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Edited by
Renata Korsakienė, Hasan Dinçer and Serhat Yüksel

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Article

Current Research Trends on Interrelationships of Eco-Innovation and Internationalisation: A Bibliometric Analysis

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Abstract: In this paper, bibliometric analysis is conducted on eco-innovation and internationalisation, since in the scientific literature, both research fields have been considered as being interrelated. Although the adoption of eco-innovation and internationalisation are risky processes, they reduce competitive risk and increase performance in a highly competitive business environment. The main objective of this study is to identify current research trends on the interrelationships of eco-innovations and internationalisation as well as the main areas of knowledge and to provide a general overview of research streams that can be classified using by papers, authors and journals found in the Web of Science database. In total, 1677 publications published between 1991 and 2020 related to eco-innovations and internationalisation were taken into consideration. For the visualisation of bibliographic material, VOSviewer software was used. These findings provide valuable insights by revealing the trends and highlighting the possible research streams for future investigations in the field of eco-innovations and internationalisation research.

Keywords: eco-innovation; internationalisation; risk; performance; bibliometric analysis

1. Introduction

The total quantity of scientific research literature on a particular field of study can often be overwhelming (van Nunen et al. 2018) and continues to rise, which makes it difficult for scientists to have a structured overview of important information. Bibliometrics is a valuable tool for a literature analysis that can efficiently reveal the latest advances in a specific field of research (Wang et al. 2014). The worldwide shift towards sustainable development and environmental integrity makes it necessary for companies to take adaptation and risk management actions in order to reduce their environmental impact while developing products and services. There is a solidarity among academics and market professionals regarding the changes needed in current business practices and how these changes affect natural and social environments. Due to the environmental issues and increased focus on sustainability, eco-innovations are gaining more and more attention. This concept has been discussed in the majority of the United Nations (UN) sustainable development goals (SDGs) and thus, to achieve these goals, eco-innovation must be involved, i.e., innovations that reduce environmental and social impacts while causing disruptions and improvements to existing production models (Lopes Santos et al. 2019).

The growing demand from consumers and world-wide regulatory requirements for eco-friendly products and services challenge companies to adopt eco-innovations not only in their domestic markets but also for exporting companies in their foreign markets, making both internationalisation

and eco-innovation more a necessity than a choice (Hojnik et al. 2018). Notably, eco-innovation is considered to be a source of global competitive advantage and becomes a key factor in increasing the exporting profitability of the firms that utilize it (Martínez-Román et al. 2019). This innovation enables internationalisation and facilitates companies' adaptation to a global competitive environment. Furthermore, the positive impact of eco-innovation on firms' financial performance (Marcus 2015) through results such as cost reductions and an increase of sales has been observed (Ociepa-Kubicka and Pachura 2017). Internationalisation and development of eco-innovations may bring economic growth to companies and improve their competitive advantage, however, it may give rise to uncertainties and are assumed to be risky processes (de Perea et al. 2019). The development of new products or processes implies a high level of risk and paradoxically this type of risk can exert a negative impact on companies' internationalisation (Martínez-Román et al. 2019). Thus, the outcomes of eco-innovation and internationalisation might demonstrate the difference between the expected result and a negative result (Inanoglu and Jacobs 2009). While eco-innovation is riskier in terms of investments (Cainelli et al. 2015), the risk level is directly proportional to the level of innovativeness. Thus, the firms might encounter financial risk, especially with eco-innovative activities and a low level of acceptance in the market (Ociepa-Kubicka and Pachura 2017; Martínez-Román et al. 2019) while expanding internationally. Consequently, the higher costs of internationalisation will negatively influence the performance of the firms that experience these challenges (Nguyen et al. 2019). In spite of prevailing risk, businesses are encouraged to invest into innovations (Qi et al. 2020) by considering financial eco-innovation, i.e., a specific mechanism bridging the financing of eco-innovation and sustainability (González-Ruiz et al. 2018). Moreover, these scholars suggest making eco-innovation the main focal point of a firm's strategy and subsequently, diminishing their risk (Munodawafa and Johl 2019). Thus, aiming to manage a risk of eco-innovation and internationalisation, the interrelationship between eco-innovation and internationalisation requires deeper investigation.

1.1. Eco-Innovation

Over the last three decades, the eco-innovation concept has been embedded in most sustainability research documents. Although the term was defined in 1996, most eco-innovation research publications have been published after 2009 (Kuo and Smith 2018). Eco-innovation (sometimes defined as environmental or green innovation) is usually defined as innovation that results in a reduction of environmental impact. Furthermore, as compared to traditional forms of innovation, eco-innovation emphasises the companies' mitigation of negative impacts and are associated with environmental benefits (Liao and Tsai 2019). Over the last 30 years, other terms have been used to define the strategy of eco-innovation, such as green innovation, environmental innovation, sustainable innovation, etc. The main methods used to extend beyond traditional forms of innovation over the time emphasise social and environmental impacts, changes of business models that involve the consumption of materials, energy and water (Lopes Santos et al. 2019). Moreover, eco-innovation can be adopted by companies or non-profit organisations at different social, technological, institutional or organisational levels (González-Ruiz et al. 2018). Notably, the definitions of eco-innovation are based on the concept of "traditional innovation with reduction of environmental impact" and reflect regulatory requirements for companies to consider the consequences of their operations (Lopes Santos et al. 2019).

Organisation for Economic Cooperation and Development (OECD) defines eco-innovation as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method for business practices, workplace organisation or external relations, that results in a reduction of environmental impact, no matter whether that effect is intended or not and the scope of eco-innovation may go beyond the conventional organisational boundaries and involve broader social arrangements that trigger changes in existing socio-cultural norms and institutional structures". Furthermore, Organisation for Economic Cooperation and Development (OECD) distinguished three main facets of eco-innovation: 1. Targets, such as products, processes (rely on technological development), marketing methods, organisations and institutions

(rely on non-technological development). 2. Mechanisms, that involve practice modifications, redesign and new alternatives, or the creation of entirely new practices. 3. Impacts, which defines how the eco-innovation affects environmental conditions.

The European Commission grouped 16 indicators into five dimensions determining eco-innovation: inputs, activities, outputs, resource efficiency and socio-economic outcomes (Spaini et al. 2018). Paraschiv et al. (2012) argue that one of the main factors influencing companies' sustainable development is eco-innovation, which plays a key role in achieving global corporate sustainability goals. Hence, eco-innovation is one of the key factors involved in achieving global sustainability objectives and moving industries towards sustainable development, with important potential benefits for innovative companies, industries and even entire economies (Paraschiv et al. 2011). However, the main barrier towards implementing eco-innovation is financial factors and a lack of sufficient resources (Przychodzen and Przychodzen 2015).

In the context of sustainable development, eco-innovations are essential for organisations seeking to align themselves with international concerns related to environmental protection, human rights and the wealth of their employees (Paraschiv et al. 2012). In order to achieve the SDGs, eco-innovation has been proposed as an effective solution to help companies to reduce their negative environmental impacts (Kuo and Smith 2018). In this study, the term "eco-innovation" is in line with UN's SDGs view and emphasises the ecological dimension of these goals.

1.2. Internationalisation

Internationalisation is not as new a phenomenon as eco-innovation. As the subject of the research, internationalisation has been developing for more than sixty years (Głodowska et al. 2019); however, the number of scientific publications continues to rise. Though initial studies considered large corporations, later on the discussions have been expanded in the small business context (Korsakienė et al. 2019a). Moreover, internationalisation has been analysed in many scientific disciplines. Thus, various approaches to study the phenomenon were applied stemming from management, economics, entrepreneurship, etc.

The traditional internationalisation approaches such as the Uppsala model (Vahlne and Johanson 2013) defines internationalisation as the process of acquiring, integrating and utilising knowledge and competence in international operations through increased participation in international markets. Meanwhile, new investigations continue to study the phenomenon and define internationalisation as a multi-stage process which also has a curvilinear relationship with a firm's performance (Nguyen et al. 2019). While business, economic and social environments have been changing over time, the different phases and dimensions of internationalisation have been emerging (Deng et al. 2020). Thus, the scholars treat the internationalisation process as encompassing the opportunities for emerging foreign firms to build various relationships (Deng et al. 2020). Moreover, previous investigations in the context of smaller firms disclosed various paths of growth, such as through the improvement of products, expansion of market share through innovation or the expansion of foreign market share through exports i.e., internationalisation (Henley and Song 2019).

Finally, internationalisation is assumed to be a strategic decision through which companies seek increased involvement in global markets and foreign sales. Though scientific discussion on internationalisation has triggered a number of studies, the majority of studies rely on the degree of a company's internationalisation, i.e., the proportion of their export sales to total sales, as a single measurement of internationalisation (Genc et al. 2019; Korsakienė et al. 2019b). Moreover, export performance appears to be the main indicator used to observe internationalisation of the companies, especially in the small business context.

1.3. Interrelationships of Eco-Innovations and Internationalisation

The importance of internationalisation and eco-innovations in organisational performance has triggered scientific debates. Apparently, innovation capabilities developed by firms impact strategic

behaviour, including their stance towards internationalisation (Mi et al. 2020). Many authors, with evidence from different countries and product groups, emphasise the importance of innovation in order to increase export performance and competitiveness (Priede and Pereira 2015). For instance, investigations performed in Australia revealed that eco-innovation increased international performance (Ratten 2018). The studies revealed that companies that have international operations are more innovative than those do not, highlighting the fact that exporters are significantly more likely to introduce product, process and management innovation (Shearmur et al. 2015). Therefore, organisations must focus on two approaches. First, the companies have to innovate to exploit technological opportunities. Second, the companies have to respond to the changes in demand and lifestyles of consumers (Bossle et al. 2016). In addition, the "green barrier" hinders companies' collaborations with international organisations unless they meet all the necessary ecological regulatory requirements.

While some studies investigated the direct relationship between innovation and internationalisation (Chiarvesio et al. 2015), other studies investigated the mediation effect of eco-innovation. Juniati et al. (2019) argues that eco-innovation has an important mediating effect on the relationship between internationalisation and performance in Malaysian multinational firms. According to the authors, the relationship between internationalisation and eco-innovation enables companies to achieve better performance and competitiveness, and also contributes to their environmental and social improvements. Juniati et al. (2019) suggests that internationalisation is a driving force for companies to learn and implement eco-innovations. Moreover, internationalisation with assimilated eco-innovations enable companies to achieve better performance. Thus, it was confirmed by multiple studies that the companies are encouraged to expand business horizons to achieve cost efficiencies, as well as technological and business function improvements. However, the study only considered large multinational firms and did not take into account other variables, which is the limitation for large multi-national corporation studies (Juniati et al. 2019). Meanwhile, the study performed by Hojnik et al. (2018) investigated 151 Slovenian internationalized companies and revealed that companies which implement a learning process based on internationalisation activities and eco-innovation initiatives improve their economic performance.

The scholars discussing the organisational learning perspective aim to shed light on the relationship between internationalisation and eco-innovation. They argue that when companies export, they gain information on foreign customers' needs and regulatory demands, as well as an improved understanding of foreign markets, partners, competitors and their technological gaps. Knowledge acquisition is one of the key factors affecting the internationalisation and learning process, which lets companies incorporate gained knowledge into firm-level routines and improve their product, process, and organisational innovations. These findings complement the "learning by exporting" stream of research, which suggests that exporters learn from foreign customers and partners by implementing new production technologies and subsequently innovate. Thus, the findings of Hojnik et al. (2018) indicate that eco-innovation adoption and environmental sustainability are significant and comprise the key drivers for serving foreign markets. According to these scholars, internationalisation leads to the adoption of eco-innovation and the relationship between internationalisation and eco-innovation is stronger in medium-sized and large companies, especially in manufacturing companies, that operate in the business-to-consumer market and companies that are ISO14001 accredited. However, the study relied on the self-reported measurements provided by companies' environmental or quality managers, meaning further investigation needs to be done using more direct objective measurements (Hojnik et al. 2018).

1.4. Purpose of the Study

While considering the dynamics in economical, ecological and social environments, the research question is formulated as follows: what is the current state of knowledge about the interrelationships between eco-innovations and internationalisation and how it has been investigated? The purpose of this study is to disclose and provide a coherent overview of current research trends on the interrelationships between eco-innovations and internationalisation and to highlight the possible research streams for

future investigations. To achieve the objective, we analyse the academic literature by adopting a bibliometric methodology, which offers a systematic and macroscopic overview of current knowledge. Bibliometric analysis is a technique for providing an extensive overview of large amounts of scientific literature in a particular field of research and can be used to evaluate the research trends and cooperation patterns involving authors, journals and countries = (van Nunen et al. 2018). This paper contributes to the literature of eco-innovations and internationalisation by bringing the two together and using their core findings to study the interrelationships between them. The data in this study provides an overview on the research progress achieved in the streams of eco-innovations and internationalisation and it can help both researchers and professionals to identify the most influential authors, journals, countries and research topics.

2. Materials and Methods

Bibliometric analysis is a valuable tool for studying bibliographic materials by using quantitative methods. The method became very popular for the representation of summarised results of classified bibliography (Cancino et al. 2017). The method includes various steps that must be taken by researchers. These steps are pre-established through the research protocol and all possible sources of error (or bias) that can undermine the relevance of the study are considered (Pedro et al. 2018). The stages included in the research protocol of this study are presented in Figure 1. Moreover, before stage 1, the following research questions were formulated:

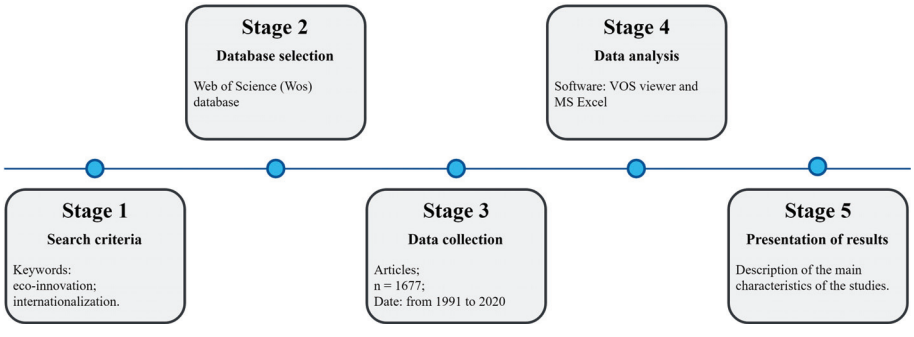

Figure 1. The five stages of bibliometric analysis.

RQ1: what is the output and growth trend of publications in the selected streams?

RQ2: which are the most influential countries and journals that are impacting the research streams?

RQ3: what is the relationship between internationalisation and eco-innovation and how it is being investigated?

2.1. Stage 1: Search Criteria

The first condition for the study was to rely on scientific papers that are investigating eco-innovation and internationalisation as the main concepts. This condition for the keywords was used for several reasons. Firstly, it aimed to ensure that the scientific literature is within the scope of this paper. Secondly, it aimed to ensure that this study did not divert away from the main research questions. Hence, numerous synonyms were used in conjunction with the main keywords and the initial search string was composed of three parts: the first focused on the ecological part using eco OR ecologic OR environment OR sustainable OR green, the second focused on innovations, using innovation and the last focused on internationalisation part, using internationalisation OR export. No quotation marks were included, however an asterisk was included to extract the synonyms. Notably, the filtering of general noun phrases, such as result, study, paper, etc. was crucial (Van Raan 2014), because these general meaning noun phrases tend to distort the structure of two-dimensional map due to their

irrelevance compared to the research topic. This search results all had the selected terms identified in the title, the abstract and/or in the keywords of the publications with the indexes SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH and ESCI.

2.2. Stage 2: Database Selection

This study included an information search using Web of Science (or WoS), which is one of the main scientific databases and is the most relevant scientific citation database. It is also a multidisciplinary database, indexing the most cited journals in the respective fields (Pedro et al. 2018), such as SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED and IC (Dabić et al. 2019). Every publication in Web of Science includes many details such as the publication year, authors, addresses, title, abstract, journal, references, etc. (van Nunen et al. 2018).

2.3. Stage 3: Data Collection

The search was performed in April 2020. Only empirical research papers were included, as they featured the results of investigations on internationalisation and eco-innovation; therefore, the document type was selected as Article and included the period from 1991 to 2020. The preliminary results of the search in WoS were a total of 1841 articles. In order to analyse the selected keywords, the language filter was applied, which resulted in a total of 1677 papers found that were published in English from 1991 to 2020. Once the data search was finalised, we exported the results with all available information in the ".txt" format, which was used for the analysis.

2.4. Stage 4: Data Analysis

After data collection, the selected articles were assessed by considering the chosen streams prior to the data synthesis. This stage let us confirm the relevance of the study. The main ideas in the discovered texts were analysed and their relevance to the eco-innovation and internationalisation was studied.

For quantitative data analysis, the construction and visualisation of bibliometric networks (van Eck and Waltman 2017) was used by applying the free access VOSviewer (www.vosviewer.com) software. VOS viewer software provides a more general view of search results by generating two-dimensional maps based on bibliographic coupling, co-authorship, citation, co-citation, co-occurrence of keywords, authors and countries to visualise relationships between them (van Nunen et al. 2018; Cancino et al. 2017; Gall et al. 2015). The clustering method was used to identify different clusters, where each group is differently coloured (van Eck and Waltman 2017). The clusters were formed by selecting all papers that together are linked by a specified co-citation threshold. The interpretation of visualisation, in general, is as follows: the size of the circles represents the number of occurrences, the distance between two circles reveals similarities and relatedness, different colours mark separate clusters (van Nunen et al. 2018).

Cancino et al. (2017) describes the principles and explains that bibliographic coupling links two papers that cite the same third article. Co-citation is a method used to establish subject similarity between two documents. Meanwhile, co-authorship measures the degree of co-authorship between the most productive sources. Citation analysis focuses on the degree of citation similarity between two variables. Co-occurrence of author keywords shows the most common keywords and the network connections visualises the keywords that appear more frequently in the same papers (Van Raan 2014).

2.5. Stage 5: Presentation of Results

After data processing and analysis, only the final results and quantitative evaluation of the examined phenomenon are presented in the following sections. The detailed results and visualisations are provided in the results section. The discussion and conclusions sections follow.

3. Results

3.1. The Output and Growth Trend of Publications

To answer RQ1, we measured the output of annual publications. The number of scientific papers is an important measurement for evaluating the development in a specific research discipline or a field. The publications related to eco-innovations and internationalisation increased over the analysed period (Figure 2). In total 1677 scientific documents were published during the years 1991–2020. There was only one publication in 1991. The number of publications remained limited until 2008 as compared to later years (less than 50 publications was published every year until 2009). From 2009, an increasing number of scientific papers was observed every year (with exception of 2010, (n = 45)). A small jump was observed in 2011 (n = 79), while in a decline was observed in 2012 (n = 65). The number of publications continued to grow rapidly from 2012 until 2019 (n = 252). The publications from 2020 was not included in the Figure 1 due to the limited number of publications so far this year (n = 54), which distorts the trend.

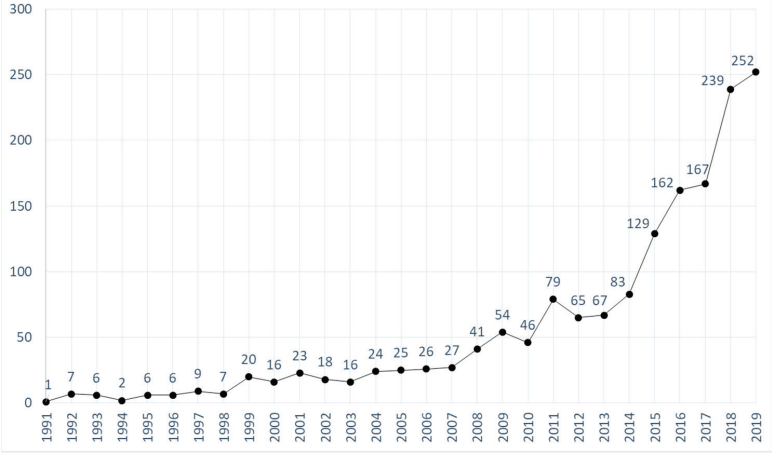

Figure 2. A number of publications related to eco-innovations and internationalisation by year.

3.2. The Most Cited Publications

The most cited and influential publications (n = 15) on eco-innovations and internationalisation are presented in Table 1. The most cited publication is published by E. F. Lambin and P. Meyfroidt "Global land-use change, economic globalisation, and the looming land scarcity" in 2011, (*Proceedings of the National Academy of Sciences of the United States of America*) and was cited 1097 times with the average citations per year of n = 121.89. The second most cited publication is published by Q. Zhu and J. Sarkis "Relationships between operational practises and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises", published in 2004, (*Journal of Operations Management*) and was cited 999 times, with an average citations per year of n = 62.44. The third most cited publication is published by J. L. Furman, M. E. Porter and S. Stern "The determinants of national innovative capacity" in 2002, (*Research Policy*) and was cited 803 times, with an average citations per year of n = 44.61.

Table 1. The most cited publications.

Title	Author(s)	Journal	Y/C *
Global land-use change, economic globalization, and the looming land scarcity	E. F. Lambin and P. Meyfroidt	Proceedings of the National Academy of Sciences of the United States of America	2011/1097
Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises	Q. Zhu and J. Sarkis	Journal of Operations Management	2004/999
The determinants of national innovative capacity	J. L. Furman, M. E. Porter and S. Stern	Research Policy	2002/803
Land use transitions: Socio-ecological feedback versus socio-economic change	E. F. Lambin and P. Meyfroidt	Land Use Policy	2010/435
Toward a spatial perspective on sustainability transitions	L. Coenen, P. S. Benneworth and B. Truffer	Research Policy	2012/390
Subsidiaries and knowledge creation: the influence of the MNC and host country on innovation	P. Almeida and A. Phone	Strategic Management Journal	2004/386
International venturing by emerging economy firms: the effects of firm capabilities, home country networks, and corporate entrepreneurship	D. W. Yiu, C. Lau and G. D. Bruton	Journal of International Business Studies	2007/375
The geographic sources of foreign subsidiaries' innovations	T. S. Frost	Strategic Management Journal	2001/362
International corporate entrepreneurship and firm performance: The moderating effect of international environmental hostility	S. A. Zahra and D. M. Garvis	Journal of Business Venturing	2000/332
Innovation and the international diffusion of environmentally responsive technology	J. O. Lanjouw and A. Mody	Research Policy	1996/310
Business Model Innovation through Trial-and-Error Learning: The Naturhouse Case	M. Sosna, R. N. Trevinyo-Rodríguez and S. R. Velamuri	Long Range Planning	2010/305
Tipping Toward Sustainability: Emerging Pathways of Transformation	F. Westley et al.	Ambio	2011/274
Practical and Innovative Measures for the Control of Agricultural Phosphorus Losses to Water: An Overview	A. Sharpley, B. Foy and P. Withers	Journal of Environmental Quality	2000/262
Innovative capability and export performance of Chinese firms	J. Guan and N. Ma	Technovation	2003/254
Lead markets and regulation: a framework for analyzing the international diffusion of environmental innovations	R. Beise and K. Rennings	Ecological Economics	2005/211

* Y/C—year published/ total citations.

3.3. Bibliographic Coupling of Publications

Bibliographic coupling analysis of publications determines the relatedness of publications based on the number of references that they share (Figure 2). The size of the circles represents the number of citations. Meanwhile, the distance represents relatedness and similarities between two publications and the colours represent clusters. Notably, the results meeting a threshold of 50 citations are presented. In total, nine different clusters can be identified (Figure 3). Three clusters are predominating: light blue (right) with the author E. F. Lambin and their citations (n = 1097); green cluster (bottom) with the author Q. Zhu and their citations (n = 999); and dark blue (top) with the author J. L. Furman and their citations (n = 803).

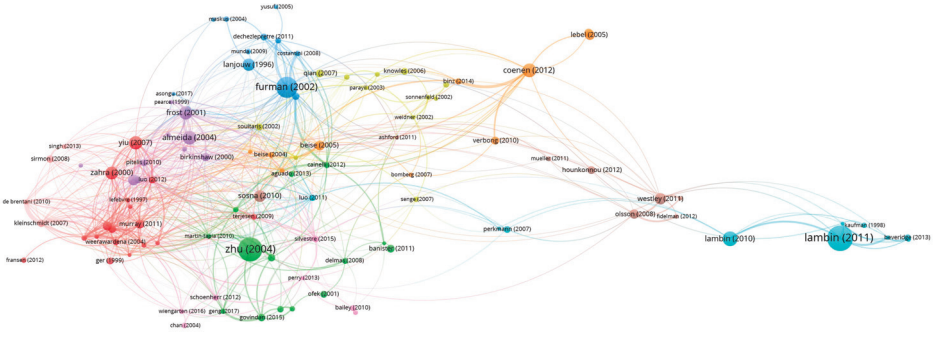

Figure 3. Bibliographic coupling of publications.

3.4. The Most Cited Journals

Aiming to answer RQ2, we analysed the most cited and influential journals. The most cited and influential journals (n = 15) on eco-innovations and internationalisation are presented in Table 2. The most cited journal is Research Policy with 16 documents and is cited in a total of 2210 citations with an average citations per document of n = 138.13. Second, the most-cited journal is Proceedings of the National Academy of Sciences of the United States of America with 6 documents and in a total of 1476 citations, with average citations per document of n = 246. Third, the most-cited journal is Journal of Operations Management with 2 documents and in a total of 1476 citations, with average citations per document n = 500.

Table 2. The most cited publications.

Journal	Documents	Citations	Avg. C. per doc.
Research Policy	16	2210	138.13
Proceedings of the National Academy of Sciences of the United States of America	6	1476	246.00
Journal of Operations Management	2	1000	500.00
Strategic Management Journal	4	763	190.75
Land Use Policy	5	566	113.20
Journal of International Business Studies	6	553	92.17
Journal of Cleaner Production	37	454	12.27
Ecological Economics	8	423	52.88
Technological Forecasting and Social Change	16	419	26.19
Energy Policy	12	393	32.75
Journal of Product Innovation Management	6	390	65.00
Long Range Planning	5	372	74.40
Technovation	8	366	45.75
Journal of Business Venturing	2	365	182.50
International Business Review	17	361	21.24

3.5. Co-Citation Analysis of Journals

Co-citation analysis of journals determines the relatedness of the journals based on the number of times they are cited together (Figure 4). The size of the circles represents the number of citations, the distance represents relatedness and similarities between two journals while the colours represent clusters. Notably, only the results meeting a threshold of 50 citations are presented. In total, four different clusters can be identified: the cluster in yellow (the most co-cited in the cluster: *American Economic Review* (n = 431) top left); the cluster in red (the most co-cited in the cluster: *Research Policy* (n = 1509) bottom left/ middle); cluster in blue (the most co-cited in the cluster: *Strategic Management Journal* (n = 1543) top right); and cluster in green (the most co-cited in the cluster: *Harvard Business Review* (n = 459) bottom right). The most co-cited journals are: *Strategic Management Journal* (n = 1543), *Journal of International Business Studies* (n = 1519) and *Research Policy* (n = 1509).

3.6. Co-Citation Analysis of Authors

Co-citation analysis of authors determines the relatedness of authors based on the number of times they are cited together (Figure 5). The size of the circles represents the number of citations. Meanwhile, the distance represents relatedness, similarities and cooperation between the authors and the colours represent clusters. Only the results meeting a threshold of 20 citations are shown. In total, five different clusters can be identified: cluster in purple (Q. Zhu (n = 66) top left); cluster in red (D. Teece (n = 196) left); cluster in blue (J. H. Dunning (n = 144) bottom middle); cluster in green (C. Freeman (n = 93) bottom right) and cluster in yellow (M. Porter (n = 306) top right/ middle).

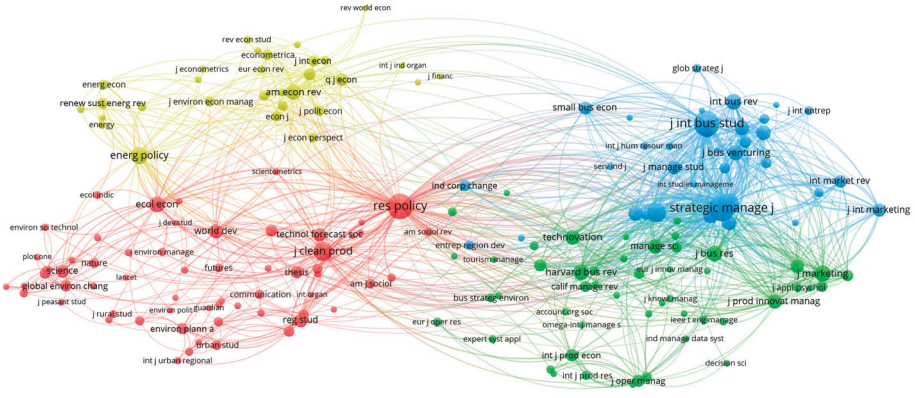

Figure 4. Co-citation analysis of journals.

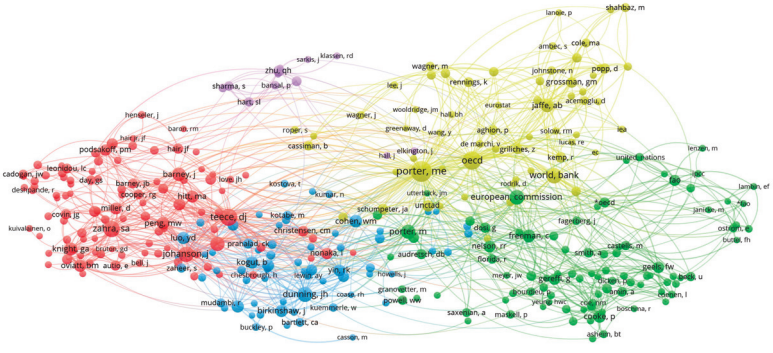

Figure 5. Co-citation analysis of authors.

3.7. Co-Authorship Analysis of Countries

To answer RQ2: we analysed the most cited and influential countries. Co-authorship analysis of authors determines the relatedness of countries based on the number of co-authored documents and measures the degree of co-authors between the most productive sources (Figure 6). The size of the circles represents the number of citations. Meanwhile, the distance represents relatedness, similarities and cooperation between countries while the colours represent clusters. In total, six different clusters can be identified: the cluster in yellow (Germany (n = 1061 citations, documents n = 83) left); cluster in green (the United Kingdom (n = 4631 citations, documents n = 191) top left/ middle); cluster in purple (France (n = 976 citations, documents n = 47) top middle); cluster in orange (Taiwan (n = 847 citations, documents n = 39) top right); cluster in red (USA (n = 11,518 citations, documents n = 320) right); cluster in light blue (Spain (n = 1524 citations, documents n = 97) bottom middle); and the cluster in dark blue (Netherlands (n = 2114 citations, documents n = 61) middle). Only the results meeting a threshold of 10 publications on the topic are shown. The USA is predominating with a total of 320 publications (n = 11,518 citations), the United Kingdom is the second largest country (n = 191; citations n = 4631) and the People's Republic of China is the third largest country with total of 172 publications (n = 3468 citations).

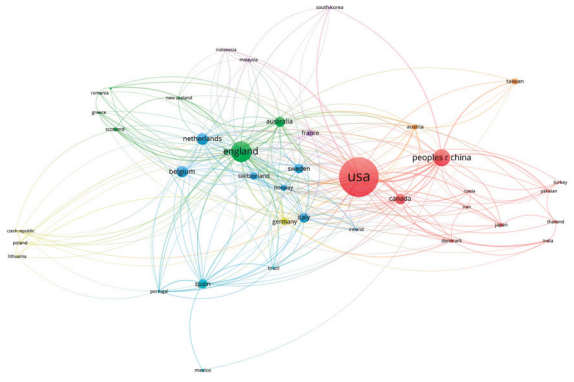

Figure 6. Co-authorship of countries.

3.8. Keywords

To answer RQ3, we analysed terms that are being used in scientific documents. Co-occurrence of author's keywords analysis determines the relatedness of keywords based on the number of documents in which authors used specific keywords. Figure 7 reveals common keywords used by authors below the abstract to characterise their papers. The size of the circles represents the number of keywords being used, the distance represents relatedness and similarities between keywords and the colours represent clusters. Notably, only the results meeting a threshold of 15 times are presented. The general noun phrases such as result, study, paper, etc. were extracted from the keyword analysis. In total, seven different clusters can be identified: The cluster in orange ("Globalisation" (n = 82) left middle); cluster in dark blue ("Innovation" (n = 162) top left/middle); cluster in light blue ("Internationalisation" (n = 72) top middle); cluster in pink ("Dynamic capabilities" (n = 18) top right); cluster in yellow ("Exports" (n = 27) and "Eco-innovation" (n = 21) bottom right); cluster in green ("Sustainable development" (n = 47) bottom middle), and the cluster in red ("Competitiveness" (n = 33) middle right). The most used keywords by authors below the abstracts to characterise the papers on eco-innovations and internationalisation are "Innovation" (n = 162), "Globalisation" (n = 82) and "Internationalisation" (n = 72).

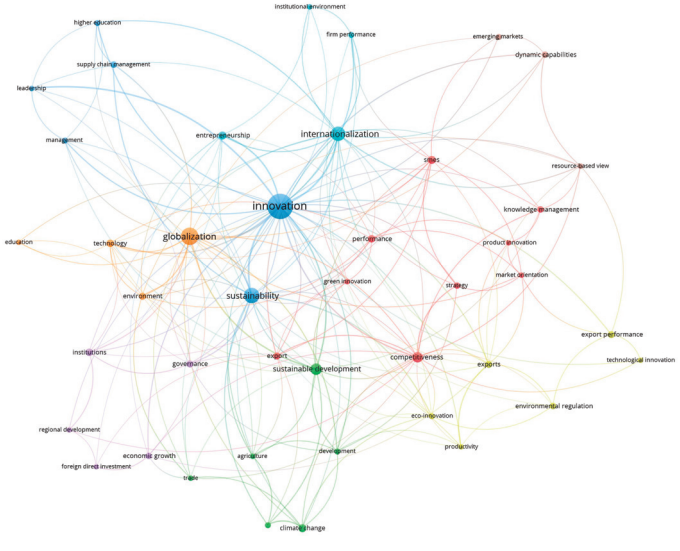

Figure 7. Co-occurrence author keywords.

4. Discussion and Limitations

The analysis of scientific papers on eco-innovations and internationalisation published from 1991 to 2020 is presented. The study includes 1677 publications and covers 4143 authors, 860 journals, 112 countries and 1889 institutions. The academic literature on analysed topics has been increasing during the last ten years. Thus, the publication output is characterised by exponential growth.

- The bibliometric analysis provided information on the most influential and productive scholars in the research field:
- the most cited publication is by authors E. F. Lambin and P. Meyfroidt with an average of 121.89 citations per year;
- the most-cited journal is *Research Policy* with a total of 2210 citations, the *Research Policy* journal is also one of the few most co-cited journals with a total of 1509;
- the most co-cited author is M. Porter (n = 306);
- the country with the largest publication output is the USA (n = 11,518 citations, documents n = 320). Other countries are linked (directly or indirectly) to one of the main countries that are publishing the most scientific documents, thus the data showed that cooperation between authors and countries is mediocre due to the circles' distance from each other; the circles are widely spread, although they are linked together (directly or indirectly).

The power-law distribution lets us observe that:

- the largest proportion of authors (95.70%) are only credited in one publication;
- a small group of authors (0.73% of all authors) published at least three papers;
- among the journals publishing the topic, only 6.05% of journals published more than 5 documents (from a total of 859);
- among all countries (total n = 112) publishing on a topic, 36.61% countries published over 10 documents;
- a total of 390 publications (23.75% of all publications) was not (yet) cited;
- a total of 18 publications (1.10% of all publications) was cited over 200 times.

The distribution corresponds with the study published by van Nunen et al. (2018), which observed that a large proportion of authors, journals and countries do not contribute nearly as much as a much smaller number does and the majority of academic literature is produced by a small group of authors.

Based on author keyword co-occurrence, it is possible to distinguish between four main areas of research: (1) innovations; (2) internationalisation; (3) globalisation; (4) sustainability and sustainable development. Despite its own research stream, all of the main research areas are close to each other in the network analysis and are linked directly together.

The obtained results let us develop the operational model of analysis (Figure 8). The findings of bibliometric analysis and literature review suggest that the rapid growth of globalisation, technology development and digitalisation and sustainable development trends have been impacting the internationalisation process. Moreover, eco-innovation mediates the relationship between internationalisation and financial performance of the firms.

Though bibliometric analysis reduces the bias that is often associated with the expert surveys and traditional reviews, it nevertheless has some limitations. In spite of the benefits for overcoming biases, this method cannot replace rigorous content analysis and overcome its shortcomings, which are that it is a method of quantitative analysis by nature. The number of scientific publications was used as the data in this study. However, it is hardly possible to extensively discuss all the theoretical insights that were presented in the articles. This study is limited to the quantitative method, leaving behind the quality and deeper theoretical knowledge, cornerstones and conclusions presented by the authors in the field of the interrelationship between eco-innovation and internationalisation. Another possible drawback of this study is that citation analysis may be misleading due to authors citing

some publications in a negative context or self-citations. The last limitation of this study is tied to a selected timeline. For instance, if a similar study would be performed on a different date, the result would be slightly different. The fact that the WoS database is constantly updated with newer scientific documents affects these changes. Furthermore, some important publications may be cited after many years and gain "delayed recognition" in the scientific literature. These limitations can be considered in future studies.

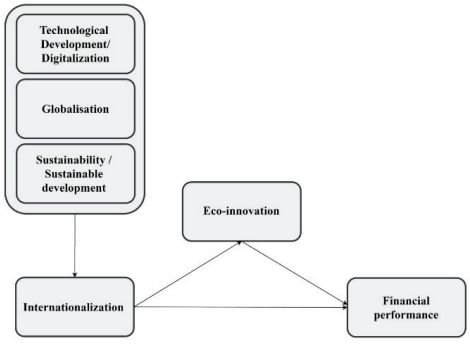

Figure 8. The operative conceptual model of analysis.

5. Conclusions

While the expectations of various stakeholders encourage firms to be involved in risky activities, such as the adoption of eco-innovation and internationalisation, we set forth to investigate the interrelationship between eco-innovation and internationalisation by applying bibliometric analysis. The study addressed the research gap emphasising that eco-innovation and internationalisation are barely related factors (Chiarvesio et al. 2015). In total, 1677 publications found in the WoS database that were published between 1991 and 2020 related to eco-innovations and took internationalisation into consideration.

Considering the dynamics in economical, ecological and social environments, we argue that both eco-innovations and internationalisation are closely related and the research trends on interrelationships between eco-innovations and internationalisation study fields are constantly increasing. This is confirmed by the fact of exponential growth of scientific publications on selected topics each year. However, the most influential countries affecting research on these topics are developed countries, such as the USA and the United Kingdom. It appears that the most significant actions on political and company levels are taken toward sustainable development in these countries. However, future investigations have to consider developing countries as well.

We outline a future research agenda to create a more holistic theoretical approach on eco-innovations and internationalisation. By using the fractional counting method for keywords, different trends have been identified involving globalisation and supply chain management. Other interesting interactions between most frequent terms and related to innovation occur for green innovation, technological innovation and product innovation. Thus, future studies should investigate the interrelationships of the selected terms on the dimensions of sustainable development and internationalisation. In addition, other databases such as Scopus have to be taken into account. Also based on the presented limitations of bibliometric analysis, deeper content analysis is recommended for further research.

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Valuing Dynamic Capabilities-Based Synergies with Real Options

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Abstract: Acquisition-based dynamic capabilities have become well established as a new imperative for organizing mergers and acquisitions (M&A) processes. However, understanding the full benefits and possible limits of real options applications to measure a dynamic capability-based synergy in M&A deals remains a challenge. This paper draws on real options theory to explore some of these benefits and limits to value a synergy in two highly strategic M&A deals. More specifically, the author develops the proposition that justifies the role of dynamic capabilities as antecedents of the success of M&A deals in the information and communications technology industry and demonstrates real options application to measure M&A synergies.

Keywords: real options; synergy; acquisition; dynamic capabilities; business model; the ICT industry

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1. Introduction: Purpose, Motivation, and Originality

1.1. Research Objective and Approach

The objective of this article is to explore the antecedents of the dynamic capabilities-based synergies in mergers and acquisitions (M&A) deals and to demonstrate an application of real options to measure those synergies. The paper argues that the intersection of the framework of dynamic capabilities and real options theory can shed light on the antecedents of successes (synergies) of M&A deals in the information and communications technology (ICT) industry.

The paper develops a proposition as follows. Dynamic capabilities-based synergies in M&A deals provided by the degree of their similarities, complementarity, and transferability can be valued by real options application using the Black–Scholes Option Pricing Model (BSOPM) and Binominal Option Pricing Model (BOPM).

1.2. Research Motivation and Originality

The motivation for this research is as follows. Even though the dynamic capabilities framework and its empirical applications (Teece 2007, 2011; Capron and Anand 2007) make dynamic capabilities more visible and tangible, the real options application is making dynamic capabilities measurable, at least in such collaborative types of strategies as M&A deals. The author uses the real options valuation approach to measuring synergies of recent M&A deals in ICT industries, namely, LinkedIn acquisition by (Microsoft 2016), and Amazon's acquisition of Whole Foods in 2017.

The author selected the two mentioned cases due to the following reasons. First, the ICT industry is a global dynamic and highly competitive industry, and to sustain competitive dynamic capabilities. Second, the acquisitions of LinkedIn and Whole Foods by Microsoft and Amazon were incredibly interesting, highly strategic, and not standard (Clarence-Smith 2020). So, what do two global ICT industry leaders, namely, Microsoft and Amazon hope to gain with those mergers? This paper demonstrates originality by analyzing antecedents of acquisitions giants through the lenses of dynamic capabilities framework, building blocks of business models, and consequences of acquisitions (synergies) through the lenses of real options theory.

1.3. Research Topicality, Contributions, and Structure

Scholars have opportunities to deepen and broaden our understanding of the dimensions of dynamic capabilities, including their micro-foundations (Wilden et al. 2016; Schilke et al. 2018). This paper researches the synergies' phenomenon in the context of M&A deals of the ICT industry. Thereby, the paper contributes to the current discussion on triggers of dynamic capabilities of M&A deals in ICT industries, on the processes of the reinvention of an acquirer's business model, and dynamic capabilities-based synergies as an organizational outcome of those processes. In this vein, two exploratory case studies justify the proposition and unpack micro-foundations of acquisition-based dynamic capabilities. Namely, the paper illustrates what triggers the dynamic capabilities of an acquirer, why and how those capabilities underpin a reinvention of the acquirer's business model, and how to measure a dynamic capabilities-based synergy of collaborative strategies with real options theory.

This paper is organized as follows. First, the dynamic capabilities as antecedents of successful M&A deals are discussed in terms of abilities to integrate two business models of an acquirer's and a target's companies in search of synergies. The section is devoted, respectively, to developing the proposition that can be justified empirically by analysis of the recent two explorative case studies. The following sections demonstrate the use of real options to measure dynamic capabilities-based synergies of the two above-mentioned acquisitions. The paper ends with a discussion on managerial and theoretical contributions. In conclusion, the paper highlights the research limitations and future works.

2. Theoretical Background

Dynamic capabilities are the renewing and regenerative capabilities that enable firms to change their operating processes incrementally and radically. Real options valuation provides an appropriate platform for firms to measure managerial flexibilities and, thereby, dynamic capabilities.

2.1. Exploring Dynamic Capabilities and Business Models in Merger and Acquisition (M&A) Deals

Teece (2014, p. 328) argues that the "dynamic capabilities framework was created . . . to help scholars and practitioners understand the foundations of firm-level competitive advantage." A dynamic capabilities framework emphasizes how a successful firm can "integrate, build, and reconfigure internal and external competencies to address rapidly changing environments" (Teece et al. 1997, p. 516). There is very little research on acquisition-based dynamic capabilities. Teece argues that it might be "because assets are bundled together often tightly linked inside incumbent firms, it may be difficult to obtain assets in the desired configurations through asset purchase or sale in mergers and acquisitions" (Teece 2007). What is more, there is no consensus on how to measure synergies in merger and acquisition deals created by dynamic capabilities.

Similarity and complementarity of dynamic capabilities affect post-M&A deals' outcomes. "Studies give clear empirical evidence that complementarities are a significant factor for M&A success" (Bauer and Matzler 2014, p. 272). Thanks to the interaction of complementary characteristics, value creation occurs not only through cost savings but also through the growth of turnover and market share due to dynamic opportunities (Kleinbaum and Stuart 2014). Moreover, Signoria and Vismara (2018) measure business similarity as a proxy for Mand A synergies. In this vein, an application of real options to measure market value added by the similarities and complementarity of dynamic capabilities is an appropriate approach. In the recent publications, scholars argue and demonstrate (Čirjevskis 2017, 2019a, 2019b) that a dynamic capabilities framework of Teece (2007, 2011) is a useful tool of business analyses for M&A deals to identify similarities and complementarity of an acquirer's and a target's dynamic capabilities.

The business model frameworks were developed as instruments for visualization of customer value proposition, cost structure, and profit formula of early-stage endeavor.

What is more, business models "have considerable significance but are poorly understood—frequently mentioned but rarely analyzed" (Teece 2010, p.192). According to Teece (2018), the most important components of business models are to unmet customer needs, specifying the technology that will address them, and capturing value from the activities. Moreover, Teece argued that "business models, dynamic capabilities, and strategy are interdependent. The strength of a firm's dynamic capabilities helps shape its proficiency at business model design" (Teece 2018, p. 40).

Management's ability to develop and refine business models is a core micro foundation of dynamic capabilities (Teece 2007). Scholars should dig deeper to explore the connection of acquisition-based dynamic capabilities and their micro-foundations of the reinvention of a business model of an acquirer and synergies in M&A deals. Recently Corbo et al. (2020) developed the continuous validation framework (CVF) as a mechanism in business model design and presented a sequence of steps of reinvention in relation to the building blocks of a business model that might be followed to sustain a new competitive advantage.

2.2. Exploring the Link of Real Options Theory with Dynamic Capabilities Framework in M&A Deals

By definition, a financial option gives its holder the right, but not the obligation, to buy or sell the underlying asset at a specified price (i.e., the exercise price) on or before a given date (i.e., the expiration date). The holder of a call option on a financial asset who finds the option to be in the money can simply exercise the option and cash in on the difference between the market price and exercise price specified in the option contract (Ragozzino et al. 2016).

Options considered in corporate finance and strategic management labeled as "real" represent claims on real (physical) assets and not financial ones (Damodaran 2002, p. 16; Li et al. 2007). Thus, a real option is understood as the right and not the obligation to pursue a particular investment in a pre-determined time frame (Luehrman 1998; Adner and Levinthal 2004). The idea behind the current research is to view an acquisition as a growth option on potential benefits since acquisitions can open opportunities that would not have been available otherwise (Damodaran 2005).

Now, we link the dynamic capabilities framework with a real options valuation model. From a real options and dynamic capabilities perspective, where the firm is going in the future depends on the opportunities that lie ahead and management's dynamic strategic plans (Smit and Trigeorgis 2004). Teece (2014) defines that dynamic capabilities can usefully be broken down into three primary clusters: (1) identification, development, co-development, and assessment of technological opportunities concerning customer needs (sensing); (2) mobilization of resources to address needs and opportunities, and to capture value from doing so (seizing); (3) continued renewal (transforming).

In turn, Damodaran argued, " . . . that the real options argument is heavily dependent upon two concepts—the learning that occurs by being in a new market and the more informed decisions that flow from the learning" (Damodaran 2005, p. 20). What is more, scholars argue that learning mechanisms guide the evolution of dynamic capabilities (Eisenhardt and Martin 2000; Winter 2003). Easterby-Smith and Prieto (2008) consider a process of learning as a possible central element in the creation and renewal of dynamic capabilities. Thus, since dynamic capabilities arise from learning and they constitute the firm's systematic methods for modifying operating routines (Zollo and Winter 2002), we can propose that the real options argument is tightly dependent upon the dynamic capabilities' framework.

In this vein, Nishihara (2012) studied dynamic management of multiple real options and highlighted the advantage of dynamic management over static management. Having compared static and dynamic management of multiple real options, Nishihara (2012) has found that a firm under static management determines the type of exercise of real options ex-ante; on the other hand, a firm under dynamic management decides the time of exercise and enjoys the synergy gains even for weakly correlated projects. What is more, Nishihara

(2018) argued that the real option can capture market uncertainty, which dynamically changes due to specific and macroeconomic shocks on the demand market.

Thereby, the real option can measure dynamic management (Nishihara 2012), which is provided by the dynamic capabilities of the acquirer's and target's companies, namely, by co-development of technological opportunities in the relationship to changing customer needs (sensing), by capturing value from doing so, (seizing), and continued renewal (transforming).

Smith and Triantis (1995) argue that acquisition creates valuable growth options that discounted cash flow models do not capture. These growth options can be the result of more growth opportunities, a better competitive position for the combined firm, and add value (synergies) to the acquiring firm. The idea of the growth option is that acquisition of a target company is like purchasing a call option on the value of a subsequent target. By engaging in the acquisition, the acquirer earns the right but not the obligation to develop a subsequent target. These assumptions are identical to the growth option.

The value of the growth option at the time of the getting synergies is added to the value of an acquirer and a target without acquisition. Let us consider the first case study example of the Microsoft corporation buying LinkedIn in an emerging market of professional social networking with immense growth potential. The acquiring corporation Microsoft is buying is an option to expand in the emerging social network market rather than a set of expected cash flows.

2.3. Valuing Dynamic Capabilities-Based Synergies with a Real Options Application

"Synergies do not magically materialize. By definition, they are possibilities, not certainties" (Ficery et al. 2007, p. 35). There is no single way to identify, validate, and value the potential of dynamic capabilities-based synergy. " . . . Discounted cash flow models are too limiting when it comes to valuing synergy. The synergy benefits in most acquisitions . . . can be better understood using an options framework . . . " (Damodaran 2005, p. 19). Even, " . . . the NPV does not properly capture the dynamics and active management of investment under uncertainty, except indirectly (and inadequately) through the adjustment of discount factors" (Smit and Trigeorgis 2004, p. 103).

An evaluation of synergy in a dynamic environment is often more complex than standard discounted cash flow (DCF) analysis may suggest, which implicitly assumes a static view of investment decisions and projected cash flow scenarios (Smit and Trigeorgis 2004). "A real-options framework adds a dynamic perspective to the traditional valuation approach by incorporating the value of flexibility and growth opportunities in an uncertain environment". (Smit and Trigeorgis 2004, p. 94).

Dunis and Klein (2005) argue that synergies can be assessed as a real option value, employing input variables for the European and/or American call options with Black–Scholes Option Pricing Model and/or accordingly with the Binominal Option pricing model.

"The option on potential merger benefits to the shareholders is a European call option on the market value of the merged company with the expected future stand-alone market value defined as the exercise price" (Dunis and Klein 2005, p. 7). "The share price equivalent of the option is the cumulated market value of target and acquirer before the announcement of the deal terms" (Dunis and Klein 2005, p. 7). Thus, the share price (So) is proxied by the sum of capitalization of merging companies before the deal's announcement.

"The exercise price is the hypothetical future market value without the merger . . . The exercise price is the combined hypothetical future market value after one year" (Dunis and Klein 2005, p. 7). According to Dunis and Klein (2005), the exercise price (K) is proxied by the sum of the future market capitalization of the merging companies in one year if the merger is not be consummated. The future capitalization of two separate companies can be calculated by employing a discounted free cash flow method. Cash flow is, in theory, the free cash flow, but in practice, it is proxied by earnings before interest, taxes, depreciation, and amortization (EBITDA). Therefore, the exercise price is the hypothetical future market

value without the merger or theoretical market value calculated by using revenue and EBITDA multiples.

The volatility (σ) of share price can be obtained from the V-Lab APARCH Volatility Analysis (NYU Stern) or by the calculation of the standard deviation of the acquirer stock price return that was started the week after the announcement (Dunis and Klein 2005).

As to the duration (T) of achieving synergy, Dunis and Klein assumed one year for the time to maturity (Dunis and Klein 2005, p. 7). However, other studies use different values in M&A of listed companies, using 3 years for acquisitions (Vergos 2003) or using even larger periods, up to ten years (Damodaran 2002). For time to maturity, one year was assumed for the deals of Microsoft–LinkedIn and Amazon–Whole Foods. This was due to data availability and the assumption that efficient markets should have well-anticipated potential long-term merger gains within this period. The US dollars was chosen as the reference currency for those two acquisitions. The risk-free rate (Rf) is a long-term government bond yield of an acquirer's country (Dunis and Klein 2005).

The option premium gives the value of this option and should be equivalent to the takeover premium or even bigger. The acquisition is justified only when the perceived value to the buyer is greater than the exercise price (Kogut 1991). "This call option is in the money if the market value of the merged entity exceeds the expected future market value of the two separate companies." (Dunis and Klein 2005, p. 6). In this vein, the value of a real option is a synergy being added to the value of the combined firm, reflecting the time premium on the option. The option premiums as a competence-based synergies result can be calculated using an Excel spreadsheet. Therefore:

Proposition 1. *Dynamic capabilities-based synergies provided by the degree of their similarities, complementarity, and transferability in M&A deals can be valued by real options application using the Black–Scholes Option Pricing Model (BSOPM) and Binominal Option Pricing Model (BOPM).*

To test the internal and external validity of the proposed proposition, it was applied to two exploratory cases of dynamic capabilities-based M&A deals in the ICT industry in the years 2016 and 2017.

3. The First Explorative Case Study: Microsoft's Acquisition of LinkedIn in 2016

On 11 June 2016, Microsoft Corporation announced a merger with LinkedIn under which the transaction valued at approximately USD 26.2 bn. What triggers the acquisition-based dynamic capabilities of such a technologically advanced corporation such as Microsoft? What similarities and complementarity of dynamic capabilities of Microsoft and LinkedIn existed and what building blocks of the business model of LinkedIn could be transferred to Microsoft's business model?

Regarding the similarities of the dynamic capabilities, both companies were successful when they were developing new market niches, Microsoft with Office products and LinkedIn with its professional social network. Both companies were successful in sensing possible needs in non-developed markets, seizing popular products and services and keeping them on track over the years, maintaining leading positions and achieving satisfactory results. Companies used both in-house resources and acquisitions for transformation, developing new tools, and adopting products to various operational systems.

When it comes to its complementarities and triggers of acquisition-based dynamic capabilities, the first trigger is the fact that Microsoft was behind iOS and Google mobile ecosystems. Moreover, the Skype example shows that Microsoft was rather weak in sensing in already developed, rapidly growing markets, such as consumer internet. The dynamic capabilities of Microsoft showed poor results when the company tried to gain leadership positions in an already developed market. In contrast, LinkedIn successfully runs a social network on mobile devices with a high mobile presence (60% of users).

The second trigger is the deal as a means for Microsoft to foray into the professional social networking space. LinkedIn had immense potential to grow as a professional social network with revenue generation similar to that of a software business. However, despite

having a strong user base of 433 million in 2016, LinkedIn continued its struggle to grow the user base and had little scope for profit.

Thereby, LinkedIn's users offered opportunities for Microsoft to develop its cloud and customer relationship management initiatives (Sapersen and Gonzales 2017). As far as Microsoft was concerned, the main objective for the tech giant was to occupy a position at the center of peoples' business lives. That leads to the conclusion that the building blocks of the corporation's business model are compatible and transferable if Microsoft keeps LinkedIn autonomous in its development and provides it resources for the development.

In turn, it evidences the high probability to generate dynamic capabilities-based synergies in the acquisition of LinkedIn. The acquisition-based dynamic capabilities helped Microsoft to innovate a business model by obtaining managerial synergies as shown in Table 1.

Table 1. The micro-foundations of the reconstructs of the business model of Microsoft by acquisition-based dynamic capabilities.

Acquisition-Based Dynamic Capabilities of Microsoft	Micro-Foundations (Processes) of the Reconstruct of the Components of Microsoft Business Model
Identification, development, co-development, and assessment of technological opportunities concerning customer needs (sensing).	Microsoft sensed opportunities to expand their market due to the customer base of LinkedIn, accelerate the cloud and mobile business, and improve customers' productivity and experience.
Mobilization of resources to address needs and opportunities, and to capture value from doing so (seizing).	Microsoft captured value from combining their growing business in cloud and business analytics with the existing content of LinkedIn and providing intelligent insights for the social business network.
Continued renewal (transforming) customer relationships, new channels, and new customer value proposition.	The integration of LinkedIn's marketing solution products into Microsoft products, such as Office365 and Dynamics, could increase the number of users and create a deeper relationship between users. The acquisition helps Microsoft to establish a "net mobile presence".

Source: Developed by the author.

To measure dynamic capabilities-based synergies of the Microsoft acquisition, and to justify the proposition, the author used real options application employing BSOPM and BOPM. The first valuation model used to measure dynamic capabilities-based synergies in M&A deal was based on the Black–Scholes option pricing model (Black and Scholes 1973), namely: $C(S, t) = S0 \times N(d_1) - K \times e^{-rT} \times N(d_2)$, where $N(d_1)$, $N(d_2)$ are the cumulative distribution functions of the standard normal distribution; C (S, t) is call option price at time t; S0 is the price of the underlying asset at time 0; K is the exercise price at time t; T is time in years; r is a risk-free rate; e is a mathematical constant approximately equal to 2.71828, the base of the natural logarithm; σ is expected volatility of an underlying asset's value.

On 13 June 2016, the capitalization of Microsoft was USD 394.1 bn; the capitalization of LinkedIn was USD 25.7 bn (Pillars of Wall Street 2017). The first valuation model used to measure dynamic capabilities-based synergies in M&A deals was based on the Black–Scholes option pricing model (Black and Scholes 1973) as shown in Tables 2 and 3.

Dynamic capabilities-based synergies of Microsoft's acquisition of LinkedIn are USD 92.8 bn by BSOPM valuation. The valuation of the acquisition's synergies by the Binominal Option Pricing Model (BOPM) is USD 91.3 bn and given in Tables 4–6.

Table 2. Option's variables to value dynamic capabilities-based synergies of Microsoft and LinkedIn's M&A deal with BSOPM.

Option Variables	Data
S(t)	On 13 June 2016, Microsoft's market capitalization was USD 394.1 bn and LinkedIn's capitalization was USD 25.7 bn. Therefore, S(t) was USD 419.8 bn (Pillars of Wall Street 2020).
K	Microsoft's last twelve-month (LTM) EBITDA was USD 29.2bn and the LTM EV/EBITDA multiple was 11.9. The hypothetical future market value of Microsoft was USD 347.48 bn (Pillars of Wall Street 2020). LinkedIn LTM Revenue was USD 3.2 bn, and LTM EV/Revenue was 4.8. The hypothetical future market value of LinkedIn was USD 15.36 bn (Pillars of Wall Street 2020). Thus, the exercise price (K) was USD 362.96 bn.
Rf	The annualized risk-free rate of return (Rf) on 13 June 2016 using US Long-Term Government Bond T-bonds yield (10-years). The risk-free rate on 13 June 2016 is 1.62% (Macrotrends 2020).
T	Duration (T) of obtaining synergy of the merger or acquisition is one year (Microsoft 2016).
σ	The volatility of future share price of Microsoft (σ) in 13–20 June of 2016 after the announcement of a deal. Thus, expected volatility (σ) equals 36.4% (Microsoft Corp GARCH Volatility Analysis 2020).

Source: Developed by the author.

Table 3. Valuation of dynamic capabilities-based synergies with the Black–Scholes option pricing model: Microsoft's acquisition of LinkedIn, in USD bn.

Real Options Valuation with the Black–Scholes Option Pricing Model	
Cumulative capitalization of Microsoft and LinkedIn before the announcement in June 2016 (So)	419.80
The cumulative theoretical market value of two separated entities without a merger after one year in 2017 (K)	362.96
The risk-free rate of return (Rf) on 13 June 2016	1.62%
Time to expiration in years (T)	1
The volatility of future share price of Microsoft (σ) on 13–20 June of 2016 one week after the announcement of a deal	36.40%
d1	0.626
d2	0.262
Value of the call option (C) = Synergies	92.8

Source: Developed by the author.

Table 4. Recombining binomial lattice parameters (Microsoft's acquisition of LinkedIn).

Parameters of the Binominal Option Pricing Model	
time increment (years)	$\delta t = \frac{t}{N} = 0.20$
up factor (u)	$u = e^{\sigma\sqrt{\Delta T}} = \frac{1}{d} = 1.177$
down factor (d)	$\frac{1}{u} = 0.850$
risk-neutral probability (p)	$p = \frac{e^{r\Delta T} - d}{u - d} = 0.469$

Source: Developed by the author.

Once the binominal tree of assets value is completed, the next step is to calculate the possible payoff synergies) and roll back the values using risk-neutral probabilities as given in Table 6.

Thus, the forecasted market capitalization of Microsoft Inc. in one year after the acquisition of LinkedIn is the cumulative capitalization of a target and an acquirer before the announcement—(So) USD 419.8 bn plus estimated synergies of USD 92 bn, which equals USD 511.8 bn. Microsoft capitalization on 19 June 2017 was USD 551.59 bn. Therefore, expected synergies were fully realized and the added market value even bigger than predicted. However, the connection of the theoretical value with actual value largely depends on the timing of the prices taken and is entirely difficult to justify precisely in this study. Meanwhile, having compared the calculated option value with the takeover premium paid, one should be concluded that this acquisition added market value to Microsoft corporation thanks to dynamic capabilities-based synergy.

Table 5. BOPM lattice of the underline values of Microsoft after the acquisition of LinkedIn (in USD bn).

0	1	2	3	4	5
					USD 947.39
				USD 805.06	
			USD 684.12		USD 684.12
		USD 581.35		USD 581.35	
Underline value	USD 494.01		USD 494.01		USD 494.01
USD 419.80		USD 419.80		USD 419.80	
	USD 356.73		USD 356.73		USD 356.73
		USD 303.14		USD 303.14	
			USD 257.60		USD 257.60
				USD 218.90	
					USD 186.02

Source: Developed by the author.

Table 6. BOPM of real options lattice: a value of Microsoft synergies of the acquisition of LinkedIn (in USD bn).

0	1	2	3	4	5
					USD 584.43
				USD 443.28	
			USD 323.51		USD 321.16
		USD 222.82		USD 219.56	
Value of call option (synergies)	USD 145.70		USD 135.14		USD 131.05
USD 91.3		USD 78.39		USD 61.31	
	USD 43.77		USD 28.68		USD 0.00
		USD 13.42		USD 0.00	
			USD 0.00		USD 0.00
				USD 0.00	
					USD 0.00

Source: Developed by the author.

4. Second Explorative Case Study: Amazon's Acquisition of Whole Foods

On 16 June 2017 Amazon.com announced that it would purchase Whole Foods Market for a total of USD 13.7 billion. So, what do Amazon hope to gain with this acquisition? There are several similarities between the dynamic capabilities of Amazon and Whole Foods. Both companies are sensing market demands and seizing external opportunities in online and offline grocery businesses. However, their transforming capabilities need to be mutually complemented. There are several complementarities between the dynamic capabilities of Amazon and Whole Foods.

One of Amazon's weaknesses is the huge cost of losses due to food items becoming bad, a problem which the company had never faced with toys and books and had no great experience in the offline retail environment. In contrast, Whole Foods became an organic supermarket that distinguishes itself by offering "highest quality natural and organic products". The first trigger of acquisition-based dynamic capabilities is as follows. To grab more grocery market share, Amazon should learn to sell food offline (Kowitt 2018).

On the other hand, having a variety of niche products with a high price charge, the growth of Whole Foods had slowed because competitors began to offer organic foods at a lower price. From 2013 to 2016, Whole Foods lost nearly half its market value (Helmore 2017). That is why just a few days after the merger, Amazon dropped prices by as much as 43% on a range of Whole Foods products (Garfield 2017). It makes the probability to exercise the real option of the acquisition of Whole Foods very high. The acquisition-based dynamic capabilities helped Amazon to innovate a business model by getting managerial synergies as shown in Table 7.

Table 7. The micro-foundations of the reconstructs of the business model of Amazon by acquisition-based dynamic capabilities.

Acquisition Based Dynamic Capabilities of Amazon	Micro-Foundations (Processes) of the Reconstruct of the Components of the Amazon Business Model
Identification, development, co-development, and assessment of technological opportunities concerning customer needs (sensing).	Amazon sensed that Whole Foods would provide broad access to retail outlets in a great location across the USA. Having exploited the big data strategy, Amazon can create a daily habit among buyers to order groceries from its app and to make them loyal clients who are highly profitable for the corporation.
Mobilization of resources to address needs and opportunities, and to capture value from doing so (seizing).	Amazon seized a high-end brand name of Whole Foods and affluent buyers of Whole Foods. It also can reduce Amazon's supply chain management costs due to higher purchasing and bargaining power.
Continued renewal (transforming) customer relationships, new channels, and new customer value proposition.	Having added grocery dynamic capabilities through the acquisition of Whole Foods, Amazon offers click-and-collect service for quality-conscious buyers, enjoys higher operating profit, and offers stores as points to pick up other online orders.

Source: Developed by the author.

To measure dynamic capabilities-based synergies of Amazon acquisition, and to justify the proposition, the author used real options application employing BSOPM and BOPM. On 16 June 2017, the capitalization of Amazon was USD 478.6 bn; the capitalization of Whole Foods was USD 13.8 bn (Pillars of Wall Street 2017). The first valuation model used to measure dynamic capabilities-based synergies in M&A deal was based on the Black–Scholes option pricing model (Black and Scholes 1973) as shown in Tables 8 and 9.

Table 8. Option variables to value dynamic capabilities-based synergies of Amazon and Whole Food's M&A deal with BSOPM.

Option Variables	Data
S(o)	The capitalization of Amazon was USD 478.6 bn; the capitalization of Whole Foods was USD 13.8 bn (Pillars of Wall Street 2017). The cumulative capitalization of Amazon and Whole Foods is USD 492.4 bn.
K	Having used Amazon revenues of USD 142.6 bn in 2017 and EV/Revenues multiple 3.3 (Pillars of Wall Street 2017), the theoretical market value of Amazon without the acquisition of Whole Foods is USD 470.6 bn. Using Whole Foods EBITDA of $1.3 bn in 2017, and EV/EBITDA multiple 11.1 (Pillars of Wall Street 2017), the theoretical market value of Whole Foods without the deal is USD 14.3 bn. Therefore, the cumulative theoretical market value of Amazon and Whole Foods without a deal or the exercise price (K) equals USD 484.9 bn.
Rf	The US Long-Term Government Bond T-bonds yield (10-years) in 2017 was 2.16% (YCharts 2020).
T	Time to expiration in years (T) equals one year.
σ	Expected volatility (σ) has been taken from AlphaQuery (2020). Following the AlphaQuery report (AlphaQuery 2020), the volatility (σ) of Amazon after an announcement of the acquisition was assumed as 25.25%.

Table 9. Valuation of dynamic capabilities-based synergies with the Black–Scholes option pricing model: Amazon's acquisition of Whole Food, in USD bn.

Real Options Valuation with the Black–Scholes Option Pricing Model	
The cumulative market capitalization of Amazon and Whole Foods before the announcement (So)	492.40
Cumulative theoretical market value the separated entities without merger after one year (K)	484.90
The risk-free rate of return (Rf) in 2017	2.16%
Time to expiration in years (T)	1
The volatility of future share price Amazon (σ) in July of 2017, one week after the deal's announcement	25.25%
d_1	0.273
d_2	0.020
Value of the call option (C) = Synergies	58.0

Source: Developed by the author.

Dynamic capabilities-based synergies of Amazon's acquisition of Whole Foods are USD 58.0 bn by BSOPM valuation. The valuation of the acquisition's synergies by the Binominal Option Pricing Model (BOPM) is USD 60.36 bn and is given in Tables 10–12.

Thus, the forecasted market capitalization of Amazon Inc. in one year after the acquisition is the cumulative capitalization of target and acquirer before the announcement—(So) USD 492.40 bn plus estimated synergies USD 59 bn, which equals USD 551.40 bn. Thereby, from an option-pricing point of view, this acquisition provides significant dynamic capabilities-based synergies. In short, Amazon's acquisition of Whole Foods was able to generate significant value-added for the acquirer's shareholders.

Table 10. Recombining binomial lattice parameters of Amazon's acquisition of Whole Foods.

The Binominal Option Pricing Model's Parameters	
time increment (years)	$\delta t = \frac{t}{N} = 0.20$
up factor (u)	$u = e^{\sigma\sqrt{\Delta T}} = \frac{1}{d} = 1.120$
down factor (d)	$\frac{1}{u} = 0.893$
risk-neutral probability (p)	$p = \frac{e^{r\Delta T} - d}{u - d} = 0.491$

Source: Developed by the author.

Table 11. BOPM lattice of the underline values of Amazon after the acquisition of Whole Foods (in USD bn).

0	**1**	**2**	**3**	**4**	**5**
					USD 866.01
				USD 773.54	
			USD 690.94		USD 690.94
		USD 617.16		USD 617.16	
Underline value	USD 551.26		USD 551.26		USD 551.26
USD 492.40		USD 492.40		USD 492.40	
	USD 439.82		USD 439.82		USD 439.82
		USD 392.86		USD 392.86	
			USD 350.91		USD 350.91
				USD 313.44	
					USD 279.97

Source: Developed by the author.

Table 12. BOPM of real options lattice: a value of Amazon synergies of the acquisition of Whole Foods (in USD bn).

0	1	2	3	4	5
					USD 381.11
				USD 290.73	
			USD 210.21		USD 206.04
		USD 144.38		USD 134.35	
Value of call option (synergies)	USD 94.99		USD 82.12		USD 66.36
USD 60.36		USD 48.18		USD 32.44	
	USD 27.48		USD 15.86		USD 0.00
		USD 7.75		USD 0.00	
			USD 0.00		USD 0.00
				USD 0.00	
					USD 0.00

Source: Developed by the author.

5. Discussion and Contributions of Research

Teece argues "that studies that provide a better understanding of business model innovation, implementation, and change will also shed light on important aspects of dynamic capabilities" (Teece 2018, p. 40). The paper contributes to this scientific discussion on the role of dynamic capabilities in business model innovation and justifies the proposition of Teece that "the crafting, refinement, implementation, and transformation of business models are outputs of high-order (dynamic) capabilities" (Teece 2018, p. 40).

Technological changes and new demand make previously acquired competencies obsolete and call for new competencies to be built (Danneels 2008, 2016). In this vein, empirical research is essential to the progress of research on dynamic capabilities (Danneels 2016) and on real options applications in strategic management (Trigeorgis and Reuer 2017). Jahanshahi and Nawaser (2018) argue that future research can test the relationship of a real options theory and dynamic capabilities framework in the project and firm-level (Jahanshahi and Nawaser 2018, p. 400). This paper contributes to this scientific discussion. The current paper justifies the role of dynamic capabilities as antecedents of success of M&A deals and demonstrates real options application to measure managerial synergies in M&A deals.

Moreover, the paper contributes and demonstrates how acquisition-based dynamic capabilities provide managerial synergies. Having tested empirically this relationship, the current paper enriches our knowledge about how organizations can benefit from real options and redefine dynamic capabilities framework to the heart of strategic management. This is the major theoretical contribution of the current paper.

Having explored two case studies, the proposition has been justified empirically. This paper contributes to the understanding of the micro-foundations of similarities and complementarity among dynamic capabilities of an acquirer and a target in M&A deals in the ICT industry and the transferability of building blocks of their business models. Moreover, advancing future research designs for real options valuation, Trigeorgis and Reuer (2017, p. 57) argue "we would encourage the use of real option with a greater focus . . . on individual real option cases". The current paper also contributes to the real options theory by two illustrative real option cases.

Thereby, the proposition has been justified quantitatively with an application of the Black-Sholes Option Pricing Model and Binominal Option Pricing Lattice techniques. To sum up theoretical and managerial contribution, the relationship among research variables is given in Figure 1.

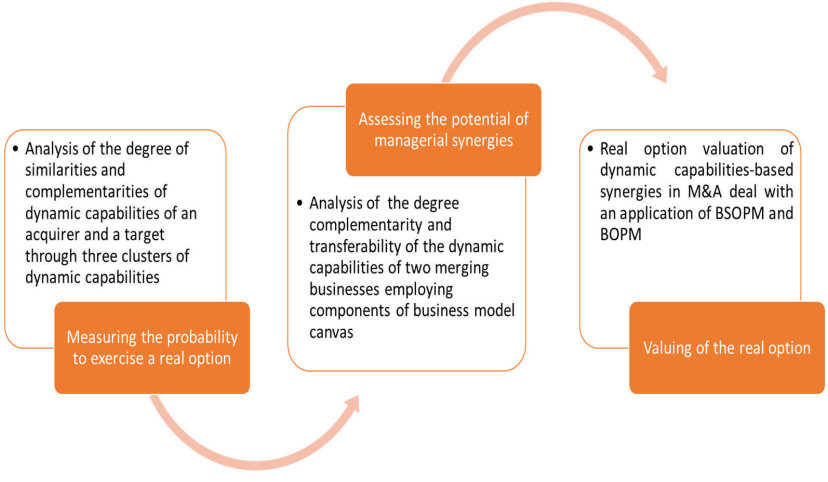

Figure 1. The relationship among research variables. Source: Developed by the author.

Figure 1 also presents the main proposed construct for future research as well as for practical due diligence purposes in the merging process. Acquirers need to absorb the dynamic capabilities of targets and to transfer building blocks of the target's business model on their own. Thereby, an acquirer converts an M&A deal into a value creation process (synergies) that can be valued by real options.

6. Conclusions, Limitations, and Future Research Direction

Trigeorgis (1995) argued that it is crucially important that appropriate valuation techniques be employed to capture the various strategic considerations that could support many acquisitions. The paper contributes to this request as well. The relationship among research variables provides a dynamic view on M&A deals to help executives in the sustaining of long-run competitive advantage and strategic adaptability.

Acquisition and alliance are some of the dynamic mechanisms by which the firm's competencies portfolio is altered (Danneels 2016). The acquisitions of Microsoft and Amazon of LinkedIn and Whole Foods were able to generate significant value-added for the acquirers' shareholders. "In most acquisitions, even those where synergy is real and creates value, the acquiring firm's stockholders get little or none of the benefits from synergy" (Damodaran 2005, p. 41), due to biased evaluation process and managerial hubris (pride). However, this statement is not about Microsoft and Amazon corporations.

The current paper also demonstrates the limitation of real options application to measure a dynamic capabilities-based synergy. It is difficult to validate the synergetic effect of one isolated acquisition deal when several acquisitions happen within the anticipation of the duration of achieving synergy. In this vein, more research is needed to justify the developed proposition.

Ongoing areas of an empirical investigation into dynamic capabilities, on topics such as acquisitions and alliances, among others, would also benefit from additional research (Schilke et al. 2018). What is more, exploration of dynamic capabilities to create new market-related and technological resources and their effects on managerial synergies (market value added) is an intriguing area for future research (Danneels 2016).

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Mapping the Scientific Research on Mass Customization Domain: A Critical Review and Bibliometric Analysis

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Abstract: Researchers of the Mass Customization domain face not only challenges of proper and timeless identification of latest practical trends, but also difficulties in rational analyses on the numerous existing scientific studies in this field as well as a need for a comprehensive and multidimensional state-of-the-art overview of the Mass Customization research domain in the last three decades. Therefore, the present research article aims to provide a critical standpoint and reveal the main research directions and content at systemic, bibliometric and historical research levels in the period of 1990–2020. Four types of bibliometric clustering techniques and a visualization of results in a format of two-dimensional maps by the VOSviewer software were applied in the analysis on 1783 scientific papers from the Clarivate Analytics Web of Science Core Collection. The analysis reveals six historical periods in the Mass Customization research domain, from which, in the last three decades, three are identified as influencing modern Mass Customization research areas and objects. Results confirmed a shift from a stand-alone scientific approach to the customization of tangible products in the manufacturing field and their risk management, to a hybrid scientific approach with a focus on the customization of non-tangible products and personalized customer behavior in online environments.

Keywords: Mass Customization; mass personalization; digitalization; risk management; bibliometric; Web of Science

1. Introduction

Mass Customization (further MC) is primarily recognized as a differentiation strategy in the manufacturing and retail spheres that provides a wide range of customized products or services as well as co-design or other value co-creation options, which are attainable for large market segments by keeping operational costs near to a mass production level. Otherwise, in late 2000s and mostly in the whole of the past decade, an intensive application of combined technology and management solutions, digital society and business transformations have shifted the orientation of the concept more towards intangible products' management, customer involvement and mutual value creation via platforms and tools in an online environment (Baranauskas 2020; Raišienė and Baranauskas 2018). Furthermore, these practical tendencies do not only illustrate different MC domain transformation periods, but also undoubtedly appear as the root cause for three theoretical research subdomain

areas, their topics and gaps. In 2000–2010, MC researchers focused on a detailed examination of a multidimensional implementation process within different types of organizations and combined subdomains of MC, influenced by organizational operational activities and specifics as well as the rise of online environments (Rungtusanatham and Salvador 2008; Morelli and Nielsen 2010; Piller et al. 2014). From 2010 up until now, the focus has been switched to a synergy of interrelated scientific domains, which together with trends of globalization, digitalization and sustainability have become the main drivers in MC research and resulted in a number of new concept versions like Smart Customization, Agile Mass Customization (further Agile MC) and Electronic (customer and data driven) Mass Customization and Personalisation (e-MCP) (Medini et al. 2015; Hora et al. 2016; Hu et al. 2011; Grosso and Forza 2019; Zhang et al. 2019). These areas and periods replaced research gaps or in some cases overlaped with the first decade's (approx. from 1987 to the beginning of 2000s) research interests in the traditional MC, including such topics as a transition from Mass Production, and an analysis of technological, economic, market specific trends and critical success factors for MC implementation in the manufacturing field (Pin et al. 1993; Gilmore et al. 1997; Schubert and Ginsburg 2000; McCarthy 2004).

Accordingly, this particular study has both theoretical and practical contributions to the MC field by assisting researchers of the MC domain with a comprehensive and multidimensional state-of-the-art overview of the MC research domain in the last three decades. The main scientific contribution of the research is exceeding the boundaries of content and methodology since, in other state-of-the-art MC-based research papers, limitations are followed rather than overcome. Another factor contributing to the scientific field is a systemized and coherent evaluation of key scientific research areas and content within MC research studies in the past three decades. Furthermore, the practical contribution is revealed by an identification of the most recent research gap and future research directions, which should be more focused on various combinations of Digitalization and Personalization sub-domains, mostly supporting a practical application of modern MC concept versions.

The main research question is how content and scientific discourse of the MC research domain have changed within the period of 1990–2020. From the methodological perspective, the research is based on a systemic analysis of the main theoretical perspectives and the context of the MC research area. Furthermore, a bibliometric analysis allows investigating and disclosing the main research outcomes, current research streams and tendencies in the selected research field.

The paper is composed of six key parts. The first part introduces the topic, the second one covers the theoretical background regarding the MC concept, the third one presents materials and methods, the fourth analyzes results and research findings, the fifth section provides a discussion of the research results, and the sixth one concludes the findings.

2. Theoretical Background

2.1. Retrospective Changes of the Mass Customization Research Area

Retrospectively, the general idea of the MC concept was described by Alvin Toffler in the works "Future shock" (1971) and "The Third Wave" (1980) while the term MC was first suggested 33 years ago by Stanley M. Davis. Later on, it was popularized and developed for practical application in business by B. J. Pine (1993), which was mostly influenced by the practices of such companies as Toyota and Dell (Piller et al. 2005; Anišić et al. 2013; Brandão et al. 2017). Numerous transformations of background and content features have been identified in the evolution of the MC concept, starting from 1850, but key semantic features have remained throughout the whole period of its usage: an orientation to specific needs and an involvement of a target mass audience; harmonization of diversity, costs, and quality features and risks; a competitive advantage via combined management and the application of technological methods and risk management. A historical transition of the MC concept and its background transformations are illustrated in Figure 1.

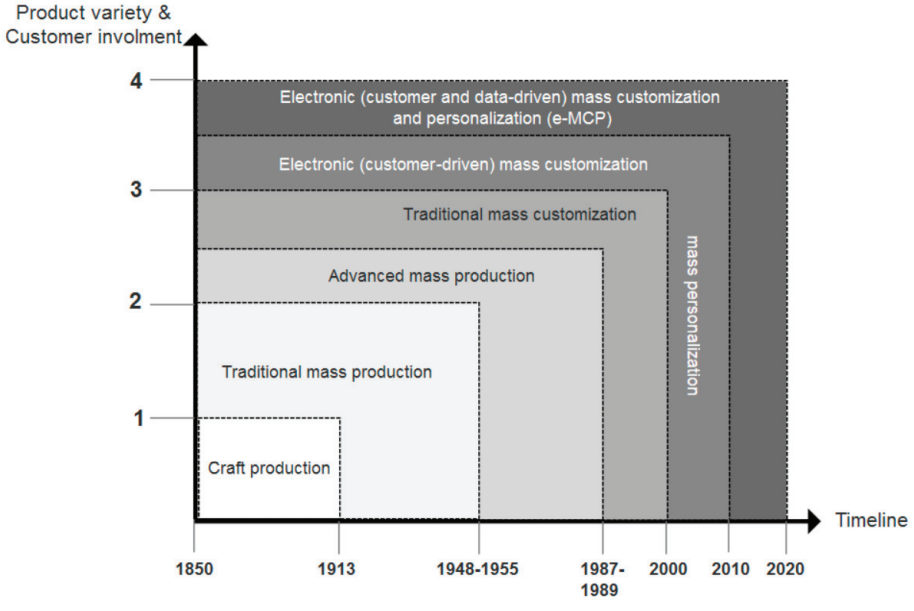

Figure 1. Historical background and evolution of the Mass Customization concept. Source: Composed by the authors according to Anišić et al. (2013); Kanama (2018); Zhang et al. (2019).

The main transformation stages of MC are based on two criteria: (a) a timeline of history including six key dates, or a time period that marks the main transformations in the context of the MC concept, and (b) a combined product variety and a customer involvement indication in a four-level scale based on the modified Gilmore and Pine II (1997) model of four types of MC.

In accordance with the above defined criteria, six historical stages have been identified. The first is a craft production stage known as a large scale (mass) production prototype, where a process features low volume manufacturing by hand with or without machine toolkit usage. Its origins date back to 1850 and are closely related to the Second Industrial revolution and the Art and Crafts movement of around 1913 (Kanama 2018). It also stands for the transition from the traditional business and risk management model of "pull" principles to the new model of "push" and sequential production techniques (Orošnjak et al. 2017). The second period, from 1948 to 1955, shows a transition from traditional mass production to an advanced (flexible) mass production. The third period, 1987–1989, illustrates the origin of the term MC and its practical transition to a new multidimensional and combined business and manufacturing strategy. Retrospectively, and from the content point of view, the main evolution of the MC concept can be split into three main periods and sub-stages including the traditional MC from the 1990s, its transformation to the electronic or customer-driven MC and Mass Personalisation (further MP) concepts from late 2000s, while in the last decade the transition of the concept to a combined version with Personalization (named as Mass Customization and Personalization (MCP)) and digitalization domains (named as E-MC) is identified (Pollard et al. 2016; Xu et al. 2016; Zhang et al. 2019). This assumption about the development of the MC concept is related to the direction and content of the scientific research in the MC domain as well. Otherwise, the following analysis on the most cited scientific journals and publications of the MC research domain in the period of 1990–2020 also indicates a strong legacy and vitality of the traditional MC concept version over the whole investigation period.

2.2. Literature on Methods Applied in Systemic MC Research

The analysis of prevailing studies suggests that there is a need to apply a methodological triangulation as a relevant and valid methodology for a more comprehensive state-of-the-art analysis of the MC field. Da Silveira et al. (2001) conducted a literature review and disclosed research directions of MC in the selected 10-year period. Moreover, the study focused on the development of a comprehensive and structured framework of the MC domain as well as success factors and enablers of MC systems in practice. Fürstner et al. (2009) presented insights and an analysis of a relevant MC status in practice and science, where a literature review was used only to support the author's findings and proposals of the knowledge support system methodology. Later, this scientific discourse was acquired by Ferguson et al. (2010). Here, the state-of-the-art analysis logic was applied to determine and highlight specific future research areas in MC, which refer to the paradigm across the marketing, engineering and distribution domains in the context of practical MC application metrics and barriers. Fogliatto et al. (2012) continued studies in the MC domain and, after a decade, presented an updated review of the literature, where the MC was investigated from both scientific and industrial perspectives. However, the scholar adopted a view of operational and concept application methods. Furthermore, Anišić et al. (2009, 2013) investigated the status and trends of MC and MP strategies at research institutions at the scientific activity as well as practical implementation levels. However, these studies were focused on Central and Southeast Europe. Sandrin et al. (2014) conducted a wide scientific literature review by considering the EBSCOhost, Web of Science, JSTOR and Wiley databases. The research focused on MC organizational antecedents. The latest research was carried out by Chatzopoulos (2017), where an application of web analytics was examined to focus on the usage of five specific terms in practice in the MC and interdisciplinary domains in the period of 2012–2016. Brandão et al. (2017) mapped the most relevant scientific works within last two decades in the field of MC and Personal Fabrication, but only in relation to production and design control.

This particular study aims to provide a comprehensive and an extended state-of-the-art analysis, shaped around the MC scientific domain and indicating not only historical changes of the concept or a relation to other scientific domains, but also presenting key points of scientific research in this field in the period of 1990–2020 including leading countries and researchers, publications, dynamics of research interests and analysis objects. This study evaluates the largest scope of scientific papers in terms of quantity as well as a wide period of time, 1990–2020, as compared to the previous state-of-the-art analyses in the MC domain. Additionally, this study covers results not limited to any specific region or scientific domain, while other preceding studies considered certain areas as the focus for investigation.

3. Materials and Methods

The data for this particular research paper was retrieved on May, 2020, from Clarivate Analytics Web of Science (WoS) Core Collection. Thus, the scientific integrity of the data source is assured (Bužavaitė et al. 2019; Meng et al. 2020). The database was selected due to its popularity and efficient selection possibilities. The search defined the timeline from 1990 to 2020, and keywords selected for the analysis were "mass customization" and "mass customisation". The search was conducted using the WoS field tag "Topic", keywords were observed in the title, abstract, author keywords, and Keywords Plus. Notably, the search resulted in 1783 scientific papers. The data was extracted to Tab-delimited format (Unicode Transformation Format– 8-bit for Windows applications (Win, UTF-8)) for convenient management in VOSviewer. With the data results set up, the analysis was conducted by applying a graphical visualization with the VOSviewer version 1.6.15 (www.vosviewer.com) software.

This study adopted the approach of analyzing a large number of papers, which is common in other scientific studies, investigating various issues (Kokol et al. 2018; Meng et al. 2020). Moreover, the above presented analysis has disclosed the evolving interest in customization and the contribution of scholars from various fields. The investigation of interdisciplinary fields is more common by adopting data mining methods (Stepanić et al. 2017; Dinçer et al. 2020; Qi et al. 2020). For instance, these methods were adopted by the scholars investigating social media websites or industry 4.0 issues when big

data sets were analysed (Pejic-Bach et al. 2020). The selection of mixed research methods, such as an interdisciplinary and literature review, and text mining with a bibliometric analysis using data and characterization logic, are also applicable in different studies of management science (Kostoff 2012, 2013; Youngblood and Lahti 2018). In general, the interdisciplinary mapping method is useful for identifying layers of the analysed concept as well as for a visualization of relationships between different approaches to MC among authors, a support of historical assumptions about the development of fields, and positioning the research in relation to previous works of MC (Aboelela et al. 2007; Brandão et al. 2017; Youngblood and Lahti 2018).

The popularity of bibliometric analysis as an alternative approach has been recently increasing among scholars investigating interdisciplinary fields. This type of bibliometric analysis discloses the latest trends and provides a systematic overview of the overall developments in a specific field of research (Wang et al. 2014). Moreover, it allows the analysis of a large scope of scientific literature, so scholars obtain a facilitation to identify relevant research trends and patterns at different levels, for instance, at the author, scientific journal or country level (Nunen et al. 2018). The usage of a wide range of bibliometric indicators and analysis types allows a significant reduction in the researcher bias, effort and time required for a traditional systematic literature review and mapping (Blanco-Mesa et al. 2016; Radhakrishnan et al. 2017). Moreover, it is agreed that bibliometric networks provide meaningful cumulative knowledge by holistically mapping the main trends in a selected scientific field as well as supporting the results of traditional user-driven data categorization methods and processes (Blanco-Mesa et al. 2016; Radhakrishnan et al. 2017).

In this paper, four types of bibliometric clustering techniques were applied: bibliographic coupling (of publications), co-citation analysis (of journals and authors), co-occurrence (of keywords) and co-authorship (of countries). Finally, a synthesis of results and final results presentation were conducted using the VOSviewer software. Moreover, the data was reorganized using MS Office Excel 2016 software. The outcome of the analysis is a construction of visual bibliometric data networks in the format of two-dimensional maps.

4. Research Results and Analysis

4.1. Dynamics of Scientific Publications

The historical development of the MC research domain during the period of 1990–2020 can be measured and evaluated by the number of scientific papers as well. An article was selected as a document type, and English was selected as a research language. It is important to note that the publication dynamics in 1990–1996 appear to have been very limited since, for example, only seven articles were published within 1992–1995 (Figure 2).

The analysis reveals the following tendencies:

(a) A steadily increasing number of scientific articles from 1992 until 2007;
(b) A fluctuating number of articles from 2007 until 2017.

In spite of the historical dynamics in the field of MC research, it is relevant to analyze the most cited and influential publications. The 15 most cited publications in the MC domain are listed in Table 1.

In the last two decades, the selection of topics in the research field illustrates that the scientific literature on the MC domain is rather prolific and addresses the research subject from numerous points of view, including general product engineering and manufacturing processes, business operations and strategic management, as well as the specifics of customization processes and the usage of tools. Moreover, it also reflects significant changes of organization practices in this period, which influence a transition of the concept towards becoming a stand-alone multidisciplinary business operations management concept. Furthermore, a strong focus on applying combined management and Information and Communication Technologies (ICT), customer centric approaches, Big Data and Big Data Analytics

(BDA) development, and value co-creation in digital platforms, should be outlined as currently trending in this research domain (Hora et al. 2016; Risdiyono et al. 2016; Tiihonen and Felfernig 2017; Zhang et al. 2019).

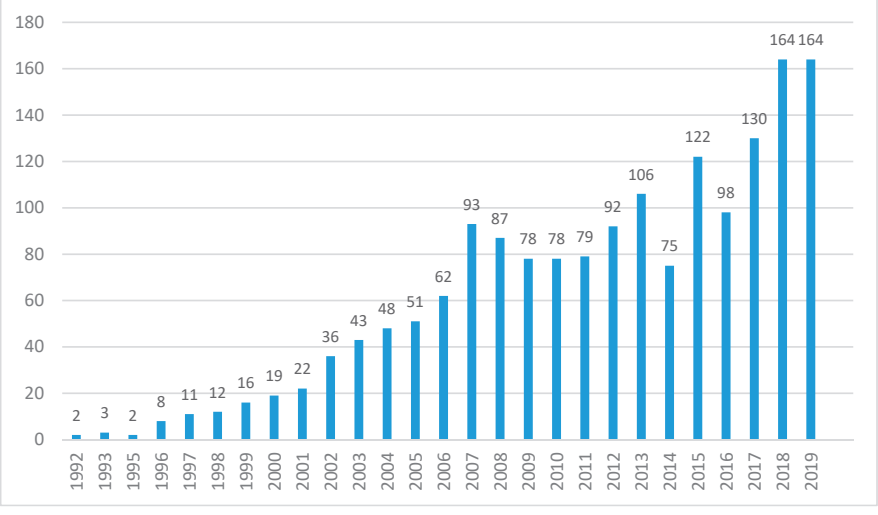

Figure 2. Dynamics of scientific investigations in domain of Mass Customization (1992–2019). Source: Composed by the authors using Web of Science Clarivate Analytics (WoS).

Table 1. The 15 most cited publications in the MC domain in 1990–2020.

Author and Publication Year (Sorted by Date)	Title of Publication	Total and Average Citations per Year
Franke et al. (2010)	The "I Designed It Myself" Effect in Mass Customization	281/25.55
Hu et al. (2011)	Assembly system design and operations for product variety	253/25.30
Berman (2012)	3-D printing: The new industrial revolution	804/89.33
Fogliatto et al. (2012)	The mass customization decade: An updated review of the literature	269/29.89
Zhong et al. (2013)	RFID-enabled real-time manufacturing execution system for mass-customization production	242/30.25
Huang et al. (2013)	Impact of Rapid Organism Identification via Matrix-Assisted Laser Desorption/Ionization Time-of-Flight Combined With Antimicrobial Stewardship Team Intervention in Adult Patients With Bacteremia and Candidemia	294/36.75
Schubert et al. (2014)	Innovations in 3D printing: a 3D overview from optics to organs	233/33.29
Weller et al. (2015)	Economic implications of 3D printing: Market structure models in light of additive manufacturing revisited	208/33.29

Table 1. *Cont.*

Author and Publication Year (Sorted by Date)	Title of Publication	Total and Average Citations per Year
Marcel Bogers and Bilberg (2015)	Additive manufacturing for consumer-centric business models: Implications for supply chains in consumer goods manufacturing	98/19.60
Wu et al. (2016)	A critical review of the use of 3-D printing in the construction industry	142/28.40
Tao et al. (2017)	Advanced manufacturing systems: socialization characteristics and trends	137/34.25
Attaran (2017)	The rise of 3-D printing: The advantages of additive manufacturing over traditional manufacturing	148/37
Zhong et al. (2017)	Intelligent Manufacturing in the Context of Industry 4.0: A Review	322/80.5
Yin et al. (2017)	The evolution of production systems from Industry 2.0 through Industry 4.0	75/25
Ngo et al. (2018)	Additive manufacturing (3D printing): A review of materials, methods, applications and challenges	626/208.67

Source: Composed by the authors using a search engine and metadata of WoS.

4.2. Bibliographic Coupling of Publications

Bibliographic coupling is a method for the visualization of bibliometric networks, which represents data with an overlap in reference lists of publications. To explain, the number of overlaps indicates the ratio of relation strength among publications, where a higher ratio means more bonds in reference lists. This allows the visualization of actual referencing connections among separate studies; therefore, the VOSviewer software has been selected as the main work tool, as it offers a detailed visualization of the bibliographic publication coupling option with specific characters to illustrate relatedness level. In detail, a circle character indicates a specific publication while its size represents the number (frequency) of overlapped citations. Lines and the distance between circles are important characters too, as they show how related and similar pairs of publications are at this point. Colour marking stands for clusters of publications (Van Eck and Waltman 2014).

Seven predominating clusters were identified by defining a threshold of 50 citations, as per Figure 3. The red color cluster is predominated by Salvador et al. 2009 (citations n = 269) and Simpson T.W. (citations n = 349). The green color cluster is predominated by von Hippel E. (citations n = 458). The blue color cluster is predominated by Fixon S. K. (citations n = 253). The dark khaki color cluster is led by Kotha, S. (citations n = 288). The purple color cluster is led by Berman B. (citations n = 748). The light blue color cluster in the upper left corner is led by the most cited author Akkermans H.A. (citations n = 246). The light brown cluster is led by Elmaraghy H. (citations n = 206). Moreover, highly influential and closely related, but keeping clear boundaries, the four clusters (red, green, blue and khaki color) confirm that the MC domain had clear thematic boundaries in the first two decades. It is undoubtedly important to outline that a less influential and cross mixed part of the figure stands for the domain transition to an interdisciplinary approach and, later, to practical outcomes, which came into clear recognition in the past decade.

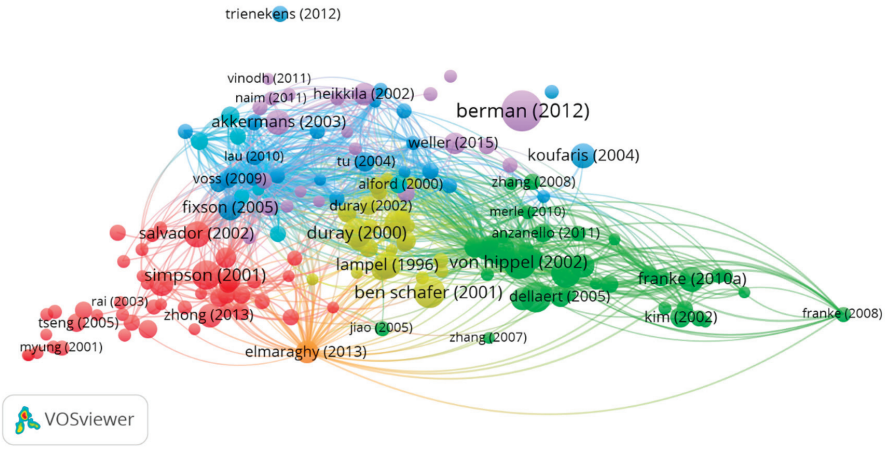

Figure 3. Bibliographic coupling of Mass Customization publications in 1990–2020. Source: Composed by the authors using VosViewer software.

4.3. Bibliographic Coupling of Publications

An important feature of nodes in bibliometric networks is an evaluation of a citation relation by applying an analysis of the most cited and influential scientific journals as well as a co-citation analysis of scientific journals and authors. The analysis reveals a level of a relatedness of selected scientific journals based on the number of citations in journals by which two selected journals are co-cited. The same logic is applied to a co-citation analysis of researchers, meaning that the relatedness of research relies on counting their co-citation by a third researcher. The VOSviewer software tool was used with specific characters and logic to illustrate a relatedness level, as defined in Section 4.2. Accordingly, the top ten most cited journals of the MC research domain are presented in Table 2.

Table 2. Top 10 most cited scientific journals of the Mass Customization research domain in 1990–2020.

Journal Title	TP	% of Total Number	IF2019	CPP2019
International Journal of Production Research	135	7.57	4.577	19.5
International Journal of Production Economics	65	3.65	5.134	30
International Journal of Advanced Manufacturing Technology	64	3.59	2.633	15
Journal of Intelligent Manufacturing	58	3.25	4.311	18.7
Production Planning Control	45	2.52	3.605	20
International Journal of Computer Integrated Manufacturing	40	2.24	2.861	14
Computers in Industry	38	2.13	3.954	23
International Journal of Operations Production Management	35	1.95	4.619	41.8
Computers Industrial Engineering	26	1.455	4.135	13
IEEE Transactions on Engineering Management	26	1.455	2.784	31.9

Source: Composed by the authors using a search engine and metadata of WoS. TP: total number of articles; IF2019: journal impact factor in 2019; CPP2019: citations per paper (TC2019/TP), where TC2019 is the total citations received since publication until the end of 2019 (Hu 2012).

The results show that the International Journal of Production Research (IF2019 = 4.577) published the majority of articles (135 articles, 7.57% of 1783), followed by the International Journal of Production

Economics (IF2019 = 5.134) with 65 articles and the International Journal of Advanced Manufacturing Technology (IF2019 = 2.6.33) with 64 articles. It should also be noted that six out of seven of the most cited scientific journals belong to the engineering, manufacturing and computer science fields. This situation confirms that customization research topics in the overall MC research domain are strongly related to a still vital legacy and an interest in tangible products. The co-citation analysis of journals demonstrates five clusters in total, where not only product manufacturing and operations management hold predominant positions, but also journals oriented to end-user studies are distinguished, as per Figure 4. It should be specified that the results were presented by following a benchmark of at least 50 citations, using specific characters and logic to illustrate a relatedness level, elaborated in the paper above.

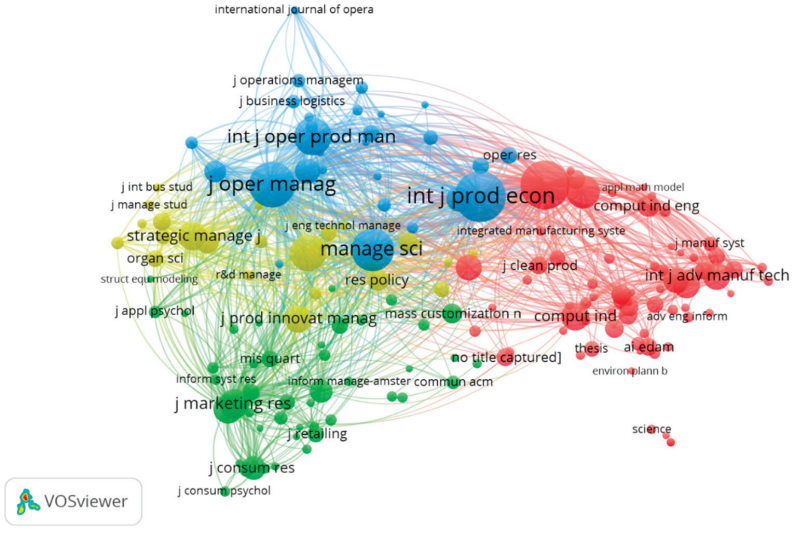

Figure 4. Co-citation of scientific journals in 1990–2020. Source: Composed by the authors using the VosViewer software.

The analysis of the co-citation of scientific journals led to four clusters. The biggest cluster in red color is predominated by the International Journal of Production Economics (total link strength n = 88,825). The green cluster is led by the Journal of Marketing Research (total link strength n = 34,766). The blue color cluster is led by the International Journal of Production Economics (total link strength n = 93,691), the Journal of Operational Management (total link strength n = 106,710). The khaki color cluster is predominated by the Harvard Business Review (total link strength n = 46,129). The nodes and edges of the red cluster confirm the above defined transition period of the MC research domain in the past decade as well as an increased concept focus on modelling end-user behavior and their experience management, and an overall combined methods application in customization processes. Supplementary results came from the author co-citation analysis, as per Figure 5. It should be specified that results were presented by following a benchmark of at least 20 citations, using specific characters and logic to illustrate a relatedness level, elaborated in the paper above.

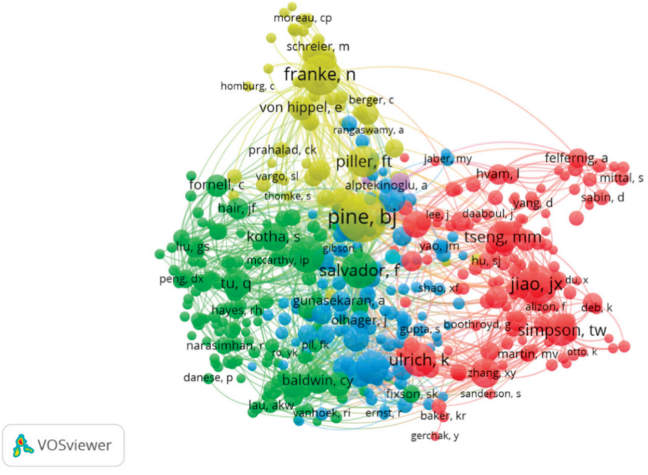

Figure 5. Co-Citation of Mass Customization researchers in 1990–2020. Source: Composed by the authors using VosViewer software.

A bibliometric map of an existing influence level and connections among studies of the MC research domain in past three decades was observed, as per Figure 5. In total, five closely related central themes and clusters are highlighted. On the right side, the red color cluster represents Ulrich, K. (with 402 links and 252 citations), Jiao, J.X. (with 390 links and 356 citations), Tseng, M.M. (with 384 links and 258 citations) and Simpson, T.W. (with 334 links and 244 citations) as the most influential authors. In the middle part, the blue color cluster represents Lee H.L (with 392 links and 249 citations) as the most influential author. In the left part, the green color cluster represents Salvador et al. 2009 (with 428 links and 304 citations), Kotha, S. (with 384 links and 178 citations), Baldwin, C.Y. (with 386 links and 147 citations), Tu, Q. (with 388 links and 174 citations) and Fornell, C. (with 326 links and 112 citations) as the leading authors. In the top-center part, the khaki color cluster represents Pine, BJ. (with 437 links and 543 citations), Piller, F.T. (with 411 links and 222 citations), Franke, N. (with 354 links and 366 citations) and Von Hippel, E. (with 319 links and 132 citations) as the leading authors. In the top-middle part, the purple color cluster represents Trentin, A. (with 319 links and 87 citations) as the leading authors. Clear and intensive links are visible between the green and blue color clusters, which indicates that representatives of these clusters have quite common investigations, research methodologies and methods.

4.4. The Co-Authorship Analysis of Countries

Bibliometric networks based on the co-authorship at the level of countries are studied extensively in different scientific fields, however, with relatively little attention to the visualization part (Van Eck and Waltman 2014). This type of visual bibliometric network is used to identify leading countries in a specific research area and assess their collaboration trends that are based on a number of publications, which researchers from certain countries have authored jointly (Van Eck and Waltman 2014). It should be specified that results were presented by following a benchmark of at least 11 citations, and using specific characters and logic to illustrate a relatedness level, elaborated in the paper above.

There are five predominate clusters identified, as per Figure 6. In the middle-bottom part, the cluster in red has the People's Republic of China (with 39 links; total link strength n = 243,530) as the leading country. In the middle-top part, the green color cluster has the USA (with 39 links; total link strength n = 243,530) as the leading country. In the right part, the blue color cluster has England (with 39 links; total link strength n = 121,523) as the leading country. In the left part, the khaki color has Germany (with 39 links; total link strength n = 56,074) and Canada (with 39 links; total link

strength n = 68,669) as the leading countries. In the middle and right parts, the purple color cluster identifies a relation between two countries, Brazil (with 39 links; total link strength n = 31,690) and Japan (with 39 links; total link strength n = 12,661). Moreover, similar tendencies are identified by analyzing numbers of the most productive countries regarding the MC research domain in 1990–2020, as per Table 3.

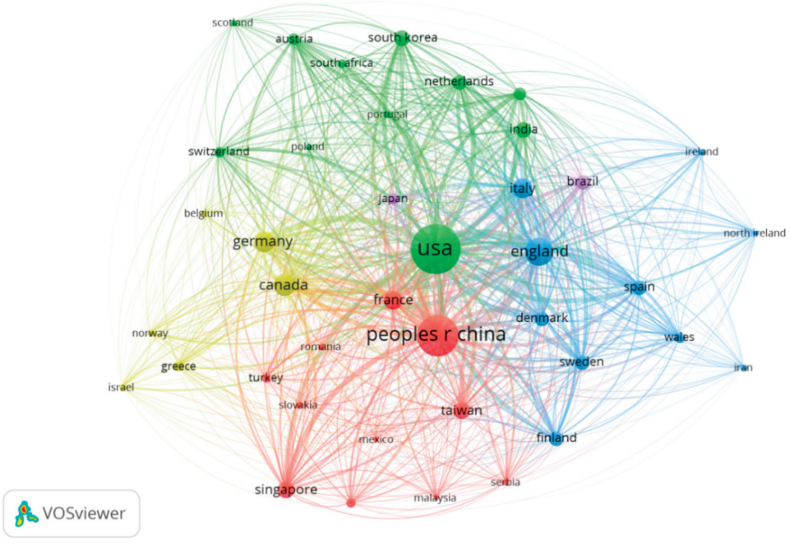

Figure 6. Co-Authorship of Mass Customization researchers at the country level (1990–2020). Source: Composed by the authors using VosViewer software.

Table 3. The top 10 productive countries regarding the Mass Customization research domain in 1990–2020.

Countries/Territories	TP	% of Total Number	CPP2019
USA	540	29.687	39
People's Republic of China	371	20.396	18
England	171	9.401	24
Canada	99	5.443	30
Germany	93	5.113	24
Italy	91	5.003	25
France	81	4.453	22
Singapore	63	3.463	33
Taiwan	62	3.408	18
South Korea	58	3.189	13

Source: Composed by the authors using a search engine and metadata of WoS. TP: total number of articles; IF2019: journal impact factor in 2019; CPP2019: citations per paper (TC2019/TP), where TC2019 is the total citations received since publication until the end of 2019 (Hu 2012).

There are three top countries, which together generate near to 60% of total publications in this research domain: the USA, the People's Republic of China and England, as per Table 3. In addition, the researchers from these countries mostly focused on a practical application of customization across a broad range of tangible products like automotive, food and clothing, and industries. From a geographic perspective, two main groups of the most productive countries can be identified: four countries from Europe and four countries from Asia. External factors of global market dynamics, new automation tendencies of services and product lines, and the infusion of digitalization in recent decades, are worth mentioning as substantial development factors, which extend the map of researchers to non-industrial

countries. In detail, MC primary is accepted as a modern business model, a process and risk management version for customer and data driven small and medium service-based organizations by covering their highly heterogeneous demand patterns from customers, and an approach to the value co-creation process (Elgammal et al. 2017; Zhang et al. 2019). The listed factors do not only illustrate new development of the concept, but also influence its organizational frameworks, its practical operating logic, the application format of mass service or product systems and processes, as well as stimulating new forms of innovation in the Customization field (Ferguson et al. 2010). Therefore, the pre-dominance of five clusters in researchers' countries should not lead to the misleading interpretation that Customization does not work and is not compatible with any modern technology application, customer experience management or intangible goods (Piller et al. 2005; Trentin et al. 2013).

4.5. The Co-Occurrence of Keywords

The analysis of keyword co-occurrence is based on a data mining procedure by extracting keywords from a title, an abstract of a publication, or from an author-supplied keyword list. A visualization of the results of an analysis depends on the number of times that a keyword or a pair of keywords co-occurs in multiple sources and a weight of the link connecting a keyword or a pair of keywords. In general, keyword co-occurrence networks (KCNs) are relevant for a researcher as an existing knowledge mapping tool as well as for understanding a holistic view and development of a specific research domain in a selected period (Van Eck and Waltman 2014; Radhakrishnan et al. 2017). It should be specified that results were presented by following a benchmark of at least five keyword occurrences, using specific characters and logic to illustrate a relatedness level, elaborated in the paper above.

It should be noted that general noun phrases such as literature review, survey, etc., were extracted from the keyword analysis. In total, there were 11 clusters identified. The biggest clusters reveal the following results:

- For the biggest cluster in red, the most influential keyword is customization (total link strength 113);
- For the yellow cluster, located in the left part, the most influential keyword is modularity (total link strength 101);
- For the purple cluster, located in the right part, the most influential keywords are additive manufacturing (total link strength 67).

A variety and quantity of keywords in the bibliometric network above confirm the existence of a multidimensional approach to the MC domain and its relevance in different scientific fields. Considering development in MC scientific research, it should be noted that MC was widely discussed as a part of process management, marketing, engineering and other related scientific domains until the end of the 2000s. Only in the decade of the 2010s, after receiving a practical approval as an efficient e-business approach and strategy of supply chain and process management, did it become a separate research area (Piller et al. 2005). There is a need to mention the studies of Da Silveira et al. (2001) as they proposed a dual definition model of a visionary and practical MC as well as its later development by Kaplan and Haenlein (2006) (Brandão et al. 2017). Together with the definition, Da Silveira et al. (2001) noticed that this concept would never be appropriate enough for a practical adaptation for all types of products and all kinds of consumers. These closely interconnected theoretical and practical interpretations, as with application and adaptation abilities in different practical areas, might be the key reasons why the concept still does not have any coherent and universal framework for assessment or implementation as well as any commonly agreed position regarding the semantical meaning on a scientific level, as illustrated in Figure 7. On the other hand, this situation explains the long-lasting vitality and relevance of the MC topic, as researchers influenced by dynamic changes in the society and business environment constantly seek for new formats to explain a variety of MC outcomes or obstacles. The concept is addressed from different points of view in practice and is frequently understood under definitions of typologies, models, evaluations and deployment frameworks as a management concept, a paradigm, a stand-alone business model, an operations or manufacturing

strategy, or a product development approach (Medini et al. 2015; Elgammal et al. 2017; Ezzat et al. 2019; Zhang et al. 2019). Although in rare cases MC is defined on behalf of the term Mass and its content, according to McCarthy (2004), the term Mass signifies an important feature, which clearly indicates that the concept excludes low volumes of bespoke products or services, and this is proven by two of the three predominant keyword clusters in Figure 7. This position is also supported by Joergensen et al. (2014) by stating that MC is a general, strategic level change model, while MP is the most relevant towards individual customers or small groups of customers as it generates requirements for a service or product. This is a questionable position, taking into evaluation recent trends in MC, where a tendency of E-MC, Smart Customization or Agile MC application is identified and, respectively, partly indicated in Figure 7 (Xu et al. 2016; Zhang et al. 2019).

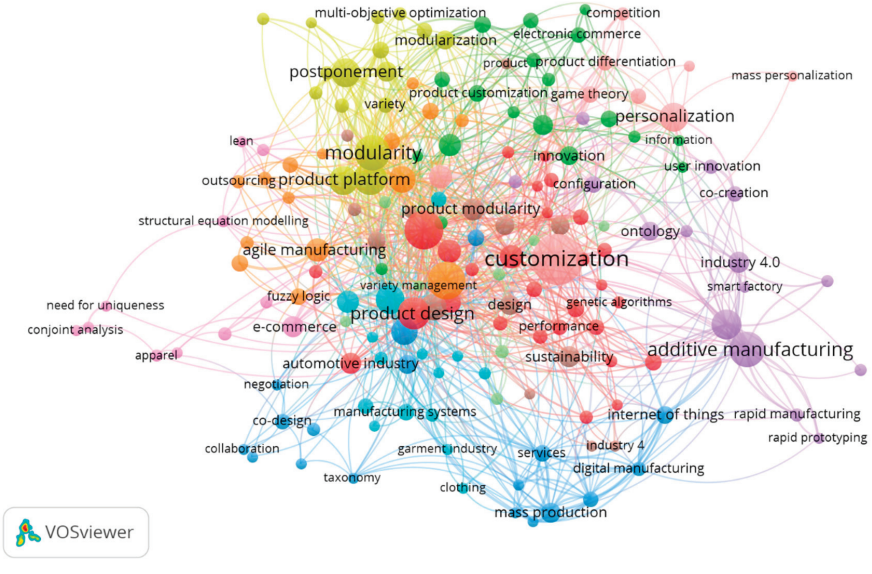

Figure 7. Co-occurrence of author's keywords in the Mass Customization domain (1990–2020). Source: Composed by the authors using VosViewer software.

4.6. Summary of the Main Research Streams in the Mass Customization Domain in 1990–2020

Before the beginning of 2000, the meaning and role of the MC concept were mostly influenced by internal risk factors coming from product manufacturing processes and their features of standardization, modularity and made-to-order, as well as from issues of supply chain and communication network management, and difficulties in terms of long-term strategic management and planning. A wide range and complexity of risks were not only the key reasons for a low practical adoption level of customization, especially in service-oriented organizations, but also triggered a parallel development of scientific methodologies and methods of agile manufacturing, lean production, six sigma and more, which conflicted or diverted the attention away from the MC concept.

In general, findings on MC revealed that studies in 1990–2020 have mainly focused on three subdomain areas:

1. The focus on major external factors (technological, economic, market specific) and their trends, which naturally influence a shift from Mass Production to MC. The analyses mainly include the topics of internal Customization features and risk factors as a critical source of success for a new business strategy or model transformation, the integration and assessment of an organizational structure, and the capabilities of processes to change. Despite the focus on current features

and principles the shift presents, it also draws back to the origins of MC with a historical and semantical evaluation (Morelli and Nielsen 2010; Piller et al. 2014; Brandão et al. 2017).

2. The focus on the implementation process and elements in MC. The scientific works from this particular category are oriented to multidimensional and combined subdomains, including separate enablers–elements of the MC system, for instance, supply or value chain management, employee training, marketing and MP processes, overall operational performance, resource management, etc. It also analyzes possible links among these enablers–elements, and maps coherent frameworks in detail in order to outline leading factors towards a successful implementation of MC in the context of organizational activities and the online environment. Retrospectively, it is claimed that the most intensive research period of first and second subdomains were two decades from the middle of the 2000s to the 2010s (Morelli and Nielsen 2010; Stojanova et al. 2013; Piller et al. 2014; Brandão et al. 2017).
3. The focus on the dynamic demand side and influence of interrelated scientific domains, crossing information and computer technology management, marketing, environmental, and social dimensions. In detail, from the middle of the 2010s, the MC concept has been recognized in new combinations of globalization, digitalization, networking, and short product life cycles, and has usually been named E-MC. Accordingly, this synergy became one of the main drivers towards value and competitiveness in both organizational practice and overall economy levels, although relatively little attention has been paid to this subdomain on a scientific level. Publications of recent years, more specifically in last 7 years, appear to interpret the object of MC as a multidimensional management paradigm based on a combination with the MP concept, user and data driven technologies' application, Big Data sources, e-commerce and e-business, environmental impact via sustainability feature, etc. (Medini et al. 2015; Brandão et al. 2017; Tiihonen and Felfernig 2017; Zhang et al. 2019).

In the last decade, a recognition of an extended concept meaning and scientific studies can be explained as a transition from a standard understanding of a stand-alone business/manufacturing/operations strategy or a concept oriented narrowly to a technological-instrumental approach, to a widespread e-business philosophy and a value driver of economics with a concentrated focus on synergy, digitization and sustainability features. Paradoxically, during this time, the well recognized terms MC, Individualization, Modularization or MP were transformed into buzzwords such as Mass Customerization, Smart Customization, Agile MC, Sustainable MC, but they still stand for the creation of new possibilities to set up highly contextualized, cost efficient, globally available customized goods or service solutions for local markets or microsegments of customers (Pourabdollahian et al. 2014; Xu et al. 2016; Chatzopoulos 2017; Tiihonen and Felfernig 2017; Grosso and Forza 2019).

5. Discussion

Over the last 30 years, the number of scientific articles covering the interdisciplinary MC research domain has increased enormously both in quantity and in the range of topics. In general, MC as a research domain has a rich historical background, which is amply evident from six long-term transformation periods. The origins of the idea and the scientific term MC extend back to 1987 and mark the beginning of the three main historical development periods. Accordingly, the systemic and bibliometric analysis on the MC research domain in 1990–2020 supports the above defined findings by showing that there are three MC sub-domains identified throughout the scientific research. It should be noted that three key semantic features remained throughout all transformations: an orientation to individual demands and an end-user involvement in the customization process, a harmonization of diversity, costs, and quality features and risks, and an aim of competitive advantage by applying combined customization and risk management methods. From the practical perspective, this is confirmed by the latest modern e-MCP version, which is adapted to a clear demand of a combined version of online customized products and personalized service types, rapid response times to requests sent, and a constant communication and support model need.

The historical business environment evolution and significant changes of end-users draw researchers from five different scientific domains, including traditional, manufacturing and engineering-based semantical and practical interpretations, as well as a modern version with a lead from combined business operations management, marketing and information technology domains. This situation confirms the continuity of the fragmentation of the concept and challenges the idea of there being one coherent framework. It should be added that the original approach and interpretation of the MC concept still has a high scientific research interest, which is confirmed by pre-dominant clusters of co-citation of scientific journals as well as the most cited scientific journals and most cited publications of MC in 1990–2020. Moreover, the topics of the most cited publications show tendencies of the research discourse towards a practical transition and issues of intelligent and additive manufacturing–production systems or an application of innovative technical solutions such as, for instance, 3D printing.

The results of the four types of bibliometric clustering analysis in 1783 scientific articles from 1990–2020 add new findings and provide a holistic view of the MC research domain:

- Scientific publications and interest in the Customization topic has two periods: a stable growth until 2007 and dynamic development after 2007, where a high intensity of publications was reached in 2017–2019. Even though the quantity of publications significantly increased from 2007, 14 out of the 15 most influential publications were published during the first period, and the most co-cited author remained Pin et al. (1993) with 437 links and 543 citations.
- The most cited publication is Fisher, M.L. (1997) *What Is the Right Supply Chain for Your Product?* with a total of 1312 citations per analysis period. The author presents the influence of a new technology application at the operational and product levels. The second one by citing rate is Berman (2012) article 3-*D printing: The new industrial revolution* with a total of 804 citations per analysis period, where an application of new technological innovation is evaluated in the MC context. It is worth mentioning that the most cited journal is the International Journal of Production Research with a total of 135 citations and a 7.57% citation rate while the most co-cited journal was the Journal of Operational Management.
- The co-authorship analysis illustrates that the leading countries in the scientific research of the MC domain are the USA (with 39 links; total link strength n = 243,530) and the People's Republic of China (with 39 links; total link strength n = 243,530). Researchers from England (with 39 links; total link strength n = 121,523), Germany (with 39 links; total link strength n = 56,074), and Canada (with 39 links; total link strength n = 68,669) have a significant influence in this field.
- The co-occurrence of keywords analysis shows that the most influential keyword pair is the concept title MC. It also confirmed a dynamic and a multidisciplinary background in the MC domain. In general, the most influential keywords can be divided into two main groups as being oriented to a standard technological-instrumental approach to MC or to a modern and extended concept meaning with a high focus on end-user and digital solutions.

6. Conclusions

The complex and dynamic business environment and its risks, technological innovations and digitalization have stimulated significant changes in past three decades not only in the practical attitude and organizational frameworks of MC, but have also influenced the continuous development of the concept at a theoretical level. A historical and systemic analysis reveals three main periods in each decade and, respectively, three research sub-domains, which marks a transition of the concept towards a stand-alone, multidimensional and interdisciplinary business operations concept. The analysis confirms that the modern MC has increased focus to non-tangible products, end-user behavior, sustainability and an application of combined Digitalisation and Personalisation methods in customization processes. The results of bibliometric analysis indicate a long-lasting vitality and relevance of traditional MC research topics, and note last 5 years as the most intensive research period.

The main scientific contributions rely on an extension of preceding MC state-of-the-art research in the sense of a selected methodological triangulation approach, the largest research scope both in time scale and quantity, as well as following the theoretical outcomes of the research. The research confirmed assumptions regarding the historical development of the concept and its content, where the three main historical development periods and the research interests within them can be identified as follows: the period of 1987–2000 stands for an evolution and a rise of the traditional MC concept, where the dominant research focus is on the manufacturing and engineering domains, a shift from Mass Production to MC and the influence of external technological, economic, market specific factors. The period from approximately the 2000s to the 2010s marks an increased focus on the MC implementation process and elements in it, while studies in the decade of the 2010s have illustrated a semantical and content transition from a traditional technological-instrumental approach to a modern e-business philosophy and operations approach. Research has focused on the dynamic demand side and the influence of interrelated engineering, information and computer technology management, marketing and social science scientific domains. It was confirmed by the variety and quantity of keywords in the bibliometric network analysis.

Considering the practical implications of the research, it should be outlined that the results of scientific publication dynamics, the most cited publications, as well as bibliometric networks in the co-authorship and co-occurrence of keywords, confirm both the diverse nature of the concept and a necessity of continuous studies in the field of practical MC application. Modern e-MCP concept versions support current global economic and business trends, which demand that organizations use agile, smart innovations and a customer-oriented business model with a broadly segmented market, omni-channel retail and sustainable development strategy focused on daily operational activities. An alignment and a continuous adoption of new digital solutions or sources for making proper decisions on the customization and management of personalized customer experience are undoubtedly required as well.

The conducted research has limitations that should be taken into consideration. The analyzed data was extracted only from the WoS database. This database features constantly update, therefore, a constant self-follow up of the latest data in WoS, as well as a comparative analysis with data from another well recognized database, for instance, Scopus, are required. The study analyzes the whole period of the MC research with limited attention to the dynamics within and among separate periods of the MC research domain. The bibliometric analysis has limitations in the visualization of the massive and heterogeneous scope of the topic by eliminating parts of important data, which are under a threshold indicator (minimal number) and not well applicable in a niche field with quite sparse networks (Van Eck and Waltman 2014). There are also certain software limitations that do not offer any option to connect and get metadata via Crossref Application Programming Interface (API) or support interactive querying for other scientific sources that are important to mention. Therefore, future investigations should consider other techniques and approaches, for instance, a bibliometric analysis combined with a content analysis.

Further studies on the MC research domain should focus on a more detailed investigation over the content and major differences among last three transformation periods, presented in Figure 1. Besides, a recommendation would be to examine recent practical trends and new research sub-domains of Digitalization and MP, their combinations, interpretations and incorporations into the concept, to a deeper extent in terms of online customization frameworks and end-user behavior modelling methods in customization processes or platforms. An argument over the preceding recommendation is that recent practical trends illustrate an extended approach to the MC research domain as an interdisciplinary business operations concept, which is widely applied in digital platforms and service-oriented organizations.

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A.G.R.; Funding Acquisition, R.K., A.G.R., G.B. All authors have read and agreed to the published version of the manuscript.

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Mixed Methods Utilisation in Innovation Management Research: A Systematic Literature Review and Meta-Summary

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Abstract: The main purpose of this article is to explore the application of mixed methods research in the innovation management sub-discipline utilizing a systematic literature review and meta-summary analysis. Regardless of the growing number of studies in innovation management there is still a lack of research that integrates and synthesizes this body of knowledge. Our review of 93 articles from Web of Science and Scopus databases, including content analysis, presents trends and research background in innovation management that use the mixed methods approach. This study addresses the inconsistencies in the literature and presents a holistic picture of what existing empirical studies have found to date. In addition, we have developed an innovation management model based on selected theoretical lenses to enable future researchers in a given area to choose the appropriate method. The results of the meta-summary show that 50.54% articles from our dataset are related to partially mixed dominant sequential methods, 12.90% fully mixed dominant sequential methods and 11.83% fully mixed dominant concurrent methods. We identified several research gaps and provided a future research avenue in the context of innovation management. The article analyzes empirical papers, enables identification of problems in the current research and identifies trends in the area of the studied phenomenon. The results on the topic of mixed methods in innovation management and used tools have indicated that this issue is still in a premature phase but with an upward trend of research development.

Keywords: mixed methods research; mixed research approaches; mixed research models; innovations; innovation management

1. Introduction

One of the most important and sustainable sources of long-term success of organizations is innovation (Camisón and Villar-López 2014; Iturrioz et al. 2015). Over the last 45 years the body of innovation management literature grew considerably especially in the area of innovation, innovation management or commercialization of innovation. This led to an increasing number of different models of innovation processes, especially in the field of innovation management research, from research on the impact of creative thinking on green innovations (Awan et al. 2019) and the innovative behavior of high-tech businesses (Wach 2016) to the use of managerial competencies and innovation in enterprises (Szczepańska-Woszczyna and Dacko-Pikiewicz 2014; Okoń-Horodyńska et al. 2020; Szczepańska-Woszczyna 2020).

Mixed research methods are one of the most important and the most effective ways of generating more accurate results in order to provide a broader and more complete vision of a problem in management research (Bazeley 2015).

The area of innovation management (Ritala et al. 2020) is studied both with the help of two groups of research methods: quantitative methods (e.g., to study expenditures on innovations or dynamics of start-up development) (Awan 2020; Faems 2020), as well as qualitative methods (Goffin et al. 2019), as innovations are complex and multidimensional processes. Many researchers indicate that only by employing mixed methods the most accurate measurements of innovation management can be achieved. Therefore, it is supposed that there is a relationship between the use of mixed research methods in the articles and obtaining results that are more accurate. Many innovation management tools are used in this discipline, the use of which has real effects. With the development of research and the deepening of knowledge on innovation management, many researchers are verifying the usefulness of existing innovation management tools and developing new ones. Nevertheless, to the best of our knowledge, there are no studies extensively exploring the application of mixed methods within the area of innovation management research, since most of them concentrate on general management (Cameron and Molina-Azorin 2011; Bazeley 2015; Molina-Azorin et al. 2017). For this reason, presenting a review of literature and meta-summary in a given field seems to be scientifically justified.

Considering these gaps in the literature, and the scholars' calls to address the absence of systematic reviews regarding innovation management (Cameron and Molina-Azorin 2011; Lopes et al. 2016), specifically in the area of application of mixed method approaches, our main goal is to explore the application of mixed methods research in the innovation management sub-discipline using a systematic literature review and meta-summary analysis. More specifically, the present study first undertakes a systematic review of the literature in order to identify drivers and outcomes of using mixed methods in the articles on innovation management. We explore the relationships between the use of mixed research methods in the innovation management sub-discipline with all drivers and outcome variables that have been empirically studied in the systematic review. Second, we conduct a meta-summary to further explore drivers and outcomes of using mixed methods in innovation management research, where adequate independent empirical studies are available.

This article contributes to the literature on innovation management research in various ways. First, it synthesizes the contributions of research published in the innovation management sub-discipline. Second, it develops a framework that covers studies on mixed methods in innovation management research. Third, it uses a meta-summary method to aggregate prior empirical studies on innovation management to identify the direction and effect of mixed methods used in the field of innovation management discipline. Fourth, through the critical analysis of the literature, this study highlights the gaps in the literature and provides suggestions for future studies to further explore the field. This is critical given that the field of innovation management sub-discipline is still in its infancy stage and, therefore, research on using mixed methods in innovation management research is strong in certain areas but weak in others.

2. Mixed Methods and Innovation Management Research

2.1. Definition of Mixed Methods Approach

Looking from the historical perspective, the mixed methods approach can be perceived as a methodology developed around the end of 1980s and beginning of 1990s, which, in its present form, stemmed from the work of researchers in various scientific fields, such as sociology, education, management, and health sciences (Creswell and Creswell 2018). Mixed methods research (the combined use of quantitative and qualitative methods in the same study) is becoming an increasingly popular approach in the discipline fields of many sciences. The main feature of mixed methods research is its methodological pluralism, which frequently results in research, which provides broader perspectives than those offered by monomethod designs.

Calls for the integration of quantitative and qualitative research methods have been announced in social sciences (Denscombe 2008) especially in the business and management discipline areas

(Cameron and Molina-Azorin 2011). On the other hand, management researchers trying to utilize a mixed methods approach may still encounter opposition from the guards of a discipline where research is heavily inculcated with a positivist ideology, an adoration of indicators, measures, and an assumption of developing statistical analyses of numeral data (Currall and Towler 2003).

The growing use of mixed methods has practical implications for research training and capacity building within business schools (Cameron 2011; Frias and Popovich 2020). Therefore, there is an increasing need to develop research capacity through the introduction of postgraduate courses in mixed methods and advanced research skills training for existing researchers.

W.E. Thurston, L. Cove, L.M. Meadows (Thurston et al. 2008) indicated that a single definition of mixed methods research does not exist, as "mixed methods studies can either combine methods from different paradigms or use multiple methods within the same paradigm, or multiple strategies within methods". One of the most popular definitions found in The Journal of Mixed Methods Research (Tashakkori and Creswell 2007), in its call for papers, defines mixed methods as "research in which the investigator collects, analyses, mixes, and draws inferences from both quantitative and qualitative data in a single study or a program of inquiry". In this paper, the following definition supplied by Greene et al. (1989) is applied, where mixed methods research designs are perceived as those that include at least one quantitative method (designed to collect numbers) and one qualitative method (designed to collect words).

A monomethod study uses only one type of method, one qualitative or one quantitative. In general, in a qualitative study, the information, which is mainly in textual form, is analyzed employing qualitative data analysis techniques. In a quantitative study, the data is in numerical form and this information is analyzed using quantitative data analysis techniques. Drawing an initial distinction between monomethod research and multiple methods research may be helpful to determine what is understood as "mixed methods". A multiple methods study uses more than one method. Moreover, a differentiation can be made within multiple method designs between multimethod research (multiple qualitative or quantitative methods) and mixed methods research (integration of quantitative and qualitative methods) (Creswell and Clark 2017).

The need to combine methods is due to the complexity of the object research, the need to enrich the results with different research perspectives and obtain a more complete and comprehensive picture of the reality being examined.

2.2. The Application of Mixed Methods Research

For researchers, two factors are most important: priority and implementation of data collection to design and conduct a mixed methods study (Morse 1991; Tashakkori and Teddlie 1998; Creswell and Clark 2017). Priority means that, depending on the researcher's preferences, research questions, and limitations in the possibilities of data collection, researchers can give equal priority to both quantitative and qualitative research or place more emphasis on qualitative or quantitative parts. Mixed methods designs can therefore be divided into the following categories: equivalent status designs and dominant-less dominant studies, or nested designs. Using the first model the researcher conducts the study using both the quantitative and qualitative approaches equally to understand the phenomenon under study. Using the other model, the researcher conducts the study within a single dominant paradigm with a small component of the overall study drawn from an alternative design.

Implementation of data collection refers to the sequence that the researcher uses to collect all data. If the research problem is solved by applying both qualitative methods as well as quantitative ones, the researcher uses a simultaneous, also referred to as concurrent, or parallel design. The relationship between methods can be equivalent (equal status of qualitative and quantitative paradigm) or leading for one of the methods (e.g., dominance of qualitative or quantitative method). In a sequential design, results obtained using one approach are the basis for research using the second approach. The third type of approach is transformational design. The transformational approach is characteristic of mixed methods used in evaluation studies being the basis for conducting economic research. In these studies,

the test results are the basis for shaping social change that comes from the adopted theory. When the researcher has quantitative data, the goal is to test the variables on a large sample. To confirm the results obtained from a large sample, it is worth conducting a more in-depth analysis of several cases using qualitative methods. However, if qualitative data were collected, the intention is to first investigate the problem under study using qualitative methods, and then to continue this study using quantitative data that can be tested on a large sample so that the results can be deduced from the population.

Morse (Morse 1991) and Johnson and Onwuegbuzie (Johnson and Onwuegbuzie 2004) proposed four groups and nine types of mixed method projects with a combination of two dimensions. The dominant method is marked with capital letters (QUAN, QUAL), while the complementary method is represented by lowercase letters (quan, qual). The notation "+" means simultaneous design, and the arrow "→" is used to indicate a sequential design.

Equivalent status/simultaneous design: QUAL + QUAN.

Equivalent status/sequential designs: QUAL→QUAN; QUAN→QUAL.

Dominant/simultaneous designs: QUAL + quan; QUAN + qual.

Dominant/sequential designs: qual→QUAN; QUAL→quan; quan→QUAL; QUAN→qual.

2.3. The Advantages and Limitations of Mixed Methods

In the field of management research, a significant reflection prior to designing and conducting a mixed methods study is whether mixed methods, as compared to monomethod designs, best address the research questions and the research problems. Malan et al. (2019) described in detail that conducting a mixed methods study requires more work, time and financial resources. Additionally, increased demands on time depend on how long it takes to implement both aspects of the study.

In the field of management research, Jick (1979), Tashakkori and Teddlie (1998) and Creswell and Clark (2017) have been strong advocates for pluralism or multimethodology. Jick (1979) discussed triangulation in terms of the weaknesses of one method being offset by the strengths of another. It is often stressed that different methods have different weaknesses and strengths, and therefore the main effect that triangulation can offer is to overcome the weaknesses of any single method. Tashakkori and Teddlie have advised that better understanding and increasing the validity of inference can be obtained, for example, by triangulating one set of results with another. Additionally, "the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone" (Creswell and Clark 2017). Other advantages of using mixed methods in research include complementarity understood as complementing one method by another, initiation (the ability to exclude paradoxes and changing inappropriate research questions), extension by extending the scope of questions and answers and development (by using both methods in a given research area) Greene et al. (1989).

Other advantages presented by Bryman (2007) are: triangulation and analysis of processes and statistical features. Qualitative research can facilitate the interpretation of relationships between variables, because qualitative research facilitates quantitative research and quantitative research facilitates qualitative research.

Similar to the arguments above, Creswell and Creswell (2018, p. 281) have argued in favor of the advantages of using this type of approach by means of comparing various viewpoints obtained from quantitative and qualitative data, clarifying quantitative results with a qualitative complementary data collection and analysis, designing better contextualized measurement tools, augmenting experiments by including the perspectives of individuals, creating cases (i.e., organizations, units, or programs) for comparisons and obtaining a more complete perception of changes required for a marginalized group.

Despite the mentioned advantages of this sophisticated approach of conducting research, it is important to mention some challenges that may occur before starting a new research project

(Creswell and Creswell 2018, p. 281): the need for large-scale data gathering, the time-consuming character of analyzing both qualitative and quantitative data and the necessity for the researcher to be acquainted with both quantitative and qualitative types of research. Moreover, due to the complexity of the research design it is important to develop clear, visual models to comprehend the specifics and the course of research activities within this approach. Bryman (2007) and Bryman (2007) mapped a brief division of barriers to using mixed methods research, pointing out that researchers need to develop a wider set of skills that span both the quantitative and qualitative research approaches. Another barrier is connected to the challenges of publishing mixed methods studies, such as word and page limits in journals (Wipulanusat et al. 2020).

2.4. Innovation Management Research

Innovation management is essentially perceived as inter-disciplinary research, where various theoretical and methodological concepts developed in business and management are applied, resulting in a separate sub-discipline of management (Tidd and Bessant 2018b). Within the literature, innovation management is referred to in many ways, routed in different theories that include new product development (Cooper 1990; Wheelwright and Clark 1992), technological innovation (Dosi 1982; Shea 2005; Nambisan and Nambisan 2008), process innovation (Tidd and Bessant 2018a), and open innovation (Sawhney and Prandelli 2000; Chesbrough et al. 2006).

The lack of a common definition of innovation is partly explained by referring to its multidisciplinary origin that influences the theory of innovation management. Two trends in innovation management influenced the basic idea of this paper. (Pereira and Leitão 2016)

Selection of the correct research method is one of the main fundamentals for success in the field of solving innovation problems. We were encouraged by the ideas of publications having methodological character that pay attention to methods, their development and applications, since comprehension and utilization of several different methods may cause some difficulties to researchers (Blumberg et al. 2011; Gupta and Trusko 2014). Moreover, notion innovation is very often connected with the questions of creativity, invention and intuition as expressions associated with newness. This fact was acknowledged, and the final method selection includes those methods that focus on gathering real data, data processing, analysis, etc. (so-called empirical or experiential methods) and the distinction between qualitative and quantitative methods. Study of innovation processes showed that it is necessary to apply a set of methods according to the way the innovative solution progresses. These so-called theoretical methods should be included in solving problems in the area of innovations, as those are usually verified by the internal logic reflection and relationship to business and commercial practice. There is a lack of comprehensive studies on utilizing the mixed methods approach in the innovation management subdiscipline. This research problem will be solved by applying an appropriate research methodology provided in the next section of the paper.

3. Research Methodology

A systematic literature review is the method that explores and sorts publications in order to identify the essential attributes of the studied materials. Moreover, the systematic literature review makes a special contribution in distinguishing past trends and forecasting future models, using a set of concepts, interpretative reflections, and analyzing all the evidence on a specific question (Rousseau et al. 2008). The advantage of this method is that it focuses on individual journal researches and chooses small samples or characteristics of cases according to the subject requirements and the interests of researchers (Aliaga-Isla and Rialp 2013).

According to the method applied, steps suggested by Tranfield et al. (2003), Aliaga-Isla and Rialp (2013) and Kitchenham (2004) are followed. In the planning stage, we prepared a study plan for review and developed a review protocol based on the objectives of the study. In the execution stage, we developed search keywords, identified the data sources, defined study selection criteria and

extracted and synthesized data from selected studies. In the reporting stage, we reported our findings and explained the relationships between mixed methods and innovation management research.

Before the actual search for the articles, several initial searches of Scopus, Google Scholar and Web of Science were undertaken in order to determine keywords and appropriate search terms. All relevant keywords were searched in November 2019 as the next step. Electronic databases searched were Scopus and Web of Science.

For the literature search in the Web of Science and Scopus databases, we have applied a set of alternative keywords including such combinations as: "innovation management AND mixed methods", "mixed models AND innovation management", "quantitative and qualitative methods AND innovation management", "quantitative and qualitative research AND innovation management". Additionally, we made a manual search to find studies not included in the search of the databases.

We have only included the journals written in the English language. Nevertheless, all results should be treated with some reservation due to delays in publishing. In order to recognize the interest in the subject of mixed methods in innovation management research, we decided to search for articles from the Web of Science and Scopus databases. This is a typical procedure in this type of research order so as to increase reliability of results.

Based on the search criteria, we identified 1414 initial papers. It is common to retrieve a very large number of hits from the searches in databases. Therefore, once all studies had been retrieved from the databases, the inclusion and exclusion criteria were used to identify relevant studies. Initially, after applying two criteria: type—"article" and language—"English", 104 articles were found. The following documents were excluded: (1) in languages other than English, (2) book chapters, conference proceedings.

Firstly, we removed the duplicate publications (11) and this process brought down the number of studies to 93. The first author then read the full text of the 93 articles and data from the 93 studies were extracted and synthesized for the purpose of systematic review (see Appendix A).

In the next stage, data from the 93 studies were extracted and synthesized for the purpose of systematic review. Data synthesis was achieved using content analysis. Content analysis is an established method of research and is used to condense a text into fewer content-related categories (Cavanagh 1997). Following Ritchie et al. (2013) method, a series of steps were undertaken in order to analyze the papers in our final pool. First, the literature was read and textually studied to derive a set of suitable categories. This led to identifying recurring themes and methods used in the papers from the collected literature. The extracted data was organized and examined based on method used in two main groups: non-empirical and empirical articles. Additionally, the group of empirical studies were divided into three types: quantitative, qualitative and mixed methods approach articles.

To lead the meta-summary, we used the Sandelowski and Barroso (2003) analytic guideline in this study. The approach includes the extraction, grouping, and formatting of findings, and the calculation of frequency and intensity effect sizes, which can be used to produce mixed research syntheses and to conduct analyses of the relationship between reports and findings. Additionally, meta-summaries can serve as a basis for a further synthesis.

The following studies were excluded from our meta-analysis: all articles in languages other than English and book chapters, conceptual studies, conference papers, and review papers, as we are interested in empirical evidence of mixed methods in innovation management research. We excluded studies that used the same dataset and stated the same correlations as in previously published papers.

The meta-summary examined relationships between the application and the characteristics of mixed methods in innovation management research. In the included studies, a sequential mixed methods study with two stages was undertaken to identify mixed methods articles and determine their main characteristics. In the first phase, a qualitative stage was used in the manual search strategy for the purpose of determining whether each article represented a non-empirical, quantitative, qualitative or mixed methods study. This deep analysis involved using all information presented in each article starting from the title, which is followed by keywords, abstract, introduction, literature review, methods,

results, and finally discussion and conclusions. After a precise investigation of their content, including analysis of individual tables by journal and by year, listing the journal title, year, number of total articles, number of non-empirical articles, number of quantitative articles, number of qualitative articles and number of mixed methods articles. A database was created to compare different types of papers, techniques, methods, objects of analysis and a summary of findings. Once the mixed methods articles were identified, they were re-examined through a content analysis and coded according to two main dimensions: implementation of data collection (simultaneous or sequential) and priority (equal or dominant status of the quantitative and qualitative parts). In another phase, descriptive statistics were used for the quantitative analysis of prevalence, for providing sums and percentages depending on the type of article (non-empirical, quantitative, qualitative and mixed methods articles). Furthermore, regarding the mixed methods articles, numbers and percentages by type of priority (equal or dominant status), type of implementation (simultaneous or sequential) and purpose were also provided.

4. Characteristics of the Included Studies

As Figure 1 shows, the number of studies investigating the use of mixed methods approach in innovation management research has increased rapidly in recent years. There is a notable growth in publications from 2014, which suggests that mixed methods in innovation management research have grabbed the attention of academics as well as practitioners. Another purpose of the large number of publications in 2014 was raising the number of citations in the same year (see Figure 2). The observed number of citations shows small randomness in relation to the number of publications (see Figures 1 and 2), even considering the publishing cycle.

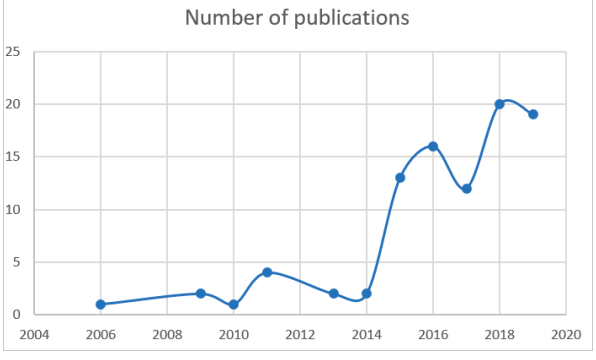

Figure 1. Number of publications of the studied literature collection (source: own study).

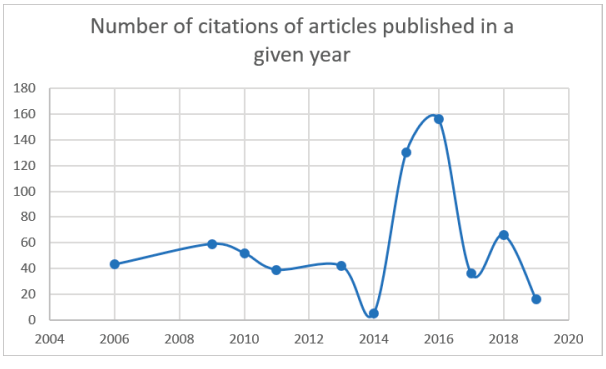

Figure 2. Number of citations of the studied literature collection (source: own study).

This is due to two phenomena: the first is the high homogeneity of the publications, expressed by many citations (International Journal of Production Research and Journal of Product Innovation Management are the most appropriate journals for targeting texts related to this issue as those have the largest number of citations).

Only "Technological Forecasting and Social Change" has published five articles; they appear in stable time intervals (2006, 2015, 2018, 2019). The next are "R & D Management", "Journal of Business Research", with four and three publications, respectively. "Technological Forecasting and Social Change" has (according to the average: 2006, 2015, 2018, 2019) the most recent articles of them all and is in an upward trend.

The second reason is the large number of publications in general, which is noticeable in the form of small fluctuations in the number of publications. During bibliometric analysis of 4185 references we noticed that 13 authors out of 314 worked on five publications from the collection. This indicates the lack of chances of specialization in the topic.

Compared with Lotka's schedule (Lotka 1926) in de Solla Price's interpretation (Price 1986), this is the number of publications above the elite borderline (i.e., 10 publications), since there is a theoretical capacity for the author who would be responsible for 13 publications (with c = 314 n = 2 for Lotka's distribution should be 1.858 author with 13 publications). It is also an argument demonstrating that this topic started to be a part of knowledge on innovation management research.

We also examined the superficial content of the articles using the RAKE method (Berry and Kogan 2010) to identify keywords. The udpipe package (Straka and Straková 2017) for the language R (R Core Team 2018) was used for this purpose; the method was carried out on lemmas (basic forms of expression), so as not to multiply variations of the same phrases. The set of keywords identified from the abstracts is quite extensive (see Figure 3). The mixed methods approach shows the greatest link here as well as open innovation processes and innovation management and regional competitiveness. These are all concepts identified as essential for mixed methods in the innovation management topic, whose relationship with the examined subject is sometimes not obvious.

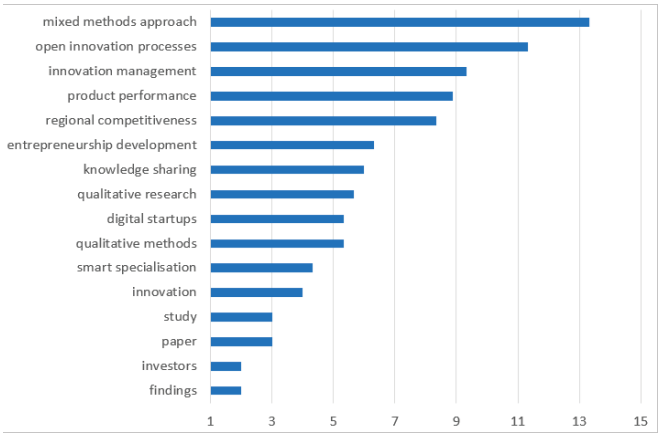

Figure 3. Identification of keywords by the Rapid Automatic Keyword Extraction method (RAKE) (source: own study).

We examine the recent information visualization phenomenon known as tag clouds, which are an interesting combination of data visualizations (Hearst and Rosner 2008). We used this method to compare the results using two different techniques. Figure 4 demonstrates that most keywords are repeated in both figures, which means two tests were carried out correctly.

Figure 4. Identification of keywords in a tag cloud representation (source: own study).

After a summary review of the collection due to its separation, it is worth going back to the properties of the publications related to their individual characteristics associated with geographical division of the threads into countries and content meta-summaries. The utilization of the mixed methods approach in innovation management research can be divided into several groups, in terms of the usage of those mixed methods in paper, which will be reflected in network analysis of collaboration between authors and in the analysis of co-occurrence and frequency.

5. Discussion of the Results of Systematic Literature Review and Meta-Summary

Application of mixed methods in research can open a new methodological approach for researchers. Numerous typologies and ordering of mixed methods have been proposed (Bryman 2007; Leech and Onwuegbuzie 2009), but in research studies the method that gives the best results (Bloch et al. 2014) is the typology proposed by Leech and Onwuegbuzie (2009). The advantage is in considering three dimensions in the proposed typology: degree of integration of mixed methods, their dependence over time and the weight assigned to individual methods. The first criterion indicates to what extent such elements of the research plan of a single research process, like the purpose of the research, the type of data and operations performed on it, the type of analysis and the type of inference performed, consider quantitative and qualitative methods. The second criterion is about whether different methods are used concurrently or sequentially in a study. The third criterion shows whether any of the methods in the study is dominant or whether they are treated complementarily.

Based on these criteria, eight types of mixed methods are distinguished in our article: (1) partially mixed complementary concurrent methods, (2) partly mixed dominant concurrent methods, (3) partly mixed complementary sequential methods, (4) partially mixed dominant sequential methods, (5) fully mixed complementary concurrent methods, (6) fully mixed dominant concurrent methods, (7) fully mixed complementary sequential methods, (8) fully mixed dominant sequential methods (Creswell and Clark 2017).

The partially mixed complementary concurrent methods approach occurs when the test plan provides for two phases of the study—quantitative and qualitative—implemented at the same time and their test results are given equal weight (Ahmadi and Osman 2020; Ghaben and Jaaron 2017; Birdthistle et al. 2016). An example of such a study (Birdthistle et al. 2016) explores the creation of realistic, engaging entrepreneurial competences among second-cycle students in the Republic of Ireland. The quantitative study concentrated on this case, on the comparison of student efficiency, in the case of teacher interactions with the Student Enterprise Awards (SEA) program in relation to the lack of access to a given program during the semester and at the end of it. The qualitative approach involved 29 partially structured interviews with teachers and nine school principals. This example illustrates the first type of mixed methods, because data were collected in parallel, and combinations

of methods and results were made only at the last stage, when the data were collected and analyzed adequately using individual methods (qualitative and quantitative).

Partially mixed dominant concurrent methods occur when the plan research provides for two phases of research—quantitative and qualitative—implemented at the same time, the results of which are assigned different weights. An example is Hofmann (2015) research focusing on the question of who the companies should address in order to be able to make complex long-term decisions, come up with a vision and develop products and services that will appear on the market in a few years. A quantitative study to review existing concepts in this case had a smaller role than the qualitative study (questionnaire and interviews). Data collection and analysis were made prior to comparison and drew conclusions from the entire study.

Partially mixed complementary sequential methods occur when test phases using different methods follow one another and have the same weight in assessing test results. Based on the results of exploring the selected articles database (see Appendix A), seven authors used a given type of method (Yström et al. 2015; Jafarnejad et al. 2014; Siripongdee and Fongsuwan 2015; Barak and Usher 2019; Korneta 2019; Cortimiglia et al. 2016; Hoffmann 2011). An example of this variation of the mixed method is the article (Yström et al. 2015), which explored the creative climate in the open arena of innovation called SAFER, where 26 partner organizations meet to innovate together. First, a quantitative randomized study, i.e., a quantitative creative climate questionnaire, was conducted. The second phase of the study took place towards the end of the program and covered it and supplemented the data through interviews; the interviews were to reflect the perspective of the experience of group members related to the program. The analysis of the results of individual stages was made separately, and the combination was conducted only at the stage of data interpretation.

Partially mixed dominant sequential methods occur when one of the methods used in the sequential system is treated as more important in determining the results of the entire study. This type of method is very popular in our article database because it was used in 47 articles (Hankammer et al. 2019; Teixeira et al. 2019; Jensen 2011; Blindenbach-Driessen et al. 2010; Lagos and Kutsikos 2011; Radovanović et al. 2017; AI and Wu 2016a, 2016b; Bouette and Magee 2015; Teirlinck and Spithoven 2013; Walwyn et al. 2019; Almeida et al. 2019; Ghezzi 2019; Duarte and Pinho 2019; Burleson et al. 2019; van de Burgwal et al. 2019; Olsson et al. 2019; Harrison et al. 2018; Chasanidou et al. 2018; Reinhardt and Gurtner 2018; Ilonen et al. 2018; Al-edenat 2018; Holis et al. 2018; Geyskens et al. 2009; Cowell et al. 2018; Al-Husseini and Elbeltagi 2018; Tu 2018; Perenyi et al. 2018; Grimpe et al. 2017; Kılkış 2017; Bala and Venkatesh 2017; Lucas et al. 2016; Kopcha et al. 2016; Boerchers et al. 2016; Klingebiel and Joseph 2016; McCarthy et al. 2016; Swartz et al. 2016; Bakhshi et al. 2015; Udawatta et al. 2015; Timma et al. 2015; Owusu-Manu et al. 2015; (Maurice Khosa and Kalitanyi 2015; Flores Ituarte et al. 2018; Saunila 2017; Walravens 2015; Abubakar 2015; Dadfar et al. 2013; de Miranda Santo et al. 2006). Most often, the dominant method was the quantitative method used at the beginning of the study (in 25 articles), while in 22 the dominant method was the qualitative one. For example, authors (de Miranda Santo et al. 2006) in their study concentrated on analysis conducted by the Center for Management and Strategic Studies related to the research and development in nanotechnology to provide recommendations to the Brazilian government agencies on improving the competitiveness of selected sectors of the country's economy. The first stage—which was the dominant phase—involved data monitoring using text mining techniques. The second stage involved the use of quantitative methods to support the decision-making process related to establishing policies and activities. The next article concerned exploring utilization of the mobile city applications by citizens of Brussels, where the use of the iTunes App Store and Google Play applications was analyzed (Walravens 2015). Quantitative data was supplemented by qualitative interviews by experts with individuals in this field, such as city councilors, representatives of interest groups and developers.

Fully mixed complementary concurrent methods occur when a combination of different approaches—treated as equally important in assessing the result—is made on at least one of the elements of a single research process: determining the purpose of the study, choosing the type of data

and activities performed, choosing the type of analysis or the type of inference. Different approaches are used in parallel at one or more stages of the research process. An example of this type of approach is the analysis of the nonscientific achievements of traditional disciplines and their reference citations in various disciplines (Corsi and Prencipe 2018). The study was based on the analysis of quantitative and qualitative results, which should already be considered a combination of these two types of approaches at the stage of determining the purpose of the study. This combination was also made at the data analysis and inference stage. The authors of two subsequent articles (Islam and Miyazaki 2009); (Crammond et al. 2018) also used this approach, using in their methods questionnaires with closed and open questions.

Fully mixed dominant concurrent methods occur when methods are combined in the scope of the elements of the research process—qualitative and quantitative, with one of them being treated as more important when determining the test result. Examples of such method combinations may be found in the following studies: (Hwang and Katayama 2009); (Kruger et al. 2018); (Kraus et al. 2018); (JosephNg 2018); (Kapasi and Grekova 2018) (Fu et al. 2018); (Ho et al. 2016); (Vicente-Oliva et al. 2016); (Hayter 2016); (Monsson and Jørgensen 2016). One of the mentioned articles was about examining students' perceptions and perspectives in relation to self-determination of learning in the context of entrepreneurial education (Kapasi and Grekova 2018). Data—both quantitative and qualitative—was obtained by means of a questionnaire and the combination of methods was made at the stage of determining the purpose of research, data analysis and conducted conclusions.

Similar research was performed in the study by Monsson and Jørgensen (2016). The authors presented differences in the characteristics of entrepreneurs, which influenced the benefits that resulted from various elements of the regional incubator program.

Fully mixed complementary sequential methods occur when a combination of different approaches is made on at least one element of the research process. Different approaches are used sequentially—one after another—at one or more stages of the research process, with both approaches given the same weight in determining the result of the study. Examples of this combination could be observed in the research conducted by Hu and McGrath (2011) and Hu and McGrath (2011). In the former, the potential utility of Maslow's theory in understanding technology adoption was examined. Initially, quantitative measures were considered, then these results were compared with the results obtained using a qualitative study. The second article describes a teacher development study related to the expansion of information and communication technologies (ICT) in the context of the national reform of English language teaching. Four groups of teachers were distinguished, considering quantitative measures of pedagogical effectiveness and sources of student success (external vs. internal). These groups were then compared with the received qualitative teacher study data.

Fully mixed dominant sequential methods and fully mixed complementary sequential methods occur in similar cases, but one approach is given greater weight in determining the final test result. An example of such a combination is research in 12 articles from the database (Imran and Gregor 2019; Lütjen et al. 2019; Shen 2019; Grimsby and Kure 2019; Yetis Larsson et al. 2019; Malan et al. 2019; Bican et al. 2017; Fellnhofer 2017a, 2017b; Thomas 2017; Berker and Throndsen.Throndsen 2017; O'Dwyer and Cormican 2017). One article (Bican et al. 2017) examined the way in which companies best manage knowledge through intellectual property rights in open innovation processes.

In the first phase of the study, qualitative methods (focus groups and interviews) were used, which provided information on the activities of the organizations studied. In the second, quantitative phase, a questionnaire was used which contained narrowed and more specifically targeted questions. In the last qualitative phase, focus groups were reused and the research focused on one topic—sources of customer satisfaction of this organization. The next phases of the study were planned based on data and results obtained in the preceding phase, and qualitative research was decisive in determining the results of the entire study.

Theoretical papers (Lecossier et al. 2019a, 2019b; Edling and Danks 2018; (McAdam and Debackere 2018; Guidice et al. 2016; Spiegel and Marxt 2015; Titarenko et al. 2014) were not included in our analysis.

Regarding the conclusions derived from our study, several aspects may be emphasized. First, regarding the characteristics of identified articles with mixed methods, 92% of the entire database were empirical articles, and the most common purpose for using mixed methods in research on innovation management was development; the most common priority type was priority of quantity and quality. Additionally, sequential implementation of data collection was the most common implementation pattern used in the studied field.

The description of our dataset (out of 93 articles analyzed), shows that around a half of the analyzed articles (50.54%) use partially mixed dominant sequential methods, 12.90% fully mixed dominant sequential methods and 11.83% fully mixed dominant concurrent methods. As shown, partially mixed dominant sequential methods were common, as data were collected sequentially, initially with quantitative data gathering. The researchers believe that mixed methods have allowed the expansion of the statistical data interpretation because qualitative findings have helped to elaborate on the quantitative results in order to fully address the research questions and have profoundly elucidated the "real" phenomenon. Moreover, mixing the methods has also allowed a deeper examination of the research problem because qualitative methods were used to re-examine research questions, research objectives and the assumptions underlying each component proposed in the study. Mixed methods achieved two major goals related to theory verification and theory generation.

Second, the analysis of the number of studies of mixed methods in innovation management shows great variation year to year, and journal to journal. There is a clear growing trend in the publication of mixed methods research in innovation management in the case of the studied journals. Third, it can be indicated that it is very difficult to classify a given article into one area because various aspects are being described in many articles. The increase in publication from year to year may indicate that the topic is constantly being updated.

In the presentation of the meta-summary results, we begin with showing geographical coverage patterns of the articles analyzed in our study (Figure 5). Since authors from different countries cooperate with each other in order to obtain unambiguous results, we applied the lead author's affiliation as a determinant for the articles being discussed. Most of the studies included in our analysis have been conducted in the USA (10 papers), United Kingdom (7 papers), Germany (7 papers) and Australia (5 papers).

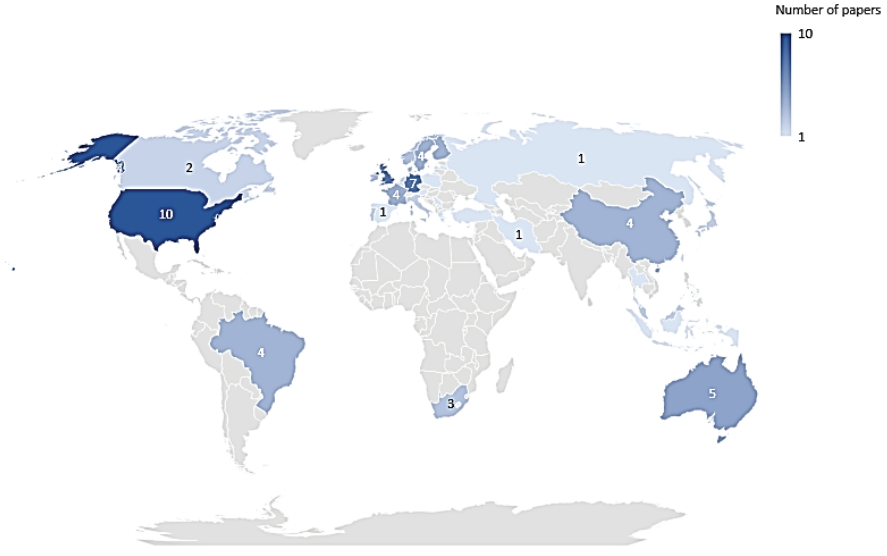

Figure 5. Frequency of the publication per country—by the lead author's affiliation (source: own study).

The analysis of cooperation networks (Figure 6) between authors from different countries shows a high rate of cooperation of countries such as the USA, Germany, Denmark, Italy and the UK. Still, many researchers decide only to research with authors from their own country. It is evident that the network of connections of such clusters as Singapore and China does exist, and connections are paradoxically not obvious between Ireland and Belgium, despite obvious economic, cultural or geographic relations.

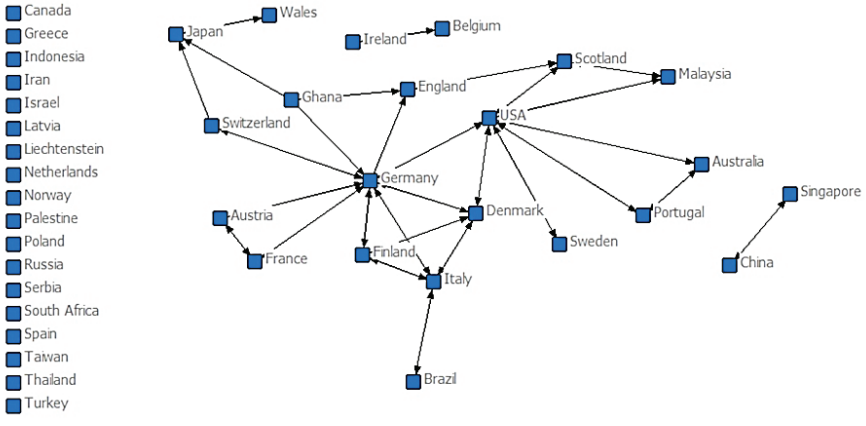

Figure 6. Network analysis of collaboration between authors (source: own study).

The bibliographic data from Scopus with an ris extension was converted to the .txt extension of plain-text format used by Web of Science with the Cite Space converter utility (Chen 2006). Then, based on these two files, a keywords co-occurrence network was created and analyzed with VOS viewer (van Eck and Waltman 2010). There were 871 unique keywords, 29 appeared at least 5 times, and this was chosen as a threshold for the research, to eliminate purely accidental and unrelated keywords. Three thematic clusters (see Figure 7) were formed.

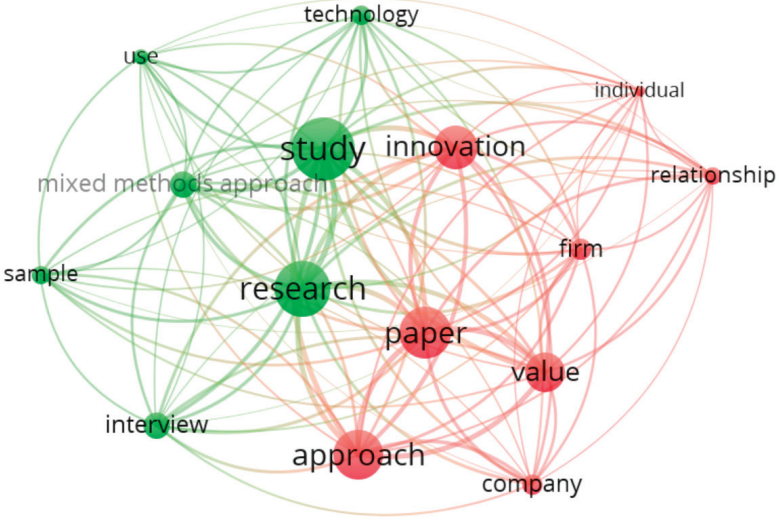

Figure 7. Keywords co-occurrence network with colored clusters, node size by number of occurrences (source: own study).

Modularity of thematic network means that, apart from the central concepts that are obvious given the query types (mixed methods and innovation management), there are other research areas highly related to the scope of the query, like business, knowledge management, or countries such as the UK and USA. This outcome brings two additional conclusions. Firstly, it means that these identified areas should be subjected to additional, deepened literature analysis leading to better categorization of the related areas (clusters) of knowledge. Secondly, further analysis that would enhance understanding of this division's nature and explore social aspect of links is required to fully understand the leading authors, countries (USA and UK) and possible knowledge gaps.

6. Conclusions

Analysis using a mixed methods approach in innovation management research seems to be an interesting topic for academicians and practitioners because of its positive effects on organizational performance as well as growing interest in the subject of innovation and thus implementation in the culture of the organization. Companies seek to gain a competitive advantage by using innovation more effectively in enterprises.

Regardless of the increasing number of studies referring to mixed methods in innovation management research, there is a lack of studies that integrate and synthesize this body of knowledge. To advance our understanding of the various methods of innovation management, we carried out analyses of mixed methods in innovation management and we presented the results using figures. The results contained will be useful to scientists interested in using individual methods in research and using them in research. Additionally, this study offers a good starting point for future research to do more thorough research into the given method.

This study reported on the characteristic of mixed methods in innovation management research present in the existing literature. Regardless of the increased number of studies referring to this topic, there is a lack of review of this body of knowledge. This study answers a call by Cameron and Molina-Azorin (2011) and Cameron and Molina-Azorin (2011) for a systematic literature review. In addition, consistent with recent recommendations to develop an advanced standard of methodological rigor of reviews of the management literature (Newbert 2007), we analyzed 93 articles published in seventy-one academic journals using a systematic literature review approach. Our paper is a compendium of knowledge in the field of mixed methods in innovation management that analyzes the most important publications in a given field published in the Web of Science and Scopus databases.

Based on the literature review, it can be concluded that some studies reveal conflicting findings regarding the use of mismatched methods in the innovation management literature, which makes it difficult to draw general conclusions. Some authors believe that it is worth starting their research by conducting partially mixed dominant sequential methods.

As Mason (Mason 2006) indicated, mixing methods offers enormous potential for exploring new dimensions. The predominance of more quantitative-based methodological tools in innovation management research does not mean that these tools are applicable to all research questions. The research question and context should dictate the choice of the appropriate research methods. We would like to indicate that the knowledge about mixed methods research can stimulate a researcher to better define and analyze innovative problems and research questions in innovation management research. Hopefully, this review of management empirical studies which have used mixed methods designs along with the ideas offered for the application of mixed methods studies may favor progress on innovation management research.

Some limitations of our research should be explicated. One limitation of this study to mention is the selection of the articles, since some papers may have not been included due to missing keywords or owing to the fact that articles have not been included in the search in the two chosen databases. We only included peer reviewed journal articles in our study and excluded books and conference proceedings. Moreover, excluding unpublished articles may introduce a bias into the effect size of our result. While such an issue is common in most meta-summaries (Sandelowski and Barroso 2003) our

result should be interpreted with caution. In our view, extensive searches into two databases illustrate the current state of research into mixed methods in innovation management. Nevertheless, future research on a given topic may show the phenomenon in a different way due to the inclusion of other databases and the inclusion of unpublished research.

Finally, regarding future research, although the current study attempts to extend the knowledge of the application of mixed methods research in management research, much remains to be learned. For example, it would be interesting to analyze the yield from mixed methods studies regarding the added value of these articles, or the contribution to the improvement of several methodological aspects such as validity or construct measurement. Moreover, an analysis of the use and application of mixed methods research in other organizational and management fields would also be interesting and could expand upon the research reported here. Further research is also required to develop a deeper understanding of the relationship between the element of commitment and innovation performance improvement. For this purpose, it is worth exploring the management of relationships between enterprises for sustainable social development and examining the impact of the buyer-supplier relationship in terms of innovation (Awan 2019; Awan et al. 2018).

Additionally, thanks to future application of bibliometric analysis and cluster analysis of the co-citation analysis, studies could offer a comprehensive and up-to-date identification and assessment of trends in mixed methods utilization in innovation management research.

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Appendix A

List of articles included for literature review by year (source: own study)

Source Title	Authors	Year	Cited by
International Journal of Business Innovation and Research	Ahmadi M., Osman M.H.M.	2020	0
INTERNATIONAL JOURNAL OF INNOVATION SCIENCE	Almeida, Fernando; Kennedy, Andrew John; Lin, Brook; Nowak, Irina V.	2019	0
COMPUTERS & EDUCATION	Barak, Miri; Usher, Maya	2019	3
ENERGY RESEARCH & SOCIAL SCIENCE	Burleson, Grace; Tilt, Bryan; Sharp, Kendra; MacCarty, Nordica	2019	0
JOURNAL OF BUSINESS RESEARCH	Duarte, Paulo; Pinho, Jose Carlos	2019	3
TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	Ghezzi, Antonio	2019	3
BRITISH FOOD JOURNAL	Grimsby, Sveinung; Kure, Cathrine Finne	2019	0
Journal of Cleaner Production	Hankammer S., Brenk S., Fabry H., Nordemann A., Piller F.T.	2019	3

Source Title	Authors	Year	Cited by
INFORMATION TECHNOLOGY & PEOPLE	Imran, Ahmed; Gregor, Shirley	2019	0
BRITISH FOOD JOURNAL	Korneta, Piotr	2019	0
INFORMATION AND ORGANIZATION	Larsson, Zeynep Yetis; Di Gangi, Paul M.; Teigland, Robin	2019	1
International Journal of Services Operations and Informatics	Lecossier A., Pallot M., Crubleau P., Richir S.	2019	2
AI EDAM-ARTIFICIAL INTELLIGENCE FOR ENGINEERING DESIGN ANALYSIS AND MANUFACTURING	Lecossier, Adrien; Pallot, Marc; Crubleau, Pascal; Richir, Simon	2019	0
JOURNAL OF BUSINESS RESEARCH	Luetjen, Heiner; Schultz, Carsten; Tietze, Frank; Urmetzer, Florian	2019	0
INTERNATIONAL REVIEW OF RETAIL DISTRIBUTION AND CONSUMER RESEARCH	Olsson, Annika; Paredes, Karla Marie B.; Johansson, Ulf; Roese, Malin Olander; Ritzen, Sofia	2019	0
JOURNAL OF THE ASSOCIATION FOR INFORMATION SCIENCE AND TECHNOLOGY	Shen, Yi	2019	0
Management Research Review	Teixeira E.K., Oliveira M., Curado C.	2019	0
JOURNAL OF TECHNOLOGY TRANSFER	van de Burgwal, Linda H. M.; Dias, Ana; Claassen, Eric	2019	0
INTERNATIONAL JOURNAL OF TECHNOLOGY MANAGEMENT	Vlok, Awie; Ungerer, Marius; Malan, Johan	2019	0
JOURNAL OF MANUFACTURING TECHNOLOGY MANAGEMENT	Walwyn, David; Bertoldi, Andreas; Gable, Christian	2019	1
JOURNAL OF ORGANIZATIONAL CHANGE MANAGEMENT	Al-edenat, Malek	2018	3
INNOVATIONS IN EDUCATION AND TEACHING INTERNATIONAL	Al-Husseini, Sawasn; Elbeltagi, Ibrahim	2018	0
CREATIVITY AND INNOVATION MANAGEMENT	Chasanidou, Dimitra; Sivertstol, Njal; Hildrum, Jarle	2018	0
INTERNATIONAL JOURNAL OF ENTREPRENEURIAL VENTURING	Corsi, Christian; Prencipe, Antonio	2018	0
JOURNAL OF ENTERPRISING COMMUNITIES-PEOPLE AND PLACES IN THE GLOBAL ECONOMY	Cowell, Margaret; Lyon-Hill, Sarah; Tate, Scott	2018	3
BALTIC JOURNAL OF MANAGEMENT	Crammond, Robert; Omeihe, Kingsley Obi; Murray, Alan; Ledger, Kirstin	2018	1
ENERGY RESEARCH & SOCIAL SCIENCE	Edling, Laura; Danks, Cecilia	2018	1
LEADERSHIP & ORGANIZATION DEVELOPMENT JOURNAL	Fu, Lihua; Liu, Zhiying; Liao, Suqin	2018	1
ASIA PACIFIC JOURNAL OF MANAGEMENT	Harrison, Richard; Scheela, William; Lai, P. C.; Vivekarajah, Sivapalan	2018	3

Source Title	Authors	Year	Cited by
1ST ITB CENTENNIAL AND 4TH PLANOCOSMO INTERNATIONAL CONFERENCE	Holis, Y. M.; Syabri, I.; Prabatmojo, H.	2018	0
INTERNATIONAL JOURNAL OF ENTREPRENEURIAL BEHAVIOUR & RESEARCH	Ilonen, Sanna; Heinonen, Jarna; Stenholm, Pekka	2018	5
RAPID PROTOTYPING JOURNAL	Ituarte, Inigo Flores; Chekurov, Sergei; Tuomi, Jukka; Mascolo, Julien Etienne; Zanella, Alessandro; Springer, Patrick; Partanen, Jouni	2018	3
TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	JosephNg, P. S.	2018	1
EDUCATION AND TRAINING	Kapasi, Isla; Grekova, Galina	2018	3
JOURNAL OF BUSINESS RESEARCH	Kraus, Sascha; Kallmuenzer, Andreas; Stieger, Daniel; Peters, Mike; Calabro, Andrea	2018	5
JOURNAL OF CLEANER PRODUCTION	Kruger, Claudia; Gusmao Caiado, Rodrigo Goyannes; Braga Franca, Sergio Luiz; Goncalves Quelhas, Osvaldo Luiz	2018	6
R & D MANAGEMENT	McAdam, Maura; Debackere, Koenraad	2018	10
INTERNATIONAL JOURNAL OF ENTREPRENEURIAL BEHAVIOUR & RESEARCH	Perenyi, Aron; Zolin, Roxanne; Maritz, Alex	2018	8
TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	Reinhardt, Ronny; Gurtner, Sebastian	2018	3
INTERNATIONAL JOURNAL OF LOGISTICS MANAGEMENT	Tu, Mengru	2018	10
BUSINESS PROCESS MANAGEMENT JOURNAL	Bala, Hillol; Venkatesh, Viswanath	2017	2
JOURNAL OF ENVIRONMENTAL POLICY & PLANNING	Berker, Thomas; Throndsen, William	2017	1
JOURNAL OF KNOWLEDGE MANAGEMENT	Bican, Peter M.; Guderian, Carsten C.; Ringbeck, Anne	2017	12
INTERNATIONAL JOURNAL OF KNOWLEDGE-BASED DEVELOPMENT	Fellnhofer, Katharina	2017	2
JOURNAL FOR INTERNATIONAL BUSINESS AND ENTREPRENEURSHIP DEVELOPMENT	Fellnhofer, Katharina	2017	0
International Journal of Project Organisation and Management	Ghaben R.K., Jaaron A.A.M.	2017	2
JOURNAL OF PRODUCT INNOVATION MANAGEMENT	Grimpe, Christoph; Sofka, Wolfgang; Bhargava, Mukesh; Chatterjee, Rabikar	2017	9
MANAGEMENT OF ENVIRONMENTAL QUALITY	Kilkis, Siir	2017	0

Source Title	Authors	Year	Cited by
Journal of technology management & innovation	O'Dwyer, Clare; Cormican, Kathryn	2017	1
ENTREPRENEURIAL BUSINESS AND ECONOMICS REVIEW	Radovanovic, Nikola; Dmitrovic, Veljko; Joksimovic, Nevenka Zarkic	2017	1
MEASURING BUSINESS EXCELLENCE	Saunila, Minna	2017	6
BUSINESS PROCESS MANAGEMENT JOURNAL	Thomas, Ashish	2017	0
INDUSTRIAL MANAGEMENT & DATA SYSTEMS	Ai, Chi-Han; Wu, Hung-Che	2016	2
JOURNAL OF ORGANIZATIONAL CHANGE MANAGEMENT	Ai, Chi-Han; Wu, Hung-Che	2016	5
EDUCATION AND TRAINING	Birdthistle, Naomi; Costin, Yvonne; Hynes, Briga	2016	3
EXTRACTIVE INDUSTRIES AND SOCIETY-AN INTERNATIONAL JOURNAL	Boerchers, Morrissa; Fitzpatrick, Patricia; Storie, Christopher; Hostetler, Glen	2016	3
R & D MANAGEMENT	Cortimiglia, Marcelo Nogueira; Ghezzi, Antonio; Frank, Alejandro German	2016	35
JOURNAL OF BUSINESS RESEARCH	Guidice, Rebecca M.; Mero, Neal P.; Matthews, Lucy M.; Greene, Juanne V.	2016	6
RESEARCH POLICY	Hayter, Christopher S.	2016	43
TECHNOVATION	Ho, Yuen-Ping; Ruan, Yi; Hang, Chang-Chieh; Wong, Poh-Kam	2016	8
STRATEGIC MANAGEMENT JOURNAL	Klingebiel, Ronald; Joseph, John	2016	14
BRITISH JOURNAL OF EDUCATIONAL TECHNOLOGY	Kopcha, Theodore J.; Rieber, Lloyd P.; Walker, Brandy B.	2016	5
IEEE TRANSACTIONS ON PROFESSIONAL COMMUNICATION	Lucas, Kristen; Kerrick, Sharon A.; Haugen, Jenna; Crider, Cole J.	2016	3
BRITISH FOOD JOURNAL	McCarthy, Breda; Liu, Hong-Bo; Chen, Tingzhen	2016	17
JOURNAL OF SMALL BUSINESS AND ENTERPRISE DEVELOPMENT	Monsson, Christian Kjaer; Jorgensen, Soren Berg	2016	8
INDUSTRIAL MARKETING MANAGEMENT	Purchase, Sharon; Kum, Christina; Olaru, Doina	2016	4
INTERNATIONAL JOURNAL OF GENDER AND ENTREPRENEURSHIP	Swartz, Ethne; Amatucci, Frances M.; Coleman, Susan	2016	0
INTERNATIONAL JOURNAL OF INNOVATION MANAGEMENT	Vicente-Oliva, Silvia; Martinez-Sanchez, Angel; Berges-Muro, Luis	2016	0
WORLD JOURNAL OF ENTREPRENEURSHIP MANAGEMENT AND SUSTAINABLE DEVELOPMENT	Abubakar, Habib Auwal	2015	3

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RESEARCH POLICY	Bakhshi, Hasan; Edwards, John S.; Roper, Stephen; Scully, Judy; Shaw, Duncan; Morley, Lorraine; Rathbone, Nicola	2015	7
JOURNAL OF SMALL BUSINESS AND ENTERPRISE DEVELOPMENT	Bouette, Martin; Magee, Florence	2015	6
TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	Hofmann, Rupert	2015	7
JOURNAL OF ENTERPRISING COMMUNITIES-PEOPLE AND PLACES IN THE GLOBAL ECONOMY	Khosa, Risimati Maurice; Kalitanyi, Vivence	2015	10
JOURNAL OF ENGINEERING DESIGN AND TECHNOLOGY	Owusu-Manu, D.; Quaigrain, R.; Edwards, D. J.	2015	1
ENGINEERING CONSTRUCTION AND ARCHITECTURAL MANAGEMENT	Singh, Vishal; Holmstrom, Jan	2015	14
Research Journal of Business Management	Siripongdee S., Fongsuwan W.	2015	2
INTERNATIONAL JOURNAL OF ENTREPRENEURIAL VENTURING	Spiegel, Markus; Marxt, Christian	2015	0
INTERNATIONAL SCIENTIFIC CONFERENCE ENVIRONMENTAL AND CLIMATE TECHNOLOGIES, CONECT 2014	Timma, Lelde; Blumberga, Andra; Blumberga, Dagnija	2015	2
RESOURCES CONSERVATION AND RECYCLING	Udawatta, Nilupa; Zuo, Jian; Chiveralls, Keri; Zillante, George	2015	41
TELEMATICS AND INFORMATICS	Walravens, Nils	2015	32
European Journal of Innovation Management	Yström A., Aspenberg H., Kumlin A.	2015	5
Research Journal of Applied Sciences, Engineering and Technology	Jafarnejad A., Mohaghar A., Manteghi M., Yasaei M.	2014	0
PROGRESS IN INDUSTRIAL AND CIVIL ENGINEERING III, PT 1	Titarenko, B.; Titov, S.; Titarenko, R.	2014	5
TOTAL QUALITY MANAGEMENT & BUSINESS EXCELLENCE	Dadfar, Hossein; Dahlgaard, Jens J.; Brege, Staffan; Alamirhoor, Amir	2013	23
R & D MANAGEMENT	Teirlinck, Peter; Spithoven, Andre	2013	19
EUROPEAN JOURNAL OF MARKETING	Hoffmann, Stefan	2011	18
TECHNOLOGY PEDAGOGY AND EDUCATION	Hu, Zhiwen; McGrath, Ian	2011	18
International Journal of Knowledge, Culture and Change Management	Jensen K.R.	2011	2
European Research Studies Journal	Lagos D., Kutsikos K.	2011	1

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Journal of Product Innovation Management	Blindenbach-Driessen F., Van Dalen J., Van Den Ende J.	2010	52
International Journal of Production Research	Hwang R., Katayama H.	2009	57
SCIENCE AND PUBLIC POLICY	Islam, Nazrul; Miyazaki, Kumiko	2009	2
TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	Santo, Marcio de Miranda; Coelho, Gilda Massari; dos Santos, Dalci Maria; Filho, Lelio Fellows	2006	43

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Innovative Work Behavior—A Key Factor in Business Performance? The Role of Team Cognitive Diversity and Teamwork Climate in This Relationship

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Abstract: The aim of our paper is to examine whether the support of innovative work behavior by management is positively related to business performance and at the same time, whether this relationship is mediated by the teamwork climate and cognitive diversity of teams. Cognitive diversity is defined as differences in knowledge and perspective, which arise from professional diversity and account for its positive effects. A teamwork climate represents staff perceptions of collaboration between personnel. Business performance is defined by the level of sales. Our sample consisted of 211 managers of companies operating in Slovakia, and data collection took place in the form of a questionnaire. The main tool for examining the mechanism of operation of the investigated relationships is mediation using regression analysis and the Sobel test to determine the significance of the indirect effect of mediation variables. The findings point to a significant direct relationship between the innovative work behavior of company employees and business performance. The intensity of this relationship can be partly influenced by promoting cognitive diversity, especially in the area of knowledge and ways of thinking. The significant role of a teamwork climate was not demonstrated in the examined model.

Keywords: management; innovative work behavior; business performance; cognitive diversity; teamwork climate

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1. Introduction and Theoretical Background

The context of the study stems from the fact that innovation is currently considered one of the basic preconditions for business competitiveness. Several studies have shown a positive relationship between the performance of companies and their innovation potential. Organizational performance is multidimensional, connected to the goals and objectives of organizations, and can be defined as an organization's ability to use its resources efficiently and create outputs that are consistent with its objectives and relevant for its users (Peterson et al. 2003). Organizations that continually innovate have been found to achieve a higher level of organizational performance (Ogbonnaya and Valizade 2016). According to Cainelli et al. (2004), innovating firms tend to have higher levels of productivity and economic growth compared to zero-innovating companies. Thanks to innovative performance, companies are able to gain and maintain a competitive advantage (Martins and Terblanche 2003; Lin et al. 2018). Therefore, much of the current research focuses on the study of the innovative activity of companies and factors that could support it. Therefore, we consider it equally important to examine the issue of innovative behavior in the context of the diversity of knowledge and working conditions that companies create for their employees in more depth.

Innovative business behavior is directly related to the ability of employees to create and implement new ideas and solutions (Janssen 2000), simplify processes, and improve collaboration (Messmann and Mulder 2012). As it is obvious that employees are an essential

part of the innovation process of companies, supporting their innovative behavior plays a key role in this regard. According to Thurlings et al. (2015), innovative work behavior (IWB) is crucial for business sustainability.

Studies on innovation management show the positive effect of cognitive diversity (CD) in the context of the teams' abilities to create new innovative solutions (Mitchell et al. 2017). The positive impact of CD on innovative behavior lies in the breadth of expertise found in inter-functional groups, enabling problems to be identified and more innovative solutions leading to process improvements to be implemented (Mitchell et al. 2017). According to Chow (2018), diverse groups have a broader base of experience that can be used to generate innovative problem-solving ideas. Thus, if companies purposefully support CD, they can positively influence their innovation potential.

Several studies present findings that a teamwork climate (TWC) also contributes to increasing employee performance (Bogan and Dedeoglu 2017) as well as the company as a whole (Ali et al. 2018). This positively affects the perceived sense of security of employees (Weng et al. 2017; Lee et al. 2015) and reduces the risk of their burnout (Bowers et al. 2011). The relationship between TWC and the rate of innovation in enterprises is still under investigation (Fay et al. 2014). The role of knowledge sharing and learning is emphasized as a contribution to innovation processes (Basadur and Gelade 2006; Maccurtain et al. 2009), which make it easier for team members to share knowledge and insights. Autonomy within teams leads to responsibility and increases internal motivation, which, in turn, is associated with the generation and implementation of new ideas (Urbach et al. 2010). Based on these findings, we assume that TWC can create a suitable environment to support the innovative behavior of employees.

In view of the findings described above, pointing to the importance of individual partial factors in the context of IWB and its impact on business performance (BP), we consider it important to examine their interrelationships. To the best of our knowledge, the interaction of these factors has not yet been investigated.

As teamwork, properly supported by CD, currently plays an important role in business management, we see a research gap here to answer the extent to which these factors can support the impact of innovative employee behavior on BP. Therefore, the purpose of the study is to test the research proposition of a positive link between management's support for IWB and BP, which is mediated by team CD and TWC.

The aim of the study is to further investigate how CD in conjunction with TWC enters into the relationship between IWB and BP. We assume that the diversity of knowledge and experience available to employees involved in business innovation processes, if applied in a teamwork environment, can affect the overall result and increase the innovative activity of the company.

2. Literature Review and Development or Research Propositions

2.1. Innovative Work Behavior

Janssen (2000) defines IWB as: "the intentional creation, introduction and application of new ideas within a work role, group or organization, in order to benefit role performance, the group, or the organization (p. 288)". Yuan and Woodman (2010) define it as: "employee's intentional introduction or application of new ideas, products, processes, and procedures" (p. 324). IWB is basically thinking out of the box with alternative methods (Ma Prieto and Pérez-Santana 2014). In the case of services, Stock (2014) defines IWB as the extent to which front line employees create new ways and techniques to address encountered and potential problems and turn these into activities when employees interact with customers.

IWB consists of (a) individual behaviors, such as exploring, generating, championing and implementing creative ideas (De Jong and Den Hartog 2007); and (b) three interrelated tasks, namely the creation, promotion and implementation of ideas (Janssen 2000). It can take various forms, such as simplifying processes, using new tools and materials, introducing new routines, improving cooperation, or creating new offerings (Messmann and

Mulder 2012). Three distinct components or stages of IWB are the generation, promotion and realization of ideas (Kanter 1988; Scott and Bruce 1994). Employees do not have to be part of the whole process, but can be involved in a combination of stages, because innovation is characterized by discounting activities (Schroeder et al. 1989). Especially in the implementation stage, IWB may involve a fair amount of risk taking, as it is necessary to form coalitions of supporters of ideas (Chen and Aryee 2007).

Unfortunately, knowledge about IWB still lacks consistency and is fragmented (Bos-Nehles et al. 2017), even though it helps to gain (Martins and Terblanche 2003) and maintain (Lin et al. 2018) a competitive advantage, which even applies to knowledge-intensive industries (Anderson et al. 2014; Foss and Laursen 2014; Montani et al. 2014; Scott and Bruce 1994). IWB is pivotal to organizational sustainability (Thurlings et al. 2015). Luu (2019) also draws attention to the problem that the innovative behavior of employees has not received sufficient attention compared to team or organizational innovation. On the other hand, interest in IWB and innovation research is growing as the world globalizes, the economic environment changes, and the demands on competing increase (Chen 2011; Kim and Lee 2013; Akram et al. 2016; Bani-Melhem et al. 2018).

According to the study of Javed et al. (2017), antecedents of IWB at organization, work group, and individual levels are leadership, work group, work climate, individual differences, job characteristics and demands, personality, and values, which are significantly associated with IWB. However, the authors emphasize that leadership plays a prominent role. The positive effects of IWB are mutual for both the organization and the employees themselves in the form of, for example, better working conditions, higher job satisfaction or increased well-being (Lukes and Stephan 2017). Among the organizational benefits and psychological benefits for employees, Usmanova et al. (2020) include the harmonization of needs for jobs and resources of employees, increased job satisfaction and communication efficiency.

2.2. Business Performance

BP is a reflection of organizational success, which means that the better the BP, the more successful the business can be considered (Sumiati 2020). According to Klopotan et al. (2018), the BP of a company is affected by good communication and a good personnel policy. As BP is a broad and common concept and a complex construct, we will deal with it in the following text only in connection with innovations and small and medium-sized enterprises, although Guzman et al. (2018) argue that relatively few analyses and discussions are currently published on innovation and BP at this business size. On the other hand, Expósito and Sanchis-Llopis (2019) state that extensive literature has addressed this in recent decades. However, the authors point out that, due to the resource intensity of innovation, and thus a significant limitation of the innovative capacity of small and medium-sized enterprises (Sok et al. 2016), the findings of some studies are mixed and inconclusive. Although empirical studies do not provide conclusive results on the interrelationships between different dimensions of innovation and BP (Camisón and Villar-López 2014), there is a consensus on the fact that both innovation (Prajogo 2016) and BP (Mensah et al. 2012) are of a multi-dimensional nature (Kafetzopoulos et al. 2019). The basic types of performance measures are those that relate to results and those that focus on the determinants of results (Neely et al. 2000; Kafetzopoulos et al. 2019). Profit, sales growth and employment growth (Zahra 1991) are suitable indicators for studying the relationship between innovation and BP, although Löfsten (2014) argues that the most important indicator for a company's survival is long-term profit.

Expósito and Sanchis-Llopis (2019) found that innovation does not have to be technological to have significant and positive effects not only on the financial (sales increase and reduction of production costs in subsequent years) but also on the operational (productive capacity and product/service quality) dimensions of BP in the context of small and medium-sized enterprises. Kraus et al. (2012) argue that there are significant differences between family and non-family businesses in terms of innovation and BP. Brines et al.

(2013) confirmed this hypothesis in terms of small and medium-sized enterprises. Among others, the moderating factors of the innovation–performance relationships are the national, regional, cultural or sectoral characteristics or governance environmental factors (Saunila 2016; Yang 2017; Exposito and Sanchis-Llopis 2018).

Based on those findings, we declare our first research proposition:

Proposition 1 (RP1). *Innovative work behavior positively influences business performance.*

2.3. Cognitive Diversity of Teams

The theory of CD provides insights into team diversity variables and their effects on performance outcomes (Wang et al. 2016), as it is believed that diverse groups have a broader and richer experience base for stimulating novel and innovative ideas to solve problems (Chow 2018). There are observable and unobservable types of diversity. The former includes, age, gender or race, while the latter include beliefs, knowledge, or ways of thinking (Harrison et al. 1998; Mannix and Neale 2005; Aggarwal et al. 2019). Harrison et al. (1998) call these categories surface-level diversity and deep-level diversity; CD belongs to the second category.

CD is defined as the differences in knowledge and perspective, which arise from professional diversity and account for its positive effects (Kilduff et al. 2000), while cognitive-style diversity is defined as differences in processing and organizing of information by members of teams (Aggarwal and Woolley 2019). Mello and Rentsch (2015) categorize CD variables into four types: trait-like, developmental, acquired, and exposed. CD might be a competitive advantage for organizations due to the stimulation of consideration of non-obvious choices in task groups by minority views (Cox and Blake 1991) and it can improve executive judgment, as it has an asymmetric effect on the level of illusion of control bias among decision makers (Meissner and Wulf 2017). However, it is also important to point out the negative outcomes for the organization (Milliken and Martins 1996), as diversity can lead from a higher level of disagreement to conflict within teams (Van Knippenberg and Schippers 2007; Nowak 2020). CD is directly task-relevant/job-related—especially for knowledge-based or decision-making tasks—is a natural characteristic of any team, and exists in many forms (Martins et al. 2013). According to Van der Vegt et al. (2006), there are two types of task-related CD: expertise diversity and expertness diversity. Interestingly, Lantz and Brav (2007) found that CD does not always have a positive effect on team innovation, because perceived diversity leads to the creation of sub-teams and inter-team biases (van Knippenberg 2017). It may also slow down decision making due to difficulties in reaching consensus and diminish organizational responsiveness to environmental changes (Marcel et al. 2011).

A CD measurement tool was introduced by Van der Vegt and Janssen (2003), which was subsequently used in several empirical studies (e.g., Shin et al. 2012), capturing how group members differ in their ways of thinking, knowledge and skills, world views and beliefs in what is right and wrong. The extensive CD research base suggests that it can increase creativity, especially if transformational leadership and team perspective-taking are high (Kim et al. 2020; Hoever et al. 2012; Shin et al. 2012). Pieterse et al. (2011) emphasize the importance of CD in the context of increasing additional information in uncertain times, such as crises.

Accordingly, we decided to propose the second research proposition:

Proposition 2 (RP2). *Cognitive diversity is positively associated with innovative work behavior.*

2.4. Teamwork Climate

TWC is perceived as an important predictor of safety outcomes (Zaheer et al. 2018). It reflects staff perceptions of collaboration between personnel (Sexton et al. 2006; Weng et al. 2017). Salas et al. (2005) found that TWC is facilitated by communication and mutual trust. It is a perceptual measure that is helpful in measuring the teamwork culture

that is otherwise not easily measurable (Zohar and Hofmann 2012; Ginsburg and Bain 2017). In addition to the safety climate, working conditions, perception of management, stress recognition and job satisfaction, TWC is one of the six domains of the Safety Attitudes Questionnaire; it has seven questions with five possible answers on the Likert scale (Bleakley et al. 2012).

As a tool, it contributes to increasing employee performance (Bogan and Dedeoglu 2017) and to increasing BP (Ali et al. 2018). Knowledge and studies on the impact of TWC on innovation rates are still evolving (Fay et al. 2014) and are often associated with the innovation of the company as a whole (Jiang et al. 2012).

If staff members perceive TWC positively, the result may be a reduction in staff burnout (Bowers et al. 2011) and other positive effects may occur (Zaheer et al. 2018). If managers want to improve the safety climate, they need to start with TWC, as it is a mediator in this relationship and deserves due attention (Weng et al. 2017; Lee et al. 2015).

Based on the arguments presented above, we propose the third and fourth research propositions:

Proposition 3 (RP3). *Cognitive diversity is positively associated with teamwork climate.*

Proposition 4 (RP4). *Teamwork climate is positively associated with business performance.*

3. Materials and Methods

3.1. Sample and Data Collection Methods

For data collection, we used a questionnaire survey conducted in the period of August and September 2020. The questionnaires were sent electronically to managers of companies operating in the Slovak Republic. The questionnaire contained an introductory text explaining the meaning and purpose of the study and a note on the voluntary participation in the research based on anonymity. By sending the completed questionnaire, the respondent agreed to its processing. In the next part of the questionnaire, managers evaluated the individual variables on the selected scale. We selected individual companies in the sample by random selection from the database of verified INFOMA companies operating in the Slovak Republic. We sent 1650 questionnaires; the rate of return was 245 (which means 14.8%). After checking the completeness of the data, 211 questionnaires were included for further processing. The research sample, thus, consisted of 211 managers; the structure of the sample is shown in Table 1.

Table 1. Structure of the sample.

	Business Focus	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	other	9	4.3	4.3	4.3
	sale	38	18.0	18.0	22.3
	services	132	62.6	62.6	84.8
	production	32	15.2	15.2	100.0
	Total	211	100.0	100.0	
	Business Performance				
Valid *	SMEs with revenue level of 100% or revenue increase	113	53.6	53.6	53.6
	SMEs with revenue level of 51–99%	49	23.2	23.2	76.8
	SMEs that closed business. or their revenues fell by more than 50%	49	23.2	23.2	100.0
	Total	211	100.0	100.0	
	Length of Respondent's Practice as a Manager (in years)	**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	less than 1 year	2	0.9	0.9	0.9
	from 1 to 5 years	89	42.2	42.2	43.1
	from 6 to 10 years	54	25.6	25.6	68.7
	more than 10 years	66	31.3	31.3	100.0
	Total	211	100.0	100.0	

Table 1. *cont.*

	Business Size (Number of Employees)	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	small	46	21.8	21.8	21.8
	medium-sized	123	58.3	58.3	80.1
	large	42	19.9	19.9	100.0
	Total	211	100.0	100.0	
Gender of the Respondent		**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	female	55	26.1	26.1	26.1
	male	156	73.9	73.9	100.0
	Total	211	100.0	100.0	
Highest Achieved Education of the Respondent		**Frequency**	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Secondary education	71	33.6	33.6	33.6
	Higher education	135	64.0	64.0	97.6
	MBA. PhD.	5	2.4	2.4	100.0
	Total	211	100.0	100.0	
Descriptive Statistics	**N**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Age of respondents	211	35	65	45.91	8.234
Valid N (list wise)	211				

Note: * reference period January—July 2020 compared to January—July 2019.

3.2. Variable Measures

Mediation was used to test the relationships between the variables IWB, CD, TWC, and BP, which takes into account the mediating role of CD and TWC in the relationship between IWB and BP. Through mediation, we can examine the interrelationships and the mechanisms by which the relationships between individual variables operate.

IWB is the independent, explanatory variable. This variable was created based on managers' responses to ten statements using a 5-point Likert-type scale ranging from 1 (almost never) to 5 (almost always). The ten-item scale for IWB was adopted from the study of De Jong and Den Hartog (2010). The statements are shown in Table 2. After the reliability analysis, the Cronbach's alpha of the IWB was 0.977 (10 items). Ten IWB items represent opportunity exploration (2 items), idea generation (3 items), idea championing (2 items) and idea implementation (3 items).

The second variable, understood to be a consequence, is the dependent variable BP, which was measured through a year-on-year comparison of the performance of companies in terms of their revenues. Managers determined the average level of their sales for the months of January to July of 2020 compared to the same period of the previous year on the following scale: 0 = decrease in sales in this period by more than 50%; 1 = decrease in sales in this period in the range of 51 to 99%; and 2 = the average level of sales remained the same or increased during this period. In accordance with Zahra (1991), we assume that sales growth is a suitable indicator for examining the relationship between innovation and BP.

Based on the literature review, CD and TWC were identified as mediation variables. The CD variable is operationalized as a score given by managers to selected items based on the tool for measuring CD presented by Van der Vegt and Janssen (2003), which was subsequently used in several empirical studies (e.g., Shin et al. 2012). It captures how the members of the group differ in their ways of thinking, knowledge and abilities, how they see the world and their beliefs in what is right. After the reliability analysis, the Cronbach's alpha of the CD was 0.942 (4 items).

The TWC variable is operationalized as a score created based on managers' statements to items listed in Table 2. Our TWC data were abstracted from the Safety Attitudes Questionnaire, a validated tool that assesses the safety culture across six organizational domains—TWC, job satisfaction, perceptions of management, safety climate, working conditions, and stress recognition (Sexton et al. 2006). In total, the TWC intermediate

variable contains six items that are scaled using 5-point Likert-type scales (1 = completely disagree, 5 = strongly agree). After the reliability analysis, the Cronbach's alpha of TWC was 0.950 (six items).

We confirmed the defined structure of factors by confirmatory factor analysis. We used a robust method of maximum likelihood: CFI 0.800, TLI 0.792, RMSEA 0.075 and SRMR 0.065. The first two are slightly lower (ideally greater than 0.9). However, the other two are satisfactory because they are less than 0.08.

Table 2. Variable items.

Innovative Work Behavior (1—Never, 5—Always)	**Teamwork Climate: Perceived Quality of Cooperation between Staff (1—Completely Disagree, 5—Totally Agree)**
1. How often do your subordinates pay attention to activities that are not part of their daily work?	1. All team members can ask questions if there is something they do not understand.
2. How often do your subordinates care about how things can be improved?	2. Staff members do receive the support they require from other staff in the performance of their duties.
3. How often do your subordinates look for new working methods, techniques or tools?	3. The contribution of employees is positively perceived in our company.
4. How often do your subordinates generate original solutions to problems?	4. Disagreements in the team are resolved adequately, it is not important who is right, but what is best for the task.
5. How often do your subordinates discover new approaches to performing tasks?	5. Team members work together as a well-coordinated team regardless of their functional positions.
6. How often do your subordinates inspire innovation in your team?	6. In our company, it is not difficult to express myself critically if I perceive problems in performing performance.
7. How often do your subordinates try to persuade colleagues to support an innovative idea?	**Cognitive Diversity (1—Strongly Disagree, 5—Strongly Agree)**
8. How often do your subordinates introduce innovative ideas into their work processes?	Teams in our company are created so that the members are different in:
9. How often do your subordinates contribute to the implementation of new things?	(a) Way of thinking.
10. How often do your subordinates make efforts to develop new things?	(b) Their knowledge and skills.
	(c) The way they see the world.
	(d) The belief in what is right or what is wrong.

Given their theoretical relevance, as control variables, the manager's practice, gender, age, and education and the size of the company were selected. For example, Shin et al. (2012) or Kim et al. (2020) state that age and gender can influence individual creativity. Similarly, Exposito and Sanchis-Llopis (2018) consider, inter alia, age and gender to be an important control variable when examining the links between innovation and business performance, and Shanker et al. (2017), when examining the links between climate for innovation and organizational performance. Choi and Chang (2009) state that innovative behavior is influenced not only by the job category but also by age and gender.

Figure 1 shows the model used to test the relationships between IWB, BP, CD and TWC. The model is based on the mediating role of CD and TWC in the relationship between IWB and BP.

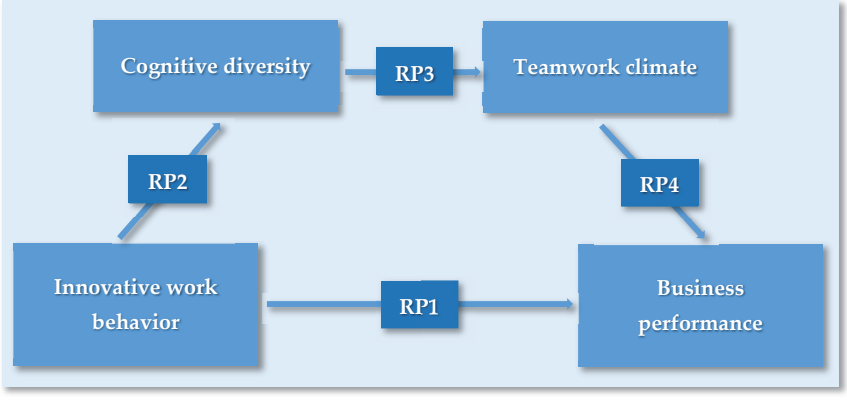

Figure 1. The mediation model and the four tested research propositions.

3.3. Data Analysis

All data were analyzed using the SPSS 24.0 software package. We used Cronbach's Alpha coefficient to assess the internal consistency of the scale's reliability. We conducted a hierarchical regression analysis to test the mediating effect. Additionally, we followed Baron and Kenny's (1986) procedure to test the stated mediating effect. The mediation model can be described as a mechanism or process that seeks to explain, name, or describe the identified relationship between an independent and a dependent variable through the inclusion of a third explanatory variable. The mediator variable is used to explain the relationship between independent and dependent variables, where the independent variable is the cause of the mediator and the latter then acts on the dependent variable. For this reason, mediating an effect is also referred to as an indirect effect. The Sobel test was used to test the mediator effect. A series of regression analyses were used to identify the proposed research propositions, and the ANOVA variance analysis to analyze multiple dependencies. We worked with a 5% significance level. A confirmatory factor analysis was used to verify the suitability of the selected factor structure.

4. Results

4.1. Descriptive Analysis and Identification of Connections

Relationships between individual variables were determined using a correlation matrix, which also includes control variables (Table 3). The table also provides brief descriptive statistics.

Based on the correlation matrix, we can state that there are significant positive correlations between all examined variables, which indicates the use of a mediation model. However, we also see a significant relationship between BP and the size of the company, which is positive (larger companies performed better); between CD and age where the dependence is negative (lower age means a stronger diversity orientation of the manager and his inclination to form diversity teams); and between TWC and the size of the company where the dependence is positive (a smaller company means higher TWC values). At the same time, descriptive statistics point to individual descriptive values of the file. The highest average rating was given to IWB (mean = 3.58). IWB consists of opportunity exploration, idea generation, idea championing and idea implementation. The lowest rating was given to items within idea championing, and the highest rating to items within opportunity exploration. TWC was rated 3.49 with the highest rating of "The contribution of employees is positively perceived in our company" and with the lowest rating of "Staff members do receive the support they require from other staff in the performance of their duties". The CD variable was rated lowest (mean = 3.20). Low average CD scores were

influenced by "Teams in our company are created so that the members are different in the belief in what is right or what is wrong".

Table 3. Descriptive statistics of variables and correlation matrix.

Variable	N	Mean	SD	BP	IWB	CD	TWC	Practice	Gender	Size	Education
BP	211	1.30	0.82	-							
IWB	211	3.58	1.17	0.908 **	-						
CD	211	3.20	1.13	0.761 **	0.737 **	-					
TWC	211	3.49	1.25	0.886 **	0.954 **	0.753 **	-				
practice	211	2.87	0.87	−0.058	−0.043	−0.083	−0.023	-			
gender	211	1.74	0.44	0.004	−0.012	0.001	−0.020	−0.025	-		
size	211	1.98	0.65	0.136 *	0.113	0.122	−0.146 *	0.114	0.167 *	-	
education	211	1.68	0.51	0.045	0.059	−0.025	0.060	0.442 **	−0.173 *	0.312 **	-
age	211	45.9	8.234	−0.115	−0.116	−0.148 *	−0.075	0.663 **	−0.261 **	0.116	0.508 **

Note: Experience as a manager (1 = less than a year, 2 = 1 to 5 years, 3 = 6 to 10 years, 4 = over 10 years), gender (1 = female, 2 = male), company size (1 = small enterprise, 2 = medium-sized enterprise, 3 = large enterprise), education of the manager (1 = secondary, 2 = university, 3 = PhD. or MBA). ** Correlation is significant at the 0.05 level (2-tailed). * Correlation is significant at the 0.01 level (2-tailed).

4.2. Innovative Work Behavior as Predictor of Business Performance

Using mediation, we wanted to test whether a third variable (CD and TWC) explains the relationship between the predictor and outcome in the form of an indirect effect. In mediation, we proceeded from the established main research proposition, which applies when the indirect effect is significant using the Sobel test. We added control variables of practice, gender, education, age and size of the company to the modeling of the overall effect. As an intermediate step, the analysis of variance ANOVA was used in the analysis of multiple dependence, where we found that of the mentioned control variables, only the variable is significant.

Subsequently, we proceeded in three steps (A, B, C), in which we verified partial research propositions by calculating three regressions. The steps examine the following relationships, expressed in Models 1 through 4, shown in summary in Table 2:

(C) There is a relationship between BP (variable Y) and IWB (variable X).
(A) There is a relationship between the mediation variables CD (variable M1) and TWC (variable M2) and IWB (variable X).
(B) There is a relationship between BP (variable Y) and the mediation variables CD (variable M1), TWC (variable M2), in which the IWB (variable X) does not participate.

The value of C represents the total effect. The product A × B is a mediated (indirect) effect of X on Y through M (due to the existence of two mediation variables, the mediated effect is expressed in the form A1 × B1 + A2 × B2 + A1 × B2 × D21, where member D21 is the path from M1 to M2). The difference C′ = C—A × B indirect effect is the pure (direct) effect of X on Y without the participation of M. The research proposition applies when the indirect effect is significant. Using the Sobel test (A × B = 0.099, z = 2.862, Sig. = 0.004), we found that the overall indirect effect is significant in the positive direction.

The results in Table 4 clearly indicate that the overall effect (C) is significant, and the dependence is positive (model 1, coef. = 0.640. Sig. = 0.000), which indicates the existence of a relationship between BP and IWB. Step A is significant, so there is a relationship between the mediation variable CD and IWB (model 2, coef. = 0.793, Sig. = 0.000); at the same time, due to the implementation of serial mediation, there is a relationship between both mediation variables (D21)—model 3, coef. = 0.100. Sig. = 0.000. Furthermore, there is a relationship between the IWB and the mediation variable TWC (model 3, coef. = 0.848, Sig. = 0.000). The direct effect (C′), i.e., the effect without the participation of mediating variables, is significant (model 4, coef. = 0.462, Sig. = 0.000). Step B, expressing the relationship between BP (dependent variable Y) and mediation variables (M1 and M2) in the form of CD and TWC, in which the independent variable X (IWB) does not participate, is significant in part only for the variable CD (model 4, coef. = 0.125, Sig. = 0.000). For the

TWC variable, coef. = 0.085, Sig. > 0.005 and means an insignificant dependence. The total indirect effect of A × B is very low at 0.099, but it is significant.

Table 4. Regression results for main effects and mediation analysis.

Variable	Model 0		Model 1		Model 2		Model 3		Model 4	
Dependent	**BP**		**BP**		**CD**		**TWC**		**BP**	
	C	**SE**	**C**	**SE**	**C**	**SE**	**C**	**SE**	**C**	**SE**
Constant	−0.979		−0.963	0.107	0.808	0.261	−0.023	0.106	−1.068	0.104
Main effects										
IWB	0.682 **	0.023	0.640 **	0.021	0.793 **	0.050	0.848 **	0.029	0.462 **	0.065
CD							0.100 **	0.027	0.125 **	0.028
TWC									0.085	0.068
Controls										
Education	0.049 **	0.059	0.039 **	0.051	0.029 **	0.049	0.039 **	0.051	0.007	0.045
Age	−0.002	0.0,004								
Practice	−0.020	0.039								
Gender	0.019	0.061								
Size	0.003	0.041								
R2adj.	0.813		0.812		0.952		0.538		0.896	

Note: Experience as a manager (1 = less than a year, 2 = 1 to 5 years, 3 = 6 to 10 years, 4 = over 10 years), gender (1 = female, 2 = male), company size (1 = small enterprise, 2 = medium-sized enterprise, 3 = large enterprise), education of the manager (1 = secondary, 2 = university, 3 = PhD. or MBA). R2.adj—adjusted coefficient of determination, C = unstandardized coefficient B, SE—standard error of the estimate, (**) statistically significant result at the level of significance 5%, i.e., $p < 0.05$.

The obtained results show that the BP of the examined companies is influenced mainly by the independent variable IWB in the form of a direct effect, acting in a positive direction. Its operation is only, to a very small extent, influenced by mediators in the form of CD and TWC. When expressing the sizes of the individual effects as a percentage, based on the determined coefficients, we state that the size of the direct effect is 72% and the size of the indirect effect is 28%. The relationship between IWB and BP is largely mediated by the direct action of these two variables. The variables CD and TWC are also involved in the relationship to some extent. Of their 28% share, 55% falls on CD, 40% on TWC (but this effect is not significant) and 5% on the path between them.

As the indirect effect is higher than 20% and the direct effect is lower than 80%, this is mediation, specifically, incomplete serial mediation.

5. Discussion

The results of the presented research study, motivated by the need for a deeper examination of the determinants of innovative activity in companies, can be considered beneficial for academics and professionals. Our analyses and data suggest positive CD-mediated associations between IWB and BP.

This study builds on previous research and addresses this shortcoming in the literature. We agree with Luu's (2019) statement that the innovative behavior of employees themselves was not given sufficient attention compared to team or organizational innovations. No previous research in the conditions of Slovak companies has been conducted exploring relations and the mechanism of cooperation of IWB, CD and TWC in the context of their performance.

As organizational innovation is currently one of the most important sources of competitive advantage for companies (Honyenuga et al. 2019; Camisón and Villar-López 2014; Meyer and Subramanian 2014; Saunila 2016; Hamel 2009), IWB is crucial for organizational sustainability (Lin et al. 2018; Thurlings et al. 2015; Foss and Laursen 2014).

The research propositions of the mediation effect of CD and TWC in the relationship between IWB and BP have been confirmed. The main finding of our study is the significant impact of IWB on BP. This finding is consistent with the research of Honyenuga et al. (2019) and Shanker et al. (2017), which identified IWB as a significant variable in support of organizational performance.

However, mainly a strong direct relationship between IWB and BP was identified. This suggests that the very innovative behavior of employees, supported by the company's management, has a positive impact on the company's result. IWB includes employee activity at all stages, from the generation of ideas, through their promotion to implementation. Businesses are most successful in supporting employees in finding and creating new ideas, but support for their promotion is lower. This opens up space to increase the effect of the IWB. The results of the study also point to the fact that the link between IWB and BP companies, mediated by CD, was more significant among managers with higher education. We therefore assume that the training and expansion of managerial competencies may be the factor that allows managers to be more qualified to support the IWB of their employees. Leitão et al. (2019) indicate that for workers, feeling their supervisors' support through listening to their concerns and by sensing that they take them on board, being integrated in a good work environment, and feeling respected both as professionals and as people positively influence their feeling of contributing to organizational performance.

The indirect effect in the relationship between IWB and BP was significant only for CD but was lower than the direct effect. The CD transfers a partially positive effect between IWB and BP. Thus, the indirect effect also proved to be significant, but its impact on the BP is lower (only 28%). This means that the intensity of the direct effect can be enhanced by involving CD. These findings are consistent with the findings of Wang et al. (2016) and Chow (2018), who point to a broader and richer base of experiences in diverse groups that are useful in generating innovative ideas and their positive impact on performance outcomes. Of the individual attributes of the CD, the most significant influence is the orientation of the diversity of teams in terms of the way of thinking and knowledge and skills, which supports the findings of Martins et al. (2013). On the contrary, the diversity of teams, in terms of their worldviews and beliefs in what is right and what is wrong, has proven to be less important. Efforts to increase CD in the corporate environment, therefore, seem to be an appropriate solution, especially in times of crisis when the need for additional information and new solutions is growing (Pieterse et al. 2011). In addition, Sauer et al. (2006) point to the fact that an important factor determining the effects of CD is the complexity of the solved tasks. Complex tasks benefit from cognitive diversity, while simpler tasks remain unaffected. The results of our study also show that younger managers are able to reap the benefits of CD to a greater extent.

This means that if management unequivocally declares and implements the policy of opportunity exploration, idea generation, idea championing and idea implementation, less influence from CD and TWC mediators is sufficient to transmit the effect of the IWB variable on BP. While the positive effect of CD on team performance has been confirmed by several studies (Liao and Long 2016; Kilduff et al. 2000), the results of our study show that TWC, as a serial mediator, does not transmit a significant effect. This is an interesting and partly surprising finding, as TWC is highlighted by many authors as an important support tool within various innovative management tools. Fay et al. (2014) state that the wider use of teamwork leads to a higher level of innovation. Jiang et al. (2012) also highlight the role of teamwork in organizational innovation. Factors that have been cited as supportive in this regard are knowledge sharing, mutual learning (Basadur and Gelade 2006; Maccurtain et al. 2009) and autonomy, leading to responsibility and motivation (Urbach et al. 2010). In our study, a simple correlation revealed significant positive partial relationships between TWC and BP and also between TWC and IWB. Thus, their direct effect on the variables examined is clear, which is consistent with the above statements, but has not been shown to be significant in mediation. From a theoretical point of view, Martins et al. (2013) also point out the complexity of the effects of diversity in interaction with team dynamics. The

authors found that the impact of TWC and CD on the outcome is influenced by the sense of psychological security of team members. If the perception of psychological safety is low over time, the effect of CD will not be fully manifested, and the diversity of knowledge will not positively affect the overall performance of the team. Olson et al. (2007) also point to the risk of CD being associated with conflicting roles in teams.

The results of this study build on previous research works and expand our understanding of how IWB can positively affect BP by engaging CD. Based on the above, we can conclude that there is a strong direct relationship between IWB of employees and the performance of a company. The indirect effect was significant only for CD but was lower than the direct effect. Thus, CD transfers a partially positive effect between IWB and BP. The importance of TWC has not been shown to be significant in this context. This result indicates the strong position of an effectively functioning IWB management setup and is a signal for business management to focus attention in this direction.

As already mentioned, the support of IWB of employees by the management brings results for the company in the form of BP, competitiveness and sustainability, but the positive effects of IWB are two-way. In addition to the company, the employees themselves also benefit from them; for example, in the form of better working conditions (Lukes and Stephan 2017), higher job satisfaction and increased well-being (Usmanova et al. 2020). Therefore, focusing on its support appears to be well-invested energy.

6. Practical and Theoretical Implications and Limitations

The results of our study complement the hitherto fragmented and inconsistent findings on IWB (Bos-Nehles et al. 2017) and confirm the findings of previously conducted studies on the importance of the IWB as a key variable influencing BP (Honyenuga et al. 2019; Saunila 2016). Our results complement the findings on the impact of CD on innovation processes, confirmed by studies by Thurlings et al. (2015) and Luu (2019), especially in terms of the diversity of knowledge and experience of employees, from which companies can significantly benefit in this area. Valuing diversity is less important in terms of IWB. At the same time, the results draw attention to the fact that TWC may complicate the process in the case of the innovation activity of employees and, thus, not have the expected effects, which contradicts several findings confirming the contribution of teamwork to supporting innovation (Jiang et al. 2012; Urbach et al. 2010).

The results also strongly point to some benefits for managers and practitioners. Our findings show that it is important for companies to support their own employees in the creation and implementation of new solutions, because it has a proven direct positive effect on BP. Attention needs to be focused not only on supporting the generation of new ideas and solutions, but especially on their implementation, as significant shortcomings have emerged in this area. The effect of IWB can be intensified by involving CD, especially in terms of knowledge and way of thinking. At the same time, both parties benefit from the support of the IWB: companies, in the form of better results and competitiveness, and employees, through greater job satisfaction.

Despite the usefulness of the findings, this study has some theoretical and practical limitations. We carried out our research in Slovak companies. Although the Slovak Republic is a relatively small state in Central and Eastern Europe, it is very similar in development and mentality to the surrounding states, such as the Czech Republic, Hungary, Poland and other states of the former Warsaw bloc. Due to this fact, we do not consider the results to be limited to our territory, but applicable to a wider area. Given the nature of the relationships examined and their solutions in many studies, we can assume that our findings may have universal validity. In addition, a limitation of this study was the use of a cross-sectional survey design. As a result, cause and effect cannot be established. Finally, all data were collected using self-administered surveys. Response biases may have skewed the answers. In consideration, generalizability may be limited.

The limitations of our research could indicate the direction of further research. While our exploratory model proved very useful and conclusive, future research could consider

including other variables in the framework that would help to better understand the relationships examined. This could be, for example, examining the impact of corporate culture and/or leadership style. By conducting research in companies operating in one of the surrounding countries, we would be able to confirm our assumption that the results are applicable to the Central European area of the countries of the former Eastern bloc.

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Impact of Value Co-Creation on International Customer Satisfaction in the Airsoft Industry: Does Country of Origin Matter?

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Abstract: The paper's objective is to investigate the impact of value proposition co-creation on international customer satisfaction in the airsoft industry. This empirical paper aims at answering a question "Which factors influence satisfaction of the international customers involved in the process of value co-creation in the airsoft industry" and sets a hypothesis that value co-creators' country of origin has a positive impact on customers' satisfaction. A case study approach of an entrepreneurial company (GATE) was supplemented with data collected via a survey (n = 176), where consumers' perception of the firm's value proposition and its influence on their satisfaction were investigated. The study contributes to the value creation theory by identifying the main factors influencing customer satisfaction in the airsoft industry and verifying whether the co-creators' origin affects the factors' ratings. The results indicate that the most crucial factors influencing international customer satisfaction in this industry are quality level and product functionality and that the country of origin of customers has no significant impact on international customer satisfaction.

Keywords: airsoft industry; customer satisfaction; country of origin; entrepreneurship; value co-creation; value proposition

1. Introduction

Recently, there has been an observable growth of importance of value as a subject of broad debate among scientists and practitioners. Value creation is considered to be a key concept in the management and organization literature for both macrolevel (organization theory, strategic management) and microlevel (individual, group) research (Lepak et al. 2007). It can be linked not only to entrepreneurship (Dyduch 2019) and organizational ideology (Jaki and Siuta-Tokarska 2019), but also macroeconomics and public investments (Berawi and Woodhead 2020). Nevertheless, the process of how value is formed as well as the assessing and the capture of value is difficult and challenging (Gray 2006; Nickerson et al. 2007; Chatain 2011; Cunningham et al. 2018). Conservatively, it was assumed that value was created by the firm and streamed to the customer. Lately, it has been acknowledged that creation of value is in fact a co-operative value creation process that arises between the customer and the firm. This shift evidently highlights the increasing significance of customers and their resource contributions towards value creation (Priem 2007). Moreover, customer involvement in a value co-creation process (Etgar 2008) leads to an improvement in the value of a product and results in an increase in customer satisfaction and loyalty (Banyte and Dovaliene 2014; Agrawal and Rahman 2015; Cossío-Silva et al. 2016). By attracting customers in the product design process, companies provide tailored solutions that meet individual customers' needs and prevent product failures (Luchs et al. 2016). Until now, very few studies have

investigated entirely customer involvement at this stage (Menguc et al. 2014), especially at the international level. Discovering this crucial issue would improve companies' identification of novel product ideas, which builds extra value for international customers (Najafi-Tavani et al. 2020).

Some academics have already explored the influence of country of origin on customers' service expectations (Seger-Guttmann et al. 2017) and proved that the customers have varying expectations due to cultural differences. Thus, enterprises shall take into consideration that these vast differences in expectations depending on country of origin may affect sales and shall be considered while designing a marketing strategy. Other researchers analyzed cultural influences on evaluations of service quality (Albu 2013; Guesalaga et al. 2016). One very recent study has investigated the impact of cultural distance on relationship learning on international customer involvement in the context of a manufacturing company in China and its international customers. The results proved that there are far more benefits from the relationship learning capabilities for suppliers when they share a similar culture with customers, and that cultural differences remarkably diminish the effectiveness of international customer involvement on company performance (Najafi-Tavani et al. 2020). However, to our best knowledge, there are no studies investigating the impact of country of origin on international user satisfaction in technology-based firms.

The main research purpose of this paper is to explore the impact of value proposition co-creation on international customer satisfaction in the airsoft industry. The airsoft industry was selected especially because this niche market has been developing fast in recent years and airsoft guns have lately received a boost in consumer enthusiasm (McGee 2017). Nevertheless, literature investigating the relationships between satisfaction and customer involvement in the process of value co-creation in high-tech companies is scarce (Hsieh and Hsieh 2015). There is some evidence in the scientific literature that a few academics have researched the airsoft topic, however, the focus has been directed mostly towards possible injuries deriving from improper use of airsoft guns (Haavisto et al. 2019; Saunte and Saunte 2006, 2008), the impact of Amazon on distribution in the airsoft market (Acocella and Zhu 2017), and technical aspects of airsoft guns' functioning (Do Duc et al. 2016; Horák et al. 2014). Thus, there is a need for deep marketing-oriented research on airsoft, which would also improve the field of management. Starting with the matter of value and customer satisfaction, the research results may prove to be crucial for the strategies of businesses operating in the airsoft market (Szarucki and Menet 2018).

The paper contributes to the theory and practice of value co-creation in at least two ways. Firstly, by proving that the main factors influencing international customer satisfaction in the analysed industry are quality level and product functionality. Secondly, by testing the set hypothesis and providing evidence that the country of origin of customers does not influence international customer satisfaction significantly.

The structure of the paper includes the theoretical background divided into three parts: (1) the essence of value and value propositions, (2) delivered value and customer satisfaction, and (3) value proposition creation and co-creation. After that, the materials and methods are described. The last three sections of the article focus on the results, discussion and conclusions.

2. Theoretical Background

2.1. Essence of Value and Value Propositions

Value is an ubiquitous concept that appears in many different fields of knowledge: from philosophy and ethics, through social sciences, physics, chemistry, mathematics, economics and many others (Sánchez-Fernández and Iniesta-Bonillo 2007). The theoretical considerations of value cover such terms as: economic value, market value, exchange value, utility value, functional value, psychological value, creative value and emotional value. In marketing and management theory, the value proposition has been introduced as a statement that summarizes the reason for a consumer's purchase decision. In addition, many companies, consciously or not, use a so called "value-focused approach", which helps them to specify the exact consumers' needs and therefore to easily meet them.

There are plenty of definitions of value being found in different fields of science (philosophy, ethics, medicine, mathematics or economics). Nevertheless, due to the objective of the paper, it is necessary to take a deeper look at different types of value that appear in the management and organization literature (Bowman and Ambrosini 2000; Sánchez-Fernández and Iniesta-Bonillo 2007; Barnes et al. 2009; Frow and Payne 2011; Osterwalder et al. 2014; Goedhart et al. 2015; Deng 2019). The typology of value is rich and encompasses, among others, the following important sorts of value: creative value, economic value, market value, emotional value, psychological value, exchange value, utility value, functional value and company value.

Creative value may be defined as "the value added to the customer when using the breakthrough idea for the first time" (Yang and Sung 2011). This type of value can also be understood as the value of creative content, which has never appeared before and is added to a product or service. The next, very important type of value is economic value, which means the financial benefit a customer obtains when using a product or service (Gupta and Lehman 2005). In other words, it is the maximum amount of money a customer is able to pay for the delivered value. The economic value is always larger than the market value. It is important to distinguish the market value from the economic one. Usually, the market value represents not the maximum but the minimum price a consumer is willing to pay. It is sometimes used interchangeably with open market value and fair value. However, in some contexts, the definition may vary, e.g., Boyce (1975, p. 137) defines the market value as "the highest price in terms of money which property will bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and seller each acting prudently and knowledgeably, and assuming the price is not affected by undue stimulus". Thus, the general definition is different than the specific one connected with the real estate market. Another category of value is emotional value, which is associated with the perception of emotions, human interactions, as well as emotional exchanges, and is a part of studies on cognition and emotions (Hareli and Hess 2012). On the contrary, the psychological value is the benefits associated with the intangible values of the product or service, such as brand names (Gupta and Lehman 2005). Next is exchange value, which derives from the political economy and constitutes one of the attributes of a commodity, i.e., a product or service manufactured for, and sold on, the market. The other three aspects are utility value, economic value, and price (Howard 2011). There is also a specific kind of exchange value—advertising exchange value, which "is related to consumers' evaluation of a specific medium in regard to the importance of the content and their attitudes toward the advertising associated with the medium" (Kelty 2013, p. 7). Thanks to the value-in-use, a customer receives economic, financial or social value. The functional value is defined as "the practical benefits a customer receives from the performance or the features of the product or service" (Gupta and Lehman 2005). The firm value can be equal to the sum of the market value of tradable shares, the market value of non-tradable shares and the market value of debt, divided by the total assets (He and Zhang 2019). In this paper, value is analyzed from the customer perspective, thus we follow the definition of Bowman and Bowman and Ambrosini (2000) as the subjective valuation of consumption benefits by a consumer. Understanding value is very important for both value proposition creation and constructing the strategic plan for a company.

The research problem analyzed in this paper is situated within the theory of organization and management, thus, when mentioning the term "value proposition", the value should be perceived according to Camlek (2010, p. 119) as 'worth in usefulness or importance to the possessor; utility or merit'.

The ability of companies to recognize and introduce value propositions perceived as desirable on their target markets is commonly regarded as a key to competitive success (Anderson et al. 1993; Lanning 1998; Covin et al. 2015). Every business has a value proposition. As noticed by Morris et al. (2005, p. 729): "There is no business without a defined value proposition, and the creation of value provides a justification for the business entity". In their study, Kaplan and Norton (2004, p. 10) explored the concept of value proposition and stated that "strategy is based on a differentiated customer value proposition. Satisfying customers is the source of sustainable value creation. Strategy requires a

clear articulation of targeted customer segments and the value proposition required to please them. Clarity of this value proposition is the single most important value of strategy". Therefore, the value proposition itself is a very important concept for every company that wants to expand. In the 1970s and 1980s, a similar attitude was directed towards quality, which is an essential element of value delivered in a product. There was a conviction that quality must be built into the offering (including all the products and services sold). Thus, the Total Quality Management approach has much in common with value propositions and managing customer value (Barnes et al. 2009, p. 21).

The concept of the value proposition emerged in the 1980s. First, Bower and Garda (1985), and later, Lanning and Michaels (1988), highlighted the importance of communicating the value in products and offerings. Lanning (1998) defined the "value proposition" as the essence of the business and believed that a business is a value delivery system. In Lanning's theory, the value proposition is "about customers but for your organization; not addressed to customers but must drive these communications; defines exactly what the organization fully intends to make happen in the customer's life" (Barnes et al. 2009, p. 22). Originating from a supplier's point of view, and compliant with a goods-dominant logic, the expansion of the value proposition consists of three main steps: "choose the value, provide the value, and communicate the value" (Kowalkowski et al. 2012, p. 1555). From this viewpoint, the value proposition concept can be treated similarly to a marketing offer. In recent years, scholars noted that the value proposition concept is elusive and usually not defined clearly. It was signified that "only recently have value propositions evolved from earlier value delivery and value exchange contexts to the ecosystem context" (Riihimäki et al. 2016, p. 66). Next, value co-creation arose as a process in which stakeholders create value jointly (Prahalad and Ramaswamy 2013).

The value proposition will be perceived as "the benefits customers can expect from your products and services" (Osterwalder et al. 2014). This definition provides the most proper basis for later research, which aims at developing the value existing in the eyes and beliefs of customers. Now, it is necessary to introduce the notion of the value-focused approach and the value-focused enterprise. At the heart of the value-focused business approach lie value propositions. In the value-focused enterprise, the value inputs start with the strategic goal and are carried throughout the whole organization. The value proposition is inserted into the core of the business model, and is the basis of the business. It is crucial for everyone in the company, starting from the chief executive officer and ending with recently employed workers (Barnes et al. 2009, pp. 40–41).

2.2. Delivered Value and Customer Satisfaction

Nowadays, customer satisfaction is a crucial indicator of a company's competitiveness. Not only tangible but also intangible aspects form customer satisfaction. It is not a simple task to make customers satisfied, especially because everyone has different emotional reactions, a distinct character and values different things. A situation that would make one pleased can make somebody else anxious. The feeling of satisfaction appears only in the moment when consumers' needs and expectations are completely met. The increase in rivalry among competitors led to making customers more demanding than they were before. However, every company that wants to succeed must focus its marketing activities on creating value, which makes customers more satisfied and attracts more loyal consumers. If the service satisfies the customers, the purchase frequency increases while a reduction in the search for alternatives occurs (Yang et al. 2014).

For many years, customer satisfaction has been seen as the key element, which makes it possible to explain why customers resign from the products or services of a company, move towards competitors or stay (Cohen et al. 2006). A company should satisfy its customers in order to achieve success in a particular market, no matter whether it produces goods or services and no matter whether those are business to businessor business to customerrelations. The notion of satisfaction derives from the Latin language: satis—enough, and facere—to make, which can be understood as making something sufficiently so as the expectations of somebody are met (Fornell 1992). Customer satisfaction is connected not only with the product itself, but also with the particular brand and post-sale experience.

There are many different definitions of customer satisfaction. Olivier (1980) defines it as the emotional response to a product or service that a customer took advantage of. According to Giese and Cote (2000), it is a reaction (cognitive and emotional), which focuses particularly on the experience of the client associated with the purchase of a product and is present at a given time (e.g., after the purchase or consumption). Satisfaction can be understood as the reaction of a customer to a product or service, as the level of fulfillment of the customer's needs and expectations, as the feeling of a consumer connected with purchasing a particular good, as well as a factor that is significant for creating a company's value.

Different factors may influence the customer satisfaction among which the delivered value that has to meet the customers' expectations is situated. In service industry, these factors include: efficiency, availability, fulfillment, privacy, responsiveness and contact (Jo and Mo 2018), whereas, in the case of products, it might be price, promotion, product reliability, brand image, health concern and perceived value (Pattarakitham 2015). In particular, the perceived value is highlighted by academics as extremely important when researching customer satisfaction and loyalty (Scridon et al. 2019; Servera-Francés and Piqueras-Tomás 2019). A company may deliver perfect value at a reasonable price, but if the value does not meet the customers' needs, it is useless and has no impact on the company's growth. According to Riihimäki et al. (2016, p. 67), it is important to note that "the nature of value propositions was always exhibited and analyzed in network context". Despite many difficulties, there was a necessity of further research on the impact of value perception on buyer behavior (Gronroos and Voima 2013). Indeed, marketers put a lot of effort into understanding the customer perception of value (of both individual and institutional buyers) to develop policies, which would help them to capture the perceived value (Aitken and Paton 2016). This led Aitken and Paton (2016) to conduct a comparative analysis of how the wider, psychological needs of customers interact with the effects of business goals. Moreover, there is even the concept of customer-centric focus, which describes "how organizational strategies are combined with consumer needs to generate profit by maximizing the lifetime value of the customer" as "in the end the success of the product is often considered before the need of the customer; but even if a product performs functionally according to its specifications, it will be unsuccessful in the market place if it does not address a real customer need" (Van der Merwe et al. 2015, p. 61). Kessler et al. (2001) developed the concept of vasa syndrome, a term well known in marketing and management studies that is connected with a project failure resulting from insufficient communication. In principle, it refers to the necessity for identifying and addressing the customer needs.

The connection between value and customer satisfaction is a basis for one of the quality measurement tools: Kano's model. The model divides product attributes into the following categories: must-be attributes, one-dimensional attributes, attractive attributes, indifferent attributes, and reverse attributes (Van der Merwe et al. 2015, p. 63). Yang (2005) improved Kano's model into a Refined Kano's model in order to take into account a customer's perception of the degree of importance of a quality attribute.

According to the theory, as the one-dimensional attributes are better fulfilled, customer satisfaction is improved. That is because a one-dimensional attribute is equal to the linear relation between a customer's perception that the attribute will meet their needs and the attribute's ability to fulfill them. Thus, as better fulfillment of one-dimensional attributes raises the customer satisfaction, a company, which would like to improve the satisfaction of its clients, shall focus on those attributes. On the other hand, the low value-added quality attributes do not impact significantly on customer satisfaction, but their absence may cause customer dissatisfaction. The lack of "Must-be" quality attributes leads to complete customer dissatisfaction. Must-be attributes of high importance are "critical" quality attributes. When present, the "Reverse" quality attributes lead to total customer dissatisfaction and customer satisfaction when absent. The "Potential" quality attributes are indifferent but highly important. They have the potential to become attractive quality attributes. Companies should definitely avoid the care-free quality attributes. When present, the "Attractive" quality attributes mean the greatest customer satisfaction, but are not expected by customers to be found in a product. Attractive attributes of high importance are "highly attractive" quality attributes, an organization's strategic

offerings, which attract new customers. Low attractive quality attributes can be eliminated in cost versus quality trade-offs (Van der Merwe et al. 2015, p. 63).

Osterwalder et al. (2014, p. 48), in their study, noticed that the "fit between what a company offers and what customers want is the number one requirement of a successful value proposition". The scholars distinguished three kinds of fit: (1) Problem–Solution Fit (on paper)—when a company strives to identify customer needs; (2) Product–Market Fit (in the market)—when a company strives to validate or invalidate the assumptions underlying its value proposition; (3) Business Model Fit (in the bank)—a great value proposition without a sound business model may lead to failure. The three kinds of fit interact with each other. However, the fit might be much harder to achieve when the customers are not only local, but also international—the distinction that many studies highlight (Rozian Sanib et al. 2013, pp. 297–313; Pluta-Olearnik 2016, pp. 266–75; Khan 2019, pp. 117–29). The term "international customers" is often used in the context of customers clearly from various cultural backgrounds (Wang et al. 2015, pp. 96–104).

2.3. Value Proposition Creation and Co-Creation

Studies on value started with the research of added value, followed by value chain investigation, superior value, perceived value, relationship value, stakeholder value and value in-use (Payne and Holt 2001; Woodruff 1997; Sánchez-Fernández and Iniesta-Bonillo 2007; Agrawal and Rahman 2015). Frow and Payne (2014, p. 214) argue that "developing a superior value proposition is a clear strategic imperative for enterprises". The process of value creation should start in the beginning stages of business foundation and then, as the company develops, the value shall be reassessed and often recreated. Vargo and Lusch (2004), when describing the theory of Service-Dominant (S-D) Logic, claimed that companies cannot unilaterally create, develop and deliver value to clients by turning knowledge into products, but they can only devise value propositions. Many believe that value propositions should be developed in cooperation with consumers through the process of reciprocally exchanging knowledge (Kowalkowski et al. 2012, p. 1554). Nevertheless, it is obvious that building on individual experience and context, users and sellers will have different views about what is valuable (Frow and Payne 2014). Therefore, the creation of a value proposition frequently means bundling distinctive, sometimes conflicting interests among actors. A firm must integrate and align different resources to become valuable. According to Lerro (2011), a company that is managed in an integrated way succeeds through value formation and fulfills the needs of its stakeholders through the creation, execution and control of accurate value propositions. Due to the main objective of the paper, below we concentrate on the co-creative practice approach and technology approach.

There is a growing interest among researchers in value co-creation (Galvagno and Dalli 2014; Saha et al. 2020). Kambil et al. (1996) introduced the term "value co-creation" to emphasize the role of customers in business strategy and marketing. Then it was popularized and disseminated by Prahalad and Ramaswamy (2000, 2004), who theorized value co-creation as the "co-creation of personalised experiences with the customers". In their study, Kowalkowski et al. (2012, p. 1554) provided a deepened understanding of complexities that are inherent in a co-creative practice of value proposition formation. They believed that the theoretical section should be accompanied by practice. Therefore, they labelled and identified the activities of the reciprocal exchange of knowledge. The scholars empirically illustrated how resource-integrating actors apply, assess, adapt and adopt knowledge when co-creating a customer-loyalty card. Moreover, other academics suggest that managers of small and medium-sized enterprises (SMEs) shall improve their procedures relating to knowledge formation through market sensing, learning and entrepreneurial orientation, as the appropriate attitude towards knowledge may positively impact on a company's growth (Alshanty and Emeagwali 2019).

Forming a value proposition should be portrayed as an exchange of knowledge between a group of resource-integrating actors who possess distinct understandings, procedures and engagements. The understandings are defined as "the practice-related knowledge (know-how), skills, and experiences of each resource-integrating actor", the procedures are "the practice-related rules, principles,

and cultural norms of each resource-integrating actor", whereas the engagements should be understood as "the practice-related wants and needs, goals, and purposes to which each resource-integrating actor is committed" (Kowalkowski et al. 2012, p. 1563). Each of the resource-integrating actors gives some inputs during the formation of a value proposition. Through application, they provide inputs. Assessing is connected with input evaluation. Altering the inputs is named "adapting", whereas "adopting" refers to the inputs' acceptance.

There would be no co-creative practice of forming value proposition without knowledge exchange. Brown et al. (2007) described the reciprocal knowledge exchange as something "between either wholly inductive or completely confirmatory". The foundation of process is based on the theory of knowledge creation and sharing, which was developed by Nonaka and Takeuchi (1995) as well as widely-known literature on knowledge management, represented, e.g., by Alavi and Leidner (2001) or Davenport and Prusak (1998). Taking into consideration their theories, the exchange of knowledge can be characterized as a sequential process in which the knowledge is assessed, gathered, interpreted and used. It is also important to highlight who can be considered as a resource-integrating actor (Kowalkowski et al. 2012, p. 1559).

In order to depict the influence of technology on value creation, it is necessary to define the notion of technology commercialization. According to Davila (2000), technology commercialization means the application of modern technology to improved or new products and services, which are successfully sold in customer markets. Nowadays, technology commercialization is very important, because much technological potential is unused (Swamidass 2012). Technology commercialization may take place in corporations, large companies, SMEs, as well as at universities or non-profit organizations (Sideri and Panagopoulos 2018). In our paper, technology-based firms will be analyzed. There is no universal definition of technology-based firms (Wouters and Kirchberger 2015). However, these firms can be characterized as (Groen et al. 2015): (1) being managed by a small group of experts, (2) being focused on exploiting a technologically innovative idea, (3) being independent of already established companies. Technology commercialization shall be considered in the context in which it is a result of collaboration and knowledge integration of different companies (Wouters and Kirchberger 2015). It derives from the fact that a key success factor for new technology is connected with the benefits that it will deliver to users, especially in comparison to the existing solutions (Galbraith et al. 2006). Therefore, the new products or services should be created through the connection of technology and application, in such a way that they are valuable to users. However, the knowledge necessary for making the connections is dispersed across: (1) different departments in the organization; (2) different organizations; (3) potential customers, or customers of those customers; (4) development partners of the new technology-based firm; (5) others who may know about competing technologies, regulation, and societal challenges (Wouters and Kirchberger 2015, p. 54). Every party does not fully understand the context of other parties, so collaboration should be interactive. The process of collaboration should not limit itself to listening or learning from customers, it should be focused on gaining knowledge together with customers and understanding the issues that are not understood by the customers.

The impact of technology on value creation is also visible in different areas: marketing (advertising), sales, logistics, customer relationships management, post-sale service or distribution (Akaka and Vargo 2014; Breidbach and Maglio 2016; Wang et al. 2016). Technology affects the efficiency of individual processes, changing the nature of the links of each value chain and ultimately creates new opportunities for meeting the needs of consumers both at the level of product and price (which is the cost to the customer), distribution (the convenience of purchase) or promotion (which is a form of communication with the market and a way to provide consumers with information). The information technology (IT) sector has an especially large impact on value creation in the context of international customers (Jean et al. 2010).

Based on the conducted literature review, we have noticed that the only research in the social sciences field that was conducted so far with reference to the airsoft industry was connected with the impact of playing airsoft on airsoft players' lives (Roşu 2015). We found no studies concerning

products or companies in the airsoft industry and how value co-creation influences international customers involved in that process. Based on the analysis of this theory, we have developed one research question and one hypothesis in order to explore the topic of satisfaction of international customers being involved in co-creative practices of value creation of a firm from the airsoft industry. Our study investigates the question: What are the most important factors influencing international customer satisfaction in the airsoft industry? Our main hypothesis is: (H): Value co-creators' country of origin has a positive impact on customers' satisfaction.

3. Materials and Methods

3.1. Case Background

In this research, we apply a case study approach defined as "revelatory" (Yin 2009). The case of the GATE Enterprise Sp. z o.o. Sp. k. (GATE) is well adapted to our research objective as the company applies its own strategy of involving its worldwide target customers into the process of value co-creation. Furthermore, the company grows very fast; its sales in 2017 increased by 180% in comparison to 2016, even though at that time GATE had not invested much in marketing activities. The spectacular results of the company are the product of successful value co-creation. Thus, we state that our case study is adequate and the information can be applied in similar situations. Moreover, as mentioned previously, we were unable to find relevant literature on how businesses in the airsoft industry exploit the impact of customer involvement in value co-creation on their satisfaction with the delivered product.

The research was conducted in the niche market of hobby items, on airsoft players who are customers of a small entrepreneurial enterprise. The GATE company is a technology-based firm founded in 2008. This particular company was selected as it is a firm with an interesting business model that generates the majority of turnover from customers abroad. However, the crucial point is that the GATE is characterized by a high level of innovativeness and invests around 20% of sales value in R&D. In 2017, employing more than 30 people, the company put an emphasis on value co-creation and even moved toward hiring some of its customers. The company operates in the airsoft industry. Its business model assumes designing and producing electronic systems, which are then inserted by users or technicians in airsoft guns' gearboxes. The products are known as 'MOSFETs' or Airsoft Electric Gun (AEG) controllers and serve as guns' upgrades. Moreover, GATE makes high-end software applications for Android and iOS, which allow airsoft players to control their guns with smartphones and check statistics therein. The highest sales are recorded in the USA, Hong Kong, Western Europe and Japan. GATE sells mainly to international distributors and airsoft stores.

GATE has been practicing the theory of co-creating a value proposition for several years. GATE's strategy of value creation is in line with the model of co-creative practice of forming a value proposition proposed by Kowalkowski et al. (2012). In 2017, the company involved its customers in value co-creation through engaging them in a survey, which contained questions important for future value formation. The other example of the co-creative practice of forming a value proposition is the case of beta-testers. Before a product release, almost 50 beta-testers verify the product's prototype. They give the valuable feedback and help to improve the final version of the product. Thanks to them, some new functions can be introduced as well as product adjustments, making the final product almost perfect. The co-creative practice of forming a value proposition in GATE might be crucial for the company's further success. Figure 1 depicts a suggestion for co-creating value in the future. It would engage not only the beta-testers and customers (airsoft players), but also airsoft technicians and product designers (e.g., programmers).

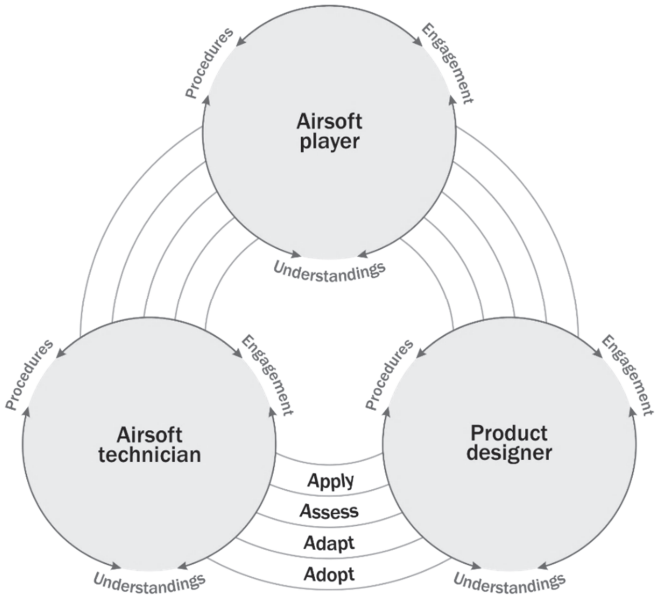

Figure 1. A co-creative practice of forming a value proposition in GATE. Source: own elaboration based on Kowalkowski et al. (2012, p. 1556).

However, this research focuses on one kind of resource-integrating actor: the airsoft player. It assumes that, based on collaboration with airsoft hobbyists from all around the world, the company can create unique value and technology, which adequately address the customer needs and influence the customer satisfaction in positive way. This strategic perspective is in line with research conducted by many prominent researchers, such as Prahalad and Ramaswamy (2000, 2004), Yang et al. (2014), Hsieh and Hsieh (2015).

Technology is part of GATE culture and philosophy. GATE can be treated as a technology-based firm, as it is being managed by several experts, it focuses on exploiting innovative ideas in terms of technology, and is totally independent of other already established companies. GATE applies modern technology to both improved and new products, which the company successfully sells in the global airsoft market. Therefore, technology commercialization is an everyday activity that takes place in the company. Most of company's products are sold online, and the purchase orders are made via email or the GATE online store. The detailed PDF product manuals with modern graphics are available on the company website. In addition, the company introduced the GATE Control Station computer app (GCS), which was very innovative way to configure the functions of its flagship products—TITAN and ASTER. The GCS turned out to be a key success factor for new technology in GATE. The app delivered new solutions to users, solutions that were never introduced before by other companies. The GCS is a mix of technology and application, and the app received very good opinions among customers all over the world. In 2020, the enterprise has planned to implement wireless connection in its product, which is its next important step toward using new technologies in airsoft. GATE is also aware of the importance of interactive collaboration with customers. This is why the company strives to co-create value with airsoft players. Thus, thorough research on value co-creation, value proposition and customer satisfaction was conducted.

3.2. Sample and Sources of Data

The analysis was carried out in April 2017 by means of the Google docs' Internet survey. The survey questions are included in the Appendix A. A total of 1033 customers from the GATE database were contacted with the link to the survey. 479 of them opened the email. In addition, the survey appeared on the GATE Facebook fanpage, reaching 5717 airsoft players. The campaign started on the 12th of April 2017 and lasted for 11 days. The answers and valid data were gathered from 178 people from all over the world. The highest number of representatives originated from the USA, UK and France. The respondents who took part in the research represented more than 30 countries from four continents. Those were: Europe (69.1%), North America (21.3%), Asia (8.4%) and South America (1.2%).

The measures of customer satisfaction used in the research are as follows: brand name, product functionality, quality level, packaging, design, warranty period, after-sales service, manuals, company website, tutorial videos, ease of installation, price, promotions and advertising. The measures were chosen as they represent the marketing mix of product, price, place and promotion in the airsoft industry (Szarucki and Menet 2018). The respondents' origin was divided into four geographical areas: Asia, European Union, North America and Others.

3.3. Methods

The methods used were specifically chosen for this kind of study. The statistical analysis was performed using an application PQStat (version 1.6.2.901). The evaluation of factors influencing customer satisfaction was measured by calculating the arithmetic average, standard deviation, minimum, lower quartile, median, upper quartile and maximum of the pre-defined elements. The received values allowed for distinguishing the key aspects that affect customer satisfaction in the airsoft industry. In order to check the impact of geographical area of origin, the above measures of tendencies in a data set were extended by Kruskal–Wallis's Test and a post-hoc (Dunn–Bonferroni) test. Significance was assumed to be at $p < 0.05$ and high significance was assumed to be at $p < 0.01$.

The survey questions are a result of thorough analysis of the theoretical background and take into consideration the strategic perspective of the company and its business objectives. There were 27 questions divided into seven categories: (1) Respondent's data; (2) Products and functions; (3) Manuals; (4) Price; (5) GATE; (6) Airsoft; (7) Satisfaction. Many of those questions include Likert-scales (mostly 1–5), where customers could rate the answers and options.

4. Results

The GATE company employed more than 10 professionals in its R&D department in 2017. The department is the core of the company, combining creativity with innovativeness and knowledge. The R&D activities are connected with the new product design, prototyping, graphic design, user experience design as well as improving hardware and software. The survey questions concerned new product functions, factors influencing customer satisfaction in the particular industry, reasons for choosing this sport and detailed metrics. The survey results are the basis for strategic decisions in new product design.

In the survey, respondents had to evaluate factors shaping customer satisfaction in the airsoft industry. The chosen approach to scaling responses is the Likert-type scale (1–5). The higher the number, the more important the particular factor is for the airsoft players. Factors' assessment allowed depicting the answer to the research question (Table 1): What are the most important factors influencing international customer satisfaction in the airsoft industry?

Table 1. Assessment of the factors influencing international customer satisfaction in the airsoft industry. Source: own elaboration (n = 176).

Factors \ Measures	Arithmetic Average	Standard Deviation	Minimum	Lower Quartile	Median	Upper Quartile	Maximum
Brand name	3.17	1.20	1	2	3	4	5
Product functionality	4.76	0.46	3	5	5	5	5
Quality level	4.83	0.40	3	5	5	5	5
Packaging	2.93	1.27	1	2	3	4	5
Design	3.69	1.06	1	3	4	5	5
Warranty period	4.03	1.11	1	3	4	5	5
After-sales service	4.29	0.85	1	4	4	5	5
Manuals	4.04	0.92	1	3	4	5	5
Company website	4.02	0.97	1	3	4	5	5
Tutorial videos	4.06	1.01	1	3	4	5	5
Ease of installation	4.21	0.92	1	4	4	5	5
Price	3.70	0.96	1	3	4	4	5
Promotions and advertising	3.99	1.12	1	3	4	5	5

According to the above results, the most important factors influencing customer satisfaction are: quality level, product functionality and after-sales service. This answered the scientific question set in this paper: "What are the most important factors influencing customer satisfaction in the airsoft industry?". Knowing this, the GATE company can design an appropriate marketing plan, focusing on the crucial factors and paying less attention to the satisfaction factors that received lower ratings.

Table 2 shows the arithmetical analysis of answers to the survey question regarding the rating of factors influencing customer satisfaction in the airsoft industry, according to the geographical area of respondent origin. The purpose of the analysis was to verify whether the customer's origin might influence the assessment of a particular satisfaction factor in the airsoft industry. The airsoft market is specific, as the hobby is forbidden in some countries, which impacts sales. Since 2008, GATE has been distributing its products in more than 30 countries. Nevertheless, there was a question as to whether the marketing strategy should be oriented globally, or targeted depending on the place to which products are being sold. This is why the Kruskal–Wallis one-way analysis of variance was carried out. The non-parametric method for testing whether samples originate from the same distribution was extended by POST-HOC (Dunn–Bonferroni) tests. As a result, no significant ($p > 0.05$) difference has been proved. This means that the hypothesis "Value co-creators' country of origin has a positive impact on customers' satisfaction" is false, as we did not find any correlation between the country of origin and customer satisfaction. Thus, GATE decided to implement the marketing strategy of not dividing its marketing activities for particular geographical areas. The change in marketing strategy saved considerable costs and made it quicker and easier to run marketing operations. Before, GATE had spent an important part of its marketing budget on creating different marketing plans depending on the areas of origin. The co-creative practice of forming a value proposition turned out to be crucial in the company's development.

Table 2. Ratings of the scales "Rate each of the elements according to the importance" depending on the continent from which the value co-creator originates. Source: own elaboration (n = 176).

		Arithmetic Average	Standard Deviation	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Kruskal–Wallis's Test	POST-HOC (Dunn–Bonferroni)			
										Asia	EU	N. America	Other
Brand name	Asia	3.33	1.18	1	3.00	3	4.00	5			1	1	1
	EU	3.12	1.19	1	2.00	3	4.00	5	H = 0.74	1		1	1
	N. America	3.24	1.20	1	2.25	3	4.00	5	p = 0.86	1	1		1
	Other	3.25	1.58	1	2.50	3.5	4.25	5		1	1	1	
Product functionality	Asia	4.73	0.46	4	4.50	5	5.00	5			1	1	1
	EU	4.74	0.50	3	5.00	5	5.00	5	H = 4.46	1		0.46	1
	N. America	4.89	0.31	4	5.00	5	5.00	5	p = 0.22	1	0.46		0.61
	Other	4.63	0.52	4	4.00	5	5.00	5		1	1	0.61	
Quality level	Asia	4.93	0.26	4	5.00	5	5.00	5			1	1	1
	EU	4.79	0.45	3	5.00	5	5.00	5	H = 2.67	1		1	1
	N. America	4.89	0.31	4	5.00	5	5.00	5	p = 0.45	1	1		1
	Other	4.88	0.35	4	5.00	5	5.00	5		1	1	1	
Packaging	Asia	3.27	1.03	1	3.00	3	4.00	5			1	1	0.23
	EU	2.93	1.30	1	2.00	3	4.00	5	H = 4.38	1		1	0.52
	N. America	2.97	1.26	1	2.00	3	4.00	5	p = 0.22	1	1		0.56
	Other	2.13	1.25	1	1.00	2	2.50	4		0.23	0.52	0.56	
Design (how the product looks like)	Asia	4.07	0.96	2	3.50	4	5.00	5			0.81	1	1
	EU	3.63	1.07	1	3.00	4	4.00	5	H= 2.68	0.81		1	1
	N. America	3.76	1.02	1	3.00	4	5.00	5	p = 0.44	1	1		1
	Other	3.38	1.30	1	2.75	4	4.00	5		1	1	1	
Warranty period	Asia	4.33	0.98	2	4.00	5	5.00	5			1	1	0.94
	EU	4.08	1.07	1	3.00	4	5.00	5	H = 2.75	1		1	1
	N. America	3.84	1.28	1	3.00	4	5.00	5	p = 0.43	1	1		1
	Other	3.75	1.04	2	3.00	4	4.25	5		0.94	1	1	
After-sales service	Asia	4.47	0.74	3	4.00	5	5.00	5			1	1	1
	EU	4.29	0.84	1	4.00	4	5.00	5	H = 0.85	1		1	1
	N. America	4.24	0.94	1	4.00	4.5	5.00	5	p = 0.84	1	1		1
	Other	4.25	0.71	3	4.00	4	5.00	5		1	1	1	
Manuals (user-friendly and multilingual)	Asia	4.53	0.74	3	4.00	5	5.00	5			0.22	0.13	0.45
	EU	4.06	0.83	2	4.00	4	5.00	5	H = 5.90	0.22		1	1
	N. America	3.84	1.15	1	3.00	4	5.00	5	p = 0.12	0.13	1		1
	Other	3.88	0.99	3	3.00	3.5	5.00	5		0.45	1	1	

Table 2. *Cont.*

		Arithmetic Average	Standard Deviation	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Kruskal–Wallis's Test	POST-HOC (Dunn–Bonferroni)			
										Asia	EU	N. America	Other
Company website	Asia	4.20	0.77	3	4.00	4	5.00	5			1	1	1
	EU	3.97	1.00	1	3.00	4	5.00	5	H = 1.06	1		1	1
	N. America	4.11	0.98	2	3.00	4	5.00	5	$p = 0.79$	1	1		1
	Other	3.88	0.99	2	3.75	4	4.25	5		1	1	1	
Tutorial videos	Asia	4.40	0.83	3	4.00	5	5.00	5			1	1	0.11
	EU	4.08	1.04	1	3.00	4	5.00	5	H = 5.93	1		1	0.26
	N. America	4.00	0.99	2	3.00	4	5.00	5	$p = 0.12$	1	1		0.61
	Other	3.38	0.92	2	3.00	3	4.00	5		0.11	0.26	0.61	
Ease of installation	Asia	4.73	0.46	4	4.50	5	5.00	5			0.21	0.07	0.41
	EU	4.23	0.86	2	4.00	4	5.00	5	H = 6.85	0.21		1	1
	N. America	3.97	1.13	1	3.00	4	5.00	5	$p = 0.08$	0.07	1		1
	Other	4.00	1.07	2	3.75	4	5.00	5		0.41	1	1	
Price	Asia	3.47	1.13	1	3.00	3	4.00	5			1	0.73	1
	EU	3.65	0.96	1	3.00	4	4.00	5	H = 3.62	1		0.54	1
	N. America	3.95	0.93	2	3.00	4	5.00	5	$p = 0.31$	0.73	0.54		1
	Other	3.75	0.71	3	3.00	4	4.00	5		1	1	1	
Promotions and advertising	Asia	4.20	1.01	2	3.50	5	5.00	5			1	1	1
	EU	4.03	1.07	1	3.00	4	5.00	5	H = 1.54	1		1	1
	N. America	3.89	1.23	1	3.00	4	5.00	5	$p = 0.67$	1	1		1
	Other	3.50	1.51	1	2.75	3.5	5.00	5		1	1	1	

5. Discussion and Conclusions

Value co-creation and customer involvement in this process are key attributes of the organizations seeking to succeed on the market (Prahalad and Ramaswamy 2004; Yang et al. 2014; Hsieh and Hsieh 2015). Seger-Guttmann et al. (2017) researched the notion of country of origin and its impact on customer satisfaction, but the academics focused on post-transaction surveys in service organizations. Another paper concentrating on the customer's country of origin was connected with cultural influences on evaluations of service quality (Albu 2013; Guesalaga et al. 2016). Najafi-Tavani et al. (2020) have verified how the cultural distance influences relationship learning on international customer involvement in manufacturing enterprises in China. They found out that the relationship learning capabilities are much more beneficial for manufacturers when their culture is similar to the customers' one, and that cultural differences importantly reduce the effectiveness of international customer involvement on company performance. However, we found no studies exploring the dependence of country of origin on international customer satisfaction in technology-based firms. Due to the lack of research among the technology-based companies, especially in the airsoft industry, our study brings valuable insights for both theoreticians as well as for practitioners. For academics, it highlights the necessity of verifying the impact of country-of-origin not only in service industries, but also in manufacturing industries, which have been omitted so far. Researchers tend to pay attention to the country-of-origin effect concentrating on the product origin, not the users' one (Montanari et al. 2018; Sevanandee and Damar-Lakadoo 2018). Moreover, this paper contributes much to the methodology of the research, as it suggests the employment of the Kruskal–Wallis's Test and post-hoc (Dunn–Bonferroni) test in order to verify the impact of the geographical area of origin on the evaluation of measures of customer satisfaction. Furthermore, the results of our study contribute to a better understanding of the factors leading to customer satisfaction involved in the process of value co-creation in the airsoft industry.

There is also a substantial contribution of the research for practitioners who operate in the manufacturing industry. In the case of GATE, technology commercialization is considered in the context in which it is a result of collaboration and knowledge integration of, not two companies, but a company and customer (Wouters and Kirchberger 2015). It stems from the fact that a key success factor for new technology is connected with the benefits that it will deliver to users (Galbraith et al. 2006). Firstly, as the analyzed company puts a lot of effort into value co-creation and even hires some of its customers, the obtained results let the company improve its marketing strategy and had significant impact on raising GATE's sales. The study revealed the most important factors influencing customer satisfaction in the airsoft industry. The evaluation of factors gave the company direct hints on what it should focus on in order to satisfy customers and meet their needs. The crucial factors encompass the quality level, product functionality and after-sales service. The least important aspects included the packaging, brand name and price. The results sketched the direction of the company's strategic plan and were the basis of its marketing activities. Moreover, the research proved that the assumption about the dependence of satisfaction factors on the geographical area of respondents' origin is false. This is a very important hint for all managers who run companies in the airsoft industry and sell on global markets. Thanks to the research, they will not waste their valuable time and energy wondering if they should target their marketing activities by taking into consideration cultural differences, as they will be aware that such differences do not have a significant impact, at least with regard to customers' continental division into Asia, European Union, North America and others.

Summarizing the above study, much attention is needed in the context of cooperation between academics and practitioners, especially in the fields of entrepreneurship, marketing and management. Managers of airsoft companies frequently lack specific academic knowledge, which would enable them to run adequate marketing campaigns and design good strategic plans. They wonder whether their companies, operating globally, should target international customers in the same way, or invest in diversifying their marketing actions depending on geographical origin. The paper is the first step towards simplifying the work of practitioners running entrepreneurial companies in the airsoft industry.

Our study has several limitations. One of them is that the survey was performed among the existing firm's customers. So, our results are based on the customers who knew the brand and had experience with GATE's products. It would be valuable to perform a study using random airsoft players who are not familiar with the company. Furthermore, it would be valuable to verify whether there is any correlation between the customers' evaluation of the factors influencing customer satisfaction and their specific country-of-origin, instead of division into the geographical areas. This would be valuable, especially for the companies that sell to a smaller number of countries than GATE does. Such research could be carried out based on customers' evaluation of factors in other companies than GATE, but still operating in the airsoft industry. In addition, valuable feedback would be gathered from airsoft stores and distributors with which GATE directly cooperates. Moreover, it would be interesting to compare the results on customer satisfaction with those customers who were not involved in the process of value co-creation. This group would be treated as a control group in order to validate the obtained results. Future studies would include longitudinal study, other qualitative research methods, developing a model and more cases, other multi-dimensional in-depth studies, or comparative case studies testing the validity of the proposed conceptual framework in other industries. Moreover, further research may examine firms that have high and low customer satisfaction or might be based on interviews with people in the firms in order to understand their assumptions and how they line up with customer demands.

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Appendix A

Survey questions.

Airsoft Mosfets Survey.

Dear Airsofters!

Would you like to get a 20% discount at GATE online store gatee.eu or just help us make better products? All you need to do is to fill out the anonymous survey, which takes up to 20 min. The −20% coupon code is valid till the end of May 2017. The survey is available till 23rd of April 2017.

This survey has been prepared in order to make you a creator of the airsoft world. By answering a few simple questions, you will impact the direction in which the airsoft technology moves. Now, you are the one who holds power to influence the future of airsoft. Share with us your unique experience to help develop the best products, and then enjoy your hobby even more!

Introduce Yourself.

1. Country.
2. Age.
    (a) <18.
    (b) 19–25.
    (c) 26–30.
    (d) 31–40.
    (e) 41<.
3. Gender.

(a) Male.
(b) Female.

4. Education.

(a) Secondary.
(b) Higher (post-secondary).
(c) Doctoral.

5. Salary (monthly in USD).

(a) <$500.
(b) $501–$1000.
(c) $1001–$2500.
(d) $2501–$3999.
(e) $4000–$5999.
(f) $6000<.

6. How much do you spend on airsoft hobby (yearly in USD):

(a) <$500.
(b) $501–$1500.
(c) $1501–$3000.
(d) $3001–$5000.
(e) $5000<.

7. How often do you play airsoft:

(a) Less than once a month.
(b) 1–2 times per month.
(c) 3–5 times per month.
(d) 6–8 times per month.
(e) More than 9 times per month.

Products and Functions.

8. Which of the GATE products do you have experience with?

(a) TITAN.
(b) WARFET.
(c) NanoHARD.
(d) PicoAAB.
(e) NanoAAB.
(f) NanoASR.
(g) MERF 3.2.
(h) NanoSSR.
(i) PicoSSR 3.
(j) None.

9. Rate the product attributes (1—unnecessary, 2—not so important, 3—important, 4—necessary, 5—extremely necessary).

- Trigger sensitivity adjustment.
- Configurable fire selector.
- Non-adjustable pre-cocking.

- Adjustable pre-cocking.
- 3-rd burst.
- Configurable burst (two to 10 rounds).
- Rate of fire reduction.
- Decreasing wear and tear of Airsoft Electric Gun (AEG) internal parts.
- Setting delay between each semishots to simulate the delay from reload or recoil.
- Two stage trigger [AUG (germ. Armee Universal Gewehr-"universal army rifle") Mode].
- 'MOSFET' reliability (internal protections).
- Low battery warning.
- Prolonging the lifespan of the motor.
- Diagnostic trouble codes.
- Resistance to atmospheric conditions.
- Resistance to water immersion.
- Built-in deans-t connectors.
- Included Mini-tamiya adapter.
- Compatibility with 14.8V lithium polymer (LI-PO) batteries.
- Complete wiring with trigger contacts.
- Functions adjustment via button and LED display.
- Functions adjustment via USB-Link and computer app.
- Functions adjustment via programmer (programming card).

10. Rate each of the following MOSFET improvements according to your needs (1- unnecessary, 2- not so important, 3-important, 4-necessary, 5-extremely necessary).

    - In case of incorrectly connecting positive and negative battery terminals (reverse polarity), the MOSFET, motor and installation will be protected against damage.
    - Functions adjustment via Bluetooth and smartphone app.
    - Bolt-catch function (if there is no airsoft pellets (BBs) in your magazine, your AEG cannot fire a shot).
    - The BBs counter (you exactly know how many BBs are currently in your magazine).

Do you have any ideas for future MOSFET improvements? (open answer).

Manuals

11. Do you think the GATE TITAN manual is detailed enough? Please skip the question if you did not see the TITAN manual.

(1—too less information; 10 – too much information).

12. Rate the types of manuals according to your preferences.

    - Written manuals (1—I dislike written manuals; 5—I like written manuals).
    - Tutorial videos (1—I never watch tutorial videos; 5—I always watch tutorial videos).
    - Printed quickstart in product kit is. (1—unnecessary; 5—extremely necessary).

Price

13. Taking into consideration the product quality, functions, features and reliability, is the price of TITAN Complete Set adequate to the product value?

    (a) YES, the price is adequate.
    (b) NO, the price is too high.

(c) I am happy I can pay less, but I think that so advanced product would cost more.
(d) I do not know the TITAN product.

14. What do you think would be the most fair price for TITAN Complete Set? (Please skip this question if you do not know the TITAN product).
15. How big a factor is price in your decision-making process? (1—price is not important for me; 5—price is extremely important for me).
16. Finish the sentence: I would like to.

(a) pay higher price and have more advanced drop-in MOSFET with many functions.
(b) pay less and have a simple version of drop-in MOSFET.

17. How does GATE rate in terms of price? (1—cheap taking into consideration quality, 5—very expensive).

Gate.

18. Do you trust in GATE brand and GATE company? (1—I do not trust GATE, 5—I totally trust GATE).
19. Rate the risks that you may perceive when choosing GATE company (1—no risk, 2—low risk, 3—moderate risk, 4—high risk, 5—very high risk).

- Installation concerns.
- Product failure.
- Difficult product usage.
- Lack of technical support.

Are there any other risks you might perceive when choosing GATE?

20. What do you consider a substitute for GATE product?
21. Airsoft.
22. What trends do you see coming in airsoft?
23. What irritates you as an airsofter?
24. Rate the factors influencing how much fun you have playing airsoft (1—not important, 5—extremely important).

- Realism.
- Airsoft field.
- Friends.
- Weather.
- Airsoft gun.
- Equipment.
- Fairness.

25. Rate the attributes of airsoft gun (1—not important, 5—extremely important).

- Range (Feet per second—FPS).
- Rate of fire.
- Trigger response.
- Option to adjust AEG with advanced MOSFET.

26. Why do you play airsoft? Rate reasons according to the level of impact on your decision to play airsoft. (—low impact, 5—high impact).

I play airsoft...

- To get entertained.
- For training.
- To show off.
- Because airsoft is a better alternative to FPS games.
- To check myself.
- To compete.

27. Had you liked FPS games before you started playing airsoft? (1—I hadn't liked FPS games before started playing airsoft, 5—I had loved playing FPS before started playing airsoft).

Satisfaction.

28. Rate each of the elements according to the importance (1—not important, 5—extremely important).

    - Brand name.
    - Product functionality.
    - Quality level.
    - Packaging.
    - Design (how the product looks like).
    - Warranty period.
    - After-sales service.
    - Manuals (user-friendly and multilingual).
    - Company website.
    - Tutorial videos.
    - Ease of installation.
    - Promotions and advertising (e.g., discounts at online store).

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The Link between Business Process Management and Quality Management

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Abstract: In an environment of intense globalization and digitalization, business organizations are increasingly faced with various challenges such as rising costs, strong competition, rapidly evolving technologies, increasingly demanding and whimsical consumers, and, in social terms, changing societal demands. It is within this context that the effectiveness and efficiency of the management of business organizations is actualized. The paper addresses the following fundamental questions regarding the scientific problem at the theoretical level: What is the place of Business Process Management (BPM) in the context of Quality Management (QM)? Should BPM be the axis of QM? There is a lack of interdisciplinary research on the link between Business Process Management and Quality Management, and this study aims to ground this link. Methods of the research are literature review and the critical analysis of the scientific sources on the issue. The findings show that there exists confusion, overlaps among different paradigms of QM and BPM. The BPM paradigm might be considered as an integral part of almost all essential quality management paradigms. BPM is like a horizontal area "crossing" different paradigms of quality management (e.g., TQM, SMS, Lean, Six Sigma). The conclusions drawn are useful for organizations that implement quality management systems. The integration of BPM into quality management systems and tools creates preconditions for the development of an effective and efficient organization.

Keywords: process; business process management; quality management; total quality management; Lean; Six Sigma; ISO 9000

1. Introduction

In an environment of intense globalization and digitalization, business organizations are increasingly faced with various challenges such as rising costs, strong competition, rapidly evolving technologies, increasingly demanding and whimsical consumers, and, in social terms, changing societal demands. Companies operating in this context seek to make the best decisions (Beilmann and Clever 2019). Becker et al. (2013a) describe competition as a "mobile war", where success depends on anticipating pertinent market trends and responding quickly to changing consumer needs. The insights of these authors are extremely relevant because most organizations have already entered or are entering the digital transformation that enables critical business changes. This leads not only to the fundamental transformation of an organization but also that of the entire industry. Digitization of business processes in many cases becomes the key to increasing business efficiency (Osmundsen et al. 2019). In other words, in recent years, the digital transformation has been changing the economic environment of organizations (Fischer et al. 2019), which highlights the importance of business process management while developing digitization (Martinez 2019). Business process management (BPM) is one of the most popular business practices nowadays, which is being explored both in the business world and by the scientific society. The relevance of this methodology is undeniable, as BPM is vital to every

organization. The relevance of BPM has become even more pronounced in the last decade, during which the functioning of organizations has been significantly affected by digitization (Pereira et al. 2019; Chountalas and Lagodimos 2019; Van Looy 2020).

To manage business processes, it is first necessary to comprehend the concept of "process" (Seethamraju 2012; Iden 2012). Quality Management (QM) has been based on this definition since the beginning of the 20th century. For several decades already, business organizations have been identifying, describing, and, in some cases, standardizing (for instance, ISO 9001) their business processes by introducing quality management systems and applying/constructing quality management models. Thus, quality management conceptions such as Total Quality Management (TQM), Lean, Six Sigma, and others do not consider processes to be a peripheral area (Chang 2006). This can be illustrated by Bhat and Fernandez's (2010) insight, which implies that process professionals may look at BPM with suspicion, considering that it might simply be "the old wine in new bottles"—that is, the same quality management. The truth of most management ideas is that they are often constructed "on top of each other," sharing key themes that have not changed over the years. Be it TQM in 1980 or Business Process Reengineering (BPR) in 1990, the main theme uniting these management ideas is the concept of process management to increase value. The existing theories of process management have emerged from the quality movement and the BPR movement over the past two decades (Chang 2006). Several twentieth-century management initiatives, including TQM, Lean, Six Sigma, and BPR, cover the core area of processes and process management. The origins and essential philosophical basis of process management are related to TQM, which generalizes the use of business management, information technology, and quality management methods (Seethamraju 2012; Klimas 2013). So, the question arises as to whether BPM is an integral part of quality management.

This paper analyses two management methodologies—that is, Business Process Management (BPM) and Quality Management (QM). The scientific problem of this paper focuses on the following fundamental questions at the theoretical level: What role does business process management play in the context of quality management? Should BPM be considered as the axis of QM? Alternatively, is BPM a completely separate discipline which has nothing to do with QM? The subject of the research is the link between BPM and QM. This conceptual topic is particularly relevant for science, as the most recent research on the link between QM and BPM, which is fragmented, may lead to appropriate decisions in terms of evolving quality management concepts, such as the direction of ISO management standards or the need of certifying other QM systems (that are not being certified yet), etc. This would allow the scientific substantiation of the relevance and benefits of the link between BPM and QM (perhaps even the convergence of these concepts) to the specifics of the business sector—that is, application of new theories (in this case, QM and BPM theories) to the solution of the phenomenon. Thus, this paper aims to define the link between the essential aspects of business process management and quality management based on theoretical insights.

The methods of the research are literature review and the critical analysis of the scientific sources on the issue. Scientific articles and other scientific sources (dissertations, books) published over a period of 20 years (2000–2020) were analyzed, looking for the research conducted on the topic of the links between BPM and QM. International databases were investigated by entering the following keywords: Business Process Management and Quality Management, the link between BPM and QM, the link between BPM and TQM, Six Sigma, Lean.

2. Concept of Business Process Management

The definition of the business process, which is relevant in the conception of BPM, is still not properly perceived in business. The process is inherently dynamic (agile). It is not just what needs to be designed or redesigned; it is an important complex organizational unit that needs to be managed. A business process is a set of all the activities of an organization, including the roles, resources, and rules required to produce and deliver a product or service to external or internal users (Iden 2012). It is a complex phenomenon and is more than just a sequence of actions (Becker et al. 2013a). Thus,

a business process is an agile, complex organizational unit with a logical and time-bound sequence of actions. This process should be managed in an organization to create a user-defined value. Given the dynamic nature of the business process, continuous process improvement is a prerequisite for creating and maintaining a long-term competitive advantage for an organization.

BPM has been developed as an important management tool that helps organizations to grow and innovate. This methodology includes designing (or re-designing) the business logic of the organization; modeling its implementation; execution; management; monitoring and changes needed to meet customers' needs to the greatest extent. "The axis of the BPM philosophy and the implementation of its principles is the satisfaction of customers' needs; therefore, it can be stated that the BPM philosophy remains as a future management philosophy" (Klimas 2013, p. 12). In other words, BPM is a management approach that treats the functioning of an organization as a network of interconnected business processes. With this approach, to increase dynamism in an ever-changing environment, most organizations partially or completely change traditional hierarchical organizational structures by focusing them on processes (Chountalas and Lagodimos 2019). Thus, while traditional organizations are established on the basis of departments and functional silos, BPM positions organizations as networks or process systems (Chang 2006). Business processes are a core unit of BPM that is focused on identification, discovery, analysis, redesign, execution, and monitoring as a body of methods, techniques, and tools. In this way, the aim is to improve performance (Dumas et al. 2018).

Iden (2012) distinguishes four dimensions of BPM: process awareness, process ownership, process measurement, and process improvement. Process awareness is defined as the most important criterion of process management; that is, business organization processes should be identified, named, and documented. This is reflected in a comprehensive process map that visualizes the processes of the organization and their interrelationships. It should be supplemented by a set of documents describing individual processes and distinguishing activities, roles, resources, rules, and results. However, to meet the criteria of understanding the processes, having documents alone is not enough. Managers and employees should comprehend these processes; employees should have a deep understanding of the processes they are involved in from the beginning to the end. This most important criterion is about how employees and managers perceive the organization—that is, how it is structured, how it works. Moreover, in case processes are immeasurable, it is impossible to define the value they create. Measurements provide a basis for the improvement of processes (Chang 2006).

To sum up, it should be emphasized that BPM is a management concept that defines the performance of an organization as a system of related, interacting processes. The management of such an organization is based on networked processes. The BPM concept should have the following components: (1) the process should be correctly understood (this is the most important part of BPM); (2) the process should have a process owner assigned; (3) the process should be evaluated/measured; (4) the process should be systematically improved in the context of other processes. The process architecture is the basis of the BPM methodology, which demonstrates how the organization provides value to users. The essential condition of the process architecture is a correct understanding of processes.

3. Evolution of Business Process Management: The Context of Digitization

The origins of BPM can be traced to F. W. Taylor, who shaped the principles of scientific management, and H. Simon, who applied systemic thinking to organizations (Chountalas and Lagodimos 2019). Shewhart (1931) was one of the first to argue for process monitoring in product control. During 1970, the methodologies of dealing with processes were refined as Just-In-Time (JIT) and Lean Production (Palmberg 2010). In 1980 and 1990, the area of monitoring the process was greatly developed and covered all areas of the organization.

Process management emerged as early as in 1980, but, despite many other management concepts, interest in process management remains very high (Palmberg 2010). Despite a relatively early discussion on the subject of processes among academics, the focus on processes began in 1980 following the approaches published by Gaitanides (1983), Scheer (1990), Porter (1989), Davenport (1993), Hammer

and Champy (1993), and Hammer (1996) (Becker et al. 2013a). However, the most powerful assumptions in shaping the BPM concept came from the works of Porter (1985) and Deming (1986), who described the horizontal interrelationships of individual activities that extend throughout the organization, perceiving these activities as a unified system (Porter's "Value Chain", Deming's "Flow Diagram"). These activities were not known as business processes; they were formally defined as a set of clearly specified, structured, and logically related activities that function together and use resources to transform specific inputs into desired outcomes (Chountalas and Lagodimos 2019).

In 1990, when the business was dominated by the Total Quality Management philosophy, to increase stakeholders and value, reduce organizational costs, and improve performance, the process-centered view, the so-called conception of Business Process Reengineering (BPR), incorporated a radical process redesign. BPR is a systematic management methodology which, in the form of an independent project of change, involves a radical redesign of the process. BPR quickly spread from production sources to non-productive areas. The first success stories of organizations appeared (for instance, Ford's Billing Division, IBM Credit Corporation). Radical managerial approaches to process improvement were used, which were publicized in management journals such as the Harvard Business Review. However, the growing interest of the management community in the concept of BPR received considerable criticism from the scientific community, which argued that BPR evokes more myths than practical methodologies (Klun and Trkman 2018). Its implementation was a major challenge for managers and not always successful. Studies show that the rate of failure of the implementation of BPR was between 50 and 80 percent. As BPR is a large, high-risk change project, failure can have a huge negative impact on an organization (Chountalas and Lagodimos 2019). It is important to note that the BPR movement made a particularly significant contribution to highlighting the importance of inter-functional processes (not just processes) (Näslund 2008). Recently, and in parallel with this conceptual transformation, the process-centered view reached a new dimension—that is, process management—which emphasizes the continuous improvement of organizational processes (Iden 2012). "BPM is a revival of BPR, as indeed BPM adopts the process-centred view on organizations" (Dumas et al. 2018, p. 15).

One of the most recent terms used in the context of BPM is Business Process Change (BPC). Harmon (2019, cit. in Javidroozi et al. 2020) defines BPC as the analysis, redesign, and improvement of existing processes to achieve competitive advantage in operations. This is implemented through the BPM program, which helps understand business requirements, the need for change, and the impact of BPC on business. Business processes, especially in large organizations, are complex; the BPC approach implies managing this complexity.

The organizations that integrate and implement digital technologies are much more innovative than other organizations (Osmundsen et al. 2019). Information systems have paid special attention to BPM and have begun to incorporate this concept into the curriculum of the IS model, research, and practice (Seethamraju 2012). The new paradigm of conceptual process management created by Hammer has led to new organizational structures and solutions that are closely related to information technology. The rapid development of IT focused on business process automation has begun. However, most of these information and communication technology-based process approaches failed because the solution of the IT software selected in the organization was more dominant than focusing on the challenges of fair business and IT alignment (Becker et al. 2013a).

Business process modeling has received special attention in recent decades, both in practical and theoretical terms. Modeling has always been the essence of BPM activities; process models have always been used to improve the organization. Gantt charts and flow charts were the earliest tools for modeling business processes (Aguilar-Savén 2004; Adamides and Karacapilidis 2006, cit. in Klun and Trkman 2018). Business process modeling languages using IT tools abound, ranking from early languages such as EPC (event-driven process chain) to BPMN (Business Process Model and Notation) and UML Activity Diagrams (Becker et al. 2013b). The most frequently and commonly used notations for business process modeling are flow chart diagrams, PetriNets, Integrated Definition for Function Modeling (IDEF0), event-driven process chains (EPC), Unified Modeling Language (UML),

and Business Process Model and Notation (BPMN). However, all these mark-up languages are criticized by practitioners and researchers. The limitations are particularly related to the lack of standardization, which poses challenges to the reuse of business processes as well as those in changing management (Becker et al. 2013b).

One of the latest technologies that enables the automation of repetitive business processes is Robotic Process Automation (RPA), which addresses the typical and relatively simple tasks of the employees of an organization. Typical examples include processing bank loans, taxes, insurance claims, or consumer inquiries. RPA is a software robot that replicates human activities in processes with structured data, clear rules of action leading to unambiguous results. Studies show that RPA has a profound effect on business operations. These robots manage structured tasks accurately, and the services of an organization are improved quickly and qualitatively, which expands the availability of services and increases compliance with the norms established. According to research, the return on investment in RPA varies from 30 to 200 percent in the first year. Research also reveals that RPA affects some activities, and the effect usually includes increasing productivity and the reduction in redundancies or removal of processes/functions from the organization (Osmundsen et al. 2019). It should be noted, however, that the IT standardization should follow the standardization of processes and not the other way round (Schönreiter 2018). A study by Martinez (2019) illustrates that the process improvement approach allows organizations to incorporate digital elements into their processes. This procedural approach encourages organizations to improve their business models by incorporating new digital elements. The results of the study confirmed that process perfection is a mandatory requirement for the introduction of new technologies. Despite the ever-growing number of scientific sources on IT-based BPM topics, BPM is essentially a management concept, and IT is its peripheral field (Chountalas and Lagodimos 2019).

Without the process, companies would fall into a spiral of chaos and internal conflict. However, the existence of BPM as a separate autonomous discipline is questionable. It is neither a new management theory nor another form of automation that governs the life cycle of improvement and optimization (Hammer 2003, cit. by Seethamraju 2012). Seethamraju (2012) notes that BPM is currently treated as a "missing middle" between business strategy and IT. BPM seems to have to convert strategies into business processes for consistent and effective management.

The BPM methodology can be summarized by Schönreiter's (2018) insight, noting that the main interest of BPM is focused on how to manage the flow of value-creating processes across the organization. BPM is often not treated as a completely separate, autonomous management discipline.

4. Links between BPM and QM

4.1. Evolution of BPM and QM

Schönreiter (2018) uses the term quality management synonymously with the term process management, arguing that processes themselves are the subject of quality management. A process-oriented quality management system encompasses, manages, and directs all the activities in the organization. Process management is an integral part of a model quality system (Iden 2012). Different sectors apply quality management to manage processes and ensure the quality of products and services.

TQM today seems to represent an "umbrella" enveloping a growing body of knowledge, science, and technology that has been popular in organizations for the past 3 decades. The TQM philosophy broadly encompasses different approaches (for instance, BPR, Six Sigma, Lean) at the conceptual level. In some parts of the world, especially in India, TQM is particularly popular as a process and quality management philosophy (Bhat and Fernandez 2010). Process management plays a huge role in it. TQM covered a particularly large body of business process management literature (Chountalas and Lagodimos 2019).

The potential of the implementation of BPM exists in each of the following four paradigms: TQM, Standardized Management Systems (SMS) (ISO 9001, ISO 14001, ISO 50001, ISO 27001, ISO 22000,

etc.), BPR, and Six Sigma; that is, BPM can be seen as an integral part of these quality management paradigms. The principles of each of these paradigms directly affect the features inherent in BPM. Despite some differences, the structure of BPM in all these paradigms confirms the classic stages of the BPM life cycle. However, each of these paradigms assigns different weights to each stage and thus reflects the different levels of BPM implementation. As described in the previous section, there exists a general paradigm-independent BPM model (Chountalas and Lagodimos 2019). The four paradigms still attract a lot of researchers' attention. They have evolved effectively over the last 3 decades. Chountalas and Lagodimos (2019), using the data from the Scopus database (20 April 2018), graphically represented the number of annually published scientific papers where these paradigms are mentioned in the title or abstract (articles, conferences, reviews, book chapters, etc.). Although Six Sigma appeared later than the other three paradigms (SMS, BPR, TQM), it evolved even into the first paradigm in the implementation of BPM.

As DeToro and McCabe (1997, cit. in Chountalas and Lagodimos 2019) aptly observed, alongside other management paradigms, BPM itself was initially unknown as a concept. Since 2000, however, it has begun to be treated as a separate concept but more closely related to IT than to management (Chountalas and Lagodimos 2019). In case there is no strong quality management on the part of the organization, process management will focus on IT. In many Indian organizations, quality management is governed by a central independent organization representing the management level. This logically implies that BPM should explore strong and synergistic partnership with quality management programs within the organization. For instance, process modeling initiatives under the BPM umbrella need to be integrated with process documentation repositories/process architectures—that is, maintained as part of the quality management system. BPM methods and tools should be combined with the quality models and awards that the organization seeks. For instance, BPM can be a great tool to facilitate Six Sigma projects (Bhat and Fernandez 2010).

To sum up, BPM is not a completely separate autonomous concept. Neither is it just another management theory existing in parallel with the concept of quality management. Business process management can be treated as an integral part of the quality management paradigm. Process management is like a horizontal field, "crossing" different paradigms of quality management (for instance, TQM, SMS, Lean, Six Sigma). This generalization is substantiated in detail in the next section of this paper.

4.2. BPM as Part of QM

The conception of process management can be traced in the definition of the quality management system itself. A quality management system is understood as the structure, policies, processes, procedures, and resources (including human resources) of the organization required to implement quality management (Bollaert 2014). This system is based on a procedural and systemic approach, where the quality of activities is created and ensured by processes that are constantly improved and merged into a coherent system (Ruževičius et al. 2008). The main purpose of the quality system is to substantiate the management of activities and processes. The concept of process is essential in quality management systems. Thus, quality systems nowadays are focused on processes and are characterized as having a beginning and an end, which resembles a cross-functional view of an organization (Iden 2012). By implementing quality management cycles, organizations can manage internal and external disorders. The result is a stabilized or even improved performance of the business process (Schröder et al. 2015).

Quality management has evolved over 100 years; innovative quality management methods and tools have been introduced and are constantly being improved. Thus, quality management has facilitated innovation and raised standards. Quality management will remain the essential success factor for each organization, society, as well as every end-user of each organization (Weckenmann et al. 2015). However, in the 21st century, quality management requires a combination of ways of thinking and application of several tools and methods from different paradigms depending on the context. It is

a multidimensional concept that encompasses four paradigms: (1) the Empirical Paradigm—that is, quality implies compliance with the requirements—uses seven tools, Six Sigma, Statistical Process Control (SPC); the risk of the paradigm is bureaucracy; (2) the Reference Paradigm—that is, quality implies compliance with the purpose—uses ISO 9000 series, Balanced Scorecard (BSC), European Foundation for Quality Management (EFQM), National Malcolm Baldrige Quality Award (NMBQA); to improve processes, Plan-do-check-act cycle (PDCA) is used; the risk of the paradigm is "indulgence"; (3) the Reflective Paradigm, which implies that quality is subjective; the quality cannot be defined, it can be discussed through stories, meetings, etc.; the risk of this paradigm is arrogance; (4) the Emergence Paradigm implies compliance with is the era of rapid change; the quality can be defined for a limited period. The fourth paradigm seeks quality to reinforce processes by adapting to context, sometimes breakthrough, or complete reorganization. All these four paradigms together form the concept of TQM. At present, the Emergence Paradigm has not received enough attention, and new methods should be sought (van Kemenade and Hardjono 2019). The new context paradigm is also called Theory C, where quality management is treated as an adaptation to the context; that is, there is no single way to implement quality management in an organization (van Kemenade 2014). As it can be seen, in the context of this fourth paradigm, special attention is paid to processes. Recent research has already addressed the philosophy of global quality management, which also emphasizes the need for inter-organizational coordination and process management (Bashan and Notea 2018).

There are seven quality management practices most studied in empirical research: top management support; relationship with customers; relationship with suppliers; management of workforce; quality information; product/ service design, and process management. They represent the broad scope of QM and are implemented within the organization to continuously improve all activities (Zu 2009). There is a consensus in the QM literature that QM practices are improved in two dimensions: essential or hard QM practices (technologically and methodologically oriented practices involving quality data and information, product design process, and use of statistical process management techniques and other process improvement techniques) and infrastructure or soft QM practices (people and culture oriented, focusing on organizational change and improvement in the areas of managerial commitment and leadership, relationships with external users and suppliers, and human resource management) (Zu 2009). Thus, when quality managers improve and support the QM systems of their organization, to achieve the effectiveness of the QM system, adequate resources should be allocated to both practices. Process management is an essential/hard QM practice.

The use of QM tools and techniques is essential for problem-solving and process management (Bunney and Dale 1997, Stephens 1997, cit. in Zu 2009). Tarı´ and Sabater (2004) investigated the importance of using TQM tools and techniques (internal audit, graphs, SPC, flow charts, quality costs, histograms, comparability, Pareto charts, cause-and-effect charts, etc.) (Zu 2009). Tauge (2005, cit. in Näslund 2008) discussed 148 different tools, dividing them into six categories (project planning and measure implementation, idea generation, process analysis, data collection and analysis, cause analysis, evaluation, and decision-making tools). All these tools are applied in business process management.

BPM is recognized as an integral part of most TQM systems. The TQM paradigm focuses on all processes across the organization, and this is primarily based on a systematic approach to BPM. The PDCA cycle can be considered as a general BPM structure within TQM. In other words, under the TQM paradigm, BPM focuses on the integration of TQM principles, methods, and tools into processes (Chountalas and Lagodimos 2019).

The European Foundation for Quality Management (EFQM) Excellence Model has an area of the assessment called "processes" that relates to all the value-generating activities of an organization. This area examines how processes are identified, analyzed, and, if necessary, redesigned to ensure continuous improvement of the organization. In the MBNQA model, the criterion "process management" examines the design and provision of the processes of core products and service of an organization; the core non-product and non-service processes (information and knowledge management, etc.) of an organization, and the key supporting processes (finance and accounting,

infrastructure management, legal services, human resources services, etc.). Nowadays, this focus on the concept of processes in the field of competitive quality is reflected even as a precondition for normative quality (Biazzo and Bernardi 2003).

A quality management system requires standardized processes. Process standardization means the unification of business processes and forming the foundation for actions among different departments or locations in an organization (Schönreiter 2018). Beilmann and Clever (2019) noted that the use of BPM methodology in developing quality management in an organization according to the well-known ISO 9001 standard is excellent proof of how to effectively and productively integrate two areas: quality management and business process management. These researchers demonstrate that in the practice of ISO 9001 certification, BPM like an iceberg covers all areas of the quality management system. In the ISO 9000 standard, quality management is strictly based on the following seven principles: customer orientation, leadership, people involvement, process-oriented approach, continuous improvement, evidence-based decision-making, and relationship management. One of the most important factors indicating the level of success in the implementation of ISO 9001 is process management (Chountalas et al. 2019). However, the early versions of SMS (ISO quality management systems) of 1980 and 1990 did not pay much attention to BPM. The first version of these standards required a lot of documentation. From that point on, the quality was understood as a system loaded with huge documentation and a high level of bureaucracy, completely non-procedural for employees (Bacoup et al. 2018). The newer versions of ISO 9001 marked a shift in focus from individual requirements to a more holistic, process-oriented approach, considering ever changing contexts. However, the myth of the ISO 9001 documentation nightmare is still present in some sectors. Many companies that are ISO 9001 certified have too much documentation and are developing cumbersome Quality Documentation Systems that provide little value (Bacoup et al. 2018). While all certified organizations receive a certificate of a standard form, it is a public secret that these organizations do not implement the requirements of the standard at the same level. It is convenient to treat ISO 9001 as a "black box" and accept it instead of analyzing phenomena such as motivation, benefits, and barriers to certification. To open the "black box", an in-depth study of the day-to-day activities conducted by certified organizations is required (Chountalas et al. 2019). Organizations need the BPM standards to have an indicator of the maturity of processes, such as the ISO 9000 series. This would make it possible to see how well they are managed, measured, and prepared for continuous improvement. Well-defined standardized practices consistently cover their costs and operational objectives and reduce the risk of failure. Thus, ISO 9001, despite its bureaucratic nature, provides standardization, which is a highly desirable attribute of any management system. When processes are repetitive and systematically implemented, consistency is achieved to help maintain quality at the high-level set. In contrast, uncontrolled variability in processes is the primary cause of quality problems (Schönreiter 2018; Chountalas et al. 2019).

In 1994, Womack and Jones (cit. in Näslund 2008) defined Lean as a systematic elimination of squander conducted by all members of an organization in all areas of value flow creation. The Lean concept is based on mapping and analyzing activities in processes. In Lean terminology, this is called value stream mapping. In most cases, Lean is an updated version of the JIT approach. Both focus on processes—that is, adding value and eliminating losses in processes. Both methods come from the Toyota Production System (TPS). The tools to implement Lean are the same as the tools offered by JIT. Well-known tools include process/value flow mapping, Kaizen, 5S, and Kanban. Lean has an excellent reputation for its focus on process efficiency and effectiveness. The Lean philosophy provides principles and practices aimed at updating innovation capacity (Solaimani et al. 2019). Thus, BPM is also actualized in the Lean philosophy.

Six Sigma is a methodology of systemic management in the form of an autonomous change project involving the incremental (step-by-step) restructuring of the process. It is a method for improving process capacity and developing process penetrability. Six Sigma focuses more on individual processes than on systemic interactions among processes. Thus, BPM is applied in this paradigm as an individual process approach. Over time, the development of Lean Six Sigma has begun, focusing on a systematic

approach to BPM already—that is, on the management of interaction among processes. In the Six Sigma paradigm, process improvement is structured according to the DMAIC (define, measure, analyze, improve, control) methodology. In addition to the widespread DMAIC methodology, alternative methodologies in the context of Design for Six Sigma (DFSS) are proposed that specifically focus on the design of new and innovative processes, such as DMADV (define, measure, analyze, design, verify) and IDOV (identify, design, optimize, validate). The Six Sigma paradigm focuses more on the management of processes itself than on their layout and interaction (Näslund 2008; Chountalas and Lagodimos 2019).

Qualifying TQM, Six Sigma, and Lean concepts from the perspective of processes, TQM is designed to improve and unify processes; Six Sigma is meant to reduce variation and improve processes; and Lean is used to improve flow in processes (Andersson et al. 2006). BPR and TQM differ in their scope. BPR is a methodology for implementing BPM, and TQM is a broader management philosophy that incorporates BPM as one of the individual principles (Chountalas and Lagodimos 2019). In other words, "BPM inherits from the continuous improvement philosophy of TQM, embraces the principles and techniques of operations management, Lean and Six Sigma, and combines them with the capabilities offered by modern information technology to optimally align business processes with performance objectives of an organization" (Dumas et al. 2018, p. 8).

5. Conclusions and Discussion

The study of the scientific sources discussed in this paper has revealed relevant insights for future research. Looking at the definitions and evolution of QM and BPM, the role of BPM in the context of quality management is actualized (Chang 2006, Chountalas and Lagodimos 2019). Having investigated the evolution of BPM (Chountalas and Lagodimos 2019) and its components (Biazzo and Bernardi 2003; Iden 2012; Becker et al. 2013a), it is obvious that these aspects are covered by quality management, and its paradigms are distinguished as well (TQM, Six Sigma, Lean). Based on the insights of Chang (2006), Schönreiter (2018), Chountalas and Lagodimos (2019), and other researchers reviewed in this paper, it can be argued that BPM is not just a completely separate autonomous concept. Moreover, it is not a management concept focused exclusively on IT (Osmundsen et al. 2019). Neither is it just another management theory running in parallel with the concept of quality management. BPM is like a horizontal area that "crosses" different quality management paradigms (for instance, TQM, SMS, Lean, Six Sigma). There is confusion, overlaps among different paradigms of quality management and business process management. Business process management is not the aim in itself. It is a tool to help achieve business goals. The business process management paradigm can be called an integral part of virtually all quality management paradigms. Thus, frequently, BPM is not treated as a completely separate, autonomous management discipline. It is neither a new management theory nor another form of automation that manages the life cycle of improvement and optimization.

This paper contributes to the scientific sources by presenting a theoretical link between Business Process Management and Quality Management. It is also relevant in the practical sense. The conclusions drawn are useful for organizations that implement quality management systems. The integration of BPM into quality management systems and tools creates preconditions for the development of an effective and efficient organization. Organizations should not view BPM and QM as separate management disciplines with different tools. BPM can be seen as a tool integrated into quality management paradigms. Thus, quality goals can be achieved by efficiently and effectively managing processes.

We admit that this paper of communicative type is not without limitations. Firstly, a quantitative review of scientific sources has not been performed. This paper is based on researchers' insights identified in the scientific literature to scientifically substantiate and communicate the theoretical links between QM and BPM. In the future, it would be beneficial to conduct a systematic literature review, involving a quantitative analysis of scientific investigations. Thus, other methods of research should be used. Secondly, this paper does not seek to refine the terminology in the field of quality management (how quality management systems, models, methods, practices, tools are defined). Different scientific

sources use different terms to define certain QM phenomena; for instance, in one source, Lean is referred to as a QM system, but in another source, it is a method, etc. The issue of the definition of the terms related to quality can be the subject of future research. The future research on the topic of the links between BPM and QM substantiating the effectiveness and efficiency of quality management systems while dealing effectively with quality management systems through BPM is very relevant. Highly emphasized is the need for business process digitization research to reveal the impact of digitization on the effectiveness of quality management systems.

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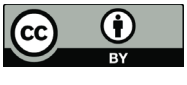

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Emergency Management in Resolving an Emergency Situation

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Abstract: Experience gained from NATO operations shows that the basis for an effective solution to a crisis is a combination of a comprehensive political, civilian and military approach. The cooperation of all stakeholders is thus a basic prerequisite for the effective resolution of crisis situations. These aspects and stakeholders include emergency management. This paper deals with civil-military cooperation in times of emergency caused by the COVID-19 pandemic in the Czech Republic. It qualitatively evaluates the findings resulting from the questionnaire survey focused on the state of crisis preparedness of the Army of the Czech Republic and the functionality of emergency management in cooperation with rescue work with other teams of the rescue system. The questionnaire was carried out at military units in all regions of the Czech Republic; organizational units of the Ministry of Defence with nationwide competence, which were directly involved in securing measures related to the declaration of a state of emergency due to the COVID-19 pandemic in March—May, 2020; Operations Command, which currently manages operations in the Czech Republic designed to manage the consequences of a pandemic; and members of the Ministry of Defence participating in the activities of the Strategic Command and Control Group. A total of 21 stakeholders took part. The experience in managing the consequences of the COVID-19 pandemic have shown that armed forces around the world have an irreplaceable position in dealing with nonmilitary crises. The conclusions and recommendations obtained from the research survey are the content of this paper.

Keywords: civilian-military cooperation; emergency management; emergency preparedness; rescue system; state of emergency; threats

1. Introduction

The various threats and disasters with local and national impacts (e.g., terrorist attacks by small groups or individuals, migration waves, climate change, political change) which significantly affect the normal functioning of society are becoming more and more intense. This fact requires, hierarchically, from government officials, crisis management authorities, the rescue system, security and armed forces, and from the population itself, preparedness to deal with crises and dangers. Crisis management deals with the individual phases of preparedness and solution (Svarcova et al. 2016).

Large-scale natural disasters include e.g., a forest fire on 1 May 2016 in the Canadian province of Alberta near Fort McMurray, which caused very dry weather (Government of Alberta Home 2016). Another example of the cause of emergencies are industrial accidents caused by human factors, failures of technological or technical equipment or even the influence of natural elements. The accident of the Fukushima Daiichi nuclear power plant in Japan in March 2011, which occurred as a result of the earthquake that triggered the tsunami, can be mentioned (Acton and Hibbs 2012). The current threat to society, not only social and economic, is terrorist attacks, the motives for which vary considerably.

They include a fragmented group of political, religious, criminal or psychotic reasons. These motives are not static, they evolve or disappear over time in response to the development of a given political or socio-economic system. Given the total number of victims and injuries, the largest terrorist attacks in Europe took place in 2004 in Madrid, Spain (191 victims, 2050 injured; (Carresi 2008)), in 2005 in the United Kingdom in London (56 victims, 700 injured; (Hines et al. 2005)), in 2011 in Oslo, Norway (77 victims, 151 injured; (Sollid et al. 2012)). The success of the intervention of rescue system subjects is influenced, among other things, by geographical differences (accessibility to the extraordinaly event site), population density, experience from cooperation exercises and differences in the responsibilities of individual security forces in dealing with an emergency (Rehn and Sollid 2013). More than ever, successful management depends on the most rational use of all available resources of the rescue system as a whole. It is in such a situation that the importance of rational communication and teamwork according to the principles of emergency management and communication becomes apparent (Urban and Hoskova-Mayerova 2017).

Current and future threats, including threats to health, force countries to review, modify and implement plans for large-scale emergency situations or crisis situations including those in the field of public health. Previous plans often focused on managing the consequences of situations associated with specific diseases (e.g., influenza pandemics, SARS, MERS, Ebola) or other health threats (Kelly and Cowling 2011; Napoli et al. 2014; Napoli et al. 2015). Significant efforts are therefore now being made to improve crisis plans, methods and amendments to legislation.

The framework for the coordination of preparedness and response planning is set out at an EU level in Decision No 1082/2013/EU on serious cross-border threats to health, which also serves to strengthen the capacity for monitoring, early warning, evaluation and response to health emergency situations. Under the EU program, support is provided through professional training and exercises, as well as by facilitating the sharing of experience, guidelines and processes across EU countries (LA 2013; Kroupa et al. 2011).

The Decision contributes to the crisis preparedness of EU countries by sharing best practices and experience in preparedness and response planning. It can also be seen as an instruction to member states in drawing up national preparedness plans for various types of public health threats, such as influenza pandemics or chemical accidents, natural disasters or disasters caused by intentional actions (Navrátil et al. 2019; Otrisal et al. 2018). It also supports the interoperability of national plans through coordination mechanisms, analysis and communication tools (Riccardo et al. 2016).

Crisis preparedness in general (Svarcova et al. 2015), on a national scale, can be understood as the ability of a system to have an early response to danger with adequate capacity of competent forces and resources. Such forces and resources, as part of resolving an emergency situation caused by a natural disaster or threat, with a national impact, also include rescue teams, which include both civilian and military units (Tušer and Jánský 2020b). The harmonization of civil-military cooperation in response to life-threatening and health-threatening situations is an essential aspect for the successful management of emergency situations in a given country.

If the harmonization of cooperation is successful and the process of resolving the emergency situation is coordinated, there is no waste of energy or material and financial resources. Properly implemented risk management leads to significant savings in the state budget.

The amount of savings can be quantified only after the end of the intervention in an emergency or after its completion. The greatest financial savings occur if there is good planning, and the coordinated decision-making of all responsible persons can completely prevent an emergency. If it is not possible to prevent the emergence of extraordinary event, then at least minimize their consequences.

The essence of emergency management is a systemic and coordinated approach to the application of preventive measures and emergency management. Emergency management is implemented at all levels of state management and administration through emergency management bodies (CMB) with their working bodies for crisis planning and management (i.e., security councils, crisis staff). The manifestation of CMB's systemic approach to emergency management is the elaboration and

subsequent use of crisis and emergency plans. The Security Council's analyze the risks and the state of preparedness, and take decisions on preventive measures (Tušer and Navrátil 2020). Decisions of security councils are made to prepare for imminent danger. Crisis staff, in turn, deal with specific situations in real time.

The article responds to the identified shortcomings in civil-military cooperation in the Czech Republic during a state emergency or disaster. A study of the current situation revealed that in the case of a longer-term deployment of the above-mentioned forces, financial and legislative support is required for the acquisition of property and services for consideration. In the Czech Republic, there are no financial limits, procedures and areas of responsibility of individual actors in the acquisition process of public contracts for the acquisition of property and services for consideration in a state of emergency. Ineffective deployment of the forces and resources (F&R) of the Army of the Czech Republic (ACR) to perform tasks in crisis situations of a nonmilitary nature due to the insufficiently legislated regulated way of requiring the ACR F&R and inconsistency (asynchrony) of information flows for all components of the rescue system.

The structure of the paper is as follows: Section 2 describes used methods; Section 3 is the essential section of the paper as it summarizes the received results. In Section 4 the key measures to overcoming the found shortcomings are mentioned and the Conclusion section summarizes the paper as well as mention the limitations and possible future trends in our research.

2. Materials and Methods

Experience in managing the consequences of floods and other natural disasters, and experience in managing the consequences of the COVID-19 pandemic has shown that armed forces around the world have an irreplaceable position in dealing with nonmilitary crises. This is why it is essential that modern armed forces have a type of force whose primary activity is precisely to prepare for crisis situations of a nonmilitary nature. For these cases it is necessary to have types of forces designed to defend the territory and other types of forces that will perform humanitarian tasks of civil protection.

In (Tušer and Jánský 2020a) were the results of a study dealing with civil-military cooperation during the COVID-19 pandemic in the Czech Republic, and the preparedness of the Army and other units of the Integrated Rescue System (IRS) for effective cooperation in case of an emergency situation. The aim was focused on the quantitative processing of the obtained results. To determine the current situation, the method of a multicriteria evaluation of the ACR's capabilities was chosen. The evaluation criteria formulated in the research questionnaire also included open-ended questions (Appendix A) concerning the level of crisis preparedness of the forces and resources of the Army of the Czech Republic (ACR). These questions required a qualitative approach to crisis preparedness assessment, and the conclusions drawn from them are the content of this paper.

Questions from the crisis preparedness of the ACR included the following areas:

I. Human Resources
II. Technical Security of Allocated Forces
III. Command and Control of Allocated Forces
IV. Planning the Deployment of Forces and Resources (F&R) of the ACR.

As was mentioned in (Tušer and Jánský 2020a) "A questionnaire survey (allocation of points to individual sub-questions) was conducted at military units in all regions of the Czech Republic and at all organizational units of the Ministry of Defence with nationwide authority, which directly participated in securing measures related to the declaration of a state of emergency due to reduction and management of the consequences of the COVID-19 pandemic. Further questionnaire surveys were conducted at the Operations Command, which currently manages operations in the Czech Republic designed to manage the consequences of the pandemic, and with members of the Ministry of Defence participating in the activities of the strategic command and control group. A total of 21 respondents cooperated".

The main goal was to determine the functionality of processes, find the main problems, name them, describe them and find possible solutions to the identified shortcomings. Improvement was ensured as soon as possible by formulating proposals for improvement and putting them into practice immediately.

3. Results

This section presents the results obtained using the questionnaire method on the open questions. Given that the questions were answered only by specialists and experts in the field, it is possible to consider their answers as relevant and based on them propose research questions for further investigation or directly propose measures to improve the current situation.

The answers to the open questions (highlighted in italics in the questionnaire—see Appendix A) revealed the following findings on the individual criteria:

I. Human Resources (Criterion A)

Criterion A consists of the number of allocated forces (personnel quantity), the preparedness of the allocated forces to perform tasks (quality) and the preparedness of the commanding officers of the allocated forces.

According to the majority of the respondents, the amount of forces and resources (F&R) of the ACR allocated on the basis of the Planned Assistance Agreement is sufficient. Some respondents expressed interest in greater involvement of the ACR in joint activities with the IRS. However, the increase in the number of forces is linked to an increase in the number of professional soldiers, or an increase in the number of members of the active reserve of the armed forces. For the successful implementation of the increase in the amount of F&R of the ACR allocated for the benefit of the IRS and regions of the Czech Republic, it is necessary to identify the risks and capabilities of primary units of the IRS. The positioning of detachments of the ACR is determined by the dislocation of the parent (providing) crew (Procházka and Procházková 2018). At present, the positioning of individual detachments is not uniform for the entire territory of the Czech Republic.

According to the respondents, the preparation of allocated units (executive elements) for the implementation of rescue and liquidation work does not take place rather than takes place. The ACR does not currently have a professional unit to carry out humanitarian civil protection tasks (Otřísal and Florus 2014). Part of the humanitarian tasks of civil protection can be taken over by the corps of engineers of the ACR, but these activities are not the main type of activities of this type of corps.

In order to increase the level of preparedness of the allocated units themselves, it would be appropriate to include in the training programs of all types of forces the issue of nonmilitary operations in the Czech Republic and abroad. At present, education and training in nonmilitary operations are sidelined at the expense of training the main activities of individual types of forces (Malachová et al. 2017; Oulehlova et al. 2015).

In order to increase the level of preparedness of commanding officers of allocated forces, it is appropriate to include training in nonmilitary operations in the career training of officers at the tactical and operational level, for example in courses for lower and senior officers, or in the Master's study program, Management and use of the Armed Forces at the University of Defence (Bekešienė et al. 2009; Oulehlova et al. 2017; Tušer 2020). For the training of officers at the strategic level, I propose to include this issue in the General Staff course. Within these types of education, it would be appropriate to use the capacity of the Center of Simulation and Trainer Technologies at the Training Command—Military Academy to train the decision-making process of commanders at all levels of command (Urban and Urbanova 2011). Scenarios with the outbreak of a nonmilitary crisis situation in the Czech Republic and the subsequent deployment of the F&R of the ACR would involve all levels of command in the decision-making process.

II. Technical Security of Allocated Forces (Criterion B)

Criterion B deals with the capabilities of transport equipment, special equipment, and the capabilities of the parent units of the allocated detachments to ensure material and logistical support.

Investments in transport and special equipment are needed to improve the current state of criterion B. Some respondents stated that the current transport and heavy special equipment is technically obsolete and it would be appropriate to modernize or replace it with new equipment. In the case of purchasing new equipment, it is necessary to ensure the retraining of the operator for this type of equipment. This problem concerns both transport equipment and special heavy equipment intended for earthworks, ensuring the access of roads and rescuing vehicles, with the exception of special equipment for chemical and veterinary detachments, which currently does not require extensive modernization.

From the point of view of logistics, military units are able to provide allocated detachments for a weekly cycle. However, in the case of a longer-term deployment, financial and legislative support is required for the acquisition of property and services for consideration. The laws do not set financial limits, procedures and areas of responsibility of individual actors in the acquisition process of public contracts for the acquisition of property and services for consideration in states of crisis (Kudlák et al. 2020; Potůček 2020).

III. Command and Control of Allocated Forces (Criterion C)

Criterion C consists of a system of command and control, a system of notification of ACR units and facilities, and means of communication.

Apart from minor nuances, the respondents stated that the command and control system allows for a flexible response to emergency events and crisis situations. In rare cases, when the command and control system is not able to react flexibly to the situations that have occurred, the majority of the commanding officers of the ACR have built up a high capacity for improvisation and adequate response to ad-hoc problems through training and continuous education (Urban and Urbanova 2012). The verification of the command and control system in nonmilitary crisis situations takes place within NATO and the EU using simulation and trainer technologies, and is not linked to the actual maneuver of forces and resources. This training is sufficient to test the command and control system of the allocated forces. There is no maneuver of real F&R of the ACR during simulation exercises. For a deeper examination of real capabilities of the command and control system for the deployment of the F&R of the ACR in crisis situations of a nonmilitary nature, it would be appropriate to involve a real maneuver of these F&R in these exercises.

The notification of military units and facilities upon receipt of a request from a superior level allows for an immediate response, is flexible and there is no delay. However, in order to increase the effectiveness of the deployment of F&R of the ACR to perform tasks in crisis situations of a nonmilitary nature, it would be appropriate to make legislative changes in the way the F&R of the ACR are required and to set a uniform information flow for all units of the IRS.

IV. Planning and Deployment of F&R (Criterion D)

Criterion D deals with the prepared planning and management documentation and its level, standardized operational procedures for military facilities, and the frequency of exercises performed according to these procedures (Adamonienė 2018).

According to the respondents, this is the most fulfilled criterion with the least weight. Each of the interviewed respondents stated that their facility has developed standard operating procedures for activating the F&R of the ACR in nonmilitary crisis situations. Nuances then occur in the frequency of revisions of this documentation and in the frequency of training to perform tasks in nonmilitary crisis situations. For some military units, this revision is planned at least once a quarter or more often, for other units completely randomly, and for some about once a year. For the planning and deployment of the F&R of the ACR in nonmilitary operations in the Czech Republic, it is important to identify the risks for which the F&R of the ACR will be predetermined and prepared. For the planning

and deployment of the F&R of the ACR, it is also necessary to take into account the place and role of the ACR as a secondary unit of the IRS, which is activated in case the primary units of the IRS are exhausted or in the event of a large-scale emergency.

In its activities, the ACR has long been using a sophisticated system called Lessons Learned for gaining knowledge and evaluating experience, which is usually applied after the end of each job, training, foreign operation or operation in the Czech Republic for the benefit of the IRS and regions of the Czech Republic. The aim of this system is to learn from every activity that is carried out at all levels of the ACR, so that in the future the errors that occurred in the activities of the ACR or were revealed in the subsequent retrospective analysis are not repeated. The result of this process is the acquisition of the best practice (Hošková-Mayerová 2016; Bekesiene and Hoskova-Mayerova 2018). The current system of deployment of the F&R of the ACR in favor of the IRS and regions of the Czech Republic was set on the basis of experience with deployment of F&R of the ACR in rescue and liquidation work in managing the consequences of floods in 1997, 2002, 2009, 2010 and June 2013 (Talhofer and Hošková-Mayerová 2019; Petráš 2020). Measures to manage the COVID-19 epidemic in the Czech Republic, in the implementation of which the F&R of the ACR participated, revealed gaps in the current way of command and control of the allocated F&R of the ACR for the benefit of the IRS and regions of the Czech Republic, which were not detected by activities in favor of these institutions in the past. It can be assumed with certainty that at all levels of command and control of the ACR, the evaluation of the deployment of the F&R of the ACR is already underway or will take place in the near future using the Lessons Learned system. On this basis, measures will be proposed to improve the current situation and gain best practice.

4. Discussion

The ACR primarily performs tasks related to ensuring external security in the event of a military crisis. The ACR is established for this activity, and preparation for this type of threat is its main task in time of peace. The forces and resources of the ACR is involved in the management of crisis and emergency situations of a nonmilitary nature in the regions of the Czech Republic as a secondary unit of the IRS upon request by eligible applicants, according to concluded cooperation agreements or regulations of the government of the Czech Republic.

In the initial phase of the outbreak of the COVID-19 pandemic, the shortcomings of the current system of providing cooperation of the ACR to the primary units of the IRS and other eligible applicants for providing cooperation were revealed. These shortcomings are mainly caused by nonuniform operational procedures within all units of the IRS, and the nonuniform way of requiring the cooperation of the F&R of the ACR, which are not specified in the cooperation agreements.

The following are key to overcoming the above-mentioned shortcomings:

- setting up information flows;
- identification of specific responsible persons;
- determining the area of responsibility of these persons;
- a uniform system for receiving and evaluating requirements;
- specify the system of requirements of the F&R of the ACR, which are not listed in the cooperation agreements, and acquaint all eligible applicants with this system.

Due to the large scope of operations coordinated by the Ministry of the Interior through the Operations and Information Center (OIC) of the IRS, the ACR could not comply with all requests for the provision of F&R of the ACR that it received. The deployment of the F&R of the ACR took place only if the given application was forwarded to the relevant OIC of the given region. This then analyzed the application and only then passed it on to Permanent Shift of the Joint Operations Center of the Operations Command (PS JOC OC). This caused unnecessary delays in the deployment of the required F&R of the ACR. The nonuniform system of requiring F&R of the ACR also caused problems in securing transport by military means.

Recommendations for the Harmonization of Civil-Military Cooperation

As a measure it is proposed:

1. To create a working group composed of members of the primary and secondary units of the IRS and regional representatives, the output should be standardization and optimization of processes from the request of the F&R of the ACR at the regional level to the actual deployment of the F&R of all units of the IRS.
2. Legislative measures to remedy the current inconsistency.
3. Legislative amendment to the Public Procurement Act, or related legislation or a decree laying down precise rules for the acquisition of property and services for consideration in states of crisis.

It is therefore necessary to specify exactly who can award public contracts in the event of a state of crisis, who can be a supplier of materials or services (e.g., purchase of protective equipment), what can be purchased, the financial and time scope of these contracts, for what purpose public contracts can be performed, and the exact procedure how, in the event of a state of crisis, to proceed with the acquisition of property and services by public tender, or by directly contacting the supplier.

The implementation of risk management at state or public administration entities, or even in the armed forces and security forces, obtains data for decision-making processes, minimizes the costs of dealing with negative impacts on the mission of the entity, increases the efficiency (prosperity) of their activities, etc. The identified shortcomings in civil-military cooperation in the Czech Republic during the state emergency or disaster criteria presented in the article negatively affect all the above-mentioned aspects, including the caused financial costs and losses. These are the current risks in the Czech army:

- Force education and training is suppressed in nonmilitary operations.
- Insufficient material and logistical capacity for more than a week during the crisis. In the case of a longer deployment, financial is necessary and legislative support for the acquisition of property and services for consideration.
- In the Czech Republic, there are no financial limits, procedures and areas of responsibility of individual actors in the acquisition process of public contracts for the acquisition of property and services for consideration in crisis situations (state emergency).
- Ineffective deployment of the ACR F&R to perform tasks in crisis situations of a nonmilitary nature due to insufficiently legislatively regulated way of requiring the ACR F&R and inconsistency (asynchrony) of information flows for all components of the rescue system.

There are no identified risks (types of emergency situation and disaster) for the planning and deployment of the ACR F&R in nonmilitary operations in the Czech Republic, for which the ACR F&R will be predestined and prepared. Measures to manage the epidemic of the COVID-19 disease in the Czech Republic, in the implementation of which the ACP F&R also participated, revealed gaps in the current way of command and control of the allocated ACP F&R. At the same time, shortcomings in the related legal norms became apparent.

5. Conclusions

The first measure is of a systemic nature, its application would lead to the unification of procedures of all units of the IRS, the establishment of a uniform system of requiring the deployment of F&R of the ACR and thus to the increase in the level of flexibility in responding to events in crisis situations. Part of this measure is also a proposal to complete the issue of acquisition of property and public contracts for consideration in the event of declared crisis situations. In the Czech Republic, until the declaration of a state of emergency associated with the outbreak of the COVID-19 pandemic, individual ministries (Ministry of the Interior, Ministry of Health) did not make extensive purchases. This area is not sufficiently covered by legislation.

Both the experience in dealing with the consequences of natural disasters, and the experience in managing the consequences of the COVID-19 pandemic have shown that armed forces around the

world have an irreplaceable position in dealing with nonmilitary crises. For this reason, it is essential that modern armed forces in the Czech Republic and in the world also have a type of force whose primary activity is precisely to prepare for crisis situations of a nonmilitary nature. Being prepared and ensuring the management of crisis situations, setting the conditions for the renewal and development of the affected areas, is a basic principle of emergency management.

The limiting factor for the scope of the entire investigation was the prohibition of personal contact within the Ministry of Defence, issued as a measure to prevent the spread of the COVID-19 epidemic. Personal contact with the respondents was necessary for the correctness and completeness of the questionnaire, so it was possible to obtain only a limited number of respondents at that time. Due to this fact only a limited number of respondents were available.

For the future it will be necessary to extend the sample of respondents. After the end of the COVID-19 pandemic, we plan to first repeat the entire research on the basis of the same questionnaire, and if all conclusions are confirmed on a significantly larger sample of respondents, we plan to offer our conclusions to those responsible for their inclusion in practice. Moreover, to start research with the primary units of the IRS and in the regions of the Czech Republic with eligible applicants for ACR cooperation. The aim of the follow-up research on the primary units of the IRS and the regions of the Czech Republic should be to specify the real needs and requirements of all participants in emergency management for the F&R of the ACR in emergency management at the regional level.

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Appendix A

The questionnaire subquestions structure was as follows:

Criterion A—Human Resources

A1 indicator sub-questions—Quantity of allocated forces

- In your opinion, is the amount of allocated forces in favor of the IRS sufficient to fulfill the tasks?
- Is the distribution of predetermined detachments adequate for the performance of tasks in the event of emergency events and crisis situations (hereinafter referred to as EE/CS) throughout the Czech Republic?
- Are the time standards adequate with regard to the transport capabilities of the allocated equipment?

A2 indicator sub-questions—Preparedness of allocated forces to perform tasks in favor of IRS

- Is systematic and continuous education and training implemented in connection with specific risks/potential EE/CS mentioned in crisis planning? *If so, how often?*
- Is your department/military facility participating in cooperation exercises with the involvement of primary and secondary IRS units?
- Does the authorized employee periodically re-evaluate/verify/inspect and respond to the current state of knowledge, skills and competencies of employees?
- Is there a quality evaluation system in place? (e.g., internal audit) *If yes, which one?*

A3 indicator sub-questions—Preparedness of control officers of allocated forces

- Is there a systematic and continuous education and training of officers in charge of managing the allocated forces in connection with specific risks/potential EE/CS mentioned in the crisis planning?
- In your opinion, is the training of commanding officers in the field of EE/CS sufficient?

Criterion B—Technical Security of Allocated Force

B1 indicator sub-questions—Transport equipment

- Are the numbers of allocated transport equipment adequate for the performance of tasks in favor of the IRS?
- Is the predetermined transport equipment maintained in proper condition (from the point of view of modernization and operability)?

B2 indicator sub-questions—Special equipment

- Are the numbers of allocated special equipment adequate for the performance of tasks in favor of the IRS?
- Is the predetermined special equipment maintained in proper condition (from the point of view of modernization and operability)?

B3 indicator sub-questions—Material and logistical support

- Is your unit/military facility able to secure the allocated units during a weekly cycle?
- Is your unit/military facility able to secure the allocated units during 30 days?

Criterion C—Command and Control of Allocated Forces

C1 indicator sub-questions—Command and control system

- Does the command and control system allow a flexible response to EE/CS?
- Are there regular inspections and exercises to check the command and control system?

C2 indicator sub-questions—Notification of ACR units and facilities

- Depending on time standards, is the unit and facility notification system effective?
- In case of danger in delay, are military facilities able to flexibly allocate the necessary forces and resources?

C3 indicator sub-questions—Means of communication

- Does the ACR have a sufficient number of connecting means to secure the main and backup voice connection?
- Is there a regular modernization of connecting means and their revision? (In the case of large EE/CS, there is a possibility of network congestion.)
- Is the compatibility of the means of connection between the IRS and the ACR ensured? (telephone, mobile phone, radio connection, connection via operations and information center)
- In the case of a "blackout", is the ACR able to provide an alternative connection?
- *If so, which ones? How will the transfer of information during rescue work be solved in the event of a large-scale disruption of electricity supplies for a period of approximately three days between the IRS and the ACR?*

Criterion D—Planning the Deployment of F&R of the ACR

D1 indicator sub-questions—Planning and management documentation

- Are there regular inspections of the planning and management documentation at your facility?
- Are the facts stated in the planning and management documentation objectively feasible?
- Based on your experience with the allocation of the F&R of the ACR, is the planning management documentation prepared at such a level as to ensure the effective deployment of the F&R of the ACR for the benefit of the IRS?

D2 indicator sub-questions—Standardized operating procedures (SOP)

- Are SOP for allocating F&R prepared at your department/military facility?
- Is training performed at your department/military facility according to the given SOP?

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Impact of Capital Structure on Corporate Value—Review of Literature

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Abstract: The issue of capital structure in an enterprise is often described in the literature on the subject; however, theories are classified into various approaches, and their characteristics are often limited to selected theories. This work is an attempt at a synthetic presentation of the theory of capital structure. The aim of the article was to review and try to organise the most important theories of capital structure, paying attention to the influence of capital structure on the processes of creating value. The paper also highlights the most important theoretical works in this area. The study consists of two main parts. The first part indicates the diversity of defining the concepts of capital structure and indicates the approaches in classifying this structure. The second part characterises the theories of capital structure in the context of value creation. Based on the presented theories, it can be stated that there is no agreement as to whether and to what extent capital structure translates into the process of creating enterprise value. Therefore, it seems justified to conduct appropriate empirical research in this respect.

Keywords: capital structure; capital structure theories; capital structure decisions; financial management; external financing; corporate value; finance management

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1. Introduction

There are a number of sources for financing business activity, both in the context of one's own and external financing. In the literature on the subject, there is no full agreement as to the definition of the concept of capital structure. Usually, attention is focused on the ratio of equity to debt in this context. Sometimes, it is understood as a liability structure, and another approach differentiates between the concepts of financing structure and capital structure. In this sense, capital structure includes equity and long-term liabilities and is part of the financing structure (which also includes current liabilities). The concept of enterprise value is also understood in various ways. In the theory of capital structure, it is assumed that this is the amount that a buyer is willing to pay in return for the expected cash flows; therefore, it is determined by the sum of the future discounted cash flows. In the context of the classification of the theory of capital structure, the most common division is into tax and non-tax theories, into static and dynamic theories, and from the perspective of the perfect and imperfect market. The study attempts to classify the perspective of a company's value.

The research that has been conducted since the middle of the last century (e.g., Durand 1952; Modigliani and Miller 1963; Miller 1977; Modigliani 1982; DeAngelo and Masulis 1980; Hand et al. 1982; Myers 1984) has led to the identification of many theories that are related to the structure of capital and its impact on the value of an enterprise. These theories are often very diverse and are often mutually exclusive. According to some theories, the value of an enterprise is not related to its capital structure; e.g., the net operating income theory (Durand 1952) and the Modigliani–Miller theory in an economy without taxes (Modigliani and Miller 1958). On the other hand, the structure of capital affects this value according to others; e.g., the net income theory, the compromise theory (Durand 1952), the Modigliani–Miller theory in an economy with taxes (Modigliani and Miller 1958), the

Miller theory (Miller 1977), the DeAngelo and Masulis (1980) model, the static trade-off theory (Mursalim and Kusuma 2017); (Gajdka and Szymański 2019), the bankruptcy costs theory (Baxter 1967), the pecking order theory (Myers 1984), and the agency costs theory (Jensen and Meckling 1976).

This work is an attempt at a synthetic presentation of the theory of capital structure. The literature on the subject often points to the aforementioned issues; however, the theories are classified into various approaches, and their characteristics are often limited to selected approaches. The aim of thise study was to review and try to organise the most important theories that are related to the structure of capital together with an indication of the most important theoretical works. The work consists of two main parts. The first defines the concept of capital structure and presents the classification of capital structure theory. In the second, theories of capital structure are characterised in the context of creating enterprise value. Unfortunately, the presented concepts do not provide uniform unambiguous villages regarding the recommended capital structure from the perspective of the processes of creating enterprise value. Due to the limitations of the scope of work, the description is synthetic by definition.

2. Materials and Methods

The review of the literature was aimed at organising the theory of capital structure and identifying the theory of capital structure in the context of value-creation processes. There is no uniform nor synthetic presentation of the indicated problems in the literature on the subject. First, a review of the literature was made, which is of key importance from the point of view of the indicated issues. The data for this particular research paper was retrieved mainly from November 2020 through January 2021 from the Journals & Books ScienceDirect collection and Jstor database. The search covered the entire content of each database with no time limits. The search was conducted using the terms "capital structure" and "company value". Keywords were observed in the titles, abstracts and author's keywords.

3. Results

In a short period of time, enterprises are oriented towards maximising the operating result and demonstrating the highest possible operational efficiency. However, the goal of the action is to maximise value in the long run (Jonek-Kowalska 2020). The value of an enterprise can be understood in various ways; e.g., as book value, liquidation, replacement, or economic value. In the theory of finance, an important role is played by the concept of economic value, which is understood as the amount that a buyer is willing to pay for an enterprise in return for the expected cash flows; therefore, the value of the enterprise can be determined as the sum of the expected cash flows—Formula (1). If the prices of the capital assets reflect all of the available information about them, then the capital market is efficient. Then, their market value corresponds to the economic value, which is the present value of the future cash flows that can be obtained through the use of these assets (Duliniec 2001).

$$V = \sum_{t=1}^{\infty} CF_t \cdot \frac{1}{(1+k)^t} \quad (1)$$

where:

t—time;

CF_t—cash flow during t-period of forecast;

k—discount rate equal to cost of capital.

As noted by Sierpińska and Jachna (2017), the capital structure that enables a minimisation of the weighted average cost of capital leads to a maximisation of a company's value, as the expected cash flows are discounted at a lower discount rate. The concept of capital structure is sometimes understood in various ways; there is no consensus as to its definition. S.C. Myers (2001) noted that most research in the area of capital structure has focused on the debt-to-equity ratio, which is reflected on the right side of a balance

sheet. Orlova et al. (2020) pinpointed that capital structure is usually presented in the context of a choice between debt and equity. K. Ardalan (2017) defined capital structure as a mixture of debt and equity. On the other hand, M. Jerzemowska (2018) and Janasz (2010) defined capital structure as the ratio of equity to foreign capital. A. Ripamonti (2020) indicated that capital structure is represented by the average debt–equity ratio of companies, and capital structure is the optimal combination of equity and long-term debt according to Khémiri and Noubbigh (2018). A. Michalak pointed out that, under a different approach, it is necessary to distinguish between the concepts of financing structure and capital structure. In this context, the financing structure indicates how an enterprise is financed and is, therefore, reflected in the liabilities of the balance sheet. On the other hand, the structure of capital is understood as equity from the issue of shares, privileged capital, and long-term debt. In this sense, the capital structure is part of the financing structure. Thus, the financing structure includes equity and long-term external capital as well as current liabilities. Thus, the capital structure corresponds to the structure of the liabilities less the current liabilities. The fact that the current liabilities are excluded from the consideration is a result of the fact that their value fluctuates; therefore, the capital structure is determined by equity and long-term liabilities in the longer term. A different approach to the capital structure takes equity, long-term liabilities, and interest-bearing short-term liabilities into account. This results from the assumption that the entities that invest capital in an enterprise are oriented towards obtaining income that they can obtain from this account (Michalak 2015a). If it is assumed that, if equity includes equity and interest-bearing debt, it will represent a value that is lower than the balance sheet total. This approach is consistent with the understanding of the debt–equity relationship of an enterprise by F. Mogigliani and M. Miller, who believe that the most important feature of debt as an element of capital structure is the payment of interest (Michalak 2015b).

The issues of capital structure or financing structure are analysed in various approaches—Table 1. The presented measures can be calculated with the use of book values or market values. The assumption of market values may cause measurement difficulties. On the other hand, S. Myers (1977) observed that the adoption of book values better takes into account the fact that tangible assets provide a better security for a loan than intangible assets and cause intangible assets to show growth opportunities.

Table 1. Concepts of capital structure.

Perspective of Analysing Capital Structure	Meters
Capital structure is identified with structure of liabilities of balance sheet; it is also called structure of financing sources used in financing company's operations (R.W. Masulis)	• capital multiplier (CM) (ratio of total assets to equity); • debt ratio (ratio of liabilities and provisions for liabilities to total assets); • short-term debt ratio (ratio of short-term liabilities to total assets); • long-term debt ratio (ratio of long-term liabilities to total assets).
Capital structure is relationship between equity and borrowed capital with repayment period of more than one year	• ratio expressing relationship of long-term liabilities to equity.
Capital structure expresses combination of debt and equity securities issued by company	• debt securities-to-equity ratio; • ratios expressing relationship of value of individual debt securities issued by enterprise to equity; • ratio showing relationship of debt from bonds issued to market capitalisation (value of securities is calculated as product of number of shares and current stock exchange price).

Table 1. *Cont.*

Perspective of Analysing Capital Structure	Meters
Capital structure reflects equity and long- and short-term liabilities, excluding liabilities to suppliers, tax liabilities, and remuneration	• ratio showing relationship of interest-bearing long- and short-term liabilities to equity; • interest-bearing debt ratio (ratio of interest-bearing liabilities to total assets).

Source: Own work based on (Gostkowska-Drzewicka 2014; Pomykalska and Pomykalski 2017; Gajdka 2002).

Basically, the division of the capital structure theory may concern the following (Guzanek and Trojak 2012):

- inference related to particular theories—and therefore whether the debt affects the market value of an enterprise;
- accounting for taxation—tax and non-tax theories;
- assumptions about the functioning of the market.

In the literature on the subject, various approaches to the classification of the capital structure theory can be found with varying degrees of detail. Usually, the main criteria are those factors that influence this structure. The most general division is made into tax and non-tax theories. Another approach to the division of the theory of capital structure takes the criterion of the state within which the structure is analysed into account. In this context, static and dynamic theories are distinguished. Static theories are based on the assumption that a certain amount of capital is necessary to finance a company's operations; the optimal capital structure is sought within them. This group includes such models as the MM model of F. Modigliani and M. Miller, the traditional approach represented by J.B. Warner, H. DeAngelo., L. Dodd, D. Durand, R.W. Masulis, and B. Graham, and the trade-off model represented by J.B. Warner and H. DeAngelo (Jaros and Bartosova 2015), for example. According to dynamic theories, the amount of capital changes since each company is a unique organism; the order in which it should be obtained becomes a problem. The indicated changes in capital are usually related to its increase as a result of making invest-ment decisions. Depending on the capital that is employed, its optimal structure will be different; therefore, we cannot talk about the target debt/equity ratio (Gajdka 2002), as this is in the case of static theories. This group of theories is represented by S. Myers (the pecking order theory), which is based on research that was conducted by G. Donaldson (Jaros and Bartosova 2015).

One approach is to consider the capital structure theory from the perspective of a perfectly competitive and imperfect market—Table 2. The theories of a perfect market are logical and coherent, but the assumptions made about market perfection mean that they do not fully reflect economic reality.

Table 2. Classification of capital structure theory from the perspective of perfectly competitive and imperfect market.

Specification	Theories
Theories of perfect market	• net income theory • net operation income theory • compromise theory • Modigliani–Miller theory • Miller theory

Table 2. *Cont.*

Specification	Theories
Theories of imperfect market	• static trade-off theory • bankruptcy costs theory • information asymmetry theory: • pecking order theory • signalling theory • agency costs theory • theory of competition to take control of company • theory of situation on market of products and factors of production

Source: Own work based by (Guzanek and Trojak 2012; Gajdka 2002).

A. Miglo (2011) and A. Dulinec (2015) pointed out that the main theories of capital structure are as follows:

- the trade-off theory;
- the pecking order theory;
- the signaling theory;
- the market timing theory.

On the other hand, L. Pacheco (2016) and Prędkiewicz and Prędkiewicz (2014) listed the following in the theories that determine the determinants that influence the choice and proportions of equity and foreign capital: the static trade-off theory, the agency cost theory, and the pecking order theory. In turn, J. Gajdka (2002) pointed us to the following theories of capital structure:

- initial theories:
    - primary theories (the net income theory, the net operation income theory, the compromise theory),
    - the Modigliani–Miller theory for an economy without taxes;
- tax theories:
    - the Miller–Modigliani model for an economy with taxes,
    - the Miller model,
    - the DeAngelo Masulis model,
    - the Modigliani model;
- the bankruptcy costs theory;
- the agency costs theory;
- the information asymmetry theory:
    - the pecking order theory (the Myers–Mayluf model, the Myers model);
    - the signailing theory (the Ross model).

In the context of the problem of capital structure, an optimal relationship between equity and external capital is sought at which the value of an enterprise is maximised; therefore, the following questions can be asked (Gajdka 2002):

- does the capital structure affect the market value of a company?
- is there an optimal capital structure (i.e., one where the market value of a company is the highest and the cost of the capital is the lowest) and, if so, which factors determine it?

Taking the variety of financial instruments into account, it can be assumed that the possibilities in the area of shaping capital structure are unlimited, as this relationship may take values from zero to infinity. Determining whether there is an optimal capital structure would mean that it is possible to maximise the value for shareholders by appropriately shaping a company's capital structure. Thus, its value would be influenced not only by its investment decisions but also by its financial decisions.

In the literature on the subject, two approaches can be distinguished in the context of the impact of capital structure on the value of an enterprise—Table 3. According to the first approach, capital structure does not affect the value of an enterprise. Under the second approach, however, it is assumed that there is a particular capital structure at which the value of an enterprise is maximised.

Table 3. Classification of capital structure theories from the perspective of its impact on corporate value.

Specification	Theories
Theories according to which capital structure does not affect value of enterprise	• theory of operating profit • Modigliani–Miller theory in economy without taxes
Theories according to which capital structure affects value of enterprise	• net income theory • compromise theory • Modigliani–Miller theory in economy with taxes • Miller theory • Modigliani model • static trade-off theory • DeAngelo-Masulis model • theory of bankruptcy costs • agency cost theory • pecking order theory • signalling theory • theory of competition to take control of company • theory of situation on market of products and factors of production

Source: Own work.

4. Discussion

The problem of the theory of capital structure was first taken up by D. Durand, who made an attempt in 1952 to explain the dependencies between the structure of capital and the cost of its acquisition; he also pinpointed out that basic economic theories require revision (Durand 1952). On the other hand, the Modigliani–Miller model is considered to be the source of the development of the theory of corporate finance. In the abovementioned work, D. Durand gathered the available information and presented his research proposals. These considerations were later referred to as the original theories of capital structure. He believed that the correct valuation method was the income method that was based on discounting, as he assumed that "the businessman tries to maximise the discounted value of his future income" (Durand 1952) and that the issue of estimating the cost of capital is inherently related to the aspect of measuring the value of an enterprise. Therefore, based on three methodological approaches that are used in the valuation of companies, he focused on the net profit, operating profit and compromise approaches (now considered traditional) and also drew attention to the relationship between capital structure, its cost, and a company's value.

In the area of the net operating income theory, it is assumed that the value of an enterprise depends solely on its level of operating profit. As investors expect a higher risk premium as debt increases, the cost of equity increases. The cost of debt capital does not change, nor does the weighted average cost of capital, as changes in the debt level cause adequate changes in the cost of equity. Within the framework of the indicated theory, the value of an enterprise is not related to the structure of its financing. According to D. Durand, the indicated dependencies only exist when a company has a reasonable amount of debt. Excessive indebtedness poses a risk of bankruptcy and reduces the value of an enterprise, as investors will want to pay less for its stocks and bonds (Durand 1952).

The net income theory assumes that the value of a company is proportionate to its share of debt in its capital structure (Kedzior et al. 2020); the costs of capital do not change regardless of the structure of the financing sources. Moreover, it is assumed that foreign capital is usually characterised by a lower cost of acquisition than equity is. As debt increases, the weighted average cost of capital is, thus, reduced, and the value of an enterprise is maximised (Durand 1952). Both the net operating income theory and the net income theory apply to a situation where there is no income tax in a company's economy.

The compromise theory combines the theory of operating profit and the theory of net profit in a way. According to it, the owner(s) of a company accept debt to a certain level and do not expect an additional risk premium. Thus, the weighted average cost of capital will decrease and the company's market value will increase as long as the share of debt does not reach an acceptable limit as it grows. Once the abovementioned acceptable level is exceeded, however, the donors of both the equity and foreign capital will expect an additional higher risk premium. Thus, the weighted average cost of capital will increase, and as a result, the market value of the enterprise will decrease (Durand 1952).

The Modigliani–Miller theory was presented in a work that was prepared by Franco Modigliani and Merton H. Miller (Modigliani and Miller 1958) and is one of the most frequently mentioned theories in the litereture that are related to the structure of capital. Harris and Raviv (1991) pointed out that the modern theory of capital structure was initiated with the indicated article. F. Mogiliani and M.H. Miller presented the problem of the cost of capital and its structure in two planes in an economy without taxes and in an economy with taxes on corporate profits. In the first case, the value of an enterprise and the weighted average cost of capital do not depend on the capital structure (Modigliani and Miller 1958), as the increase in the share of cheaper foreign capital is accompanied by an increase in financial risk. This translates into an increase in the rate of return that is expected by the shareholders (Czerwonka 2017). In the second variant, the value of an undebted enterprise corresponds to the expected amount after tax capitalised by using an interest rate that is appropriate to an enterprise of a given risk class. On the other hand, the value of an indebted entity corresponds to the value of the non-indebted entity increased by the value of the tax savings depending on the tax rate and the company's debt (Sierpińska and Jachna 2007). Growing shareholder requirements cover the financial benefits of the growing portion of the debt so that the average cost of the capital will remain the same for any capital structure. Thus, the expected rate of return on the equity of a company with debt increases directly to the debt-to-equity ratio that is expressed by market value. The rate of this growth depends on the difference between the expected rate of return on the total capital and the rate of return on the debt (interest rate) (Jaros and Bartosova 2015). In subsequent papers, the autors noticed that growing debt causes the average cost of capital to decline under the influence of the interest shield. The return on capital and the market value also increase; therefore, a company should increase part of its debt while taking the capital structure into account (Jaros and Bartosova 2015). This does not mean that the company must maximise the amount of their debt at any price without taking other relevant facts into account. The same authors encouraged financial managers to not strive for maximum debt because, in some circumstances, other forms of financing may be cheaper. They considered the impact of personal income tax, increased creditor requirements, and other operating costs that cannot be captured in a static balanced model (Jaros and Bartosova 2015). In the model that assumes the existence of tax on income, F. Modigliani and M.H. Miller originally made a mistake. They detailed and corrected this in 1963 (Modigliani and Miller 1963).

Miller's theory was presented in his 1977 work entitled "Debt and Taxes" and is a kind of a modification of the Modigliani–Miller theory. In addition to taxes on profits, it also includes personal taxes on stocks and bonds. According to the presented model, the value of an enterprise with increasing debt may increase if its interest payments can be deducted from its income tax (Miller 1977). Additionally, the value of the enterprise is independent of its capital structure under equilibrium conditions (Miller 1977), as the

interest rate assumes such a level that the capital structure will not affect the value of the enterprise (Gajdka 2002).

The Modigliani model is a development of the Modigliani–Miller model and was presented by F. Modigliani in 1982. He tried to explain that enterprises do not strive to maximise their share of debt in their capital structures, as debt is important as long as it serves as a protection mechanism against income taxes (Modigliani 1982). In his research, he indicated that the value of an enterprise depends on the dividend policy, financial policy, the risk of the generated cash flow, the covariance between the cash flow of various companies, and the consequences of liabilities and inflation (Gajdka 2002).

DeAngelo and Masulis (1980) examined the impact of tax shields that are generated by factors other than the repayment of interest on debt (for example, through a tax shield that resultis from non-cash payments; e.g., related to depreciation or investment tax breaks), which may translate into a reduction of the tax base to zero. They showed that there is a non-zero use of debt by companies that maximises the value of a company without incurring bankruptcy or agency costs (Ardalan 2017). DeAngelo and Masulis (1980) showed that it is possible to find an optimal capital structure for a company.

After the publications of F. Modigliani and M.H. Miller (Modigliani and Miller 1958; Modigliani and Miller 1963), a discussion arose on the basis of which the static trade-off theory (Yıldırım and Çelik 2020; Dąbkowska 2016) was born. According to the indicated theory, a company should maintain solid investment plans and assets (Mursalim and Kusuma 2017). Each company has an optimal capital structure (Bilgin and Dinc 2019); the optimal capital structure is when the value of an enterprise is maximised (Gajdka and Szymański 2019). A company's capital structure is the result of a compromise between the tax advantage on its debt and its expected bankruptcy costs. An optimal capital structure could be described as a ratio of leverage where the marginal tax benefit of the debt equals the marginal cost of the bancruptcy (Bilgin and Dinc 2019). Companies will try to maximise the optimal financial leverage to maximise shareholder wealth (Orlova et al. 2020). T. Nguyen, M. Bai, Y. Hou, and M. Vu noted that, according to the trade-off theory, any deviation of the financial leverage from the optimal capital structure may result in a reduction in a company's value (Nguyen et al. 2021). However, this theory does not seem to explain those situations in which debt is completely absent (Miglo 2020). The existence of a tax shield increases the market value of the enterprise along with an increase in debt, because the financial costs reduce the tax base (Gajdka and Szymański 2019). J. Błach (2009) noted that, in the extended theory of substitution, agency costs are also taken into account.

The risk of bankruptcy is related to the occurrence of a number of costs of direct and indirect natures. The first group includes those costs that are related to disputes between a company's creditors (which extend the liquidation process of the assets) and its costs that are related to their sale, administrative expenses, and legal services. Indirect costs include lowering costs (resulting in lowering the quality of a company's products), selling assets at a lower price (in order to improve financial liquidity, but also the refusal by contractors to grant a trade credit), or increasing the interest on loans due to the increased risks (of enterprises). Indirect costs increase with increasing debt; thus, an enterprise should increase its debt only when the benefits of leverage increase faster than the costs of bankruptcy as the market value of the enterprise increases. If the costs of bankruptcy exceed the benefits of increasing debt, the increase in debt will reduce the value of the enterprise. Therefore, there is a certain optimal level of debt in the area of the indicated theory at which the value of the enterprise is maximised. N.D. Baxter noted that excessive leverage translates into an increase in the cost of capital. The presence of an income tax suggests that the presence of leverage is conducive to lowering the cost of the capital of an enterprise; however, the risk of bankruptcy prevents this phenomenon (Baxter 1967). Haugen and Senbet (1978) also indicated that, in a perfect market, the costs of the bankruptcy of a non-profitable enterprise are not related to its capital structure.

The considerations of the theory of agency costs were first described by Jensen and Meckling (1976). A number of conflicts of interest can arise within an agency's relationship.

There are two basic groups: conflicts between a company's management board and its shareholders, and conflicts between its shareholders and its creditors. The management of a company (agents) does not always make decisions in accordance with the interests of its shareholders (principals). In small enterprises, this takes the form of a conflict between internal and external capital donors and not between owners and managers (nor between managers and donors of foreign capital) (Hand et al. 1982). According to the theory of agency costs, monitoring mechanisms can improve the relationship between the management process and the interests of shareholders, as well as mitigate any opportunistic behaviour resulting from a conflict of interest (Kazemian and Sanusi 2015). In the context of agency costs, debt financing reduces the need to gain capital from shareholders, and a high level of indebtedness translates into an improvement in enterprise management procedures (Prędkiewicz and Prędkiewicz 2014); otherwise, the management board will lose control over the company. Therefore, the debt must be repaid; otherwise, the company will go bankrupt. This translates into improved business management procedures, as managers will be more cautious about spending cash (Vo 2021). According to the agency costs theory, an optimal capital structure that maximises the value of a company can be achieved by minimising the conflicts of interest between the stakeholders (Shoaib and Siddiqui 2020). As the share of debt increases, agency costs change ambiguously. On the one hand, the increase in indebtedness lowers the agency costs that are related to the conflict between the shareholders and the management board; on the other hand, it increases the agency costs that are the result of conflict between the shareholders and the creditors (Gajdka 2002).

B. Włoszczowski (2001) noted that, after taking the costs of bankruptcy and the agency costs into account, the Modigliani–Miller model transforms into a model of a balanced choice of capital structure in an economy with taxes. The optimal capital structure is related to the necessity of choice between the benefits and the costs of financing with foreign capital. The benefits of using financial leverage can be approximated, but the costs that are associated with financial difficulties and agency costs are subjective.

According to the information asymmetry theory, individual interest groups possess different information about economic entities and their transactions. Information asymmetry can lead to moral hazard, as those parties with an information advantage may use it to obtain greater benefits at the expense of those parties that are less informed. As part of the information asymmetry, there are a number of phenomena that may affect the relationship between the amount of debt and the value of an enterprise. Within the framework of the indicated theory, the theory of the hierarchy of financing sources and the signalling theory can be distinguished.

According to the pecking order theory of financing sources, it is not possible to determine the optimal capital structure over the long term, but it is possible to decide on a rational order of funds that are obtained for a new investment projects (Gajdka and Szymański 2019). Enterprises reduce debt financing along with the increase in profitability (Gajdka and Szymański 2019). S.C. Myers (1984) noted that enterprises prefer internal sources of financing that take the cost of resourses into account (Anton and Afloarei Nucu 2021), this was confirmed by the research carried out by Duran and Stephen (2020), for example, which was conducted for five countries in Latin America (Argentina, Brazil, Chile, Mexico, and Peru). If the funds that are obtained from these sources as well as those from external financing sources other than capital sources are insufficient, external sources of debt financing are used (Mokhova and Zinecker 2014), with enterprises preferring low-risk debt (Yıldırım and Çelik 2020). Therefore, companies will use the retained profits whenever possible (Vo 2021). On the other hand, the least frequently chosen form of financing is issuing shares, which may lead to a dilution of equity and, as a consequence, a decrease in the return on equity ratios and a decline in a company's listing on the stock exchange (Duliniec 2007). Under this model, more-profitable companies should have lower leverages. If their investments are not solely financed by internal capital, companies with high investments and growth capacities will show high leverages. In a more complex version of this model, companies with high investments and growth potentials will have

low leverage due to the current and future financing costs. Additionally, Myers (1984) anticipated that leverage decreases with higher levels of free cash flow (Aggarwal and Aung Kyaw 2010). Anton and Afloarei Nucu (2021) noticed that the profitalibilty of a company is negatively associated with its debt. A. Ullah et al. (2020) noted that the debt ratio is negatively correlated with size of a company, which was comfirmed in a study that was carried out in the textile sector of Pakistan.

S.C. Myers introduced the concept of a modified hierarchy theory; according to this, the selection of financing sources is influenced not only by the asymmetry of information but also by the costs of financial difficulties. According to it, the preferred sequence of financing sources does not change, but a company should not exceed a certain debt limit beyond which increased costs of financial difficulties will occur (Kubiak 2015).

According to the signaling theory, entities that are more closely related to an enterprise have a greater amount of information about future money flows at their disposal than other market participants. If managers' benefits are contingent on stock prices, they will be willing to send signals to the market that enable them to benefit from these benefits. It has been proven that entities with a smaller share of tangible fixed assets are characterised by a higher asymmetry of information, as they tend to underestimate investment projects more often (Jakubczyk and Lewandowska 2014).

In the literature on the subject, attention is also paid to the financial life cycle theory, where it is assumed that the life cycle influences the preferences regarding the structure of capital (Butzbach and Sarno 2019). In relation to younger and smaller enterprises, a greater asymmetry of information is shown, which affects the increase in the cost of capital (Kedzior et al. 2020). This theory points to a non-linear relationship between financial leverage and the age of an enterprise. At the beginning of a company's existence, the demand for external sources of financing is greater; however, as investment opportunities later decrease, enterprises are able to accumulate more funds to finance their activities (Butzbach and Sarno 2019).

The beginnings of the theory of competition to take control of a company can be traced back to the second half of the 1980s in connection with the processes of the mergers and acquisitions of companies. J. Gajdka (2002) noted that the problem of analysis is the market value of the right to control an enterprise, as equity instruments are related to a voting right, and debt instruments do not grant it. This problem was first characterised by M. Harris and A. Raviv, who identified four categories of capital structure determinants: mitigating conflicts among stakeholders, providing private information to capital markets or mitigating the negative effects of selection, influencing the nature of products or competition in the product market, and influencing the results of corporate competitions (Harris and Raviv 1991). In this context, the relationships among shareholders who want to take control of a company and those who do not want to take control are analysed. These relationships and the decisions made within them affect whether a company is taken over by a group that is competitive with the management board. The share of managers depends on the capital structure, and this structure affects the probability of a takeover, the share price, and the value of the company (Gajdka 2002).

It is assumed that the works that are related to the theory of the situation on the market of products and production factors were initiated by J. Brander and T. Lewis and by V. Maksimovic. In this context, the relationships between the characteristics of an industry or a company's environment and its capital structure are examined. In this area, two approaches are distinguished, which are focused on searching for premises that enable the determination of the capital structure (Gajdka 2002). In the first, the relationship between a company's financing policy and its strategy on the product market is examined; therefore, the financial structure will affect the behaviour of the sales market. In addition, enterprises will be able to predict the consequences of their financial decisions, so the conditions on the sales market will affect these financial decisions (Brander and Lewis 1986). The second subject of interest is the characteristics of the product and the type of production factors that are necessary for the functioning of an enterprise (Gajdka 2002).

Finally, it is worth paying attention to the market timing theory, which does not define the optimal capital structure but rather points out that certain conditions of the capital market and macroeconomic conditions that may affect the capital structure of the listed companies (Serghiescu and Văidean 2014). Gan et al. (2021) showed that, in the event of macroeconomic risk, the speed of adapting the capital structure becomes much slower and enterprises adjust their debt faster under good macroeconomic conditions.

5. Conclusions

Running a business requires one to have certain property resources; the scope and size of these depend on the type of business that one has undertaken. However, ensuring the necessary property needs depends on having access to a sufficient amount of capital. The basic issues mentioned in the context of the theory of capital structure include the cost of capital and the value of an enterprise. Therefore, a question arises about whether one can influence the change of the cost of capital and the value of a company by changing the capital structure. The presented theoretical concepts of capital structure do not provide direct conclusions that clearly define the premises for making decisions in the context of shaping capital structure. There is also no agreement as to whether and to what extent capital structure translates into the processes of creating enterprise value. Therefore, it seems justified to conduct appropriate empirical research in this respect. Additionally, it should be noted that the functioning of enterprises in a changing environment results in the creation of new instruments, which creates the need to search for new theoretical solutions.

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