

Ranking of the Sector of SMEs According to Different Types of Innovation

Isidora Milošević, Ana Rakić, Anđelka Stojanović, Sanela Arsić, Ana Milićević

^{1,3,4,5} University of Belgrade, Technical Faculty in Bor,

² University of Belgrade, Faculty of Organizational Sciences

imilosevic@tfbor.bg.ac.rs, ana.rakic@fon.bg.ac.rs, anstojanovic@tfbor.bg.ac.rs, saarsic@tfbor.bg.ac.rs, anamilicevic94@gmail.com

Abstract: In current market conditions, to operate efficiently and achieve a competitive advantage, SMEs need to constantly adapt to the changes that occur, innovate, and improve their business. Innovation implies a complex process consisting of a series of different activities that begin with the emergence of the idea and follow its development and implementation on the market until the moment when some effect is achieved from its application in practice. This paper aims to rank the sectors of SMEs in the Republic of Serbia according to the degree of development of different types of innovations. Secondary data were used for the research, and the final ranking was achieved using the PROMETHEE-GAIA method using the Visual PROMETHEE software package.

Keywords: Innovation, Sector of activity, SMEs, PROMETHEE-GAIA

1 Introduction

Business changes are an inevitable companion of today's turbulent, dynamic, and very unpredictable business environment, in which digital transformation is not an area of activity, but a driving force for development (Anshina & Bobyleva, 2021). In such a market, challenges are constantly imposed that the company's management must operate efficiently and effectively. In response to management's challenges, innovations appear, which play a key role in solving new, non-routine, and unique problems through various improvements to the existing situation in the company, using new approaches, new ideas, and new solutions to these problems. Managers today are forced to create something new, change one value for another or improve existing values while constantly monitoring changes in the current market to ensure the company's successful business (Drucker, 1996).

Innovation is a complex process that differs according to the function of the sector as well as the type of organization (Arundel, O'Brien, & Torugsa, 2013). The main characteristic of all innovations is that they must contain something new. However, according to the different criteria that are considered, there are various types of innovations. The innovations that this paper deals with are innovations

that can be divided into technological and non-technological innovations. Technological innovations include product/service and process innovations (Zakić et al., 2009), while non-technological innovations include organizational (Bloch & Bugge, 2013) and marketing innovations (Gault, 2016).

This paper aims to analyze companies operating in specific sectors of activity to examine the degree of development of different types of innovations. Secondary data taken from available databases were used to analyze the results.

2 Literature Review

The theoretical framework for studying innovation and its application in business is vast and relevant. In different works (Kinkel et al., 2011; Gault, 2016; Janjić & Radjenovic, 2019; Trbovic et al., 2019; Yu, Shi, You, & Zhu, 2020), a very different approach to innovation can be noticed. Some companies comprehend the innovation only as a new technology introduced into the business and will produce a new product. In contrast, for other companies, it is a new business or technological approach in the industry. Also, some companies consider innovation as a social phenomenon that will achieve a competitive advantage and better market placement. In the literature, innovations are viewed as a way and introduce something new in business that will lead to more efficient and effective business (Gault, 2016). Analyzing the interactions between innovative activities in different sectors leads to a better understanding of innovation, presented in Table 1.

Table 1

Literature review of innovation activities

Year	Author(s)	Brief description
2011	Kinkel, S., Kirner, E., Armbruster, H., Jager, A.	This paper examines the empirical significance of services related to products and the application of service innovations in manufacturing companies. The connection between products and services provided to customers plays a significant role in the modern economy.
2016	Gault, F.	This paper proposes generalized definitions of innovation applicable in all economic sectors of the System of National Accounts (SNA) to support the international comparison of innovations in each sector and monitor and evaluate innovation policies implemented.
2019	Janjić, I., Rađenović, T.	This paper aims to point out the importance of innovation in the business of modern organizations and its role in fostering prosperity, creating and maintaining a competitive advantage.

2019	Trbović, A., Vučković, A., Drašković, B.	This article explores the premises of the Fourth Industrial Revolution and its role in fostering innovation and economic growth, pointing to the potential and the gap in the Serbian economy. The applied methodology includes a review of the literature, both in the context of the global development and innovation potential of Serbia, as well as an analysis of empirical sources that could serve as a basis for future research.
2021	Yu, A., Shi, Y., You, J., & Zhu, J.	This study examines the innovation performance of high-tech companies in China using the Dynamic Network Data Analysis (DEA) approach.

3 Methodology

In this paper, a multi-criteria analysis of companies operating in specific sectors of activity was performed to examine the development of innovation in these companies according to different types of innovation. Data analysis was performed based on secondary data taken from the database of the Republic Statistical Office (<https://www.stat.gov.rs/>) and the Eurostat database (www.ec.europa.eu). The obtained data were processed using the Visual PROMETHEE software package, which uses the PROMETHEE GAIA methodology to rank alternatives based on defined criteria adequately.

The research was conducted for the period 2016-2018. Nine sectors were selected for analysis in which the largest number of companies operates and were used as possible alternatives in multi-criteria decision-making. The sectors which ranked are Information and communication; Wholesale and retail trade; Construction; Agriculture, forestry and fishing; Traffic and storage; Professional, scientific, innovation and technical activities; Manufacturing industry; Electricity, steam, and gas supply; Administrative and support service activities. Business entities that have introduced innovations in products and processes, innovations in marketing and organization, innovations in products and processes, or have not submitted any innovation in their business were used as analysis criteria.

3.1 PROMETHEE - GAIA method

Brans developed the PROMETHEE method, and later it was further developed and improved by Marshall and Vinke (Brans et al., 1984). This method belongs to the group of “outranking” methods, which compares two or more alternatives according to given criteria to identify the preference or dominance of one alternative over another (Turcksin, 2011). The PROMETHEE method is complemented by GAIA, a visual representation of multi-criteria decision-making problem, which contributes to a better understanding of the problem and makes

the best decision (Mareschal & Brans, 1988). For the alternatives to be ranked based on the selected criteria, it is necessary to define the appropriate parameters. According to Brans and Vincke (1985), the parameters that need to be defined for the application of this method are 1. The direction of preference; 2. Weighting coefficients; 3. Preference threshold; 4. Indifference threshold; 5. Preference function.

The PROMETHEE method is implemented through several steps (Brans et al., 1984, Brans & Mareschal, 2005, Doan & De Smet, 2018; Sarrazin et al., 2018; Milošević et al., 2020; Rakić et al., 2021):

Step 1: Creating the decision table

Step 2: Assigning the preference function to each criterion.

Step 3: Calculating the preference index π (a, b), based on the weights of the criteria

Step 4: Calculating outranking flows for each alternative.

3.2 Data analysis and results in discussion

For conducting a multi-criteria analysis for the period 2016-2018, it is necessary to define specific parameters for each indicator in the Visual PROMETHEE software package. The defined parameters are shown in Table 2.

Table 2

Parameters for ranking the sectors according to different types of innovation

	Product and process innovation (IPP)	Innovation in Organization and Marketing (IOM)	Product and process innovation, and innovation in organization and marketing (IPPIOM)	Non-innovators (NI)
Max/min	Max	Max	Max	Min
Weights	1.00	1.00	1.00	1.00
Preference function	Usual	Usual	Usual	Usual
Limitation	Percentage	Percentage	Percentage	Percentage

Table 2 depicts the criteria related to the introduction of innovation in the company are maximized, while the criterion of non-innovators is minimized. All indicators were assigned the exact value of the weighting factor, while the preference function of type 1 - Usual function was chosen as the most suitable. The usual function had no thresholds. All values of the given indicators are presented in percentage amounts.

After defining the parameters of the multi-criteria analysis, ranking sectors according to the types of innovation in Serbia for the mentioned period was performed. The net flow of preferences (Phi), the positive flow of preferences (Phi +), and the negative flow of preferences (Phi-) are shown in Table 3 and Figure 1.

Table 3

Results of the ranking of the sectors according to the type of innovation in the period 2016-2018

Rank	Alternative	Phi+	Phi-	Phi
1	Information and communication	0.8125	0.1875	0.6250
2	Manufacturing industry	0.6250	0.3438	0.2813
3	Agriculture, forestry and fishing	0.6250	0.3750	0.2500
4	Professional, scientific, innovation and technical activities	0.6250	0.3750	0.2500
5	Administrative and support service activities	0.5625	0.4063	0.1563
6	Traffic and storage	0.3750	0.6250	-0.2500
7	Construction	0.3125	0.6875	-0.3750
8	Wholesale and retail trade	0.2813	0.7188	-0.4375
9	Electricity, steam, and gas supply	0.2500	0.7500	-0.5000

The ranking of sectors according to the different types of innovations introduced in companies from 2016 to 2018 shows that the best-ranked sector is the Information and Communication Sector, with the most positive net preferences. The sector of Electricity, steam and gas supply stands out as the worst-ranked sector in this period. Figure 1 gives a visual representation of the obtained ranking results in the form of a GAIA plane.

Based on the positions of the criteria presented in the GAIA plane in the form of a rhombus, agreement or conflict between the criteria can be determined. According

to the criteria in Figure 1, it can be noticed that there were no significant conflicts between them because they are moving in the opposite direction. The criteria with the most similar assessments were introducing Product and process innovation and Innovation in organization and marketing. The positions of the alternatives, shown in a plane by square, determine the strength or weakness of the alternative concerning the criteria. According to the Product and process innovation and Innovation in organization and marketing criteria, the best sector was the Information and Communication Sector, so the decision stick is in the direction of the position of this alternative. On the other hand, the Sector for Electricity, Steam and Gas Supply stands out as the worst-ranked sector and the sector with the lowest degree of innovation submission in this period.

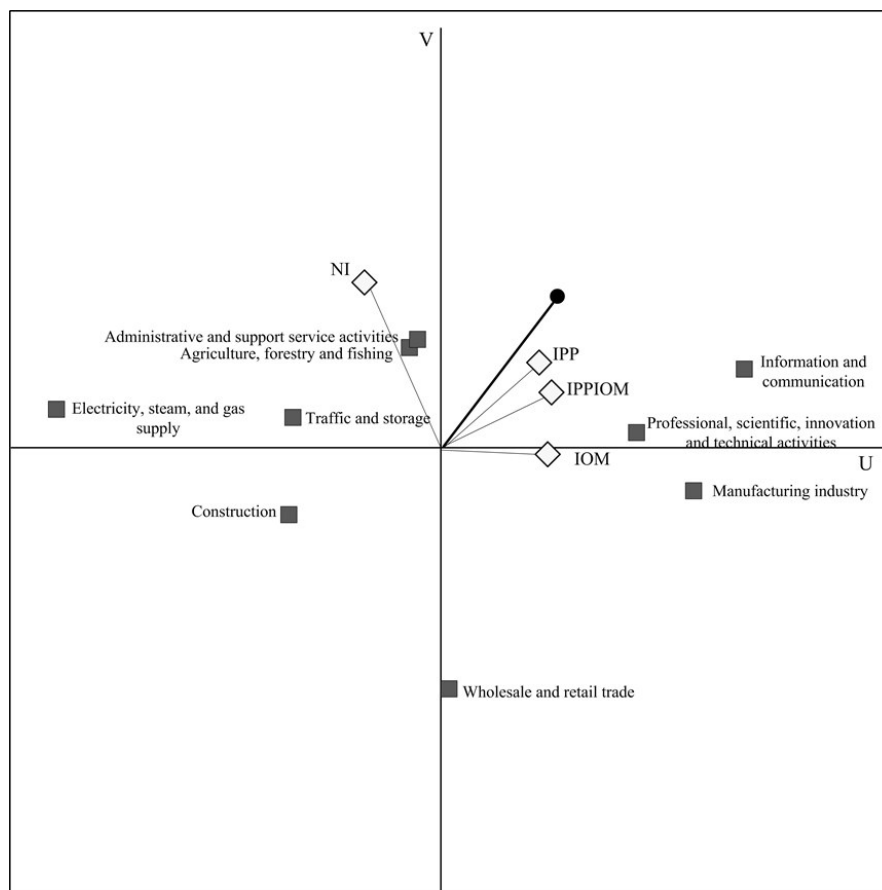


Figure 1
GAIA analysis

Conclusion

Given the circumstances of the current environment in which companies operate and the constantly happening changes, companies must continuously invest in innovation to respond to new challenges. Innovation is imperative in both technological and organizational terms. Constant innovation and improvement of products, production program, production process, technology, and knowledge of employees are the conditions for successful business both at the company level and at the sector and the economy level.

Based on the research, it was found that there is a larger share of those sectors that introduce innovations in their business in Serbia. But there are also those sectors that have not yet realized the importance and effects of innovation, so do not innovate. Sectors that introduce innovations need to be supported and certain subsidies and benefits to continue their growth and development. In contrast, sectors that have not realized the importance of innovations must first raise awareness of innovations and their effects on business and then provide support during implementation innovation.

Acknowledgement

The research presented in this paper was done with the support of the Ministry of Education, Science and Technological Development of the Republic of Serbia, within the funding of the scientific research work at the University of Belgrade, Technical Faculty in Bor, according to the contract with registration number 451-03-9/2021-14/ 200131.

References

- [1] Anshin. V., & Bobyleva., A. (2021). The digital transformation program management in medium-sized businesses: a network approach, *Serbian Journal of Management* 16 (1) (2021) 147 - 159
- [2] Arundel, A., O'Brien, K. Torugsa, A. & Gault. F. (2013). *Handbook of innovation indicators and measurement*, Edward Elgar Publishing, Inc., Northampton pp. 88-108.
- [3] Brans, J.P., Mareschal, B., & Vincke, Ph, (1984). PROMETHEE: A new family of outranking methods in multi-criteria analysis, in Brans, J.P. (Ed.), *Operational Research '84*, North-Holland, Amsterdam, pp. 447–490.
- [4] Brans, J.P. Mareschal, B., (2005). Promethee methods. Chapter 5 in: *Multiple Criteria Decision Analysis: State of the Art Surveys*, Springer Science and Business Media, Boston, p. 170.
- [5] Bloch, C., Bugge, M., M., (2013). *Public sector innovation-From to measurement, Structural Change and Economic Dynamics*, Elsevier, Vol. 2, page 8.
- [6] Doan, N.A.V., & De Smet, Y., (2018). An alternative weight sensitivity analysis for PROMETHEE II rankings. *Omega*, Vol. 80, pp. 166-174.

- [7] Drucker, P.F.(1996). The executive in action: Managing for results, innovation and entrepreneurship, The Effective Executive. HarperCollins Publishers.
- [8] Eurostat (2020), <https://ec.europa.eu/eurostat/data/database>
- [9] Gault, F. (2016). Defining and Measuring Innovation in all Sectors of the Economy: Policy Relevance. OECD Blue Sky Forum III, Ghent, Belgium, page 7.
- [10] Janjić, I., & Rađenović, T. (2019). The importance of managing innovation in modern enterprises, *Ekonomika*, Niš, Vol. 65, DOI: 10.5937/ekonomika1903045J
- [11] Kinkel, S., Kirner, E., Armbruster, H., Jager, A.(2011). Relevance and innovation of production-related services in manufacturing industry, DOI: 10.1504/IJTM.2011.041952
- [12] Milošević, I., Rakić, A., Arsić, S., Stojanović, A., Nikolić, I., & Đorđević, P. (2020). Model for Considering the Propensity of Students to Accept M-learning, *Management: Journal of Sustainable Business and Management Solutions in Emerging Economies*, DOI: 10.7595/management.fon.2020.0021
- [13] Rakić, A., Milošević, I., & Filipović, J. (2021). Standards and Standardization Practices: Does Organization Size Matter? *Engineering Management Journal*, <https://doi.org/10.1080/10429247.2021.1894060>
- [14] Sarrazin, R., De Smet, Y., Rosenfeld, J., (2018). An extension of PROMETHEE to interval clustering. *Omega*, Vol. 80, pp. 12–21.
- [15] Statistical Office of the Republic of Serbia, (2020). Usage of information and communication technologies in the Republic Of Serbia, 2020. Households/Individuals Enterprises, Belgrade.
- [16] Trbović, A., Vučković, A., Drašković, B. (2019). Industry 4.0. as a review of Serbia's potential and research opportunities, *Ekonomika preduzeća*, doi:10.5937/ekopre2002105t
- [17] Turcksina, L., Bernardinia , A., & Macharisa, C. (2011). A combined AHP-PROMETHEE approach for selecting the most appropriate policy scenario to stimulate a clean vehicle fleet, *Procedia Social and Behavioral Sciences* 20, 954–965.
- [18] Zakić, N., Stamatović, M., Cvetanović, S. (2009). Typology of innovations in enterprises, *Economic topics*, Faculty of Economics in Nis, Vol. 2, 001.895: 65.012.32, p. 77.
- [19] Yu, A., Shi, Y., You, J., & Zhu, J. (2021). Innovation performance evaluation for high-tech companies using a dynamic network data envelopment analysis approach, *European Journal of Operational Research* 292 (1), 199-212

- [20] Strategy (2020). Development of education in Serbia until 2020, Available: <http://www.mps.gov.rs/wp-content/uploads/2015/08/STRATEGIJA-OBRAZOVANJA.pdf>
- [21] Wong, A. O., & Sixl-Daniell, K. (2017). The importance of e-learning as a teaching and learning approach in emerging markets. *International Journal of Advanced Corporate Learning*, 10(1), 45-54.
- [22] Yang, J. F. (2008). Learning styles and perceived educational quality in e-learning. *Asian Journal of Distance Education*, 6(1), 63-75.
- [23] Zhang, D., Zhao, J. L., Zhou, L., & Nunamaker Jr, J. F. (2004). Can e-learning replace classroom learning?. *Communications of the ACM*, 47(5), 75-79.