764	0.305
I would like to create joint business projects with selected universities	0.744	0.392
I would like to benefit from the expertise and advice of selected universities		0.775
I would like to use the results of research conducted by selected universities for the development of my company	0.368	0.754
I would like to use the modern technologies disseminated by selected universities	0.409	0.728

Source: own research.

The data shown in Table 4 indicates that the seven input variables were assigned to two factors, which can be described as follows:

- factor 1: a desire to strengthen ties with universities, focused on more in-depth cooperation and implementation of joint projects, requiring the involvement of both parties, a good understanding of organization and processes, a relationship based on trust and interaction between the two entities (universities and companies),

- factor 2: intention to establish ties with universities, involving simple forms of cooperation and use of the university's expertise, without the need for a high level of commitment on the part of the company or for advanced cooperation.

As a conclusion for the results of the study, it should be stated that the value derived from knowledge positively influences the establishment and subsequent strengthening of the ties between universities and companies. Therefore, it can be assumed that this knowledge (in particular, solutions in the area of digital technologies that focus on monitoring and automation of processes, data integration, and *big data* analytics, as well as data protection and cybersecurity) can be applied in the process of formation of long-term relationships between universities and companies.

As a comment to the final results of the quantitative study, it should be stated that the main research hypothesis that was to be verified, namely that a university's knowledge has a stimulating (positive) effect on the propensity of companies to establish and maintain multidimensional inter-organizational cooperation, has been confirmed.

7. The main problems in the process of formation of relationships between universities and chemical sector companies based on knowledge in the light of the results of the qualitative research

The qualitative research conducted using the interview method in the form of individual in-depth interviews (IDI) involved 15 experts - representatives of universities who were directly involved in shaping relations between universities and institutional stakeholders (enterprises) (Table 5).

Table 5.

Basic information about the conducted qualitative research (IDI)

Specification	Research
Research method	Interview
Research technique	Individual In-depth Interview (IDI)
Research tool	Individual in-depth interview scenario
Sampling	Purposeful (representatives of HEIs directly involved in the cooperation of HEIs with institutional stakeholders, in particular in the cooperation between science and business)
Sample size	15 persons
The spatial scope of the survey	Silesian voivodship
Date of survey	May-June 2020

Source: own research.

As part of the qualitative research, four focus group interviews (FGI) were also conducted. The interviews were divided into two thematic sessions carried out in parallel in two groups - with representatives of companies that cooperate (group one) and do not cooperate (group two) with universities. Six experts participated in the interviews (Zoom platform) in each group - managers, employees co-responsible for making decisions regarding the company's development. Only persons representing entities employing at least 10 employees were recruited for the interview, in each group there were persons representing entities employing more than 50 employees, these were representatives of enterprises based in the area of Masovian, Silesian and Świętokrzyskie voivodeships.

Session two (repeated group interviews) (Zoom platform) involved the same people who participated in session one. The basic characteristics of the qualitative FGI study are presented in Table 6.

Table 6.

Basic information about the conducted qualitative research (FGI)

Specification	Research
Research method	Interview
Research technique	Focus Group Interview (FGI)
Research tool	Focus group interview scenario
Sampling	Target Group 1 (representatives of enterprises which cooperate with universities) Group 2 (representatives of enterprises which do not cooperate with universities)
Sample size	2 FGI x Group 1 (6 people) 2 FGI x Group 2 (6 people)
The spatial scope of the survey	Masovian, Silesian and Świętokrzyskie Voivodeships
Date of survey	October 2020

Source: own research.

According to the surveyed representatives of universities, cooperation between universities and chemical sector companies arises primarily from the need for a transfer of knowledge and technologies (including digital technologies), which are then developed in companies during the process of commercialization of goods and services. The majority of the respondents felt that the formation of long-term relationships between universities and micro, small, medium, and large companies alike led to the creation of additional value that is important to both the companies and the universities. Importantly, the shaping of relationships between universities and companies was defined by the respondents as the process where universities influence the propensity of companies to establish and strengthen their ties with the universities. At universities, the process most often requires proper management of cooperation agreements (e.g. for the admission of students for internships) and of science-business consortia, as well as the transfer of knowledge and digital technologies.

In the case of chemical sector companies, in the opinion of the respondents, the activities that initiate cooperation with universities mainly involve the performance of tasks that lead to an improved innovation and competitiveness of those companies based on the results of the scientific and research work conducted at the universities. This is because the managers of these companies realize that faster organizational development can be achieved by combining the resources of companies and universities. On the other hand, according to the respondents, universities wishing to conduct groundbreaking research must seek corporate funding. The university employees surveyed also said that universities' initiatives to establish cooperation with chemical sector companies generates a *push* strategy whereby digital technology offerings and research results are "pushed" into the market. Companies, on the other hand, apply the *pull* strategy by seeking partners in the academic sector. They "pull" the results of research, thus raising its importance, which increases the attractiveness of the university in the market for higher education services. At the same time, the surveyed university employees responsible for science-business cooperation considered medium-sized companies to be the best partners. This is because these companies show both great interest in cooperation with scientific centers and have adequate financial, market, structural, personnel, intellectual, and social resources to commission research on new technologies, as well as to implement their results. At the same time, the resources of medium-sized companies are not large enough for them to carry out research and implementation work on their own.

The respondents additionally pointed out that one of the primary ways in which universities cooperate with chemical sector companies involves implementation of educational programs using the actual activities carried out by companies as a complement to, or extension of, the knowledge gained at the university. Through active involvement in the work of these companies, students and young scientists gain practical skills regarding the use of the knowledge they acquired at the university. This knowledge, in turn, is of particular value if it can have a direct effect on a company that accepts students and graduates for work. Cooperation between universities and companies also very often takes the form of so-called academic entrepreneurship. The establishment of technology and entrepreneurship incubators, followed by *start-ups* launched by university students and graduates (based on knowledge and research results obtained in scientific centers), is an important element of cooperation between universities and micro, small, medium, and large companies. According to those surveyed, supporting the so-called *spin-off* companies and thereby disseminating research results through academic entrepreneurship should be a priority activity linking universities to chemical sector companies.

On the other hand, according to the surveyed representatives of universities, the key issue that influences the willingness to establish or strengthen ties between chemical sector companies and universities is the value category, the sense of mutual benefit, which should be measurable and tangible for the partners. However, some of the surveyed representatives of companies that do not cooperate with universities had negative experiences with cooperation

with universities: “the university sends students for an internship, they come to do the internship, and the company does not create any lasting value in this way [...], the benefits are only for the other party...” A similar argument is used by those representing business entities that cooperate with universities. Meanwhile, it is a relationship based on mutual benefits that is the source of satisfaction derived from this kind of cooperation. In other words, the one-way benefit model discourages companies from establishing relationships with universities, negatively affects the satisfaction levels, and discourages strengthening these relationships. Another important aspect is the constancy and longer-term perspective of the cooperation, which, in the opinion of those surveyed, should not be action-oriented or ad hoc, and the desirable model is to build cooperation in a systemic way (through process-based phased activities aimed at forming long-term relationships). According to the surveyed representatives of companies, university graduates are an important link between companies and universities. The respondents recognized that it is the relationships between graduates (employed at companies) and universities that is very often the starting point in the process of formation of relationships between chemical sector companies and universities.

With reference to the qualitative research and the posed research question of how knowledge fosters inter-organizational cooperation between universities and chemical sector companies, it should be stated that the operation of a university depends on a number of factors that influence the formation of long-term relations between the university and companies. As discussed herein, these factors may be due, among other things, to poor transformation capabilities, including the inability to meet increasing technological requirements, which both universities and the chemical sector companies working with them are aware of. In the authors' opinion, knowledge-based entrepreneurial universities with a combined economic, market, innovation, and management focus are far better prepared to offer knowledge as an attractive product and the value that comes with it, so they also perform better in the process of formation of long-term relationships with companies. Indeed, knowledge-based entrepreneurial university very often have the organizational capacity to anchor their activities in the market and competitive environment. They can also more quickly identify and develop knowledge-based competitive advantages (related, among other things, to digital education and research activities), which are in turn a magnet attracting potential business partners.

8. Conclusion

Although the influence of knowledge as a determinant of organizational development has never been put in question, the increasing turbulence of the environment, the growing demands of the market players, and finally the instability of the needs associated with, among other things, rapid technological advances, make its importance in the third decade of the 21st century take on a whole new dimension.

However, the research conducted for this paper leads to the conclusion that a significant number of higher education institutions in Poland are not very well prepared to transfer knowledge externally to those companies that implement innovations in an open model (in particular, knowledge about digital technologies). In the authors' opinion, it is equally important that the transfer of knowledge from the outside to universities is also far too rare if it is the university that plans to implement innovations. In addition, the research shows that there are still strong habits in the cooperation between universities and companies related to one-way knowledge transfer that do not foster the new approach (discussed herein), i.e. co-creation of value, leading to incremental growth of knowledge for both partners in the relationship. In order for co-creation leading to the growth of knowledge to be possible, it is necessary to draw from various sources of external and internal knowledge. This, in turn, requires both university authorities and business managers to be able to find a proper balance between the depth and breadth of the search for knowledge, which can often involve an adoption of a strategy of market specialization.

As demonstrated in this paper, the distinguishing feature of a university as an entrepreneurial, knowledge-based organization is its interaction with companies in various forms of inter-organizational cooperation, which may involve the achievement of at least one of the three academic missions: education, scientific and research activities, and creation of mutual relations with the environment. Each of these missions may involve other applications of knowledge, including on digital technologies, such as in academic training, research, or performance of application projects. At the same time, the complete achievement of each of these missions also requires reliance on practical knowledge and experience that the university draws from the environment, among others from companies, including those from the chemical sector. In other words, cooperation between a university and a chemical sector company is about transferring knowledge to the outside and drawing knowledge from the outside, which can be done on a market basis or as an activity related to the social responsibility of academia. As demonstrated in the article, inter-organizational cooperation between a university and a chemical company requires ensuring symmetry in the partners' structures and management methods, as well as overcoming differences in their organizational cultures that affect the course and results of their activities. Other conditions that, in the authors' opinion, should be taken into account in order to successfully shape long-term relationships between universities and business entities are organizational proximity, cognitive proximity, institutional proximity, and social proximity.

This scientific argument clearly shows the prospects for the development of inter-organizational knowledge-based cooperation between universities and companies in the chemical sector, which leads to the conclusion that the main objective of the paper has been achieved. On the other hand, a comparison of the results obtained with the solutions presented herein should fully contribute to the clarification of the adopted research problem, which concerns the determination of the importance of the impact of knowledge on the inter-organizational cooperation between universities and chemical sector companies.

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