Innovation Business Model Based on New Technologies and Company Relationships

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Abstract

Fierce market rivalry between companies has forced a need to search for new ways of competing. One such way is to innovate the company's business model innovation with the use of new technologies. In order to do so, companies often take advantage of relationships with different market actors. Although the existing literature provides some general insight on this matter, there is still a significant research gap concerning the use of specific market actors by companies characterized by BMI based on new technologies. The aim of the paper is to assess the role of relationships developed by companies characterized by BMI based on new technologies with different types of entities. In order to achieve the aim of the paper, it was decided to perform both qualitative and quantitative research. For the qualitative research, a focus study with 12 participants was performed, and for the quantitative study, a computer-assisted telephone interview (CATI) with representatives from 483 companies was carried out. The data collection method included not only primary sources (interviews with managers) but secondary sources (e.g., company materials) as well. The main conclusion drawn from the presented research is that it is beneficial (in terms of technology as well as performance indicators — profits, sales, market share, and ROI) for companies characterized with BMI based on new technologies to develop relationships with various types of entities. These various types should not only include suppliers or buyers, but competitors, the company's internal and external units, universities and research centers, financing agencies, and government or local government administration as well. The results presented in the paper add significant value to the existing knowledge. Not only is the paper one of a few which touch on the matter of relationships developed by companies characterized by BMI based on new technologies, it also provides new information. It adds a new block to the theories of open innovation and resource-based view.

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Introduction

Currently, one way for companies to build a competitive position is to implement business model innovation (BMI). According to Hutahayan and Wahyono (2019, p. 264), BMI "is an organizational innovation through which firms explore new ways to define value proposition, create and capture value for customers, suppliers and partners." With access to new technologies now available, some companies try to implement a special type of BMI— BMI based on new technologies. As stated by Minatogawa et al., (2020, p. 3), "new technologies are responsible for enabling new business models." In the literature (Adam Dymitrowski & Mielcarek, 2020), a list of what is called "new technology" can be found. These include autonomous robots, simulation, integration of horizontal and vertical systems, Internet of Things, cyber security, cloud, additive production, augmented reality, Big Data, drones, AI, electric vehicles, and blockchain. Therefore, wherever in the following paper the term "BMI based on new technologies" is used, it refers to BMI which uses at least one of the technologies mentioned above.

In the context of implementing BMI based on new technologies, the role of relationships developed by companies with other entities is important. According to Nenonen and Storbacka (2010), successful BMI is characterized not only by proper configuration of the firm's internal elements but also external adjustment of supplier and buyer. A similar point of view is presented by Holloway and Sebastiao (2010, p. 81)according to whom: "successfully implementing a business model requires the integration of resources, partners, suppliers, customers and other agents into cooperative networks that evolve with market conditions." Moreover, when considering relationships developed by a company, Dellyana et al. (2016)state that BMI describes the way of capturing value from entities identified within the network of relationships a company operates in. Similarly, according to Guo et al. (2013), BMI should be perceived as a firm's purposefully developed network of relationships. Acknowledging this fact is of utmost importance, because different networks of relationship result in different BMI (Dellyana et al., 2016).

Although relationships built with other entities by companies characterized by BMI based on new technologies are important, this problem has not been thoroughly investigated in the literature and represents a significant research gap. Existence of the research gap in the context of BMI and a company's relationships with other entities is supported by the opinions of some other authors. For example, in the context of the engagement of different entities in the BMI process, Roth et al., (2021) state: "Yet, there is no clear indication of what role these actors play /.../. It is also unclear how these actors engage /.../." Carayannis et al., (2015) provide insights in a similar manner: "the role of the value chain network has not been discussed /and/ would certainly be of value to explore." When considering BMI and companies' external relationships, Velter et al., (2021) point out: "Research to understand the processes /.../ is only in its infancy". The research gap was also identified by Foltean and Glovaţchi (2021, p. 392) who examined BMI in the context of one of the new technologies: "despite the need

/…/ to renew their business models to effectively create value for customers and capture value for the company, the strategic factors of business model innovation for IoT solutions have remained under-researched so far." All these opinions indicate that in the context of BMI companies, information on the character and essence of relationships they develop with other entities has been underestimated so far.

The existence of a significant research gap in the context of BMI, new technologies, and business relationships motivated the present authors to research this problem. Thus, the aim of the paper is to assess the role of relationships developed by companies characterized by BMI based on new technologies.

Following the Introduction, the paper is divided into six sections. The "Literature Review" section provides a critical analysis of the literature and highlights the main issues of the researched phenomenon. The "Methodology" section describes the applied research methods and the stand adopted. The outcomes of the study are presented in the "Results" section. In the "Discussion" section, the results of the study are compared with the literature. The "Conclusions section" sums up the added value provided by the paper and provides recommendations both for representatives of science and business practice. The "References" section contains the list of literature sources of information. The source of funding is provided in the "Funding".

Literature Review

The phenomenon of relationships developed by companies characterized by BMI based on new technologies can be related to at least two management theories, namely, open innovation and the resource-based view (RBV).

The theory of open innovation asserts that in order to build competitive advantage, companies should not steer away from innovation which is widely available, but should in fact acquire it from other entities. Open innovation stands in contrast to the traditionally secret and independent manner of developing innovation by companies which used to serve as the basis for the closed innovation approach (Innovation 1.0). Open innovation theory changes the perception of boundaries existing between a company and entities identified within its environment which became less conventional and shaped a new way of perceiving innovation treated as a result of company interactions with other entities (Innovation 2.0). According to H. W. Chesbrough (2003), open innovation is: "a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology." This fact is extremely important for companies characterized by BMI based on new technologies. While their competitive advantage is based on BMI which make use of technology, companies characterized by BMI based on new technologies should avidly draw from other entities in order to increase their innovativeness.

In the context of open innovation, special attention should be paid to a specific change caused by the rise of the digital economy which has resulted in the creation of a new generation of innovation — embedded innovation (Innovation 3.0). To survive in a highly competitive digitalized environment, companies build relationships

to aligned communities, networks, and stakeholders (Hafkesbrink & Evers, 2010) therefore becoming embedded in an environment with many different types of actors. In that sense, Innovation 3.0 builds on open innovation by conceptually embracing organizational capabilities in order for the company to be successfully embedded in a network of relationships (O'Reilly & Tushman, 2008). The nature of embeddedness is determined by both implicit, e.g., trust culture (Hafkesbrink & Evers, 2010) and explicit (e.g., formal contracts) factors as well as explorative or exploitative, organic or mechanic factors (Tushman et al., 2003), depending on the nature and phase of the innovation process and the characteristics of the relationships. According to open innovation theory seen from the perspective of Innovation 3.0, there is no focal company which manages open innovation processes. On the contrary, open innovation processes are run by multiple actors at the same time (Hafkesbrink & Schroll, 2011).

As far as multiple actors are concerned in the literature, some specific entities are believed to be important in the case of business model innovation. These include suppliers, buyers, competitors, a company's internal and external units, universities and research centers, financing agencies, government or local government administration (Al-Nimer et al., 2021; Bao et al., 2021; Burton et al., 2021; Adam Dymitrowski, 2017; Hao-Chen et al., 2013; Ricciardi et al., 2016; Siachou & Ioannidis, 2010). Since these types of entities are important for BMI, they are also vital for BMI based on new technologies. It has to be noted, however, that it is difficult to find sources in the literature that specifically discuss the role of different entities in reference to BMI based on new technologies. For this reason, the present discussion is based mainly on the literature concerning BMI in general, but whenever possible, references to BMI based on new technologies are made.

Information provided in the literature points out the positive influence of developing relationships on companies characterized by BMI based on new technologies. This positive influence is reflected in many benefits that companies gain from relationships such as knowledge (Yang et al., 2020), access to financial funds (Ensley et al., 2002), etc. However, there are still many unknowns and questions which deserve to be answered. One of those questions refers to the relevance of the wide range of different entities identified in the literature that companies characterized with BMI based on new technologies can develop relationships with. Are they equally important or do some entities play a greater role than others? As there were so little information to be found in the literature on the comparison between relationships with different types of entities for companies characterized with BMI based on new technologies it was decided to examine this matter. This led to the formulation of the following research question.

RQ1: How relevant are relationships with specific types of entities for companies characterized with BMI based on new technologies?

Secondly, because of technology, the phenomenon of relationships developed by companies characterized by BMI based on new technologies with different types of entities is also related to the resource-based view (RBV) theory. The RBV theory asserts that a company's competitive advantage is determined by its strategic

resources. Strategic resources could be assets that the company holds as well as their capabilities and competencies (Prahalad & Hamel, 1990). Because every company is characterized by a different set of strategic resources, they implement different strategies to utilize them and present different levels of competitive advantage. According to RBV, the role of company managers is to identify those assets, capabilities and competencies and to develop them so as to outperform their competitors. This can be achieved when strategic resources are unique, firm-specific and not easily imitated or substituted, which enables companies to perform activities in a manner different from other market players (Hooley et al., 1998).

This fact implies that not all types of resources are of equal importance for a company's competitive advantage (Fahy & Smithee, 1999). In the case of companies characterized by BMI based on new technologies, the technology used is of key importance. In line with RBV assumptions, the more unique the set of technology that companies characterized by BMI based on new technologies utilize, the more innovative they are and the greater competitive advantage they have.

In the literature (Foltean & Glovațchi, 2021), it is stated that relationships developed by companies characterized by BMI based on new technologies could result in the absorption of technology. However, the scope of this absorption remains unclear. Do companies characterized with BMI based on new technologies tend to expand their pool of technology or on the contrary — do they focus on selected types of technology? This gap in the research led to the formulation of the following research question.

RQ2: How do relationships developed by companies characterized with BMI based on new technologies affect their technology pool?

Last but not least, with respect to both open innovation and RBV, it is still unclear how the benefits gained thanks to both relationships developed with different types of entities as well as technology and affect the performance of companies characterized with BMI based on new technologies, as described in the literature (Al-Nimer et al., 2021; Bao et al., 2021; Burton et al., 2021; Hao-Chen et al., 2013; Ricciardi et al., 2016). As stated by Adam Dymitrowski and Mielcarek (2021, p. 2110): "the existing literature identifies the effects /…/ but neglects to examine how these effects are reflected in company performance indicators." Taking these facts into consideration, the third research question was formulated:

RQ3: How do relationships developed by companies characterized with BMI based on new technologies influence their performance?

Each of the three formulated research questions address the aim of the study — to assess the role of relationships developed by companies characterized by BMI based on new technologies. In this sense, the role of relationships for companies characterized by BMI based on new technologies is understood in the context of the relevance and added value provided by specific actors, how they affect the technology pool of companies characterized by BMI based on new technologies as well as the role played in influencing their performance.

It has already been shown that companies characterized with BMI based on new technologies can build relationships with different entities. These relationships can be beneficial in many ways. In the the opinion of H. Chesbrough and Schwartz (2007), relationships can grant access to the resources necessary for BMI. In the case of companies characterized with BMI based on new technologies, one type of resource is especially important — technology. Therefore, acknowledging the assumptions of open innovation theory and RBV, it seems that companies characterized with BMI based on new technologies can utilize relationships with different types of entities in order to gain access to a number of technologies.

Taking these facts into consideration, the first hypothesis (H1) states that the greater the role of relationships built with different types of entities, the more technologies companies characterized with BMI based on new technologies use.

Technology absorbed by companies characterized with BMI based on new technologies from different entities could be a valuable resource. However, technology is not the only benefit companies characterized with BMI based on new technologies could receive from relationships with different types of entities. Technology is acknowledging the assumptions of open innovation theory and RBV, merely a tool to obtain favorable performance by companies. In this context, it is important to note that the purpose of developing relationships with different entities by companies is to perform better (Adam Dymitrowski, 2012), and this is indicated by the performance indicators.

Taking these facts into consideration, the second hypothesis (H2) states that the greater the role of relationships built with different types of entities by companies characterized with BMI based on new technologies, the better the company performance indicators.

Answering the three formulated research questions and verifying the two formulated research hypotheses will help to achieve the aim of the paper as well as add value to the theories of open innovation and RBV.

Methodology

In order to achieve the aim of the paper, answer the three questions posed, and verify the two research hypotheses; it was decided to perform a two-stage study.

The first stage of the study was qualitative research. The authors used the focus study method to collect raw data. Morgan (1998) defines focus study as a research technique where information necessary for the purposes of the study are collected by a researcher through interaction with a group of participants. It was decided to use focus study for a couple of reasons (Babbie & Benaquisto, 2013): (1) little time needed in order to collect information, (2) complementary to quantitative methods, (3) no requirements for large financial outlays.

To conduct the research, interviewers were selected from companies characterized with BMI based on new technologies. In order for the company to be considered as a company characterized with BMI based on new technologies two criteria needed to be met: (1) using at least one of the technologies: autonomous robots, simulation, integration of horizontal and vertical systems, Internet of Things, cyber

security, the cloud, additive production, augmented reality, Big Data; (2) positive answer to a filter question: "Is your company characterized with an innovative and unique way of doing business?". The nature of the filter question was consistent with the essence of BMI definitions existing in the literature (Eppler & Hoffmann, 2011; Foss & Saebi, 2016; Katsamakas & Pavlov, 2020). Interviewers were selected only from top management staff, as they have the greatest knowledge on how the company operates; this is important in researching the phenomenon of BMI. While BMI refers to the manner of doing business which encompasses the whole company (Saur-Amaral et al., 2016), only top managers could answer questions about different aspects of BMI.

Twelve independent interviewees took part in the focus study. In order to ensure efficiency in collecting information; interviewees were randomly divided into two groups (each consisting of six persons). Thus the focus study was performed in two separate focus panels, each of them lasting around 90 min. In order to coordinate the merit value of the study in both sessions, a professional moderator with experience in qualitative methods facilitated the discussions. Both sessions were based on a standardized interview questionnaire with 6 open questions referring to aspects such as the nature of relationships developed with different types of entities and performance indicators of BMI companies as well as one task which required interviewers to describe the companies' BMI with a business model canvas. Both focus panel sessions were recorded, and transcripts were prepared. The analysis was then based on these transcripts. The analysis was performed using the specialist software — Altlas.ti. In order to ensure objectivity and provide high-quality information, the primary data were triangulated (Yin, 2009) with secondary data (such as materials about the companies available on the Internet). Therefore, the method of data collection included not only primary sources (interviews with managers) but secondary sources (e.g., company materials) as well.

The second stage of the study took the form of quantitative research. The motivation for choosing quantitative research was taken from the literature. For example, Bashir and Verma (2017) and Clauss (2017) point out that in case of future research on BMI, a quantitative approach should be used to enrich results from the existing qualitative studies.

The method of the quantitative study was computer-assisted telephone interview (CATI). This method was chosen for a few reasons (Ragozzino et al., 2012). Firstly, it allows data to be gathered from many participants which makes the study reliable. Secondly, it allows any doubts of the interviewees to be dispelled by the interviewers during the interview. Thirdly, the use of CATI allows information to be obtained from impenetrable sources such as companies characterized with BMI based on new technologies. Thus, CATI provides high-quality research data (Scandura & Williams, 2000).

During the interviews, a standardized survey questionnaire was used. Questions in the questionnaire referred to types of technology that the firm uses, relationships with different entities, or performance indicators. In the case of performance indicators, both financial and non-financial indicators (profit, sales, market share, ROI) assessed on a 5-point Likert scale in comparison with the company's competitors were used. Choosing these specific company performance indicators was supported

with conclusions from the qualitative stage and is approved in the literature on innovation (Adam Dymitrowski, 2014; Smajlović et al., 2019).

In order to constitute a research sample, 3500 companies located in Poland were selected from the Bisnod database. Research sample selection criteria included:

- Using at least one of the new technologies (autonomous robots, simulation, integration of horizontal and vertical systems, Internet of Things, cyber security, cloud, additive production, augmented reality, Big Data, drones, AI, electric vehicles and blockchain[1]
- Providing contact information to representatives of top management

Providing contact information to representatives of top management was important, because (as explained before) only top managers have the full knowledge of how the company operates in the market and a full picture of the BMI. The 3500 companies were subjected to further selection in order to single out companies characterized with BMI. A filter question: "Does your company have an innovative business model which means a novel and unique way of doing business?"[2] was used for this purpose. A positive answer to the filter question qualified a company to take part in the survey. This narrowed down the field to 483 companies when then took part in the survey. The study was performed between January 8th and January 14th, 2021. In the second stage of the study (quantitative research), the method of data collection included only primary sources (interviews with managers).

In order to verify whether the data gathered for the quantitative study were affected by common method bias (Palmatier, 2016), Harman's single-factor test was performed. All the variables used for the study were subjected to factor analysis with the principal axis factoring method and unrotated factor solution in order to identify if one general factor accounts for more than 50% of the co-variation (MacKenzie & Podsakoff, 2012). One general factor accounted for 24.37% of the total variance. This means that the research is not affected by common method bias.

Results

In order to answer the first research question (RQ1) which states: "How relevant are relationships with specific types of entities for companies characterized with BMI based on new technologies?", the results of the qualitative stage of the study were considered first. Interviewees, when asked about the role of relationships with specific types of entities in case of companies characterized with BMI based on new technologies, confirmed that suppliers, buyers, competitors, the company's internal

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[1] Taking into consideration results of the first (qualitative) stage of research in the second (quantitative) stage, it was decided to consider drones, AI, electric vehicles, and blockchain as new technologies as well.

[2] Taking into consideration results of the first(qualitative) stage of research in the second (quantitative) stage, the filter question was slightly reformulated in order to efficiently identify BMI companies.

units, universities and research centers, and financing agencies are important. When it comes to suppliers one of the interviewers said: "We had such a need from clients to quickly implement /…/ and then we faced many questions /…/ We started looking for partners who would be able to add competences in various areas." This means that relevance of suppliers translates into being engaged in the creation of BMI based on new technologies. In this sense, suppliers provide expert competencies which help to generate added value for BMI purposes. When it comes to buyers one of the interviewers said: "Did those partners, or our partners, our clients have any part in creating our business model? Probably yes, indirectly. Well, above all they had a need, so they had some influence on the creation of our business model." This means that relevance of buyers translates into directing the changes necessary for BMI based on implementation of new technologies. By analyzing buyers' needs, a company identifies the existing demand and adjusts its BMI accordingly. When it comes to competitors one of the interviewers said: "I would say to the competition /…/ they started doing pretty similar things /…/ and this is where an interesting race took place." This means that relevance of competitors translates into motivating the implementation of BMI based on new technologies. It also provides a benchmark for the company which can be used to either innovate the existing business model or further improve BMI based on new technologies. When it comes to a company's internal units, one of the interviewers said: "In our company every employee undergoes mandatory /…/ training. Quarterly, there are newer and more advanced trainings." This means that relevance of internal units (similar to suppliers) translates into providing added value (in terms of competencies) to BMI based on new technologies. When it comes to universities and research centers one of the interviewers said: "We were contacted by a polytechnic which was planning a project with another technological partner and they needed a company with more or less our skills." This means that relevance of universities translates into providing complementary competencies and thus creating new forms of cooperation. Such cooperation could take the form of strategic partnership and result in BMI based on new technologies. When it comes to financing agencies one of the interviewers said: "The first project, now the second – are co-financed from EU funds." This means that relevance of financing agencies translates into providing resources necessary to implement BMI based on new technologies. While both innovative and technological activities are financially demanding, such a role is especially important in the case of SMEs.

The performed qualitative study did not confirm the relevance of entities such as a company's external units or government or local government administration. None of the interviews considered these entities as relevant in the context of relationships developed by companies characterized with BMI based on new technologies. However, having considered the results existing in the literature (A Dymitrowski & Ratajczak-Mrozek, 2019; Maglio & Spohrer, 2013), it was decided to include these types of entities in the quantitative stage of research.

In order to enrich the results of the qualitative study and answer the first research question (RQ1) "How relevant are relationships with specific types of entities for companies characterized with BMI based on new technologies?" in a comprehensive manner, the results of the quantitative stage of study were considered. The assessment of relevance of relationships developed with specific types of entities

Table 1 Relevance of relationships developed with specific types of entities by companies characterized with BMI based on new technologies

	N	Mean	Std. Deviation
Buyers	483	3.69	0.915
Competitors	483	3.66	0.944
Company's internal units	483	3.58	1.055
Suppliers	483	3.44	1.052
Company's external units	483	3.41	1.013
Financing agencies	483	3.32	1.057
Universities/research centers	483	3.26	1.080
Government or local government administration	483	3.24	1.032
Valid N	483		

1, not relevant at all; 2, irrelevant; 3, no opinion; 4, relevant; 5, very relevant.

by companies characterized with BMI based on new technologies is presented in Table 1.

Findings from the information in Table 1 reveal that firstly relationships with a company's external units as well as government or local government administration (which were not identified as relevant in the case of the qualitative study) appeared to be important for companies characterized by BMI based on new technologies, while each of the mean scores exceeded 3 (which referred to "no opinion"). Secondly, relationships with different entities are not equally important for companies characterized by BMI based on new technologies. The type of entities which play the greatest role for companies characterized by BMI based on new technologies are buyers and the ones which play the smallest role are government or local government administration (however, they are still relevant). Thirdly, the fact that mean scores may seem to be similar is caused by a small dispersion of the minimum and maximum rating scale (1–5). However, the difference in means of entities with the greatest (buyers) and smallest (government or local government administration) roles is 0.45 which represents a high significance.

In order to answer the second research question (RQ2) which states: "How do relationships developed by companies characterized with BMI based on new technologies affect their technology pool?" and verify the first hypothesis (H1), which states: "The greater the role of relationships built with different types of entities, the more technologies companies characterized with BMI based on new technologies use," companies were divided into clusters. Identification of clusters was based on companies' similarity to each other in terms of the significance of relationships with different types of entities. For identification, cluster analysis was performed using the Ward's method for binary variables. The square of the Euclidean distance was taken as the measure of distance. The division into clusters was made on the basis of a dendrogram. Two clusters of companies were identified. There were 148 companies (30.6%) in the first cluster and 335 companies (69.4%) in the second cluster. In order to compare the two clusters in terms of role of relationships built with different types of entities, a Mann–Whitney U test was performed (Tables 2 and 3).

Table 2 Comparisons of two clusters in terms of role of relationships built with different types of entities

	Ward method	N	Mean rank	Sum of ranks
Suppliers	1	148	127.71	18,900.50
	2	335	292.49	97,985.50
	Total	483		
Buyers	1	148	176.75	26,159.00
	2	335	270.83	90,727.00
	Total	483		
Competitors	1	148	154.61	22,882.00
	2	335	280.61	94,004.00
	Total	483		
Company's internal units	1	148	138.21	20,455.00
	2	335	287.85	96,431.00
	Total	483		
company's external units	1	148	126.50	18,722.00
	2	335	293.03	98,164.00
	Total	483		
Universities/research centers	1	148	112.97	16,720.00
	2	335	299.00	100,166.00
	Total	483		
Financing agencies	1	148	126.75	18,759.50
	2	335	292.91	98,126.50
	Total	483		
Government or local government administration	1	148	115.15	17,042.50
	2	335	298.04	99,843.50
	Total	483		

Two observations can be deduced from the information in Tables 2 and 3. Firstly, the mean ranks of all types of entities were higher in the case of companies from cluster 2 in comparison to companies from cluster 1. This means that companies from cluster 2 assess the role of relationships built with all types of entities higher than companies from cluster 1. Secondly, test statistics proved the statistical significance ($p < 0.001$) of the results for all types of entities.

In order to answer RQ2 and verify H1, the two identified clusters of companies were compared from the perspective of new technology utilization. Table 4 presents their characteristics.

From the information presented in Table 4, it can be deduced that companies from cluster 1 more frequently (in comparison to companies from cluster 2) use the following technologies: cyber security and cloud. On the other hand, companies from cluster 2 more frequently (in comparison to companies from cluster 1) use the following technologies: autonomous robots, simulation, integration of horizontal and vertical systems, IoT, additive production, augmented reality, Big Data, AI, electric vehicles, drones and blockchain.

Table 3 Test statistics for Table 2

	Suppliers	Buyers	Competitors	Company's internal units	Company's external units	Universities/ research centers	Financing agencies	Government or local government administration
Mann–Whitney U	7874.500	15,133.000	11,856.000	9429.000	7696.000	5694.000	7733.500	6016.500
Wilcoxon W	18,900.500	26,159.000	22,882.000	20,455.000	18,722.000	16,720.000	18,759.500	17,042.500
Z	−12.625	−7.286	−9.758	−11.551	−12.786	−14.107	−12.620	−13.959
Asymp. sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

a. Grouping variable: Ward method

Table 4 Characteristics of the two identified clusters

		Clusters	
		1 ($N=148$)	2 ($N=335$)
New technologies	Autonomous robots	17.57%	20.30%
	Simulation	16.22%	40.60%
	Integration of horizontal and vertical systems	12.84%	27.16%
	IoT	29.73%	40.90%
	Cyber security	58.78%	43.28%
	Cloud	60.14%	56.12%
	Additive production	10.81%	17.01%
	Augmented reality	4.73%	16.72%
	Big Data	14.19%	33.73%
	AI	11.49%	19.40%
	Electric vehicles	5.41%	11.64%
	Drones	3.38%	7.76%
	Blockchain	4.05%	4.48%

What is important is that in 11 out of 13 cases, companies from cluster 2 more frequently use specific new technologies than companies from cluster 1. Therefore, it is justified to state that companies from cluster 2 use more technologies than companies from cluster 1.

Summing up the information provided in Tables 2, 3, and 4, it must be acknowledged that for companies from cluster 2 the role of relationships built with different types of entities is greater compared to companies from cluster 1. Additionally, companies from cluster 2 use more technologies than companies from cluster 1. Therefore, it can be stated that the greater the role of relationships built with different types of entities, the more technologies companies characterized with BMI based on new technologies use; this means that H1 is supported.

Positive verification of H1 helped to answer RQ2. It transpires that relationships developed by companies characterized with BMI based on new technologies affect their technology pool in a positive way. This means that they help to increase the technology pool used by companies characterized with BMI based on new technologies.

In order to answer the third research question (RQ3) which states: "How do relationships developed by companies characterized with BMI based on new technologies influence their performance?" and verify the second hypothesis (H2), which states: "The greater the role of relationships built with different types of entities by companies characterized with BMI based on new technologies, the better the company performance indicators." As in the case of the first hypothesis, a Mann–Whitney U test was performed (Tables 5 and 6). This helped to compare the clusters in terms of different company performance indicators.

Again, two observations can be deduced from the information in Tables 5 and 6. Firstly, the mean ranks of all company performance indicators (profit, sales, market

Table 5 Comparison of two clusters in terms of company performance indicators

	Ward method	N	Mean rank	Sum of ranks
Profit	1	148	207.04	30,642.50
	2	335	257.44	86,243.50
	Total	483		
Sales	1	148	199.34	29,502.00
	2	335	260.85	87,384.00
	Total	483		
Market share	1	148	203.61	30,134.50
	2	335	258.96	86,751.50
	Total	483		
ROI	1	148	186.60	27,617.00
	2	335	266.47	89,269.00
	Total	483		

Table 6 Test statistics for Table 5

	Profit	Sales	Market share	ROI
Mann–Whitney U	19,616.500	18,476.000	19,108.500	16,591.000
Wilcoxon W	30,642.500	29,502.000	30,134.500	27,617.000
Z	-4.017	-4.815	-4.358	-6.251
Asymp. sig. (2-tailed)	0.000	0.000	0.000	0.000

a. Grouping variable: Ward method

share, and ROI) were higher in the case of companies from cluster 2 compared to companies from cluster 1. This means that performance indicators of companies from cluster 2 are higher than companies from cluster 1. Secondly, test statistics proved the statistical significance ($p < 0.001$) of the results for all company performance indicators. These two observations justify stating that the greater role of relationships built with different types of entities by companies characterized with BMI based on new technologies, the better the company performance indicators. Therefore, H2 is supported.

Positive verification of H2 helped to answer RQ3. It occurs that relationships developed by companies characterized with BMI based on new technologies affect their performance in a positive way. This means that they help to improve performance indicators of companies characterized with BMI based on new technologies.

Discussion

When comparing the results presented in the paper with the literature, a few aspects should be highlighted. Firstly, it is difficult to discuss the role of relationships developed by companies characterized by BMI based on new technologies with different

types of entities, because of the existence of a significant research gap. Although there are studies which touch on relations of BMI companies in general (e.g., Adam Dymitrowski, 2017), it is difficult to find the research examining both BMI and business relationships and new technologies with a few exceptions (e.g., Y. Guo et al., 2021; Paiola & Gebauer, 2020) which either concentrated on specific aspects of relationships or specific technologies.

Secondly, the positive role of developing business relationships by companies characterized with BMI based on new technologies presented in the paper is in line with some other research accessible in the literature (different from difficult to be found research examining BMI and business relationships and new technologies at the same time). Results presented in the present paper confirm the benefits of business cooperation described by Adam Dymitrowski and Soniewicki (2015), the positive influence of BMI on companies' competitive advantage presented by Siachou and Ioannidis (2010), and the benefits of technology utilization described by Zane and DeCarolis (2016).The results presented in the paper further confirm that positive effects described in case of companies characterized with BMI apply also in the case of companies characterized with BMI based on new technologies.

Thirdly, the results presented in the paper about the positive role of relationships seen from the perspective of four different company performance indicators are in line with some other research (Adam Dymitrowski, 2014) which used the same set of indicators in order to assess the effects of a company's innovativeness as well as (Smajlović et al., 2019) who used 3 out of 4 indicators (profit, sales and market share) to assess BMI efficiency. This fact allows us to have confidence in the results presented in the paper.

When discussing the results, it should also be stated that the applied method (cluster analysis using the Ward's method for binary variables) had a strong influence on the research outcomes. Identifying two clusters of companies allowed a comparison to be made and the role of different entities for each of the clusters to be assessed. Nevertheless, the conclusions could have been more in-depth if there were more clusters. Perhaps, if more than two clusters had been identified, it would have been possible to grasp the eventual differences in the roles of specific entities. However, the two clusters were what the applied method delivered, and it was accepted by the authors in line with an honest and reliable research stand.

Conclusions

The aim of the paper was to assess the role of relationships developed by companies characterized by BMI based on new technologies. The aim was achieved by performing an extensive empirical study. With the use of both focus study and CATI methods, a large number of companies characterized with BMI based on new technologies were investigated.

The main conclusion from the presented research is that it is beneficial for companies characterized with BMI based on new technologies to develop relationships with various types of entities. These various types should include not only suppliers or buyers, but competitors, the company's internal and external

units, universities and research centers, financing agencies, and government or local government administration as well.

It was empirically proven that the greater the role of relationships built with different types of entities, the more technologies companies characterized with BMI based on new technologies use, which increases their competitiveness. Additionally, the greater the role of relationships built with different types of entities by companies characterized with BMI based on new technologies, the better the company performance in terms of profit, sales, market share, and ROI.

This paper is one of a few researches, with the exception of Y. Guo et al. (2021) and Paiola and Gebauer (2020), which touch on the matter of relationships developed by companies characterized by BMI based on new technologies. The results presented in the paper add significant value to the existing knowledge by adding new blocks to the theory of open innovation and RBV.

In the case of the open innovation theory (H. W. Chesbrough, 2006), the results provide additional value by assessing the relevance of specific types of entities important from the perspective of BMI based on new technologies. It was proven that entities are not equally important for companies characterized with BMI based on new technologies. Although suppliers, buyers, competitors, a company's internal and external units, universities and research centers, financing agencies, and government or local government administration are all relevant, relationships developed with buyers and competitors are of utmost importance. This fact enriches the theory of open innovation by promoting the development of relationships with competitors. Furthermore, the results identify the roles of specific entities engaged in BMI based on new technologies processes therefore helping to better understand open innovation theory seen from the perspective of innovation 3.0 by giving more in-detail information on their embeddedness.

In the case of RBV (Fahy & Smithee, 1999; Prahalad & Hamel, 1990), information presented in the paper helped to identify the influence of relationships on specific types of resources (new technologies). It was proven that relationships help to gain access to technologies such as autonomous robots, simulation, integration of horizontal and vertical systems, IoT, additive production, augmented reality, Big Data, AI, electric vehicles, drones, and blockchain. On the other hand, restricting relationships results in developing cyber security and cloud. Therefore RBV was enriched with the presented results not only by identifying new regularities for specific types of companies — those characterized with BMI based on new technologies — but also exploring relationships between relationships and specific new technologies.

Taking into consideration the results, a few recommendations for both researchers and representatives of business practice were suggested. In the case of researchers, it is recommended to research the phenomenon of companies characterized by BMI based on new technologies on large research samples. Only large research samples allow interesting conclusions to be drawn in the case of such complex research subjects. In this research, the CATI method proved to be very efficient. It is therefore recommended to use this type of method, because it allows eventual doubts of interviewees to be dispelled by the interviewer during

the interview and also allows information from impenetrable sources such as companies characterized with BMI based on new technologies to be obtained.

In the case of representatives of business practice, it is recommended to engage suppliers and buyers in technology development and BMI implementation. This can be achieved by creating joint project teams. It is also recommended to decrease the rivalry with competitors in favor of cooperation. Such cooperation can be started with activities relating to fields with the lowest level of competition. In order to implement BMI based on new technologies, it is recommended to implement employee empowerment programs along with new policies aimed at better and more effective communication. It is also recommended to constantly check the business offer for expertise from universities and research centers, which can act as a source of innovation. Last but not least, it is recommended to build close relationships with financing agencies and government or local government administration by implementation of personalized communication and invite them to company events. All the recommended activities should result in gaining access to new technologies and achieving more favorable market results by companies characterized by BMI based on new technologies.

In the future, it would be interesting to investigate differences in performance indicators resulting from different forms of cooperation (e.g., occasional transactions vs. business alliances) of companies characterized by BMI based on new technologies. It would also be interesting to examine the role of relationships built with different types of entities by companies characterized with BMI based on new technologies on different sizes and forms of ownerships and operating in different markets. That is why future research on these aspects is recommended.

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