

Analysis of Tools Supporting the Formation of Relations in an Educational-and-Economic Network

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Abstract: The analysis of the literature shows that cooperation, in particular the maintenance long-term, enhanced and stable relations between education and business is very difficult. Supported by scientific research, source literature presents a beneficial effect of the transfer of knowledge on the improvement of innovation, competitiveness and organizational conditions in enterprises, public institutions as well as other organizations. The activities developed in the educational-and-economic network analyzed herein include e.g. engaging in particular medium-sized and big enterprises in the exchange and updating of knowledge about competencies on the labour market which are necessary on job positions at which graduates of technical schools are employed. The main objective of the paper is to develop a process of cooperation between education and business institutions, in particular with respect to strengthening relations in an education-and-business network in which the activity can improve knowledge sharing. An indirect objective in its development is the analysis of the effectiveness of the application of tools stimulating companies to cooperate and exchange knowledge within the network. The studied were based on data from 2017-2020 collected from a sample of 352 companies. The analysis was also carried out in the context of the frequency of e-mail and telephone contacts as well as direct contacts understood as individual meetings most often held at a given employer's facility. Kaiser-Mayer-Olkin criterion and Bartlett sphericity test were used for analysis of relationships between individual variables. Factor analysis (KMO and Cattell's criterion) and Pearson's correlation were used to study the effectiveness of the application of tools supporting the companies' activity in the network. The analyses show that the biggest impact on forming relations is linked to participation in discussion panels. It is worth pointing out that the activity is organized for the purposes of exchanging knowledge and experience of experts who usually represent medium-sized and big employers, especially in the area of HR. As a result of the studies, a process path was proposed for the purposes of establishing, developing and maintaining long-term relations with big and medium-sized enterprises in the network of entities cooperating in the field of education and business.

Keywords: Customer relationship, Knowledge sharing, Network, Competence management

1. Introduction

Knowledge management functions within organization management, but is focused on intangible resources which differ from tangible ones due to their abstraction, metaphorical semantics and non-linearity. Supported by scientific research, source literature presents a beneficial effect of the transfer of knowledge on the improvement of innovation, competitiveness and organizational conditions in enterprises, public institutions as well as other organizations. Knowledge management in an organization is a great challenge and in the network of entities, e.g. between entrepreneurs and entities related to education, it becomes even more complicated.

In the scientific scope, cooperation is analyzed mainly from the level of selected skills, e.g. entrepreneurship and the impact of the development of these competences on young people's career (Vodă & Florea, 2019). Many of the articles are based either on the analysis of competences acquired during education (Chan & Luck, 2022) or on a literature review (Flores et al, 2020). Therefore, the current knowledge of competences necessary in the job market and the way of their acquisition for management purposes, especially in the regional context, is still a major challenge (Szafranski, 2019). The needs of business and education (Bratianu et al, 2021) are often analyzed through the prism of students (Mahamood et al, 2021) and not through real needs of the job market and cooperation with business based on a relationship in the network. The process of defining competences required in the job market can be supported by reference models that indicate the most sought-after skills in the labour market. Such reference models may additionally contain a description of the required level of skills (Spychała et al, 2017). However, they are based on real requirements in the job market. The list of skills and their level in a reference model can become a tool in the education system to update knowledge of the requirements of the labour market and adapt the education system to their needs. Therefore, an exchange of knowledge related to competence needs between education and business is essential for better learning outcomes and

continuous improvement of skills compatible with the needs of the labour market, especially among the youngest generation of employees.

Previous studies show that knowledge management affects business education through the curriculum and the impact of the business environment (Bratianau, 2021), which means that finding effective methods of building relationships between business and education, will contribute to better knowledge management, e.g. in the area of competence needs in the labour market.

The main objective of the paper is to develop a process of cooperation between education and business institutions, in particular with respect to strengthening relations in an education-and-business network in which the activity of enterprises with a focus on education. An indirect objective in its development is the analysis of the effectiveness of the application of tools stimulating companies to cooperate and exchange knowledge within the network.

The activities developed in the educational-and-economic network analyzed herein include e.g. engaging in particular medium-sized and big enterprises in the exchange and updating of knowledge about competencies on the labour market which are necessary on job positions at which graduates of technical schools are employed.

The studies were based on data from 2017-2020 collected from a sample of 352 companies. The analysis of relationships between individual variables has been done with Kaiser-Meyer-Olkin criterion and Bartlett sphericity test. Then data analysis with Factor analysis (KMO and Cattell's criterion). Pearson's correlation was used to study the effectiveness of the application of tools supporting the companies' activity in the network. The analyses show that the biggest impact on forming relations is linked to participation in discussion panels. It is worth pointing out that the activity is organized for the purposes of exchanging knowledge and experience of experts who usually represent medium-sized and big employers, especially in the area of HR.

2. Literature Review

Knowledge is the sole meaningful economic resource as stated by Drucker (1995). Moreover, research by Quintas et al (1997) has established the role of knowledge as a key source of potential advantage and thus become a widely discussed topic in the field of economics. Mårtensson (2000) also Asrar-ul-Haq and Anwar (2016) view knowledge management (KM) as an integral component of the broader concept of intellectual capital. Frow and Payne (2009) show at their research how managing, sharing, and transferring knowledge should be one of the organization's business strategies. In addition, how it is determined by situational analysis that identifies changes in the industry and competitive environments, and growth opportunities. Indeed Marimuthu et al (2009) posit that human resource input undoubtedly plays a significant role in enhancing firms' competitiveness.

In the context of the knowledge economy, it is widely recognized that connections and collaboration between individuals and organizations can significantly enhance value creation (Du Plessis et al, 2007). One form of such partnership is knowledge networks, which are specifically designed to facilitate knowledge sharing and creation. Du Preez et al (2008) define knowledge networks as a set of people, resources, and relationships that enable the capture, transfer, and development of knowledge, thereby creating value. The concept of knowledge networks can be variously understood as information networks, expert networks, practice-oriented communities, or strategic alliances, depending on the interests of members and the nature of the network itself (Creech & Willard, 2001). Our research focuses on a case study investigating the strategic relationship between an economic organization and educational entity to develop a competitive advantage and increase innovation in education. We argue that knowledge sharing is not solely an internal process but rather involves a dynamic and long-term process of knowledge transfer among organizations (Lakpetch & Lorsuwannarat, 2012). Recent research by Ziegler (2022) reinforces the importance of knowledge sharing for maintaining competitiveness and effectiveness in the current economy. Past studies have used knowledge sharing as a mediating variable, highlighting its significance in facilitating the continuous exchange and development of individual and organizational knowledge (Zhao et al, 2021).

Knowledge sharing involves combining knowledge with a sharing mechanism, and the characteristics of the knowledge and channels used for sharing can affect outcomes (Ahmad & Karim, 2019). Personal and organizational factors also impact knowledge-sharing behaviors (Asrar-ul-Haq & Anwar, 2016). According to Frow and Payne (2009), focusing solely on the technological aspects of network sharing is not enough, and organizations should adopt a strategic approach towards networking and relationships. In their analysis, Marquez-Ramos and Mourelle (2019) examined the relationship between education and economic growth in Spain, highlighting education as a crucial determinant of economic well-being and human capital development

in the labor force. Modern universities strive to produce individuals who can lead social and economic development, as noted by Shi et al (2020). Goliński and Szafrński (2020) conducted a case study on "The Wielkopolska Educational-and-Economic Network (WEEN)." This network, which has been functioning and improving since 2010, was established by the Poznań University of Technology, the Wielkopolska Province Government, businesses, secondary technical schools from the region, and other mainly educational institutions. The purpose of WEEN is to develop and enhance knowledge management of competencies in the region. Continual improvement of the partners' knowledge about the existing relations between them and the value stemming from strengthening those relations is essential within WEEN. A higher level of knowledge about the interdependencies among stakeholders has a positive influence on building and consolidating intellectual capital. The cooperation with enterprises within WEEN has resulted in good practices in human resource management by these companies. In summary, Marquez-Ramos and Mourelle (2019) analysis emphasizes the importance of education in promoting economic growth, while the case study of WEEN showcases the benefits of knowledge-sharing networks in enhancing intellectual capital and improving human resource management practices.

Universities play a crucial role in knowledge transfer as key agents. According to Seibert et al (2017), universities, as producers of ideas and knowledge, and firms, as users of knowledge, are the two essential elements of the innovation system. Collaboration between these two agents, as emphasized by Chen and Lin (2017), Rubin et al (2015), and Miller et al (2016), is essential for achieving innovation and regional economic growth. Mikalauskienė and Atkočiūnienė (2019) emphasize that knowledge management goes beyond its direct meaning and involves the creation of an environment conducive to knowledge processes, as well as purposeful, continuous, and systemic management and development of the educational, economic, ecology and societal well-being. Our research paper focuses on the production of ideas and knowledge by economic entities that are needed in the labour market, which educational institutions then use. Based on the educational reform proposed by Sahlberg (2006), this process involves three steps: first, investigating the required competencies that increase the competitive value of enterprises; second, sharing the knowledge gained from this investigation with educational institutions; and finally, researching new methodologies and educational materials to achieve these competencies while considering change management.

Higher education is viewed as an engine for development in the new global economy, as it involves investing in human capital development and contributes to the economic growth of countries. However, some of the challenges faced by higher education institutions (HEIs), including the need to re-affirm the value of sustainability, management dilemmas, the lack of academic involvement, and the absence of an external evaluation (Hadam et al, 2020).

Our study indicates that there is no one best way to achieve high network performance, and multiple paths are possible to form the relations in an educational-and-economic network. Prior studies have examined this issue in relation to certain structural and functional network characteristics, such as governance forms and size, network management, and managerial mechanisms (Cristofoli et al, 2019). Our research paper discusses the effectiveness of knowledge network management tools between economics and educational entities based on collected data.

3. Methodology

3.1 Data Collection and Measures

The studied were based on data from 2017-2020 collected from a sample of 352 companies. The data used for the analyses come from CRM, an IT system which supports network management. The analysis of the effectiveness of the application of tools stimulating the activity of companies was carried out taking into account all identified activities of each company in the network in each calendar year. Then, all the activities treated as variables were summed up to examine the correlations between them. In addition, the authors took account of data such as the date of entering the facility into the CRM which illustrates the duration of relations in the network, the distance between the company's headquarters and the network coordinator, as well as the size of the employer determined by the number of employees. The analysis was also carried out in the context of the frequency of e-mail and telephone contacts as well as direct contacts understood as individual meetings most often held at a given employer's facility. The analysis of relationships between individual variables has been done with Kaiser-Mayer-Olkin criterion and Bartlett sphericity test. Then data analysis with Factor analysis (KMO and Cattell's criterion) and Pearson's correlation coefficient.

The list of analysed Variables is as followed: 1. Date when the facility was entered in the CRM, 2. The distance between the entity and the network coordinator, 3. Size of the entity in the network, 4. Participant in the panel, 5. Long-term activity, 6. Provision of a job description, 7. Involvement in the development of a competency profile, 8. Sending job /apprenticeship /internship offers, 9. Conclusion of a cooperation agreement, 10. Activity in logging into the IT System, 11. Adding the offer to the IT System, 12. E-mailing activity, 13. Phone call activity, 14. Activity in direct meetings.

3.2 Data Analysis

In order to further explore relationships between entities and their activities in the framework of the Wielkopolska Education and Economic Network, factor analysis was carried out. It is a statistical method that allows to reduce the redundancy of the original data set as well as to detect directly unobserved common factors explaining the variability of the analyzed phenomena.

The condition for the applicability of factor analysis is the existence of relationships between individual variables. The Kaiser-Mayer-Olkin (KMO) criterion and Bartlett's test of sphericity were used to check it. In our case, the value of KMO=0.846 was obtained, which indicates that the use of factor analysis for the exploration of this data set is justified (in practice, factor analysis can be used if KMO > 0.7).

The Bartlett test of sphericity is used to verify a hypothesis which states that a correlation matrix between input variables is an identity matrix, which means the lack of mutual correlation of variables. In our test, $p < 0.001$ was obtained, which indicates a need to reject the null hypothesis and allows to claim that the variables used in the analysis are mutually correlated.

The following variables were excluded from further analyses: the date when the facility was entered in the CRM and the distance between the entity and the network coordinator, for which the resources of joint variability were the smallest (<0.2). The second stage of factor analysis is the determination of the number of distinguished factors. For this purpose, the Kaiser criterion (Table 1) was used, i.e. factors for which eigenvalues are greater than unity were distinguished.

Table 1: Kaiser Criterion - Factors for Which Eigenvalues are Greater Than Unity

Factor	Total Variance Explained								
	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cum %	Total	% of Variance	Cum %	Total	% of Variance	Cum %
1	4.863	40.527	40.527	4.401	36.674	36.674	2.511	20.924	20.924
2	1.449	12.078	52.605	.997	8.306	44.980	2.096	17.465	38.390
3	1.153	9.608	62.212	.634	5.287	50.266	1.425	11.876	50.266
4	0.921	7.677	69.890						
5	0.747	6.227	76.117						
6	0.656	5.465	81.582						
7	0.558	4.653	86.235						
8	0.417	3.475	89.710						
9	0.402	3.347	93.057						
10	0.346	2.881	95.939						
11	0.268	2.235	98.174						
12	0.219	1.826	100.00						

Also, the Cattell criterion based on the screen plot indicates the choice of 3 factors as the best (Figure 1).

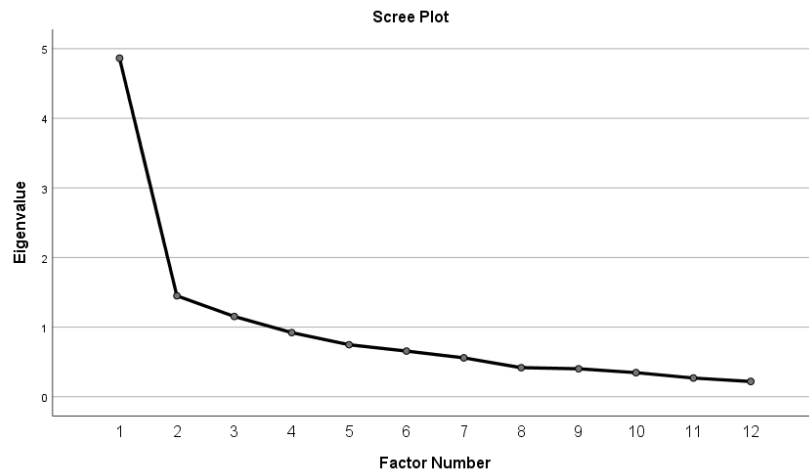


Figure 1: This is how a Figure Should Appear

For 3 distinguished factors, the maximum likelihood method with a VARIMAX rotation was used and, as a result, the following matrix of factor loadings of joint factors was obtained (Table 2).

Table 2: Rotated Factor Matrix for 3 Distinguished Factors

Rotated Factor Matrix ^a			
	Factor		
	1	2	3
Size of the entity in the network	0.197	0.409	-0.022
Participant in the panel	0.611	0.474	0.171
Long-term activity	0.305	0.047	0.124
Provision of a job description	0.832	0.252	0.164
Involvement in the development of a competency profile	0.696	0.369	0.127
Sending job /apprenticeship /internship offers	0.579	0.200	0.392
Conclusion of a cooperation agreement	0.541	0.351	0.281
Activity in logging into the IT System	0.192	0.180	0.570
Adding the offer to the IT System	0.255	0.000	0.854
E-mailing activity	0.233	0.788	0.156
Phone call activity	0.176	0.528	0.060
Activity in direct meetings	0.112	0.638	0.148

The formation of the first factor defined as: "involvement in creating job reference descriptions/models" is most influenced by the following variables: participant in the panel, provision of a job description, involvement in the development of a competence profile, sending job /apprenticeship /internship offers, sending job /apprenticeship /internship offers, conclusion of a cooperation agreement, long-term activity. The second factor called "frequency of contacts" is most influenced by variables such as: e-mailing activity, phone call activity, activity in direct meetings, size of the entity in the network. The creation of the third factor referred to as "independent use of the system" is most influenced by variables such as: activity in logging into the IT System, adding the offer to the IT System. Figure 2 presents the Factor Plot in Rotated Factor Space for 3 distinguished factors.

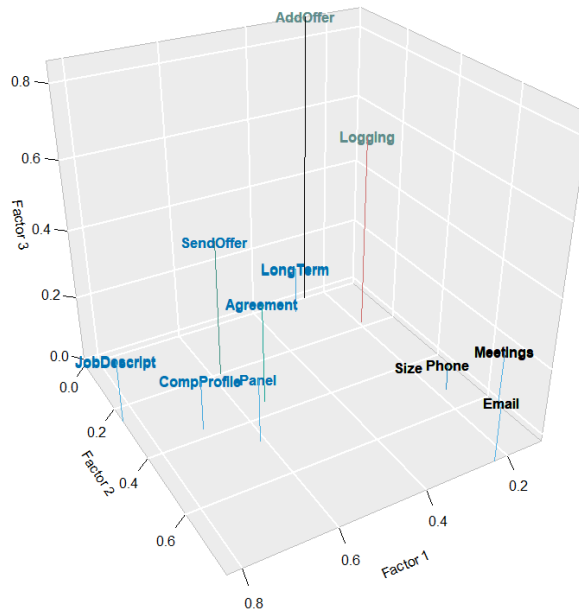


Figure 2: Factor Plot in Rotated Factor Space for 3 Distinguished Factors

In the next step, the Pearson correlation coefficient was analyzed to indicate key relationships between the studied variables. This approach is meant to help in the analysis of key and significant variables in determining the direction and key activities in maintaining relationships with entities in the network for the purpose of acquiring knowledge of competences.

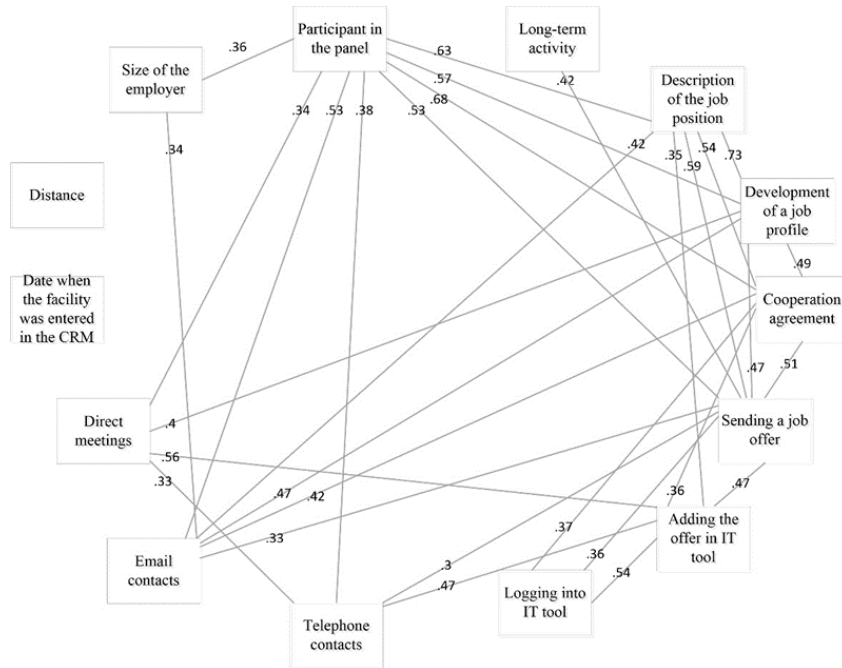


Table 3: Correlations Between Data Describing Entities in the Network and Activities in the Wielkopolska Educational-and-Economic Network

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Date when the facility was entered in the CRM	1.00*													
2. The distance between the entity and the network coordinator	0.22*	1.00*												

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
3. Size of the entity in the network	-0.21*	-0.14*	1.00*											
4. Participant in the panel	-0.21*	-0.10	0.37*	1.00*										
5. Long-term activity	-0.05	-0.04	-0.02	0.27*	1.00*									
6. Provision of a job description	-0.23*	-0.09	0.26*	0.63*	0.25*	1.00*								
7. Involvement in the development of a competency profile	-0.23*	-0.09	0.29*	0.58*	0.21*	0.74*	1.00*							
8. Sending job /apprenticeship /internship offers	-0.18*	-0.06	0.14*	0.54*	0.43*	0.59*	0.48*	1.00*						
9. Conclusion of a cooperation agreement	-0.21*	-0.07	0.26*	0.69*	0.20*	0.55*	0.50*	0.52*	1.00*					
10. Activity in logging into the IT System	-0.05	-0.04	0.23*	0.27*	0.01	0.29*	0.30*	0.36*	0.37*	1.00*				
11. Adding the offer to the IT System	0.06	-0.02	0.01	0.30*	0.18*	0.36*	0.29*	0.48*	0.37*	0.54*	1.00*			
12. E-mailing activity	-0.26*	-0.15*	0.35*	0.54*	0.14*	0.43*	0.47*	0.34*	0.43*	0.26*	0.20*	1.00*		
13. Phone call activity	-0.18*	-0.09	0.24*	0.38*	0.14*	0.29*	0.27*	0.30*	0.28*	0.12*	0.09	0.48*	1.00*	
14. Activity in direct meetings	-0.16*	-0.11*	0.24*	0.35*	0.06	0.27*	0.41*	0.27*	0.27*	0.22*	0.16*	0.57*	0.37*	1.00*

The correlations considered significant in the inference were those for which $p < 0.05$ which was marked with an asterisk in Table 3. Figure 1 in Attachment 1 only shows only those correlations which present correlation strength higher than or equal to 0.3. In the case of participation in the panels, correlations above 0.3 occur with as many as 7 other activities (from 0.34 to 0.68), with 5 of them showing a correlation higher than 0.5. The lowest correlations linked to the activity participation in the discussion panel occur between direct meetings (0.34) and telephone contacts (0.38). A much higher correlation (0.53) occurs in the context of email contacts. The highest correlation in the context of participation in the panels can be seen in relation to a signed cooperation contract (0.68) and tools supporting defining the demand for competencies such as job description (0.63), development of a job profile (0.68) or sending the job offer (0.53). A similar correlation value between the studied activities can be seen in the item cooperation contract (7 correlations), however, these remain at a slightly lower level. Only 2 correlations of out 7 reached a value above 0.5. Other tools for building relations within the network show fewer connections among one another.

4. Research Findings and Discussion

From the analysis of Total Variance Explained we can conclude that from the point of view of building relationships in the network for the exchange of knowledge of competences, other factors are crucial: involvement in creating job reference descriptions/models, frequency of contacts and independent use of the system allowing for the free addition of job offers, traineeships, internships and the exchange of knowledge of competence needs using an IT system. Sharing knowledge of competence needs in the labour market happens in this case on the side, because the value for employers is to acquire a candidate for a job and not directly transfer knowledge of competence needs in an enterprise in a specific job position. On the basis of Figure 2, it can therefore be concluded that there are 3 islands of significant variables important for strengthening relationships in the network and the exchange of knowledge of competences. The description of key requirements at job positions (Spychała, 2017) can be strengthened by signing a formal agreement between entities and conducting meetings, panels, long-term cooperation and support in the use of an IT system allowing

for the publication of job offers, traineeships and internships. Another important variable in building relationships and contacts may be the size of an entity one cooperates with. Large companies have a more complex structure, but from the level of competence requirements at job positions, their structure is more specialized and not cross-sectional. This makes it possible to precisely describe competence requirements and acquire indispensable knowledge to create a reference model of a job position. This, in turn, may allow young people to see what competences are most often required.

As a result of the studies including Pearson's correlation, a process path was proposed for the purposes of establishing, developing and maintaining long-term relations with big and medium-sized enterprises in the network of entities cooperating in the field of education and business. The path is based on 4 key steps: (1) face-to-face meeting supported by email or phone contact. It is meant to extend an invitation to a discussion panel (2) to strengthen relations in order to (3) sign a cooperation agreement and (4) deepen the cooperation further for the purposes of defining the demand for competencies in enterprises by providing a job description, participating in the development of a competency profile or flow of information on job, apprenticeship or internship offers published on a free IT portal.

Our findings align with the view that the value of external sources and collaborative relationships are critical components of open innovation theory (Stachová et al, 2019). Also Universities play also a strategic role as drivers of regional economic growth (Fluster et al, 2019). We specifically focus on the knowledge network of the strategic relationship between economic organizations and educational entities, recognizing that the creation of such networks can lead to significant benefits for both parties.

Although the results are limited to some extent, e.g. with respect to the regional range of impact of the studied network, it should be noted that the research method can be implemented in any social networks, including educational-and-economic ones. The results of many studies can be compared, providing room for improving methods of shaping and strengthening relations between enterprises and other entities within social structures. In the future, the studies can be extended by the aspect of variability in time of the demand for tools activating entities which cooperate in a network.

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