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SME'S PARTNERS IN INNOVATION COOPERATION: AN EMPIRICAL ANALYSIS OF SLOVAK SME'S

PARTNERZY MŚP WE WSPÓŁPRACY DOTYCZĄCEJ INNOWACJI: ANALIZA EMPIRYCZNA SŁOWACKICH MSP

Abstract: Innovation cooperation has become an increasingly prominent feature of firm's innovation activity. Cooperation with external subjects in innovation enables the firm to search outside of their boundaries the skills, competence or technologies that they are missing and that would take too long (and too much costs) to be developed internally. The external resources and capabilities that SMEs could access through external innovation linkages might provide them with the stimulus and capacity to innovate. The aim of the article is to examine the cooperation of Slovak SMEs with external partners in innovation in special division of mechanical engineering industry. We will answer two questions. First: to identify who are the major cooperation partners for SME's innovations in analysed division of mechanical engineering industry; second: to assess the respective type of innovation relationships with individual cooperation partners in analysed sector of SME's. We stated 14 potential external subjects for cooperation in innovations and with the Friedman test we assessed the importance (significance) of SME's cooperation with external subjects in innovation activities as well as the respective type of innovation relationships with individual cooperative partners. Suggested are positive effects of cooperation with external partners in innovation, indicated are main reasons of low cooperation. Based on the research results are formulated the implications for SMEs managers and policy makers concerned with the management of innovation cooperation.

Keywords: cooperation, innovations, small and medium enterprises, Slovak Republic

Streszczenie: Współpraca innowacyjna staje się coraz bardziej widoczną cechą działalności innowacyjnej firmy. Współpraca z podmiotami zewnętrznymi w zakresie innowacji umożliwia firmie wyszukiwanie poza jej granicami umiejętności, kompetencji lub technologii, których jej brakuje, a których opracowanie trwałoby zbyt długo i byłoby kosztownie. Zewnętrzne zasoby i możliwości, do których MŚP mogą uzyskać dostęp za pośrednictwem zewnętrznych powiązań innowacyjnych, mogą być bodźcem dla innowacji. Celem artykułu jest zbadanie współpracy słowackich MŚP z partnerami zewnętrznymi w zakresie innowacji w dziale branży budowy maszyn. Odpowiemy na dwa pytania. Po pierwsze: jak określić, którzy partnerzy są głównymi partnerami dla rozwoju innowacyjności w MŚP w analizowanej branży inżynierii mechanicznej; drugi: jak ocenić odpowiedni rodzaj relacji innowacyjnych z poszczególnymi partnerami w analizowanym sektorze MŚP. Określiśmy 14 potencjalnych podmiotów zewnętrznych do współpracy w zakresie innowacji, a przy teście Friedmana oceniliśmy znaczenie współpracy MŚP z podmiotami zewnętrznymi w działalności innowacyjnej, a także odpowiedni rodzaj relacji innowacyjnych z poszczególnymi współpracującymi partnerami. Przewidywane są pozytywne efekty współpracy z partnerami zewnętrznymi w zakresie innowacji, wskazane są główne po-

wody słabej współpracy. Na podstawie wyników badań sformułowano sugestie dla menedżerów MŚP i decydentów zajmujących się zarządzaniem współpracą w zakresie innowacji.

Słowa kluczowe: współpraca, innowacje, małe i średnie przedsiębiorstwa, Słowacja

Introduction

At present we watch an increasing trend towards cooperation in innovation activities. Cooperation offers many opportunities for problem solving, especially for small and medium enterprises. As some studies underline¹ innovation cooperation became more and more important for SMEs to promote their innovation abilities. It can be a complementary factor to achieve economies of scale and to merge and integrate diverse skills, technologies and competencies². The requirement of SMEs to cooperate, as a means of supplementing and complementing internal resources, has dominated much of the academic debate³ the external resources and capabilities that SMEs could access through external innovation partnerships might provide them with the stimulus and capacity to innovate, while the lack of innovative partnerships has a negative impact on innovation. Thus, the central motivating factor for cooperation in innovation activities is the expectation that entrepreneurs will reach their goals easier and better by cooperating that would have been possible when struggling alone.

1. Theoretical background

Successful cooperation allows the individual partner to gain access to resources otherwise inaccessible, i.e. completely new sources for innovation, skills, markets and application possibilities, and they offer a sizeable cost reduction potential to the participant⁴. For enterprises, their ability to be innovative is an important element in remaining competitive.

¹ J. Liefner, S. Hennemann & L. Xin, *Cooperation in the innovation process in developing countries: empirical evidence from Zhongguancun*, "Environment and Planning" 2006, 38(1) Beijing, 111-130; P.C. Kaminski, A.C. de Oliveira & T.M. Lopes, *Knowledge transfer in product development processes: a case study in small and medium enterprises of the metal-mechanic sector from Sao Paulo, Brazil*, "Technovation" 2008, 28(1-2), 29-36.

² T. Schott & K.W. Jansen, *Firm's innovation benefiting from networking and institutional support: A global analysis of national and firm effects*, "Research Policy" 2016, 45, 1233-1246.

³ R.D. Fitjar & A. Rodriguez-Pose, *Firm collaboration and modes of innovation in Norway*, "Research Policy" 2013, 42, 128-138; J. Liefner, S. Hennemann & L. Xin, *Cooperation in the innovation process...*, 111-130; W. Becker & J. Dietz, *R&D co-operation and innovation activities of firm – evidence for the German manufacturing industry*, "Research Policy" 2004, 33(2), 209-223; S.X. Zeng, X.M. Xie, C.M. Tam, *Relationship between cooperation networks and innovation performance of SMEs* "Technovation" 2010 30, 181-194.

⁴ J. Bessant & J. Tidd, *Innovation and entrepreneurship*, Chichester: John Wiley & Sons Ltd, West Sussex, England. 2009.

Building effective linkages outside the organization is more and more connected with the aim to develop and implement innovation for sustainability⁵. It suggests that firms should not innovate in isolation, but in cooperation with others. Many scholars⁶ stress, that such cooperation would yield not only efficiency of scale or scope but, also for innovation, a greater diversity and flexibility. In this term cooperation can be understood as an attempt to cope with the increasing complexity and interrelatedness of different technologies and markets. In cooperation with suppliers, customers, firms in related markets, and sometimes even with competitors, the firm fits existing ideas and practice into their different but related thinking and practice⁷.

Several studies demonstrate the positive effect of cooperating with specific categories of partners on innovation activity⁸ stated that cooperation with different partners has a positive effect on innovation achievement. Using data from a longitudinal sample of Spanish manufacturing firms, Nieto & Santamaria (2007)⁹ concluded that the greatest positive impact on the degree of innovation novelty came from cooperative networks with different types of partners.

In general, all the external partners on innovation activities could be divided into four main categories: inter-firm partners, universities and research institutions, intermediary institutions and government agencies¹⁰.

The main innovative partners for *inter-firm cooperation* are customers, suppliers, enterprises in the same field of activity (producers and services providers) and competitors. Inter-firm cooperation helps to gain sources of knowledge located outside the boundaries of the firm, to gain fast access to new technologies or new markets, to benefit from economies of scale in joint R&D and/or to share the risks

⁵ B. Nooteboom & E. Stam, *Micro-foundations for Innovation Policy*, Amsterdam University Press, Amsterdam 2008.

⁶ F. Malerba & N. Vorontas, *Innovation Networks in Industries*: Edward Elgar Publishing Limited, UK. Cheltenham 2015; T. Schott & K.W. Jansen, *Firm's innovation benefiting...*, 1233-1246; D. O'Sullivan & L. Dooley (2009). *Applying Innovation*. Sage Publications, United Kingdom, London 2009; H. Kressel & T. Lento, *Entrepreneurship in the global economy. Engine for economic growth*, Cambridge University Press Cambridge 2012; K. Szczepańska-Woszczyna, *Determinants of innovation activities in small and medium-sized enterprises in Poland*, "Journal of Advanced Research in Management" 2014, 5(2), 65-73.

⁷ J. Šebestová, R. Šperka, J. Małecka, T. Luczka, *Co-working centres as a potential supportive network for cross-border business cooperation*. "Forum Scientiae Oeconomia", 2007, 5(4), 23-34, 2017. B. Miller, *Innovation Diffusion in the New Economy*. Abingdon: Routledge.

⁸ F. Malerba, N. Vorontas, *Innovation Networks...*; V. Maráková, D. Kvasnová, *Cooperation as a driving force of innovations in destination marketing management*, "Forum Scientiae Oeconomia" 2016, 4(3), 67-80; V. Potočan, M. Mulej, M. *How to improve innovativeness of small and medium enterprises*, "Management – Journal of Contemporary Management Issues" 2009, 14, 1-20; D. Smith, *Exploring innovation*, McGraw Hill Education, London 2006; K. Lampikoski, J.B. Ende, *Igniting innovation: Inspiring organizations by managing creativity*, John Wiley & Sons, Chichester 1996. W. Becker, J. Dietz, *R&D co-operation and innovation activities of firm – evidence for the German manufacturing industry*. "Research Policy" 2004, 33(2), 209-223.

⁹ M. Nieto, L. Santamaria, *The importance of diverse collaborative networks for the novelty of product innovation*. "Technovation" 2007, 27(6-7), 367-377.

¹⁰ S.X. Zeng, X.M. Xie, C.M. Tam, *Relationship between cooperation networks and innovation performance of SMEs*, "Technovation" 2010, 30, 181-194.

for activities that are beyond the scope or capabilities of a single firm¹¹. Fischer & Varga¹² noted that customer networks represent the most frequent form of inter-firm cooperation. Firms that collaborate for innovation with their customers are reducing their ignorance of customer needs, increasing users' confidence in their offerings, raising acceptance of new product (thus reducing risk of its commercialization) and thereby, reducing the risk associated with bringing an innovation to market¹³. Many researchers¹⁴ stress the importance of cooperation with suppliers in innovation; they suggest that cooperation with suppliers enables firms to reduce the risks and times of product development, while enhancing flexibility, product quality and market adaptability¹⁵. In particular, suppliers are valuable sources of information to develop or improve products. Regarding competitors, the purpose of cooperation with them is mainly to carry out basic research and establish standards¹⁶ (SMEs cooperate with competitors whenever they share common problems that are outside the competitor's area of influence, such as pre-competitive research programs and co-production arrangements¹⁷ (In general competitors collaborate when they face common problems and especially where these problems are seen as being outside the competition¹⁸.

Several studies have examined the important role of *universities and research institutions* in SME's innovation¹⁹. Such cooperation helps to decrease transaction costs, correct market failures and decrease the risks of the interacting partners leading to increased productivity. Usually, cooperation with research institutions and

¹¹ M.M. Fischer, A. Varga, *A Technological innovation and interfirm cooperation: an exploratory analysis using survey data from manufacturing firms in the metropolitan region of Vienna*, "International Journal of technology Management" 2002, 24(7-8), 724-742.

¹² Ibidem.

¹³ M. Fritsch, R. Lukas, *Who cooperates on R&D?*, "Research Policy" 2001, 30, 297-312.

¹⁴ S. Chung, G.M. Kim, *Performance effects of partnership between manufacturers and suppliers for new product development: the supplier's standpoint*, "Research Policy" 2003, 32(4), 587-603; M. Ni-eto, L. Santamaria, *Technological collaboration: bridging the innovation gap between small and large firms*, "Journal of Small Business Management" 2010, 48(1), 44-69; J. Liefner, S. Hennemann, L. Xin, *Cooperation in the innovation process in developing countries: empirical evidence from Zhongguancun, Beijing*, "Environment and Planning" 2006, 38(1), 111-130; E.K. Huizingh, *Open innovation: state of the art and future perspectives*, "Technovation" 2011, 31, 2-9.

¹⁵ Ž. Dulčić, V. Gnjidić, N. Alfrevič, *From five competitive forces to five collaborative forces: revised view on industry structure-firm interrelationship*, "Procedia – Social and Behavioural Sciences" 2012, 58, 1077-1084.

¹⁶ B. Tether, *Who co-operates for innovation, and why. An empirical analysis*, "Research Policy", 2002, 31(6), 947-967.

¹⁷ Ibidem.

¹⁸ M.S. Lewandowska, *Partners and barriers in innovation cooperation – a survey of Polish exporters*, "Challenges of the global economy. Working Papers", Institute of International Business, University of Gdansk 2012, No. 31, pp. 521-537.

¹⁹ B. Tether, *Who co-operates for innovation...*, 947-967; J. Liefner, S. Hennemann & L. Xin, *Cooperation in the innovation process in developing countries: empirical evidence from Zhongguancun*, "Environment and Planning" 2006, 38(1), 111-130; E.K. Huizingh, *Open innovation: state of the art and future perspectives*, "Technovation" 2011, 31(2011), 2-9.

higher-education institutions is an important source of new knowledge for SMEs²⁰. Innovative cooperation between SMEs and universities and research institutions has mainly the form of informal communication of skills and knowledge, technology transfer, R&D cooperation, training of innovative personnel and provision of skilled workforce and graduates with knowledge and skills²¹.

According to Diez²², universities are regarded as the powerful drivers of innovation and change in science and technology; research institutions are regarded as crucial partners for supporting the innovation activities of businesses, especially SMEs. Besides the provision of new knowledge for businesses through research activities, research institutions also provide knowledge in the form of a skilled workforce through university-graduates and through their own employees²³.

Intermediary institutions such as technology intermediaries, training institutions or technology transfer organizations represent a special category of partners for cooperation. These institutions play also important roles within the innovation process. Intermediary institutions perform a variety of functions in innovation, including communication, information scanning and gathering, knowledge processing and combination, evaluation of outcomes and commercialization²⁴.

Cooperation with intermediary organizations could be the source of new ideas for SME's innovation and technological productivity. From the viewpoint of policies those intermediary institutions that are supported or funded by the government, aim to provide innovation support especially for SMEs. For example, to promote innovative activities of SMEs, many intermediary institutions or organizations are established such as "Business Innovation Centres", "Business Incubators" or "Regional Innovation Centres".

Intermediary institutions could provide spaces and contacts between universities and firms, create stable and continuing relations. Generally, SMEs benefit more than large firms from the technology information and advice provided by the local intermediary institutions.

²⁰ J. Liefner, S. Hennemann & L. Xin, *Cooperation in the innovation process in developing countries: empirical evidence from Zhongguancun*, "Environment and Planning" 2006, 38(1), 111-130; O. Arsenijević, D. Trivan, I. Podbregar, P. Šprajc, *Strategic Aspect of Knowledge Management*, "Organizacija: journal of management, informatics and human resources" 2017, 50(2), 163-177; L. Lesáková, *Small and medium enterprises in the new word of globalization*, "Forum Scientiae Oeconomia" 2014, 2(3), 111-122; M. Letonja, M. Jeraj, M. Marič, *An Empirical Study of the Relationship between Entrepreneurial Competences and Innovativeness of Successors in Family SMEs*, "Organizacija: journal of management, informatics and human resources", 2016, 49(4), 225-239; S. Colnar, V. Dimovski, *Knowledge management initiatives benefits for the Slovenian public sector*, "Management – Journal of Contemporary Management Issues" 2017, 22(2017), 145-161.

²¹ S.X. Zeng, X.M. Xie, C.M. Tam, *Relationship between cooperation networks and innovation performance of SMEs*, "Technovation" 2010, 30, 181-194.

²² J.D. Diez, *Innovative Networks in manufacturing: some empirical evidence from the metropolitan area of Barcelona*, "Technovation", 2000, 20(3), 139-150.

²³ Ibidem.

²⁴ J. Howells, *Intermediation and the role of intermediaries in innovation*, "Research Policy" 2006, 35(5), 715-728.

The special group of partners for cooperation represent the *government agencies* with the view to enhance the knowledge and SME's innovation. They are represented by the "Slovak Business Agency", "Slovak Innovation and Energetic Agency" or by "Slovak Industrial Property Office".

The cooperation with government agencies refers to the improvement of service provision, or to the public support that can promote cooperation between SMEs and other firms, intermediary institutions and research organizations. A special form of cooperation with government agencies refers to government-sponsored agreements – publicly funded cooperation stimulated by government research and development programmes²⁵.

Tether²⁶ suggested in his study, that cooperative linkages with external partners could be vertical, horizontal or lateral. Fischer & Varga²⁷ found that cooperation activities are primarily based on vertical relationships (customers, suppliers and enterprises in the same field of activity) rather than on horizontal linkages (producer networks, industry and university or research institutions linkages). Nieto & Santamaria's²⁸ study of 1300 Spanish SMEs (using data from the Spanish Business Strategies Survey) found that vertical technological cooperation was the most important factor in improving firm's innovativeness, allowing them to close the innovation gap with their larger rivals²⁹. Finally, Lasagni used data from a survey of 500 SMEs across six European countries (Austria, Germany, Italy, Hungary, Poland, and Slovenia) and has find cooperation with both customers and suppliers as very significant in aiding innovation.

What concerns the horizontal cooperation among SMEs and external partners (universities, research institutions or intermediary institutions), it can speed up product development, provide economies of scale and mitigate the risk associated with R&D resources and technology, allowing them to compete with larger players³⁰.

²⁵ M. Matt, S. Wolff, *Incentives, coordination and learning in government-sponsored vs. Spontaneous inter-firm research cooperation*, "International Journal of Technology Management" 2004, 27(8), 694-711.

²⁶ B. Tether, *Who co-operates for innovation...*, 947-967.

²⁷ M.M. Fischer, A. Varga, *A Technological innovation...*, 724-742.

²⁸ M. Nieto, L. Santamaria, *Technological collaboration: bridging the innovation gap between small and large firms*, "Journal of Small Business Management" 2010, 48(1), 44-69.

²⁹ A. Lasagni, *How can external relationships enhance innovation in SMEs? New evidence for Europe*, "Journal of Small Business Management" 2012, 50(2), 310-339.

³⁰ M.H. Morris, A. Kocak, A. Ozer, *Co-operation as a small business strategy: implications for performance*, "Journal of Small Business Strategy" 2007, 18(1), 35-55; M. Nieto, L. Santamaria, *The importance of diverse collaborative networks for the novelty of product innovation*, "Technovation" 2007, 27(6-7), 367-377; S.X. Zeng, X.M. Xie, C.M. Tam, *Relationship between cooperation networks and innovation performance of SMEs*, "Technovation" 2010, 30(2010), 181-194.

2. The aim and methodology of research

Developing cooperation the innovation targets can be reached faster and with better quality. Enterprises need to build bridges across boundaries inside the organization and to many external partners who can play a part in the innovation process. Innovations that an enterprise would not tackle alone because of lack of material, information, personnel and financial resources, can be then developed and implemented³¹.

The aim of the article is to examine the cooperation of Slovak SMEs with external partners in innovation in special division of mechanical engineering industry. We will answer two questions. First: to identify who are the major cooperation partners for SME's innovations in analysed division of mechanical engineering industry; second: to assess the respective type of innovation relationships with individual cooperation partners in analysed division of SME's.

The study is based on results of the research on innovation cooperation of Slovak SMEs operating in special division of mechanical engineering industry. We stated 14 potential external subjects for cooperation in innovations and with the Friedman test we assessed the importance (significance) of SME's cooperation with external subjects in innovation activities. Identified were respective types of innovation relationships with the major external partners in innovation. Suggested were positive effects of cooperation with individual external partners in innovation. Our findings provide also some important implications for SMEs managers and policy makers concerned with the management of innovation cooperation.

Data source used to assess the major cooperative partners of Slovak SMEs in innovation are the data gained through the empirical research conducted in the year 2016. To fulfil the aim of the paper several scientific methods of examination are used namely the method of analysis, synthesis, induction, deduction, comparison, as well as the statistical methods.

3. Assessing SME's partners in innovation cooperation in special division of mechanical engineering industry in Slovakia – results and discussion

In the year 2016 we have conducted the research oriented on identification of main factors and barriers determining innovation activities in Slovak SMEs³². One part of

³¹ A. Jaklič, J. Damijan, M. Rojec, *Innovation Cooperation and Innovation Activity of Slovenian Enterprises*. Discussion Paper 201/2008. Leuven: LICOS Centre for Institutions and Economic Performance, 2008.

³² L. Lesáková, et al., *Innovation leaders, modest innovators and non-innovative SMEs in Slovakia: key factors and barriers of innovation activity*, "Organizacija: journal of management, informatics and human resources" 2017, 50(4), 325-338.

the questionnaire was oriented on evaluation of the significance of cooperation as one of the factors determining the innovations in SMEs in analysed division of mechanical engineering industry. In accordance with the SK NACE classification, the mechanical engineering industry comprises of four divisions – 25, 28, 29 and 30. One of them, according to SK NACE, is the division 28 – Manufacture of machinery and equipment not elsewhere classified. The Division 28 includes the manufacture of machinery and equipment operating independently of materials either mechanically or thermally, or they treat material, including their mechanical parts producing and using power and all specially produced primary parts. It contains fixed and mobile or manual devices, irrespective of whether they are manufactured for mechanical or building engineering, agricultural or domestic use. The production of special equipment for passenger or freight transport beyond determined borders also belongs to this division.

Our research used questionnaire as a method of primary data collection. The parent population in analysed sector “Manufacture of machinery and equipment not elsewhere classified” contains 728 small and medium-sized enterprises (608 small enterprises and 120 medium enterprises). The questionnaire was distributed electronically to 398 enterprises. Top managers from each enterprises to whom the questionnaire was sent, responded the answers in questionnaire. 161 of the enterprises responded and sent the completed questionnaire. After reviewing each replay we collected at the end 102 valid questionnaires from SMEs that realised any form of innovation activity during the last three years. After that, we processed the data through MS Excel and made a statistical analysis of the data in R 3.2.4 statistical system. For statistical tests, we assumed significance level ($\alpha = 0.1$).

The representativeness of the sample regarding the classification SK NACE (p -value = 0.1594) and region (p -value = 0.2824) was tested using chi-squared goodness of fit test. Based on the test results we concluded that our sample of enterprises can be seen as a reasonable sample of the entire population of small and medium enterprises.

The sample included 81.37% of small enterprises and 18.62% of medium enterprises. It consisted mainly of enterprises located in the region of Bratislava (43.14%), which was most likely caused by the highest concentration of enterprises in this region. The second most frequent representation had enterprises from the region of Banská Bystrica (15.69%).

The first part of the questionnaire was focused on evaluation of the factors significant for innovation in Slovak SMEs (Table 1). Evaluating the importance of the key factors a majority of enterprises (64.71%) indicated financial resources (average 3.56) as the most important factor for the innovations. Another two factors – human resources and technology – had the same average (3.03), but 39.22% indicated human resources as the most important factor of innovation activity in the enterprise. Technology as the most important factor was indicated by 29.41%. Critical is the finding that 68.62% of enterprises consider cooperation in innovation with external partners as a factor of low importance.

Table 1. Factors determining innovation activities in Slovak SMEs

Tabela 1. Czynniki determinujące działalność innowacyjną w słowackich MŚP

Factors	The importance of factors				
	The lowest (1)	Lower (2)	Higher (3)	The Highest (4)	Average
Human resources	10 (9.8%)	16 (15.69%)	36 (35.29%)	40 (39.22%)	3.039216
Financial sources	2 (1.96%)	4 (3.92%)	30 (29.41%)	66 (64.71%)	3.568627
Technology	6 (5.88%)	14 (13.73%)	52 (50.98%)	30 (29.41%)	3.039216
Cooperation with external partners (customers, suppliers, other firms, universities, ...)	20 (19.6%)	50 (49.02%)	16 (15.69%)	16 (15.69%)	2.274510
Management of innovation activities in enterprises	8 (7.84%)	48 (47.06%)	26 (25.49%)	20 (19.61%)	2.568627
System of state support for innovation	14 (13.73%)	28 (27.45%)	26 (25.49%)	34 (33.33%)	2.784314

Source: own processing.

Special part of our research was focused on the assessment of the importance (significance) of SME's cooperation with individual external subjects in innovations.

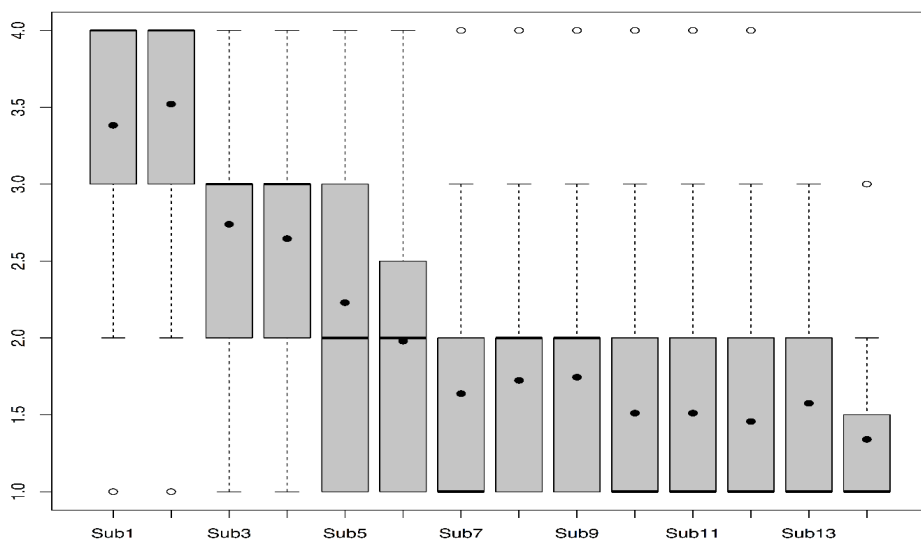
The importance (significance) of cooperation in innovation activities of the responded enterprises with external subjects was analysed with the Friedman test. The results show that the enterprises do not perceive the importance of cooperation with individual external subjects identically ($p\text{-value} < 2.2e-16$).

The enterprises indicated the level of importance of cooperation in innovations with individual external subjects on the Likert scale on a four grade scale ("the lowest", "lower", "higher", "the highest"). There were 14 different categories of external subjects: 1 = suppliers, 2 = customers, 3 = enterprises in the same field of activity, 4 = competitors, 5 = universities, 6 = research institutions, 7 = SARIO (Slovak Agency for Development of Investments and Commerce), 8 = SBA (Slovak Business Agency), 9 = SIEA (Slovak Innovation and Energetic Agency), 10 = Slovak Industrial Property Office, 11 = business incubators, 12 = Business Innovation Centres, 13 = Regional Innovation Centres, 14 = Slovak Association of Venture Capital.

The results of identifying the level of importance of cooperation with individual external subjects in innovation are presented by box plots in the Figure 1.

Figure 1. Box plots of subjects important for cooperation in innovation

Rysunek 1. Wykresy pól tematów ważnych dla współpracy w zakresie innowacji



Source: own processing.

When asked to indicate the most important subjects for cooperation in innovation activities, most enterprises in the sample mentioned customers (clients) (average = 3.520833), suppliers (average = 3.382979), enterprises in the same branch (average = 2.739130) and competitors (average = 2.602873). On the other hand, the least important external subject for the enterprises in terms of cooperation was the Slovak Association of Venture Capital (average = 1.340426) and Business Innovation Centres (average = 1.421035). The graphical illustration using box plots (Figure 1) is coherent with the average values of individual subjects.

To answer the question concerning the respective type of cooperative relationships in innovation, the respondents were asked to attach the type of cooperative relationships. Respondents had to report only those cooperative relationships that had to do only with innovation activities (Table 2).

Table 2. Share of enterprises with a respective type of relationship in innovation cooperation
 Tabela 2. Udział przedsiębiorstw o odpowiednim typie relacji we współpracy w zakresie innowacji

Type of relationship	Share of enterprises with the respective type of relationship in innovation cooperation (%)
<i>With customers</i>	35.29
Organized exchange of knowledge/experiences in the area of innovation	21.57
Involvement in planning and operation of innovation projects	14.71
Pilot use of innovation	7.84
<i>With suppliers</i>	26.47
Organized exchange of knowledge/experiences in the area of innovation	19.61
Involvement in planning and operation of innovation projects	14.71
Pilot use of innovation	5.88
<i>With other firms in the same field of activity</i>	10.78
Organized exchange of knowledge/experiences in the area of innovation	8.82
Joint use of equipment	5.88
Joint R&D projects	7.84
<i>With universities and research institutions</i>	7.84
Communication of knowledge and skills	6.87
Joint R&D projects	6.87
Technology transfer	4.91
<i>With competitors</i>	4.91
Joint use of equipment and resources	2.94
Research contracts	1.96
Exchange of information/experiences	3.92

Source: own processing.

We have discovered that about 35.29% of the SMEs in our sample have cooperative relationships with their customers, nearly 26.47% maintain cooperation with their mechanical suppliers, 10.78 with other enterprises in the same branch, 8% cooperate with academia and research institutions and 4.91% with the competitors (Table 2).

Looking at the respective type of cooperative relationships in innovation the organized exchange of knowledge/experiences in the area of innovation has the highest share. For cooperation with vertically related firms, the involvement in planning and operation of innovation projects constitutes the second important type. About 7.84% of enterprises which maintain cooperative relationships with their customers stated that these customers act as pilot users of their new products. Looking at the different kinds of relationship with suppliers, we find that 5.88% of our enterprises act as pilot users for their suppliers' innovation. In the relationships with „other firms in the same field of activity“, an organized exchange of knowledge and experiences in the area of innovation (8.82%) is the most important form of cooperation followed by joint R&D projects (7.84%) and joint use of equipment (5.88%). In relationships with academia and research institutions the communication of knowledge and skills (6.87%) and joint R&D projects (6.87%) play the most prominent roles, followed by technological transfer (4.91%).

Results confirm that cooperation (in support of innovation) exist particularly with the clients/customers and with the suppliers of equipment, material and components of software. Our findings are in correlation with results of various authors³³.

According to our results SMEs indicated as the main contribution of cooperation with clients/customers improvement of product quality (27.45%), new product design (16.67%) and exchange of information/experiences (30.39%).

What concerns the cooperation with suppliers SMEs mentioned mainly improving quality of inputs (20.59%) and exchange of knowledge/experiences in the area of innovation (32.35%). As further positive effects were declared improving delivery times (12.74%), production organisation (10.78%) and technological upgrading (11.76%). Networking with suppliers is suitable especially for process innovation. This type of innovation is focused on manufacturing/assembling efficiency, which requires resources and knowledge (usually industry specific) directly related to solving specific technological problems.

It is surprising, that cooperation with the firms in the same field of activity is less frequent (10.78%). The reasons of lower cooperation were also declared. They are: the bad experiences in cooperation, low trust to cooperating partner and problematic defence of intellectual property. SMEs have stressed that the innovation advantages, e.g. concerning certain technologies, have to be partly surrendered (these innovations are disseminated among the participating enterprises and can no longer be used exclusively).

³³ B. Tether, *Who co-operates for innovation, and why. An empirical analysis*. "Research Policy", 2002, 31(6), 947-967; M. Nieto, L. Santamaria, *The importance of diverse collaborative networks for the novelty of product innovation*, "Technovation", 2007, 27(6-7), 367-377; J. Liefner, S. Hennemann & L. Xin, *Cooperation in the innovation process in developing countries: empirical evidence from Zhongguancun*, Beijing, "Environment and Planning" 2006, 38(1), 111-130; E.K. Huizingh, *Open innovation: state of the art and future perspectives*, "Technovation" 2011, 31(2011), 2-9.

It is surprising that links with academia and research institutions were not indicated as a factor significant for innovation activities though it is generally known that innovations need creative ideas and advanced knowledge, which usually resides in academia and research community. As the reasons of lower cooperation with universities and research institutions were declared the problematic coordination of work, low openness for cooperation and not sufficient technological capacities.

Cooperation with competitors has helped SMEs in analysed sample mainly in exchange of information/experiences SMEs stressed the main benefits of innovation cooperation with competitors; it includes mostly cost barrier reduction, accelerating innovation process as well as effective joint learning and knowledge sharing. However, the decision to enter into cooperation with competitors depends also on the assessment of potential costs and risks – those related to partner's opportunistic behaviour, unwanted outflow of knowledge or to cost-benefit asymmetries.

Our findings confirm the results of similar studies from other countries³⁴. Cooperation with customers and suppliers plays a more distinct role in SME's innovation than cooperation with firms in the same field of activity as well as with universities and research institutions. Critical may be viewed the results concerning the cooperation with intermediary institutions as well as with the government agencies. The findings reveal that the actual significance of cooperation with these institutions is less than could be expected.

Conclusion

Innovation process of a higher level calls for improvement of cooperation between small and medium enterprises and external subjects. Cooperation of SMEs with other organisations in the field of innovation activities brings several synergic effects to the enterprise. The most important of them is sharing of knowledge, a similar approach to the latest know-how, sharing of capacities and a lower demand for financial sources.

The main findings coming from our research indicate that Slovak SMEs in the sector "Manufacture of machinery and equipment not elsewhere classified" (68.62% of enterprises) consider cooperation with external partners in innovation as a factor of low importance.

³⁴ J. Liefner, S. Hennemann & L. Xin, *Cooperation in the innovation process in developing countries: empirical evidence from Zhongguancun*, "Environment and Planning" 2006, 38(1), 111-130; M. Nieto, L. Santamaria, *The importance of diverse collaborative networks for the novelty of product innovation*, "Technovation", 2007, 27(6-7), 367-377; B. Tether, *Who co-operates for innovation, and why. An empirical analysis*. "Research Policy", 2002, 31(6), 947-967; M.M. Fischer, A. Varga, *A Technological innovation and interfirm cooperation: an exploratory analysis using survey data from manufacturing firms in the metropolitan region of Vienna*, "International Journal of technology Management" 2002, 24(7-8), 724-742; R.D. Fitjar & A. Rodriguez-Pose, *Firm collaboration and modes of innovation in Norway*, "Research Policy" 2013, 42, 128-138.

To assess the importance (significance) of SME's cooperation with individual external subjects in innovation and to indicate the respective type of cooperative relationships in innovation we used the data we have gained through the empirical research. The enterprises indicated the level of importance of cooperation with 14 individual external subjects. Results confirmed that cooperation (in support of innovation) exist mainly with the customers and with the suppliers. Cooperation within the firms in the same field of activity is less frequent. Links with universities and research institutions were not indicated as a factor significant for innovation. Critical may be viewed the results in cooperation linkages between SMEs and intermediary institutions (especially with "Business Innovation Centres" and "Regional Innovation Centres") as well as with the government agencies ("Slovak Agency for Development of Investments and Commerce", "Slovak Industrial Property Office" and "Slovak Business Agency"). The findings reveal that the actual significance of cooperation with these institutions is very low.

Based on the above analysis, some policy recommendations may be formulated.

- SMEs are required to seek for more cooperation with external partners; it is suitable to develop the cooperation also with research institutions, universities and intermediary institutions by establishing cooperation networks.
- Research institutions, universities as well as intermediary institutions should play a more significant role in SME's innovation. This can be achieved by improving the functions and service quality of the intermediary institutions, increasing the level of university participation in various R&D programs, enabling cooperation and technology transfer between SMEs and research institutions as well as between SMEs and intermediary institutions.
- Policy makers should place greater emphasis on creating effective institutional arrangements and policies to help to develop cooperation and to establish a stable platform for cooperation.
- To overcome barriers to cooperation the intermediary institutions like "Business Innovation Centres", "Regional Innovation Centres" could be of help in organising various joint workshops and discussions over problems which can help to build the innovation linkages.

Our research is a scan of the current situation in SME's cooperation linkages with external subjects in innovation in Slovakia and offers a space to improve. The main limitation of this study is that the empirical results are derived from a small sample of Slovak SMEs representing one division of mechanical engineering industry. In future research work we should focus on enterprises of various sizes (small, medium-sized and large enterprises) and various activities. Next, the further research could be aimed also on findings relationships between innovation cooperation and innovation performance of SMEs.

Regardless of these limitations, our study offers some contributions to the study of SME's innovation in Slovakia. As far as the SMEs, it is suitable for them to use various cooperation linkages to source external knowledge and resources. The research has indicated the significance of various external partners in innovation cooperation by Slovak SMEs. Our findings provide some important implications for SMEs managers and policy makers concerned with the management of innovation cooperation. From a managerial point of view it shows that cooperation between SMEs and other partners is a valid approach to improving their innovativeness and novelty. From a viewpoint of policy, more policies in favour of the linkages with the intermediary institutions, universities and research institutions for SMEs has to be implemented.

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