Business Systems Research

**A Systems View
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Impressum

Focus and Scope

Business Systems Research Journal (BSR) is an international scientific journal focused on improving the competitiveness of businesses and economic systems. BSR examines a wide variety of decisions, processes, and activities within the actual business setting and the systems approach framework. Theoretical and empirical advances in business systems research are evaluated regularly. Special attention is paid to educational, social, legal, and managerial aspects of business systems research. In this respect, the BSR journal fosters the exchange of ideas, experience, and knowledge between regions with different technological and cultural traditions, in particular in transition countries. Papers submitted for publication should be original theoretical and practical papers. The journal also publishes case studies describing innovative applications and critical reviews of theory.

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Business Systems Research

A Systems View across Technology & Economics

Information Systems Research Articles

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Do-it-yourself Marketing and Digital Marketing Adoption: Evidence from a Developing Country

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Abstract

Background: Digital marketing is a new form of business management and promotion, namely promoting services and products of (SMEs)small and medium enterprises. Despite the importance of digital marketing, SMEs in developing and post-transition countries still do not fully utilize the benefits of digital marketing. **Objectives:** This study aims to analyse the DIY (do-it-yourself) model and the impact that this model has on digital marketing adoption. **Methods/Approach:** The online survey research was conducted among 194 SME managers in Kosovo. The proposed research model was analysed by partial least square structural equation modelling (PLS-SEM). **Results:** Findings show that the degree of perception of ease of use impacts the process of digital marketing adoption. Moreover, the degree of control seems to be the most important factor impacting process of the digital marketing in SMEs. **Conclusions:** SMEs use DIY marketing and adopt digital marketing because this form of practicing marketing activities offers more control for companies in their marketing activities. In addition, perceived ease of use of technology facilitates the process of digital marketing adoption among SMEs. Finally, the study provides insights for managers and businesses using DIY marketing and adopting the process of the digital marketing in SMEs.

Introduction

Today, businesses face numerous technological changes that significantly impact the way marketing is applied. Businesses must adapt and build their strategies to be competitive in the market. One of the technological breakthroughs transforming marketing adoption into businesses is the internet. The internet and other digital technologies have changed the marketing environment and its adoption (Peter et al., 2021). Applying digital marketing involves different strategies on how the business aims to reach the customer through digital marketing channels. Digital marketing strategy is a marketing channel strategy, and it needs to be embedded and used with other channels of multichannel marketing.

This paper aims to explore the factors influencing businesses in Kosovo to adopt digital marketing, which will be realized by examining the motives and attitudes that push these businesses to participate in this activity.

According to Kane et al. (2015), a lot of time has passed since digital marketing was first applied commercially and subsequently created a global network. According to them, the panorama of businesses and doing business has changed substantially. Large corporations like Google, Facebook, Amazon, Alibaba, and eBay, which were unknown a few years ago, are now significant players in the world economy. Moe et al. (2011) show that corporations present the great importance of building digital relationships with customers using different devices.

Literature also suggests that enterprises' central area of activity is marketing. Digital marketing is considered the marketing of company marketing offers that will allow the digitalization of screens, mainly via the internet. Digital marketing can be used for advanced data analysis, thus enabling building relationships with customers and improving results (Elgendy et al., 2014).

Wolf et al. (2013) describe DIY as to how ipeople behave while processing various materials they transform or reconstruct. The term 'do-it-yourself' has broader applications, including performing various business tasks such as arts, crafts, fashion, software engineering, or even film production, but is not defined only by these. Digital marketing, since its first appearance in the 1990s, has undergone many changes, beginning with the way companies use it to promote their brands and the way it has emerged by incorporating marketing plans into consumers' daily lives.

Despite its importance in many developing and post-transition countries, digital marketing is not utilized to the degree comparable to developed economies. Most businesses in Kosovo believe that digital marketing can positively impact their business activity. For example, in their study of 423 businesses, Mullatahiri et al. (2019) confirm that communication through digital marketing contributes to improving the brand image, customer satisfaction, and loyalty in the telecommunication industry in Kosovo. Also, in their study of businesses, Jashari et al. (2017) find that about 59% of respondents reported making unplanned purchasing decisions based on information obtained online, and 61.5% of them stated that they were motivated to buy based on their friends' reviews on social media. However, despite these benefits in Kosovo, firms seem hesitant to practice social media as an appropriate media of communication because they have not realized opportunities versus its costs (Ejupi, 2017) yet.

Besides, the social media topic has not been investigated among Kosovar businesses with proper consideration (Ejupi, 2017). This is also confirmed by the analysis of the Independent Media Commission (2013), which states that 70% of marketing spending is focused on conventional marketing communications such as TV and radio, while on the other hand, only 3% of advertising spending are dedicated to the online channels, which is an unsatisfactory percentage, albeit in an increasing trend.

This points to the gap between the potential for digital marketing utilization and how much businesses use it.

Therefore, this study aims to explore the factors that impact adoption of digital marketing in businesses in Kosovo. This research focuses mainly on the conceptual meaning of digital marketing by applying the DIY (do-it-yourself) model and the impact on the quality of digital marketing in Kosovo. In addition, this reserach provide concrete recommendations for the SME owner-managers about the increase of use of digital marketing by Kosovo businesses, which would increase their performance. The rest of the paper is organized as follows. First, the literature review is discussed and research propositions are developede; then sample data and methodology is introduced. Last, the paper discusses results and provides managerial implications for SME managers and future literature directions.

Literature review

Digital marketing describes activities linked with marketing activities of promoting products and services through some digital platforms. The term digital marketing describes the process of digital technologies used by companies in order to retain customers, engage customers, promote products and services and increase sales. This term can also be seen as an activity, institution, or communication between businesses and customers (Wolf et al., 2013). Therefore, digital marketing is defined as any activity taken by companies while posting content about their products and services using various digital devices (Cole et al., 2017).

The digital adoption process enabled by digital technologies delivers more value in this digitalization process. Thus, digital technology empowers companies to use digital marketing in order to create such value for the company and their porspects (Gnanasambandam et al., 2012.)

Digital marketing would reshape strategies deployed by companies to enhance customer relationship marketing (CRM) and value co-creation. Hewett et al. (2016) revealed that digital technologies significantly influence customer value. Company websites enable brand communication where customers express their feelings about their preferred brands and at the same time provide feedback to both companies and customer groups (Hewett et al., 2016).

Therefore, new internet technologies provide companies with extra opportunities to reach segments they could not reach. Digital marketing devices facilitate marketing communication with the prospects to promote their marketing offer and gain their attention (Tiago et al., 2014). In addition, this new form of communication has made companies change their communication strategies and adapt to the new momentum by reacting and coping with the new demanding marketing activities (Järvinen et al., 2012; Baltes, 2015).

Digital marketing devices can also influence positioning strategies for branding by search engine optimization (SEO) since SEO can be adapted and applied in many devices, enabling customers to use more search adoption from different devices. Brand awareness facilitated by digital marketing helps consumers differentiate brands in the market (Keller, 2001). Thus, helping companies position their brands in their minds (Aaker, 1991).

Hanssens et al. (2016) discussed how digital technologies help companies analyze the firm's marketing value. Digitalization provides more opportunities to measure company performance by measuring different implementation. Smarts companies know how to deploy such digital marketing devices and technologies to help com[amies create competitive advantages, increase their market share presence, and build brand equity.

Digital marketing promotes two-way communication, where consumers can post their comments and reviews. In a study, Chevalier et al. (2006) found that online reviews impact a book's sales ranking. In this line, Moe et al. (2011) revealed that online reviews affect sales.

Research propositions development

The DIY behavior model and the TAM model describe business owners' and managers' perceptions concerning the factors and the outcomes that might impact small and medium-sized enterprises using digital marketing in their marketing activities. Therefore, the study uses two existing models: DIY model of behavior (Wolf et al., 2013) and the TAM model (Davis, 1989), to develop research propositions for investigating perceptions of managers and business owners concerning the use of digital marketing communication in SMEs in Kosovo. DIY is a behavior in which individuals process various materials they transform or reconstruct (Wolf et al., 2013). The term 'do-it-yourself' has broader applications, including performing various business tasks such as arts, crafts, fashion, software engineering, or even film production. Still, it is not defined only by these (Wolf et al., 2013).

According to the DIY model, managers may follow digital marketing activities because of some antecedents' factors (motivation factors), such as perceived economic benefit, availability of products and the lack of product quality, and the outcome results such as degree of control, degree of fun and control, and self-improvement (Wolf et al., 2013). Both motivators and outcomes of the DIY model describe consumer processes and experiences (Wolf et al., 2011). Therefore, these two models are combined to analyze motivation factors and outcomes for performing DIY activities and technology adoption because of the limited financial resources of SMEs, especially business owners and managers in small companies resulting in digital marketing activities for their marketing offers.

The use of the internet for marketing purposes provides companies with advantages. In this context, companies are motivated to use online marketing communications since this form of communication provides companies using the internet a technology that facilitates the two-way communication of companies, and they are prospective. Therefore, digital marketing facilitates this form of communication and builds company image, improving customer loyalty and business performance (Ritz et al., 2019).

The development of digital marketing since the 1990s has undergone many changes, beginning with the way brands and businesses use it and as emerging digital platforms increasingly incorporate marketing plans into consumers' daily lives. Nowadays, access to marketing activities through the internet is almost free and open, and SMEs do not specialize enough in using digital tools, like, search engine optimization (SEO), email marketing, social media platforms, and content marketing. Many previous studies point out that SMEs do not profit from the potential that digital marketing provides to businesses and do not grasp the opportunity provided by such digital tools (Taiminen et al., 2015). Therefore, the DIY model enhances the understanding of why SMEs support markers efforts in any business to enhance relationships with their customers (Ritz et al., 2019).

"Do-it-yourself' (DIY) as terminology is usually traced back to the 1950s, referencing people who performed work such as maintenance, repair, or modification of any activities in their homes or other vehicles without any prior knowledge linked with that work or activity. They believed they could perform such activities themselves without paying other parties to carry the work for them, henceforth benefiting from not

incurring costs, completing the inconvenient work time, personal satisfaction, and doing things the way one wants (Knobel et al., 2010). DIY outcomes are significant for the function of businesses internally. The feeling of sense and excitement dimension in the model postulates that people engaged in digital marketing activities can obtain positive feelings and excitement because digital communication provides an enjoyable experience (Ritz et al., 2019). The do-it-yourself project provides more enjoyable moments, regardless of any eventual difficulties during the project realization (Wolf et al., 2011). The sense of control as a factor of the DIY model suggests that business owners can use technology to realize their specific goals, henceforth providing positive feelings because of being in charge of the control of the activities (Wen et al., 2015). According to Lusch et al. (2007), new projects and unforeseen difficulties provide more control for mastery in fulfilling specific goals. Hence, we posit the following research propositions:

- o *RP1. The degree of feeling of sense and excitement as a factor of the DIY has a significant impact on digital marketing adoption.*
- o *RP2. The degree of sense of control as a factor of the DIY model significantly impacts digital marketing adoption.*

Traditional communication methods and building customer relationships are not seen as prevailing communication tools to reach the target audience. Even though information technologies have facilitated two-way communication (Pejić Bach et al., 2018), some skeptical managers still think face-to-face communication is more effective (Lacka et al., 2016; Pejić Bach et al., 2017). But, additionally, some authors point out that digital marketing provides initial experience for business owners while using social media for small businesses (Michaelidou et al., 2011). The degree of intention to use digital marketing or intention to discontinue using digital technology is influenced by expectations and new experience (Venkatesh et al., 2000), satisfaction, and intention to use technology (Sun, 2013). Thus, we posit the following research propositions:

- o *RP3. The degree of intention to discontinue as a DIY factor significantly impacts digital marketing adoption.*
- o *RP4. The degree of perceived ease of use as a factor of the DIY model significantly impacts digital marketing adoption.*

The lackof quality of product motivates businesses to undertake their activities. The DIY model's perceived lack of quality as an outcome motivator makes business owners engage in projects because they think they can perform activities with more cost-benefit and more productivity (Wolf et al., 2011). In addition, Wolf et al. (2011) suggest that performing digital marketing activities provides business managers more opportunities to respond to their customers more effectively. Thus, we propose the following research proposition:

- o *RP5. The degree of perceived lack of quality as a factor of the DIY model significantly impacts digital marketing adoption.*

Figure 1
The Proposed Research Concept
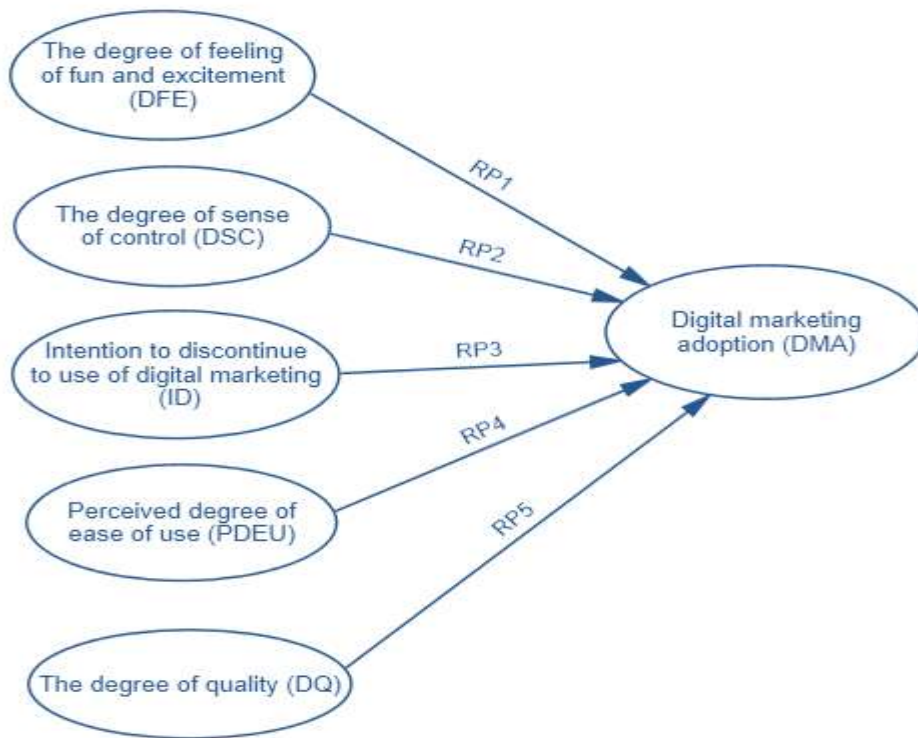
Source: Author's illustration

Figure 1 depicts the conceptual model integrating DIY behavior (the degree of feeling of sense and excitement, the degree of sense of control, degree of intention, and perceived lack of quality) the TAM model (the degree of perceived ease of use) dimension.

Methodology
Research instrument
The study investigates factors contributing to digital marketing adoption among businesses in Kosovo. The scales for measuring the degree of feeling and excitement, degree of control, degree of intention to discontinue, degree of ease of use, and degree of quality were taken from Ritz et al. (2019) and Wolf et al. (2013) whereas, digital marketing adoption construct was developed consulting the existing literature review.

Table 1 presents the research instrument, which consists of the six constructs. The questionnaire was translated to Albanian for respondents to understand the questions better. The respondents replied by responding to a five-point Likert scale.

Table 1
Research Constructs Description

Constructs	Items and codes	Source
The degree of feeling of fun and excitement (DFE)	DFE1. I find DIY internet marketing activities to be exciting. DFE2. When I engage in DIY Internet marketing projects is fun. DFE3. DIY Internet marketing projects are interesting. DFE4. I enjoy myself in DIY Internet marketing projects.	Adapted from: Ritz et al. (2019); Wolf et al. (2013)
The degree of sense of control (DSC)	DSC1. Internet Do-It-Yourself (DIY) marketing projects support managing business goals. DSC2. Internet do-it-yourself (DIY) marketing projects enable people to control the project better. DSC3. Internet do-it-yourself (DIY) marketing projects make people more responsible during the project situation. DSC4. During Internet Do-It-Yourself (DIY) marketing projects, people have confidence in the project itself.	Adapted from: Ritz et al. (2019); Wolf et al. (2013)
Perceived degree of ease of use (PDEU)	PDEU1. It's straightforward to learn how to create and promote products and services online. PDEU2. It's straightforward for me to achieve promotion goals through the internet. PDEU3. The interaction while promoting products or services are clear and understandable on the internet. PDEU4. The internet makes it easier for me to become agile in promoting our products and services online. PDEU5. I find it very easy to develop online promotions for our products and services online.	Adapted from: Ritz et al. (2019); Wolf et al. (2013)
The degree of quality (DQ)	DQ1. Website developers are not so reliable, that's why I think creating our Internet promotions is good. DQ2. Internet marketing experts do not perform what I expect them to do; that's why I think creating your Internet promotions makes sense. DQ3. Creating promotions on the internet is good because I can perform better than expert web developers. DQ4. Engaging internet marketing professionals perform worse results in jobs than when I engage myself. DQ5. I have to do the work myself because the work of the hiring people is not of good quality.	Adapted from: Ritz et al. (2019); Wolf et al. (2013)
Intention to discontinue to use of digital marketing (ID)	ID1. I plan to stop using internet marketing because of another technology superior to my needs, even though I am pleased with it. ID2. I predict I will no longer use Internet marketing because it does not suit my needs. D3. I intend to discontinue and replace internet marketing with something else I'm unhappy with. ID4. I plan to move to another superior digital tool instead of using Facebook.	Adapted from: Ritz et al. (2019); Wolf et al. (2013)
Digital marketing adoption (DMA)	DMA1. I think it is essential to apply digital marketing in our company. DMA2. Digital marketing facilitates marketing communication. DMA3. We plan to continue communicating with our customers via internet technologies.	

Source: Author's work

Sample

A research instrument (Table 1) was sent to all-sized companies in Kosovo managers. The structured questionnaire was sent to 250 companies and collected 194 questionnaires. We used an online Google Form for collecting the data, which was distributed by email.

The respondents' anonymity and confidentiality were previously consented to before taking part in the survey process.

The research was carried out with a total of 194 SME managers from Kosovo, 143 of which were men (73.7%) and 51 were female (26.3%) (see Table 1). We see that managers with secondary education are 21 or 10.8%, with university education are 95 or (49%), with postgraduate education are 71 or 36.6%, and seven did not answer this question or 3.6%. Of the 18-30 age group, 31 managers (16%), 93 of the 31-45 age group (47.9%), 52 of the 46-55 age group (26.8%), and 18 over 55 or 9.3%.

Analysis

The coded data were analyzed using IBM SPSS statistical package and Smart PLS to evaluate the measurement model and structural equation modeling.

In reflective models, we consider the outer loadings and the AVE (average variance extracted) while assessing the convergent validity of the construct (Zeqiri et al., 2020). For a better model fit, Hair et al. (2017) recommend outer loadings to be 0.708 and up as a general rule of thumb. The convergent validity evaluates how close the items are to a given construct. The average variance extracted (AVE), factor loadings, Cronbach's alpha, and composite reliability are evaluated (Rahman et al., 2016).

The heterotrait-monotrait ratio (HTMT) evaluated discriminant validity. Discriminant validity assesses how much items in one construct are different from items of other constructs (Zeqiri, 2020). As a rule of thumb, the HTMT values for all constructs must be below 0.85 (Hair et al., 2017).

A general rule for outer loadings suggests all loadings need to be 0.708 or higher (Hair et al., 2017). The collinearity issue is measured with VIF values, and VIF values that are greater than 3.3 show an issue with collinearity (Kock, 2015).

The bootstrapping technique evaluates the research propositions. With the help of the bootstrapping technique, we assess the PLS-SEM model, R-square (R2), beta, and t-values (Hair et al., 2017).

The Stone-Geisser's Q2 following a blindfolding procedur was used to evaluate the predictive relevance of the model.

In assessing the goodness of the model fit, we firstly test the Standard Root Mean Square Residual (SRMR). The SRMR values less than 0.10 or 0.08 are considered a good fit (Henseler et al., 2014). The second fit index to be tested in PLS-SEM is NFI, which are required to be above 0.9 to denote a good fit (Zeqiri et al., 2020).

Results

Table 2 reveals that values of Cronbach's alpha range from 0.838 to 0.917, denoting good reliability of the constructs since the values are over the suggested threshold of 0.70 (Ursachi et al., 2015). The values of Composite reliability range from 0.900 to 0.938, exceeding the proposed threshold of 0.70. In addition, Fornell et al. (1981) suggested a threshold of AVE of 0.50, thus, the AVE values vary from 0.635 to 0.841, which are over the suggested threshold. Therefore, the figures in table 3 indicate that convergent validity was reached, and further analysis can be carried out.

Table 2
Construct Reliability

	Cronbach's Alpha	rho_A	Composite Reliability	AVE
The degree of feeling of fun and excitement (DFE)	0.905	0.906	0.941	0.841
The degree of sense of control (DSC)	0.917	0.930	0.938	0.750
Intention to discontinue to use of digital marketing (ID)	0.838	0.881	0.900	0.751
Perceived degree of ease of use (PDEU)	0.905	0.906	0.934	0.779
The degree of quality (DQ)	0.855	0.875	0.895	0.632
Digital marketing adoption	0.901	0.901	0.938	0.835

Source: Author's work

The findings in table 3 reveal that all the HTMT values in all constructs are below the suggested threshold of 0.85. Henceforth, all constructs have discriminant validity.

Table 3
The Heterotrait-Monotrait Ratio

	DSC	DFE	PDEU	DQ	DMA
The degree of sense of control (DSC)					
The degree of feeling of fun and excitement (DFE)	0.573				
Perceived degree of ease of use (PDEU)	0.610	0.729			
The degree of quality (DQ)	0.306	0.498	0.345		
Digital marketing adoption	0.667	0.453	0.627	0.212	
Intention to discontinue to use of digital marketing (ID)	0.173	0.211	0.158	0.124	0.278

Source: Author's work
*Note that the following items: ID3, and DFE3, were removed from the model because of the VIF value issues

Table 5 shows means, factor loadings, standard deviations, t-values, and VIF for all construct items. The values provided in table 5, all item loadings vary from 0.720 to 0.945, above the suggested threshold. The VIF values in table 5 show that the model is not biased.

The findings supported RP2, RP3, and RP4 research propositions and rejected RP1 and RP5. The results in table 6 support RP2 that degree of control positively affects digital marketing adoption with path coefficient = 0.438, t-value = 5.708, and p < 0.000). The results also support in RP4, denoting that perceived ease of use impacts positively digital marketing adoption with path coefficient = 0.354, t-value = 4.192, and p < 0.000).

In addition, RP3 is also supported, i.e., intention to discontinue to use digital marketing is negatively significant with path coefficient= -0.143, t-value = 2.918, and p <0 .004).

Furthermore, the results in table 6 did not show any support for RP1 and RP5. Degree of feeling and excitement did not show any significant relationship with digital marketing adoption with path coefficient= -0.076, t-value = 0.940, and p < 0.347). Finally, RP5, degree of quality also did not show any significant relation with applying digital marketing, with path coefficient= -0.019, t-value = 0.332, and p < 0.740). Relationships are presented in Figure 2.

Table 5
Factor Loadings

Items	Loading	Mean	St.Dev.	t-values	VIF
ID1	0.881	2.530	0.797	5.386	1.885
ID2	0.913	2.559	0.895	5.190	2.444
ID4	0.801	2.599	0.852	2.300	1.900
DQ1	0.793	2.911	1.255	2.611	2.572
DQ2	0.803	2.926	1.164	2.175	2.261
DQ3	0.881	2.901	1.251	3.345	3.348
DQ4	0.720	2.446	1.353	1.670	2.986
DFE1	0.893	3.282	1.183	13.386	2.497
DFE2	0.945	3.470	1.165	16.665	4.149
DFE4	0.912	3.644	1.095	14.026	3.208
DSC1	0.882	3.668	1.087	19.853	2.572
DSC2	0.850	3.589	1.106	17.015	2.261
DSC3	0.907	3.668	1.064	17.476	3.348
DSC4	0.891	3.738	1.041	16.992	2.986
PDEU1	0.891	3.569	1.176	19.249	3.330
PDEU2	0.865	3.594	1.087	14.729	3.098
PDEU3	0.884	3.713	1.075	16.870	2.936
PDEU4	0.869	3.584	1.101	16.972	3.018
PDEU5	0.821	3.733	1.084	12.426	2.219
DMA1	0.901	3.817	1.117	28.426	2.518
DMA2	0.925	3.886	1.131	28.354	3.289
DMA3	0.914	3.822	1.107	28.437	2.922

Source: Author's calculations

Table 6
Research propositions Testing Results

	Research propositions	Path coefficient	St.dev.	T-values	P-values
RP1	The degree of feeling of fun and excitement (DFE) -> Digital marketing adoption (DMA)	-0.076	0.081	0.940	0.347
RP2	The degree of sense of control (DQ) -> Digital marketing adoption (DMA)	0.438	0.077	5.708	0.000***
RP3	Intention to discontinue to use of digital marketing (ID) -> Digital marketing adoption (DMA)	-0.143	0.049	2.918	0.004***
RP4	Perceived degree of ease of use (PDEU) -> Digital marketing adoption (DMA)	0.354	0.085	4.192	0.000***
RP5	The degree of quality (DQ) -> Digital marketing adoption (DMA)	-0.019	0.057	0.332	0.740

Note: statistically significant at 1%
Source: Author's work

Figure 2
PLS-SEM modeling
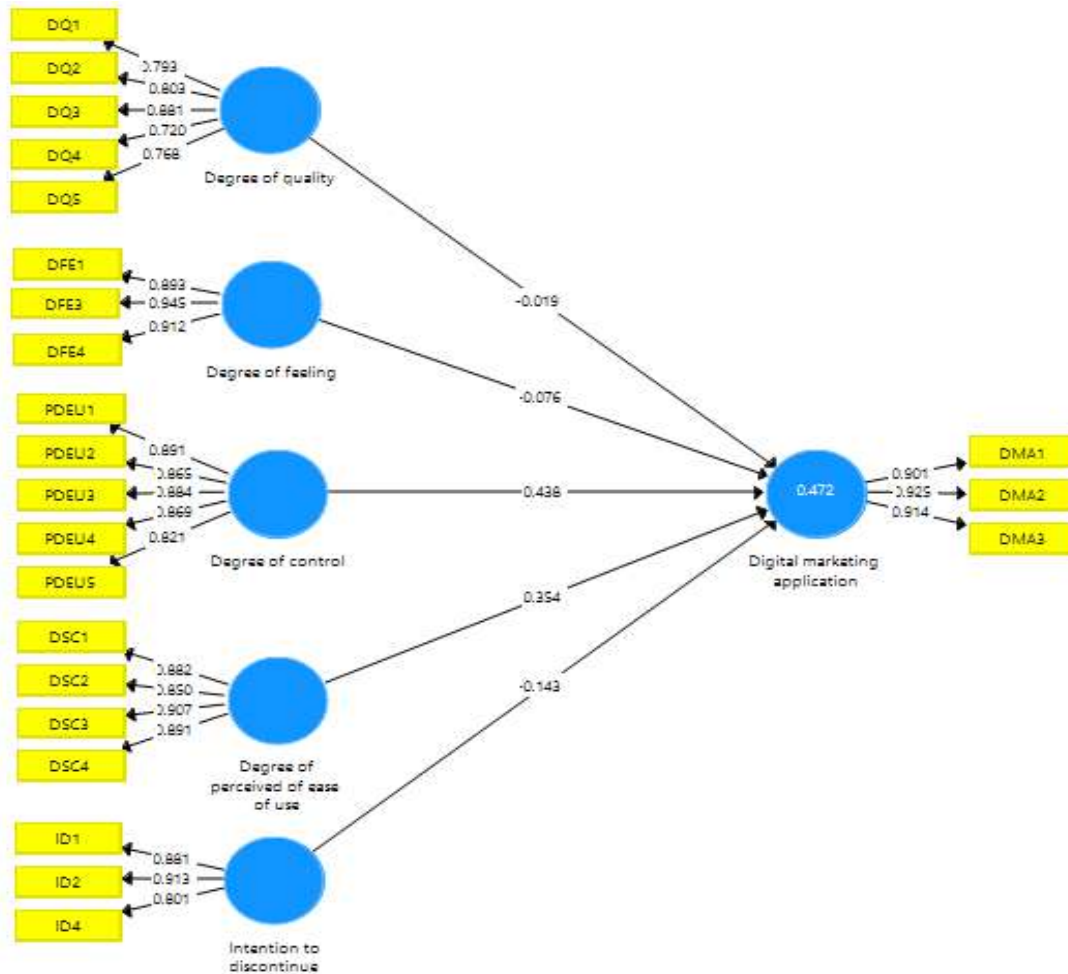
Note: DFE2, ID3, were removed from the model because of VIF issues and low loadings
Source: Authors' work

Table 6 shows the predictive relevance and the effect size or the power of the variables predicting the variance explained. As it can be seen, the degree of control as a reason for digital marketing adoption seems to be effective; next is the degree of perceived ease of use followed by other factors.

The model explained 47.2 percent of the variance in digital marketing adoption. The predictive value for digital marketing adoption is 38.4% (Q^2), showing a good relevance of prediction (Hair et al., 2017).

In our study, the NFI value is 0.801, near the proposed threshold, and SMRM is 0.062, denoting that the model fits well for the saturated and estimated models.

Table 6
Co-efficient of determination (R²), Predictive Relevance (Q²), and Effect size (f²)

Constructs	Coefficient of determination	Predictive relevance	Effect size (f²)
	R²	Q²	Digital marketing adoption
Digital marketing adoption	0.472	0.384	
Degree of control			0.220**
Degree of feeling			0.005*
Degree of perceived ease of use			0.119*
Degree of quality			0.001*
Digital marketing adoption			
Intention to discontinue			0.037*

Source: Author's work
Note: *Small effect 0 to 0.20, **Medium effect 0.20 to 0.50, ***Large effect more than 0.50

Discussion

Larger businesses are more likely to use digital marketing than small and medium-sized enterprises. Still, the vast majority of literature of digital marketing investigates the behavior of large businesses. This provides a gap in digital marketing literature about why SMEs have a limited adoption of digital marketing than larger organizations. Therefore, we contribute to the literature on digital marketing by explaining why SMEs have limited adoption of digital marketing. We used the DIY behavior and TAM models to study SMEs' digital technology marketing adoption behavior in Kosovo.

Therefore, this research explores the motivating factors and outcomes of certain behavior of SMEs linked with the need to perform digital marketing by business owners and managers of these companies. Järvinen et al. (2012) pointed out that small organizations have limited abilities to use digital marketing compared to large organizations. Thus, this study tried to explore the behavior SMEs concerning technology adoption and digital marketing activities.

The research concept is based on the TAM (Davis, 1989) dimensions and the DIY behavior model (Wolf et al., 2013) in order to explore the adoption of technology and digital marketing of businesses and managers in SMEs in Kosovo.

This study used data from 194 SME managers from Kosovo. PLS-SEM analysis indicates that the businesses and managers are motivated to apply digital marketing activities because of some antecedents of the DIY behavior model. Findings show that the main factors impacting the digital marketing adoption are the perception of the degree of ease of use of digital marketing, which has perceived opportunities to promote online products or services, achieving promotion objectives on the internet. There are opportunities for interaction and faster access to business development and promotion. The findings are supported by other previous studies, such as studies carried out by Wolf et al. (2011) and Michaelidou et al. (2011).

The second factor that statistically has an impact on digital marketing is the perception of the degree of control. It includes the opportunity for better promotion control, based on the developers of websites, and sees it as an opportunity to realize themselves without needing someone else's help. These findings are supported by Wen et al. (2015), Lusch et al. (2007), and Wolf et al. (2019).

The main factor impacting digital marketing adoption is the perception of the degree of ease of use. This is followed by the degree of control of services and use, and finally, the tendency or intent to discontinue digital marketing adoption by third parties.

The findings from this research contribute to the literature and understanding of small and medium-sized enterprises (SME) business managers and owners in several ways. First, we provide evidence for the TAM model concerning SMEs' digital marketing adoption by exploring the DIY behavior model. The benefit that motivates SMEs in Kosovo is that business managers and owners decide to adopt digital marketing as perceived ease of use. Thus, business owners and managers are motivated firstly because of its easiness as a technology embedded in their marketing communication strategies. Another implication derived from this research is that digital marketing provides a sense of control to owners of businesses and managers. This outcome benefits the DIY model outcome, where business owners and managers gain a feeling of control and self-improvement while practicing digital marketing (Wolf et al., 2019). As a result of such a positive outcome from DIY, such as control and perceived ease of use, managers and business owners are motivated to continue practicing digital marketing themselves. Therefore, having a website and practicing digital technologies for promoting products and services gives business owners and managers more control over content marketing and enables them to participate in two-way communication with their prospects more effectively. In this way, SMEs can control the customization of their marketing offers and activities.

Conclusion

Research results indicate that the DIY model is an adequate model that provides a professional approach to digital marketing management. In Kosovo, this is a new form of digital marketing management and offers an excellent opportunity for business development, which is recommended for other businesses in the regions in Kosovo and abroad. It would also be beneficial if companies in Kosovo start applying their staff training within the DIY adoption to better their digital marketing performance.

In this research, the DIY model has been combined with the TAM. Combining these two models is that the TAM considers the benefits gained from adopting technology. In contrast, the DIY model integrates marketplace characteristics (perceived lack of quality, economic benefits, and lack of availability) that play a critical role in applying digital marketing strategies.

The empirical findings show that the 'degree of perception of ease of use' and 'the degree of control' are statistically significant and positively affect the adoption of digital marketing in SMEs. As was emphasized previously, the findings from this research provide some insights to businesses and managers concerning the process of adoption of digital technology. In addition, it provides some evidence from an emerging market concerning the digital technology adoption process and the motivators and outcomes behind the digital marketing activities undertaken by SMEs in Kosovo. So, the findings have implications for both DIY behavior and small and medium-sized business research.

The study is with some limitations, that provide direction for eventual future research on this ground. First, this is a cross-section study analyzing digital marketing at one point; future studies should focus on a larger sample and data gained over a more extended period. Second, there is a need for a qualitative inquiry to investigate how digital marketing has taken place under the context of the investigation. Third, future studies should focus on cross-national analysis to determine whether the TAM and DIY model antecedents and outcomes differ in nationwide SMEs. Future studies can also focus on identifying a better environment for digital marketing adoption in larger companies in developing countries.

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A Bibliometric Network Analysis of Green Information Technology and Green Information Systems Research

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Abstract

Background: In recent years, the concepts of Green Information Technology and Green Information Systems (Green IT/IS) have attracted the attention of many researchers. Several environmental and sustainability studies have suggested that smart usage of Green IT/IS is one of the most important enablers for sustainable development in organizations and plays an essential role in greening the planet. **Objectives:** This paper aims to examine the development of the Green IT/IS field based on the published works. The focus is on analysing the keywords of related papers obtained from the Web of Science database. **Methods/Approach:** Based on the two-mode network of papers and keywords, the analysis of co-occurrence of keywords is provided. The most frequent keywords discovered by the temporal network analysis are presented from the perspective of the most prominent journals. **Results:** The main pillars of knowledge in Green IT/IS research are highlighted, and a chronological map of the field is provided. **Conclusions:** Green IT/IS's studied field shows constant growth in the last decades, and the results indicate the trends of future development in the field. The paper is one of the first studies that apply the bibliographic network analysis approach to the field of Green IT/IS.

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Introduction

In the last two decades, organizations have strived to achieve higher levels of sustainable development to contribute to the greening of the planet, primarily through the advanced use of information technology (IT) and information systems (IS) (Melville, 2010; Watson et al., 2008). The role of smart use of IT/IS in contributing to environmentally responsible human activities has become an attractive field of research and is therefore highly discussed in the literature. Consequently, aligned with the practical use in organizations, the discussions and research on these topics, two main concepts, Green Information Technology (Green IT) and Green Information Systems (Green IS), have become notable terms in professional and academic publications.

Due to the growing interest in the Green IT/IS research field, several studies have been published in recent years that deal with the related research topics. Esfahani et al. (2015) noted that the earliest study in this area was published back in 2007. Initially, the studies focused on Green IT, where the term Green IS was first introduced by Melville (2010). This work described the concept of information systems innovation for environmental sustainability and was included in the 20 most cited studies on green innovation (Albort-Morant et al., 2017). Later, Brooks et al. (2012) identified the main streams of Green IT/IS-related studies and provided a review of the literature from practitioners and academics. The authors reveal that most of the research focused on the concepts of Green IT, probably due to its popularity among practitioners. In addition, Loeser (2013) extended the literature search to the AIS electronic library using the keywords green IS and green IT and related terms such as sustain*, green or environmental. It was found that professional studies were ahead of academic ones, as most Green IT/IS papers were published in conference proceedings, while publications in top IS journals were rare.

On the other hand, Wang et al. (2015) significantly expanded the list of search terms (i.e., keywords). They classified Green IT/IS-related papers into four categories: initiation, enterprise strategies and practices, adoption framework, and outcomes. Further, Singh et al. (2020) examine five segments in the Green IS research area: Green IS concept, innovation and technology, the impact of green initiatives, measures and policies, and global context. Moreover, Esfahani et al. (2015) provided a review of research questions already addressed and the current state of research, while Bokolo (2016) used a set of search terms related to the concepts of Green IT/IS and retrieved 137 papers published in journals as well as conference proceedings. Based on this literature review, the authors provided a set of determinants that encourage/discourage organizations from incorporating Green IT/IS practices. One of the systematic literature reviews was provided by Muhammad et al. (2017), who used different search terms to retrieve Green IT/IS-related publications from various databases. The authors found that good search strings are difficult to formulate; they applied the snowballing method to complement the database search.

All these studies provide high-level research agendas and have opened new possibilities for future Green IT/IS research. One of the most important findings from the systematic Green IT/IS literature reviews concludes that the terms Green IT/IS have been vague concepts for several years. Both fundamental terms have often been used interchangeably without recognizing the differences, leading to confusion in professional and academic societies. While several authors attempted to present a clear distinction between the two terms (Brooks et al., 2012; Deng et al., 2015; Muhammad et al., 2017), Loeser (2013) distinguishes the terms based on the differences in the scopes. Following Loeser (2013), it is now clearly defined that the term "Green IT refers to measures and initiatives which decrease the negative

environmental impact of manufacturing, operations, and disposal of Information Technology (IT) equipment and infrastructure", while the term Green IS refers to "practices which determine the investment in, deployment, use and management of information systems (IS) in order to minimize the negative environmental impacts of IS, business operations, and IS-enabled products and services".

Besides the academic contribution, the research outcomes in Green IT/IS are also essential from the managerial implications point of view. Namely, Green IT/IS that are oriented to minimize the negative environmental impact is one of the key enablers of sustainable digital transformation in any contemporary organization (Gils et al., 2020). To assure organizations the valuable information for decision making for aligning the digital transformation activities with the sustainable development goals, up-to-date direction for proper use of Green IT/IS is needed. Therefore, the findings of already mentioned reviews on Green IT/IS literature are more than valuable. However, to gain a comprehensive overview of development directions, it would be worthwhile to supplement the qualitative literature research techniques with an appropriate quantitative attempt.

This paper aims to provide a comprehensive literature review on Green IT/IS to examine the development of the research field of Green IT/IS based on the published papers. Aligned this objective, the following research question was formulated: RQ: How have scientific publications on Green IT /IS research evolved over the past decades?

In addition to conventional search engines for literature analysis, advanced social network analysis (SNA) methods are applied. Our investigation will be based on Green IT/IS-related papers published in the Web of Science (WoS) database until 2020. When searching for the papers, the basic keywords Green information technology and Green information systems are expanded with various queries such as: "green information system*", "sustain* information system", "environment* information system*", "environmental informatics", "energy informatics", "green software", "green computing", "green information communication technology*", and "information system* for sustainable development". The justification for selecting the listed keywords is presented under Methodology Section.

From the obtained set of works in WoS, the complete descriptions were extracted considering the authors, the keyword list, and the work titles. Together with the initial hits, their citing articles were also obtained. Details on the data collection phase, converting raw data to network format, and analyses are presented in the Methodology section.

The paper is organized as follows; first, the process of bibliometric data collection and the preparation of the working set of keywords is presented, followed by the description of the derived networks, the normalized networks, and the temporal networks. The results start with the analyses of a two-mode network of works and keywords, followed by analyses of the keyword co-occurrence network. Furthermore, the selected journals that publish Green IT/IS topics were identified, and networks of emerging keywords within these journals were constructed and analysed. The Analysis employed enables the representation of the most frequently used keywords in the Green IT/IS research area through the lens of the most prominent journals. Moreover, the results provide a chronological mapping of the research field and show its future development trends. In the conclusions, an overview of the main findings is given, and our contribution to this research field and gaps for future research are identified.

Methodology

In the research design and data analyses we followed similar bibliographic research (e.g., Batagelj et al. 2013, 2014, 2019, 2020). For the analyses of publication practices on Green IT/IS, we analysed works included in WoS. We used the computer program WoS2Pajek to transform data into a network format to analyse the obtained data. The computer program Pajek for network analyses and Python libraries `Nets` and `TQ` for analyses of temporal networks.

Data collection

Data was collected from WoS Core Collection until 2020 using the following queries: *"green information system*", "sustain* information system", "environment* information system*", "environmental informatics", "energy informatics", "green software", "green information technology*"; "green computing", "green information communication technology*", "information system* for sustainable development"*. The justification of the ten selected queries is presented below.

- ***green information system**** *(and the* abbreviation ***Green IS****)*
- ***green information technology**** *(and* abbreviation ***green IT****)*
- **sustain* information system*:** Diverse functionalities can characterize IS as Green. According to Chowdhury (2012), one of the characteristics is the change in software development life-cycle, which aims to reduce the potential negative environmental impacts of the system. Aligned with this definition, the term sustainable information system has to be classified as a type of Green IS, whereas it is often used interchangeably.
- **environment* information system***, also known as an environmental management information system, is used to track, measure, and monitor the environmental variables: emission, waste, toxicity, and carbon footprint (Sanita et al., 2017).
- **environmental informatics:** In the 1990s, the new concept of Environmental informatics emerged, focused on the techniques of effective collection, storage, retrieval, and processing of complex environmental data (Avouris et al., 1995), which was later classified as Green IS.
- **energy informatics:** The concept of energy informatics was introduced by (Watson et al., 2010), describing the discipline dealing with the role of IS in the reduction of energy consumption.
- talking about **green computing** or rather **green information communication technology** (**Green ICT**) mainly sets the focus on hardware issues while software issues are directly named **green software** (Kern, 2018).
- **information system* for sustainable development**: The term Information system for sustainable development (Hilty et al., 2015) was used to describe various information systems supporting green initiatives.

Based on the search queries listed, the original hits and additional articles citing those hits were obtained.

Construction of network data

Using the computer program `WoS2Pajek 1.5` (Batagelj, 2017), we converted the raw text WoS file into a collection of different networks. The program `WoS2Pajek 1.5` transforms phrases from the raw WoS file into individual words when constructing networks (e.g., the phrase green information system is split into three keywords Green, information, and system). The obtained works include papers in scientific journals, papers in conference proceedings, reports, books, etc. We obtained one-mode

citation network $Cite$ of works and three two-mode networks: the authorship network on `works × authors` (WA), the journal network on `works × journals` (WJ), and the keywords network on `works × keywords` (WK). The authors were identified from the AU field in the WoS entry, the journals from the field CR or J9, the keywords from the fields of Author Keywords (DE field), Keywords Plus (given by ID field), and the document title from the field TI. Two types of works were extracted from WoS: works with full descriptions (referred as *hits*) and with partial description (referred as *terminal*). In the case of terminal works the journal name, the first author, the year of publication, the issue of the journal, and the first-page number were available. Keywords, abstract, and citations are missing in the case of terminal works.

Loops and multiple lines were removed from all networks, and we obtained the basic networks labelled as $Cite$, WA, WJ, and WK. Sizes of the networks are presented in *Table 1*. Since all terminal works (320 586) contain only partial information (without keywords and citations), we excluded them from the analyses. Since we aim to analyse the keywords of the works from the WoS on selected queries, we also removed all 9 530 citing articles. The resulting reduced networks (of hits) without citing articles are as follows: $CiteR$, WAr, WJr, and WKr. Sizes of the sets of these networks are presented in Table 1.

Table 1
Number of vertices in obtained and reduced networks

Business Performance	Networks	
	Basic from WoS	**Reduced to hits**
Number of works	332 047	1 931
Number of keywords	13 635	4 017
Number of authors	148 348	4 342
Number of journals	26 806	669

Source: Author's work

Derived networks

A rectangular two-mode matrix is usually used to represent the two-mode network. Using matrix multiplication of two matrices of compatible dimensions a new network can be constructed. More precisely, two rectangular matrices can be multiplied if the number of columns of the first matrix corresponds to the number of rows of the second matrix. Details on construction of networks can be found in Batagelj et al. (2013, 2014). Following this procedure two derived networks, described below were constructed.

First, the network of co-occurrence of keywords (keywords times keywords (KKr))

$$KKr = WKr^T * WKr \qquad (1)$$

The weight of an edge in KKr between two nodes $w[k1; k2]$ represents the number of works in which the selected keywords $k1$ and $k2$ were mentioned together.

Second, the network of journals and keywords was obtained with the following multiplication:

$$JKr = WJr^T * WKr \qquad (2)$$

The edge in a JKr network indicates how many times the journal j contained the keyword k. In the following sections, the detailed descriptions of the calculated networks as well as the result of the analyses are presented.

Normalization of derived networks

Derived networks may have some disadvantages, as, for example, works with a large number of authors or keywords may be overrated in terms of the contribution of such a work. To overcome this issue, we used the fractional approach in our analyses (Batagelj et al., 2013; 2019; Gauffriau et al., 2007). The importance of these works was normalized so that the sum of all weights in the calculating network is equal to 1.

We can illustrate this situation with the following example. In the (rectangular) two-mode network *of* `works × keywords` (WKr) an out-degree of a particular work is equal to the number of work's keywords, and an indegree of a selected keyword is equal to the number of works which included that word among the listed keyword. If the normalization is employed for the WK network, the weight of each arc is divided by the out-degree of a selected node which is equal to the sum of the weights of all the arcs pointing from that node. The contribution of each paper is normalized and the nWK is calculated as follows:

$$nWK[w,k] = \frac{WKr[w,k]}{\max\,(1, outdeg(w))} \qquad (3)$$

where w is work and k is a keyword.

The proposed normalization approach can be applied to different two-mode networks. In addition, for the normalization of the JK network, the term frequency-inverse document frequency (TF–IDF) approach was used (Robertson, 2004). Using this approach, the importance of a word to a document in a corpus of documents can be considered.

Temporal networks

Temporal networks have time quantities in their description specifying which links (or/and nodes) are active at certain points in time. Based on the WKr network with combined time quantities, temporal networks were constructed (Batagelj et al., 2016, 2020) using the Python libraries (Batagelj et al., 2014). Two types of temporal networks can be constructed – instantaneous (where values are given for each year) WKins, and cumulative (where cumulative values over the years are calculated) $WKcum$. With multiplication and normalization procedures employed on temporal networks described above, we can calculate various new temporal networks.

Results

This section presents the results of different analyses performed to reach the research objective. First, with the analysis of the WK network, we identify the most frequent keywords and their distribution over the years. Second, the most important journals where Green IT/IS topics are published are identified, and subtopics published inside those journals are investigated.

Analyses of the WK network

The works cited only (also known as terminal) do not have any keywords. In our case, the WK network consists of 96,5% of such works. Therefore, we will focus on analysing the reduced network of hits WKr.

In the works with complete description (WKr network) the number of keywords ranges from 2 to 57. The distribution of keywords is presented in *Figure 1*. Works contain 4 017 different keywords, and more than half of them (2 105) are mentioned only once, while 604 keywords are mentioned twice.

Figure 1
Frequency distribution of the keywords
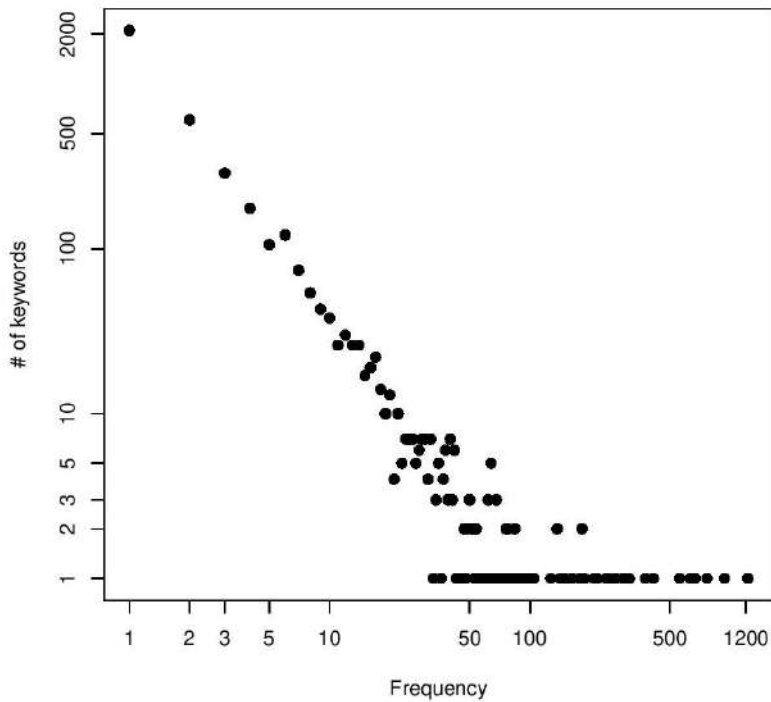
Source: Author's illustration

Eight of the most frequent vertices in the WKr network are *green, system, information, technology, energy, computing, environmental*, and *management* (*Table 2*). The word *green* occurs 1 226 times. This is expected since we use these words in phrases of the search query. Based on the most frequent keywords, the research field of Green IT/IS could be mapped. As expected, the research field consists of informatics or technically oriented keywords such as *data* (in tables and figures, the singular form of the noun is used - *datum*), *compute, cloud, base, communication, software, network, center, algorithm, application,* while also environmental aspects *sustainability, consumption, sustainable, environment,* etc. and organization performance *efficiency, performance, optimization, process*, etc. are also covered. Several words are closely related to research: *analysis, study, approach, framework*, etc.

Some words also have a different meaning related to the context, e.g., *center, issue, column,* etc. At the same time, their identification within a particular journal might reveal the specific scope or specialization of the journal.

Table 2
The frequencies of the most used keywords in the *nWKr* network

Rank	Value	Keyword	Rank	Value	Keyword	Rank	Value	Keyword
1	1 226	green	35	105	approach	68	62	assessment
2	936	information	36	103	study	69	60	adoption
3	767	system	37	102	virtual	70	59	behavior
4	668	energy	38	96	framework	71	57	save
5	633	technology	39	92	impact	72	56	sensor
6	559	computing	40	90	machine	73	54	carbon
7	413	environmental	41	86	optimization	74	54	integrate
8	378	management	42	84	scheduling	75	53	monitoring
9	313	datum[a]	43	84	process	76	52	social
10	299	compute	44	82	server	77	52	infrastructure
11	298	cloud	45	81	strategy	78	51	challenge
12	291	model	46	78	dynamic	79	51	cluster
13	267	power	47	78	architecture	80	50	simulation
14	248	sustainability	48	77	smart	81	50	policy
15	245	base	49	76	virtualization	82	50	control
16	241	efficiency	50	76	case	83	49	gi
17	217	performance	51	75	decision	84	49	method
18	213	communication	52	74	research	85	48	multi
19	209	consumption	53	72	support	86	47	waste
20	187	sustainable	54	71	practice	87	47	grid
21	184	software	55	70	perspective	88	46	informatics
22	182	network	56	68	innovation	89	45	issue
23	182	environment	57	68	distribute	90	44	scale
24	177	efficient	58	68	web	91	43	computer
25	163	center	59	66	business	92	42	emission
26	162	use	60	64	time	93	42	industry
27	161	resource	61	64	internet	94	42	eco
28	149	aware	62	64	theory	95	42	quality
29	147	algorithm	63	64	allocation	96	42	change
30	143	development	64	64	implementation	97	42	migration
31	142	design	65	63	engineering	98	41	user
32	137	analysis	66	62	evaluation	99	41	factor
33	137	service	67	62	mobile	100	41	consolidation
34	127	application						

Note: [a] As a keyword in works, a plural form data is used
Source: Author's work

Temporal analysis of the keywords

We looked at the temporal distributions of the number of all keywords and unique (*different*) keywords used in Green IT/IS (*Figure 12*). Keywords on Green IT/IS first appeared in the 1990s, while the number of publications started increasing in 2010. During the last few years, there have been around 3 000 publications in WoS on that topic. From 2013, around 1 000 unique keywords on IT/IS are published per year.

Figure 2
Distributions of keywords on Green IT/IS
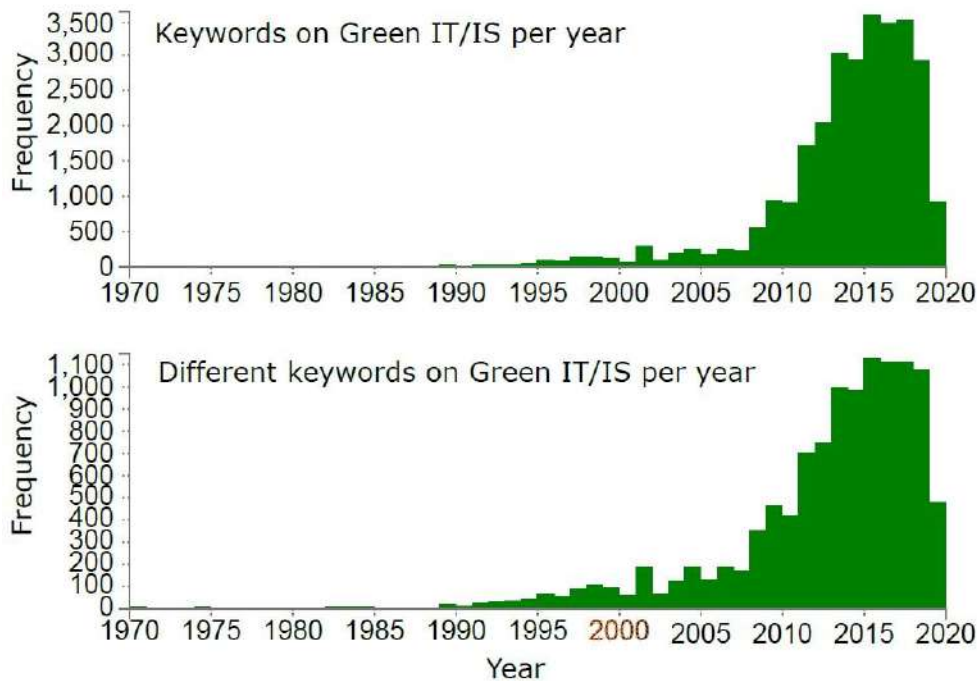
Source: Author's illustration

To determine the importance of a particular keyword over time, we calculated a proportion (ranging from 0% to 100%) of a particular keyword occurrence according to the keyword with the highest occurrence for each year based on the *WKins* network (Figure 3). We created green, system, information, technology, energy, computing, environmental, and management pictures.

Some of the keywords shown in Figure 3 have been used for a long time, as their first appearance dates back to the 1970s (e.g., system, information, and environmental). Some words appear around 1995 (energy, technology, and management), while Green becomes popular after 2005.

It is quite reasonable to expect the keywords system and information to reach the maximal level of usage (or importance) in almost all years after their introduction, with a small decline after 2010, probably due to the more sophisticated subdomains of usage and the broader set of keywords used, as shown in Figure 2. Other information systems keywords appear from 2000, and their usage (or importance) is the most extensive around 2015 (e.g., computing). The keyword environmental has been used since 1975, and it became extremely popular in 1990. There is a small drop in 2010, but its occurrence is still around 30% of the most popular words each year. The keyword green is a newly developed concept related to IS and IT, which appeared in 2009.

Figure 3
Distribution of keyword appearance proportion considering the eight most frequent keywords
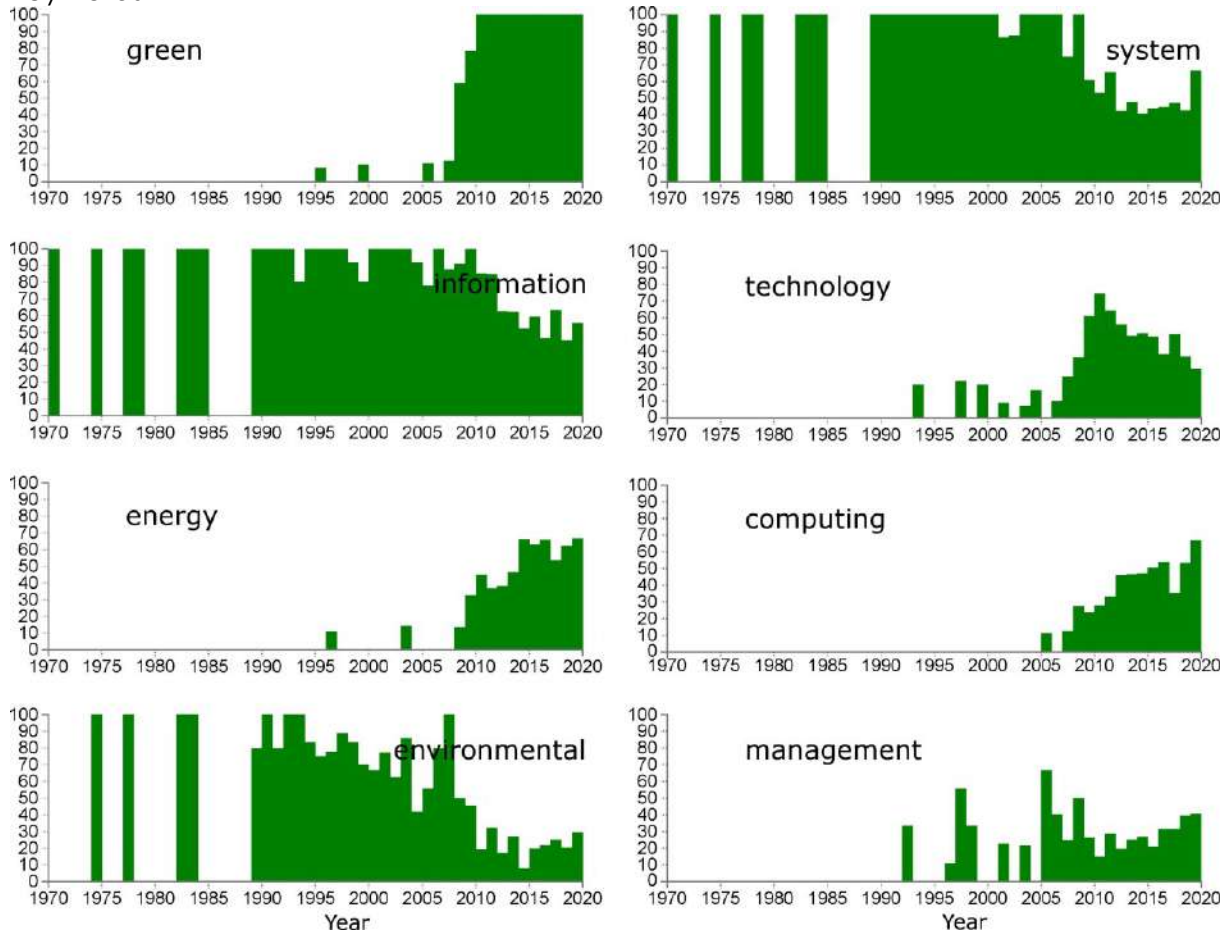
Source: Author's illustration

Keywords co-occurrence network

By column projection of the normalized hits $nWKr$ network, the normalized one-mode network $nKKr$ was calculated as follows:

$$nKKr = \mathrm{n}WKr^T * nWKr \qquad (4)$$

After the deletion of loops and the transformation of bidirectional arcs to edges, the calculated network $nKKr$ consists of 4 017 nodes and 126 639 edges. In this new calculated network, the weight on the edges between the keywords is equal to the fractional co-occurrence of keywords i and j in the same works. According to Batagelj *et al.* (2019) the $nKKr$ network is symmetric:

$$nKKr[i; j] = nKKr[j; i] \qquad (5)$$

Furthermore, value 1 of a particular work is redistributed over the keywords:

$$\sum_{1,j} nKKr[i; j] = |W| \qquad (6)$$

Since $nKKh$ is a valued network, we employed the Line Island approach (Batagelj et al., 2014) and searched for the islands of sizes 2 to 75. We obtained 13 islands, 10 of

which consist of only one pair of vertices. Figure 4 represents the largest island with 75 vertices. The width and greyscale are proportional to the line weight, calculated based on the *fractional* co-occurrence approach described in the following subsection. Strongly associated (with the largest line weights) are *green - computing*, *green - technology*, *green - information*, *system - information*, and *environmental - information*. This was expected since these words are included in our search queries. Therefore, we removed the first 8 most frequent keywords from the network and repeated the Line Island approach. We obtained 73 islands ranging in size from 2 to 50 vertices, 78% of which consist of only one pair of vertices. The largest island is represented in Figure 6 and is described below. When we compare the island with 75 vertices obtained from the $nKKr$ network (Figure 5) instead of its non-normalized version (KKr) (Figure 4) the following words appeared to be more important: *nature, education, challenge, sensor, monitoring, database, special, issue, wireless, greening, introduction*, while some others were not included in this island (e.g., *adoption, behavior, social, theory, time*).

Figure 4
Line Island of KKr network on 75 vertices

Source: Author's illustration

Figure 5
Line Island of $nKKr$ network on 75 vertices

Source: Author's illustration

The above exploratory analysis results show that 8 of the most frequent keywords (*green, system, information, technology, energy, computing, environmental, management*) are connected to many other vertices. We excluded them from the network to obtain connection patterns between other keywords and again applied the Line Island approach. Figure 6 represents the largest island with 50 vertices. The most central part of the network is a pair of keywords *compute* and *cloud*, and both vertices are connected to the *datum* and *center*. Other vertices are *efficiency, scheduling, application, resource, allocation, algorithm, virtual, machine*... Other keywords that came up are *virtual - machine*, *sustainable - development*, and *power - consumption*. Around *sustainability* and *development,* the keywords *software, communication,* and *sustainability also* stand out.

Figure 6
The largest line island (size 50) of $nKKr$ network with removed 8 vertices

Source: Author's illustration

Smaller islands (Figure 7) identify some concepts related to the information systems domain (*core - multy - agent, cloudstack - simulation - nanodevice*), others are enterprise-oriented (*make - decision - support, cause - partnership - stakeholder - unified - create - common*) or environmentally oriented (*biodiversity - endanger - species, emission - footprint - carbon*).

Further analyses of the 2-vertices islands show that some common phrases with limited value appeared in the information systems domain, e.g., *publish-subscribe, special-issue, column-response, real-time, e-waste*, etc. To get a deeper insight into those keywords, we will present them in the context of the most popular journals from the field (see the next section).

Figure 7
Line islands of size 3 to 6 of $nKKr$ network with removed 8 vertices

Source: Author's illustration

Keywords and journals

First, the analysis of WJr shows the most important journals in which Green IT/IS topics are published (Table 3).

Table 3
Journals with the highest number of works on Green IT/IS

Rank	Title	Abbreviated title & ISSN	# of works	JIF	SNIP
1	**Lecture Notes in Computer Science**	**LECT NOTES COMPUT SC** 0302-9743	48		√
2	**IFIP Advances in Information and Communication Technology**	**IFIP ADV INF COMM** 1868-4238	35		√
3	**Sustainable Computing-Informatics & Systems**	**SUSTAIN COMPUT-INFOR** 2210-5379	29	√	√
4	**Studies in Systems, Decision, and Control**	**STUD SYST DECIS CONT** 2198-4182	23		√
5	Advanced Intelligent Systems	ADV INTELL SYST 2640-4567	21		
6	Communications in Computer and Information Science	COMM COM INF SC 1865-0929	20		√
7	**Environmental Modelling & Software**	**ENVIRON MODELL SOFTW** 1364-8152	19	√	√
8	**Future Generation Computer Systems**	**FUTURE GENER COMP SY** 0167-739X	19	√	√
9	**Computer**	**COMPUTER** 0018-9162	15	√	√
10	Sustainability	SUSTAINABILITY-BASEL 2071-1050	15	√	√
11	It Professional	IT PROF 1520-9202	12		√
12	Procedia Computer Science	PROCEDIA COMPUT SCI 1877-0509	12		√
13	Cluster Computing	CLUSTER COMPUT 1386-7857	11	√	√
14	Journal of Supercomputing	J SUPERCOMPUT 0920-8542	11	√	√
15	**Information Systems Frontiers**	**INFORM SYST FRONT** 1387-3326	10	√	√
16	**Journal of Cleaner Production**	**J CLEAN PROD** 0959-6526	10	√	√
17	Advanced Science Letters	ADV SCI LETT 1936-6612	8		√
18	Computer Networks	COMPUT NETW 1389-1286	8	√	√
19	Journal of Strategic Information Systems	J STRATEGIC INF SYST 0963-8687	8	√	√
20	Fujitsu Scientific & Technical Journal	FUJITSU SCI TECH J 0016-2523	8	√	√
21	Proceedings of the Hawaii International Conference on System Sciences	P ANN HICSS N/A[a]	8		
22	Concurrency Computation Practice and Experience	CONCURR COMP-PRACT E 1532-0626	8	√	√
23	Advanced Materials Research	ADV MATER RES-SWITZ 1662-8985	8		
24	**Advances in Computer Science Research**	**ACSR ADV COMPUT** 2352-538X	8		

Note: [a] ISSN is not-applicable. Book series, different ISSN for each volume
Source: Author's work

Table 3 presents 24 journals with the highest number of published papers among our hits along with the information whether they have the Journal Impact Factor (JIF) (Clavrivate, 2019) or the Source Normalized Impact per Paper (SNIP) factor (Elsevier B.V., 2019) to reveal publishing culture among the authors. There were 48 papers published in the journal *Lecture notes in computer science* (LECT NOTES COMPUT SC), followed by 35 papers in the journal *IFIP Advances in Information and Communication Technology* (IFIP ADV INF COMM) and 29 papers in the journal *Sustainable Computing-Informatics & Systems* (SUSTAIN COMPUT-INFOR).

The construction of KJ network and its normalization is presented below. First, the derived network of `journals × keywords` was obtained by multiplying two two-mode networks

$$JK = WJ^T * WK \qquad (7)$$

To analyse keywords inside journals, two types of normalization were used: fractional approach and term frequency-inverse document frequency (TF-IDF).

Fractional normalization
The normalized reduced networks $nWJr$ and $nWKr$ were used to calculate a new normalized network of journals and keywords JK as follows:

$$nJK = nWJ^T * nWK \qquad (8)$$

In the new network nJK, the weight on the edges between the nodes j and k is equal to the fractional contribution of a journal j for a given keyword k; or of a group of journals C:

$$JK[C,k] = \sum_{j \in C} JK[j,k] \qquad (9)$$

Term frequency-inverse document frequency (TF-IDF)
$TF - IDF$ approach, proposed by Robertson (2004), was employed to the JKr network. In the normalization procedure the importance of a keyword for within a journal is considered. We used reduced networks WJr and WKr for JKr network construction, TF and IDF were defined (and calculated) as follows. TF represents the number of times a keyword appears in a selected journal, divided by the total number of (all different) keywords in the journal. IDF is defined as the logarithm of the number of the journals in the corpus divided by the number of journals in which the specific keyword occurs.

We calculated $TF - IDF$ indices for the keywords were calculated in the following way:

$$TF - IDF[k,J] = TF[k,j] * IDF[k] \qquad (10)$$

$$TF[k,j] = \frac{\# \text{ times } k \text{ appeared in } J}{\text{total } \# K \text{ in } j} \qquad (11)$$

$$IDF[k] = log \frac{\# J}{\# J \text{ with } k} \qquad (12)$$

where k is a keyword, K – all the keywords, j – a journal, and J – all the journals.

Keywords in the selected journals

To analyse the most frequent or important keywords on Green IT/IS, we selected nine top journals (denoted with bold in *Table 3*) according to the number of papers received and their influence measured by JIF or SNIP.

Three journals with the highest number of published works are Lecture Notes in Computer Science (LECT NOTES COMPUT SC), IFIP Advances in Information and Communication Technology (IFIP ADV INF COMM), and Sustainable Computing-Informatics & Systems (SUSTAIN COMPUT-INFOR). All three journals are indexed in Scopus, and the third one is also indexed in JIF. In companion to these three journals, we selected five other prestigious journals with the highest JIF among the received journals: *Information Systems Frontiers* (INFORM SYST FRONT), Future *Generation Computer Systems* (FUTURE GENER COMP SY), *Environmental modeling & software* (ENVIRON MODELL SOFTW), *Journal of Cleaner Production* (J CLEAN PROD), and *Computer* (COMPUTER). The analysis of the co-occurrence of keywords in the selected journals is presented below.

TF-IDF indices approach for keywords in selected journals
We employed the TF-IDF approach for nine selected journals. According to TF-IDF, the most important keywords are presented in Table 4 - Table 6.

Table 4
The most important keywords according to TF-IDF indices (journals LECT NOTES COMPUT SC, INFORM SYST FRONT, FUTURE GENER COMP SY)

	LECT NOTES COMPUT SC		INFORM SYST FRONT		FUTURE GENER COMP SY	
Rank	**Value**	**Keyword**	**Value**	**Keyword**	**Value**	**Keyword**
1	0,063	energy	0,176	business	0,128	compute
2	0,059	compute	0,094	modernization	0,103	efficiency
3	0,056	design	0,088	supply	0,101	aware
4	0,053	technology	0,087	chain	0,091	distribute
5	0,052	cloud	0,077	value	0,089	energy
6	0,052	spatio	0,072	performance	0,083	cloud
7	0,051	science	0,072	sustainability	0,079	center
8	0,051	aware	0,069	technology	0,070	computing
9	0,049	computing	0,069	organization	0,069	exploit
10	0,049	service	0,064	alignment	0,067	scheduling
11	0,047	temporal	0,061	environmental	0,064	management
12	0,047	datum	0,060	determinant	0,063	performance
13	0,046	base	0,058	innovation	0,062	power
14	0,046	efficiency	0,057	small	0,060	resource
15	0,046	green	0,056	theory	0,056	datum
16	0,045	application	0,056	strategic	0,054	hardware
17	0,043	system	0,054	management	0,053	optimal
18	0,043	research	0,050	ecological	0,051	hpc
19	0,043	consumption	0,047	pea	0,050	heuristic
20	0,042	information	0,047	carrot	0,049	consumption
21	0,040	community	0,047	just	0,048	green
22	0,037	performance	0,047	complementarity	0,047	parallel
23	0,037	sustainability	0,047	doi	0,044	application
24	0,037	provision	0,047	pvt	0,043	indicator
25	0,036	management	0,047	midlands	0,043	cost
26	0,035	platform	0,047	gratification	0,042[a]	protein
27	0,035	environmental	0,046	eco		routine
28	0,035	smart	0,046	informatics		fip
29	0,034	conservation	0,046	make		backtracking
30	0,034	process	0,045	firm		datacentre

Note: [a] Several keywords have the same value; not all are listed here.
Source: Author's work

The keyword *green* is the most important keyword in 6 out of 9 journals, while in the other three journals, the first place belongs to the keyword *information*. Most of the

most important keywords within the journals are related to information systems, while in two journals, specificity is shown in the publication culture. Two important keywords within the Computer (COMPUTER) journals are *column* and *response,* indicating that the authors write replies to the initial columns (papers). Similarly, four of the most important keywords in the journal Sustainable Computing-Informatics & Systems (SUSTAIN COMPUT-INFOR) are related to publishing: *special - issue, conference - paper.* The connections between the keywords specific to the journal are presented in the following subsection.

Table 5
The most important keywords according to TF-IDF indices (journals ENIVORN MODELL SOFTW, J CLEAN PROD, IFIP ADV INF COMM TE)

| | ENVIRON MODELL SOFTW | | J CLEAN PROD | | IFIP ADV INF COMM TE | |
Rank	Value	Keyword	Value	Keyword	Value	Keyword
1	0,118	environmental	0,070	travel	0,125	environmental
2	0,117	integrate	0,070	meeting	0,112	semantic
3	0,112	integration	0,064	corporate	0,094	portal
4	0,110	ei	0,062	eco	0,085	semantics
5	0,105	support	0,056	financial	0,077	search
6	0,101	decision	0,055	environmental	0,074	web
7	0,084	service	0,053	company	0,071	information
8	0,076	ogc	0,052	collaboration	0,071	architecture
9	0,074	web	0,052	innovation	0,063	system
10	0,074	system	0,050	program	0,056	infotercio
11	0,071	design	0,050	technology	0,056	sise
12	0,065	information	0,048	management	0,056	ho
13	0,060	interface	0,048	practice	0,056	diagram
14	0,058	example	0,046	communication	0,056	subsystem
15	0,057	management	0,044	empirical	0,056	link
16	0,055	open	0,043	public	0,055	open
17	0,053	architecture	0,042[a]	appraisal	0,052	infrastructure
18	0,052	software		hide	0,050	discovery
19	0,050	use		ema	0,050	datum
20	0,047	datum		willing	0,048	sustainable
21	0,047	component		logit	0,047	rest
22	0,046	spatial		valuation	0,047	czech
23	0,045	application		contingent	0,046	technology
24	0,045	access		premium	0,044	balance
25	0,043[a]	navigator		videoconference	0,043	life
26		uwedat		swedish	0,042	microservice
27		abatement		responsive	0,042	user
28		enviroinfo		publicly	0,041	series
29		spread		circular	0,041	office
30		maintain		ghanaian	0,041	generic

Note: [a] Several keywords have the same value, not all are listed here.
Source: Author's work

Table 6
The most important keywords according to TF-IDF indices (journals SUSTAIN COMPUT-INFOR, COMPUTER, STUD SYST DECIS CONT)

| Rank | SUSTAIN COMPUT-INFOR | | COMPUTER | | STUD SYST DECIS CONT | |
	Value	Keyword	Value	Keyword	Value	Keyword
1	0,172	special	0,145	column	0,206	engineering
2	0,148	issue	0,106	technology	0,115	concept
3	0,126	conference	0,089	response	0,082	technology
4	0,124	papers	0,074	green	0,074	complex
5	0,122	computing	0,073	computing	0,069	development
6	0,118	introduction	0,072	accountability	0,062	preface
7	0,118	international	0,072	generalize	0,061	implementation
8	0,104	igcc	0,072	fear	0,058	thing
9	0,095	select	0,072	wild	0,052	fpga
10	0,076	reduction	0,072	shine	0,052	taxonomy
11	0,075	software	0,072	let	0,051	network
12	0,075	energy	0,072	sun	0,051	model
13	0,069	power	0,072	showcase	0,051	green
14	0,066	green	0,072	joule	0,049	logic
15	0,059	server	0,072	hurdle	0,048	physical
16	0,058	agile	0,072	modularity	0,047	information
17	0,057	efficiency	0,072	bloat	0,047	internet
18	0,054	compute	0,072	1680	0,046	function
19	0,052	ieee	0,072	odd	0,045	operation
20	0,049	renewable	0,072	oddity	0,044	computing
21	0,045	aspect	0,072	design	0,043	classification
22	0,044	allocation	0,069	computer	0,042	fuzzy
23	0,040	consumption	0,065	information	0,041	component
24	0,039	datum	0,065	fi	0,041	optimization
25	0,039	platform	0,065	wi	0,038	adaptive
26	0,038	optimization	0,065	speedup	0,037[a]	energy
27	0,037	improve	0,065	creative		meronymous
28	0,037	enterprise	0,060	amdahl		spiral
29	0,037	technique	0,060	modular		specialized
30	0,172	special	0,145	column		engineering

Note: [a] Several keywords have the same value; not all are listed here.
Source: Author's work

Important keywords in the normalized nJK networks of selected journals
Before applying the Line Island approach to the obtained normalized networks with the fractional approach nJK, we removed the 8 most frequent keywords (*green, system, information, technology, energy, computing, environmental,* and *management)*. We want to investigate the connection patterns among other keywords within the selected journal and thus reveal the differences in subfields of the journals' scope.

The keywords most frequently associated with the corresponding journals are shown in the Appendices, Figure 9 and Figure 10. The keywords reflecting the LECT NOTES COMPUT SC (Figure 8a) is related to energy, compute, design, technology, cloud, spatial, science, aware, computing, etc. A closer look at this publishing outlet reveals several conference proceedings series related merely to technological aspects of green sustainability. For instance, the main topics identified in this publication outlet are green and cloud computing, data analytics, renewable energy, energy informatics, and similar topics. We can highlight similarities by comparing this set of keywords with another book series (i.e., IFIP ADV INF COMM TE). Both publication outlets are primarily concerned with IT. However, some studies aim to bridge IT and green aspects, particularly addressing the potential of IT to reduce the negative impact on the environment.

Given the keywords in SUSTAIN COMPUT-INFOR (Figure 10a), one can identify the technological dimensions of Green IT/IS (such as computing, software, server,

platform), the environmental dimension (reduction, energy, power, efficiency, renewable, allocation, consumption, improvement, etc.) and the organizational dimension (such as enterprise, technique, aware). Several works in this journal are related to green and sustainable computing, green high-performance computing (green HPC), and green IT. This journal is dedicated to scientific work related to the interplay between computer science and engineering and sustainability. In addition, this journal has several special issues devoted to green computing. Regarding the ENVIRON MODELL SOFTW (Figure 9a), the keywords such as environment, integration, support, decision, information, interface, management, architecture, and software can be emphasized. Examining the papers within this journal, we can outline the green infrastructure as one of the streamlined topics.

Furthermore, contrary to the publications mentioned above, the journal COMPUTER (Figure 10b) focuses predominantly on green energy and smart grid as far as green aspects are concerned. The keywords do not show a similar pattern compared to other publication outlets included in our study. Considering the FUTURE GENER COMP SY (Figure 8c), we can emphasize some similarities with other publication outlets such as LECT NOTES COMPUT SC and SUSTAIN COMPUT-INFOR. Green renewable energy, green computing, green data centers, and green IT are among the most notable research areas identified in FUTURE GENER COMP SY (Figure 8c). INFORM SYST FRONT (Figure 8b) also publishes the papers associated with Green IS practices and other non-technological aspects of Green IT/IS, such as attitudes towards Green IT, sustainability performance, etc. The keywords such as business, performance, sustainability, organization, innovation, strategy, and management also support the notation mentioned earlier on Green IS. While the scope of J CLEAN PROD (Figure 9b) is not related to IT or IS, there are also some papers on green technology in this journal, especially related to Green IT. The keywords indicate that attention is given to corporate/organizational sustainability and green technology, either information or energy, building, and other technologies.

Figure 8
Keywords inside the journals LECT NOTES COMPUT SC, INFORM SYST FRONT, FUTURE
GENER COMP SY

(a) LECT-NOTES-COMPUT-SC

(b) INFORM-SYST-FRONT

(c) FUTURE-GENER-COMP-SY

Source: Author's illustration

Figure 9
Keywords inside journals ENIVORN MODELL SOFTW, J CLEAN PROD, IFIP ADV INF COMM TE

(a) ENVIRON-MODELL-SOFTW

(b) J-CLEAN-PROD

(c) IFIP-ADV-INF-COMM-TE

Source: Author's illustration

Figure 10
Keywords inside journals SUSTAIN COMPUT-INFOR, COMPUTER, STUD SYST DECIS CONT

(a) SUSTAIN-COMPUT-INFOR

(b) COMPUTER

(c) STUD-SYST-DECI-CONT

Source: Author's illustration

Discussion and Conclusions

Despite various barriers organizations face in implementing green operations (Alves et al., 2020), there are significant literature on Green IS/IT, its adoption, and practices. We aimed to identify the topics of Green IT/IS research published in scientific journals. This study makes an important contribution to the Green IT/IS literature and provides valuable information for policymakers in public administration and organizations about the advances and orientation of the Green IT/IS research topic to follow the sustainable goals of digital transformation. Our main contribution is to outline the Green IT/IS research area development from 1975. It should be noted that our research goes beyond the traditional qualitative review. A quantitative approach to SNA, which we undertook by applying keyword analysis, provides a more objective overview of the research area and its development. Therefore, the main contribution of this quantitative approach to literature review can be conceived to understand better the scientific discipline of Green IT/IS and open future research avenues. We portrayed the development of the Green IT/IS research area and emphasized how the greening of this emerging field has been incorporated into the IT/IS literature. We have highlighted the main knowledge pillars on which the Green IT/IS research streams are built (e.g., green computing, green infrastructure, green energy, green data centers, etc.). Temporal analysis of the words associated with the Green IT/IS revealed the rapid increase of Green IT-related keywords from 2000 onwards. Indeed, the interdisciplinary field of Green IT/IS has also developed accordingly.

Interestingly, not all journals publishing Green IT/IS topics are IS-oriented, showing the importance and widespread interest in the topic. The scope of journals publishing Green IT/IS-related scholarly work extends beyond the information systems research field. J CLEAN PROD, one of the most eminent journals publishing research on sustainable development, has also published many Green IT/IS-related works. This is a clear signal that Green IT/IS has become interested in a wider research audience. The journal with the highest number of works related to Green IT/IS, LECT NOTES COMPUT SC, publishes many conference proceedings series. These research works focus more on technological aspects of green sustainability and less on academic discussions, which shows that there are still opportunities for academic research on Green IT/IS.

The main contributions of this paper can be summarized as follows:

(1) Successful implementation of quantitative methodology that can be applied to different research fields;
(2) Comprehensive overview of the literature on the Green IT/IS topic;
(3) Identification of the trends in the advancement of publications related to Green IT/IS over the past decades.

The research provides an exhaustive overview of the keywords used in Green IT/IS research, their evolution, and orientation. It provides IT management in companies' guidelines for their future activities and strategical decisions on IT investments related to sustainable development. This unbiased Green IT/IS literature review guides companies in preparing a solid background for their digital transformation process aligned with the sustainable development goals. From a management perspective, there are many innovative solutions to Green IT/IS challenges, and there is growing momentum to develop more Green IT /IS solutions that can be successfully marketed.

Further on, the opportunities for future research that can be outlined are related to the Green IT/IS investigation in more depth. Focusing more on non-technological aspects of Green IT/IS is bound to become even more significant in light of the evolution of this literature stream. For example, the investigation of the factors influencing the internalization of Green IT/IS is currently not sufficiently grounded in theories of Green IT/IS. This could entail the investigation of Green IT/IS's underlying

practices by integrating Green IT/IS into the management system of organizations, the development of Green IT/IS policies, objectives, procedures, etc. Moreover, the domains of the firm's resource-based view (RBV) and knowledge-based theory (KBV) of the firm are considered theoretical lenses that could shape the future development of Green IT/IS research.

The Green IT /IS field is still in its infancy stage. Nevertheless, there is a growing scientific interest in the Green IT/IS phenomenon. In this sense, based on the results of our study, we argue that rigorous theory development should be the focus of research on Green IT/IS. Our study showed that Green IT/IS is not narrowly specialized but is rather an interdisciplinary-oriented research stream. We anticipate that the research field will gradually mature as more multidisciplinary and interdisciplinary studies are conducted.

In addition, studies that focus on different contexts would enrich this line of research. For example, IT/IS research could be linked to the circular economy research, or future studies could expand the green perspective to a broader sustainability perspective with a balanced focus on sustainability dimensions. Besides, future research could delve into which specific aspects of Green IT/IS offer significant benefits in terms of improved business value.

While this study contributes to the Green IT/IS literature in several ways, certain limitations need further attention. The analysis is based on the data derived from the WoS, and incorporating additional bibliographic sources could further increase the generalizability of the results. In addition, it would be interesting to conduct a bibliometric analysis of Green IT/IS by including only the most prestigious journals and then comparing the results with less prestigious journals to determine possible similarities and differences between the two. A possible limitation of the study could be that citation, and co-citation data and trends are usually dynamic and are likely to change over time.

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Appendices

Table A1

Vertices within the selected journals (I.)

	LECT NOTES COMPUT SC		INFORM SYST FRONT		FUTURE GENER COMP SY	
Rank	Value	Keyword	Value	Keyword	Value	Keyword
1	2.429	green	0.445	information	1.254	green
2	1.780	energy	0.445	green	0.921	energy
3	1.737	information	0.445	technology	0.846	computing
4	1.692	system	0.386	system	0.743	compute
5	1.255	technology	0.337	business	0.539	efficiency
6	1.114	computing	0.284	environmental	0.530	cloud
7	0.907	compute	0.274	management	0.453	management
8	0.893	cloud	0.271	performance	0.432	aware
9	0.779	base	0.248	sustainability	0.353	technology
10	0.758	environmental	0.184	supply	0.352	datum
11	0.681	datum	0.184	chain	0.352	center
12	0.627	management	0.147	model	0.350	power
13	0.608	service	0.134	organization	0.336	performance
14	0.597	efficiency	0.133	theory	0.298	information
15	0.564	aware	0.133	innovation	0.294	distribute
16	0.536	design	0.131	value	0.291	system
17	0.510	research	0.108	ecological	0.286	scheduling
18	0.498	sustainability	0.108	modernization	0.250	resource
19	0.491	resource	0.095	small	0.250	special
20	0.466	consumption	0.091	strategy	0.250	section
21	0.452	performance	0.090	energy	0.234	consumption
22	0.448	application	0.090	informatics	0.167	software
23	0.444	database	0.079	make	0.166	application
24	0.383	informatics	0.077	strategic	0.150	virtual
25	0.377	efficient	0.077	process	0.148	cluster
26	0.370	spatio	0.076	alignment	0.138	cost
27	0.370	temporal	0.074[a]	determinant	0.136	parallel
28	0.347	analysis		firm	0.136	task
29	0.335	algorithm		adoption	0.133	virtualization
30	0.319	science		development	0.130	hpc

[a]*Several keywords have the same value, not all are listed here.*

Source: Author's work

Table A2
Vertices within the selected journals (II.)

	ENVIRON MODELL SOFTW		J CLEAN PROD		IFIP ADV INF COMM TE	
Rank	Value	Keyword	Value	Keyword	Value	Keyword
1	1.254	green	0.484	information	2.402	information
2	0.921	energy	0.379	green	2.065	environmental
3	0.846	computing	0.379	technology	1.850	system
4	0.743	compute	0.288	environmental	0.918	technology
5	0.539	efficiency	0.273	management	0.722	green
6	0.530	cloud	0.235	system	0.630	datum
7	0.453	management	0.193	communication	0.559	sustainable
8	0.432	aware	0.182	model	0.532	architecture
9	0.353	technology	0.134	practice	0.463	model
10	0.352	datum	0.130	travel	0.439	management
11	0.352	center	0.130	business	0.411	semantic
12	0.350	power	0.130	collaboration	0.390	web
13	0.336	performance	0.130	meeting	0.375	analysis
14	0.298	information	0.130	virtual	0.321	service
15	0.294	distribute	0.123	corporate	0.320	search
16	0.291	system	0.101	innovation	0.306	sustainability
17	0.286	scheduling	0.101	performance	0.305	development
18	0.250	resource	0.101	sustainability	0.294	integrate
19	0.250	special	0.101	eco	0.283	user
20	0.250	section	0.100	public	0.283	infrastructure
21	0.234	consumption	0.099	company	0.260	support
22	0.167	software	0.097	framework	0.254	innovation
23	0.166	application	0.091	perspective	0.250	environment
24	0.150	virtual	0.083	impact	0.234	policy
25	0.148	cluster	0.083	implementation	0.227	open
26	0.138	cost	0.081	program	0.226	issue
27	0.136	parallel	0.071	videoconference	0.224	portal
28	0.136	task	0.071	swedish	0.223	semantics
29	0.133	virtualization	0.071	agency	0.220	experience
30	0.130	hpc	0.071	web	0.205	way

Source: Author's work

Table A3
Vertices within the selected journals (III.)

	SUSTAIN COMPUT-INFOR		COMPUTER		STUD SYST DECIS CONT	
Rank	Value	Keyword	Value	Keyword	Value	Keyword
1	2.368	green	2.644	green	1.546	green
2	1.728	computing	1.255	information	1.131	technology
3	1.063	energy	1.255	technology	1.040	information
4	0.946	issue	1.238	computing	0.985	engineering
5	0.869	special	0.533	response	0.747	system
6	0.688	software	0.450	column	0.531	computing
7	0.576	introduction	0.405	energy	0.478	energy
8	0.504	international	0.250	trading	0.478	model
9	0.504	conference	0.200	accountability	0.419	concept
10	0.485	power	0.200	solve	0.411	development
11	0.461	technology	0.200	measure	0.411	network
12	0.461	compute	0.200	issue	0.353	implementation
13	0.393	papers	0.200	society	0.261	complex
14	0.393	select	0.200	future	0.245	consumption
15	0.378	efficiency	0.188	design	0.245	software
16	0.375	system	0.167	odd	0.238	thing
17	0.344	information	0.167	oddity	0.238	internet
18	0.308	datum	0.167	2.000	0.236	component
19	0.293	igcc	0.143	simulation	0.227	datum
20	0.288	management	0.143	system	0.217	cloud
21	0.288	consumption	0.143	introduction	0.211	preface
22	0.270	server	0.143	power	0.211	architecture
23	0.265	performance	0.143	smart	0.199	design
24	0.260	model	0.143	modeling	0.177	control
25	0.254	aspect	0.121	development	0.176	compute
26	0.243	cloud	0.117	computer	0.170	optimization
27	0.228	reduction	0.091[a]	visualization	0.170	algorithm
28	0.222	engineering		language	0.168	efficient
29	0.219	sustainable		fi	0.156	base
30	0.219	renewable		wi	0.154	power

[a]*Several keywords have the same value, not all are listed here*
Source: Author's work

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Sentiment Analysis of Customer Feedback in Online Food Ordering Services

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Abstract

Background: E-commerce websites have been established expressly as useful online communication platforms, which is rather significant. Through them, users can easily perform online transactions such as shopping or ordering food and sharing their experiences or feedback. **Objectives:** Customers' views and sentiments are also analyzed by businesses to assess consumer behavior or a point of view on certain products or services. **Methods/Approach:** This research proposes a method to extract customers' opinions and analyse sentiment based on a collected dataset, including 236,867 online Vietnamese reviews published from 2011 to 2020 on foody.vn and diadiemanuong.com. Then, machine learning models were applied and assessed to choose the optimal model. **Results:** The proposed approach has an accuracy of up to 91.5 percent, according to experimental study findings. **Conclusions:** The research results can help enterprise managers and service providers get insight into customers' satisfaction with their products or services and understand their feelings so that they can make adjustments and correct business decisions. It also helps food e-commerce managers ensure a better e-commerce service design and delivery.

Keywords: online feedback; food ordering services; Vietnamese sentiment analysis; text analytics
JEL classification: C61; C63; C67
Paper type: Research article

Introduction

Today, advanced information technology has changed the way of communication; it helps users easily access information and exchange their opinions about products and services on a large scale in real-time. The advent of social media and review websites allows users to express their opinions (Akila et al., 2020). The explosion of big data has made online community comments or reviews need to be collected and mined automatically, allowing enterprises to track customers' shopping behavior, interests, and satisfaction with products and services (Yadav, 2015; Akter et al., 2016). Hidden in those comments are the happy, sad, love, and hate feelings. Such "emotional" things it is a big challenge for computers without human reading and self-understanding. From an e-commerce standpoint, detecting the correct customer emotions will help us display better advertising content. For example, spotting a person in a tired mood can suggest some energy drinks, an entertainment venue, or simply play a piece of gentle music. The research direction is not a new one. However, each method has its advantages and disadvantages, and no method is accurate. Because of the intricacy of the Vietnamese language structure, using a lexicon-based technique for opinion mining poses a significant barrier for academics. To deal with the Vietnamese language, there aren't many sets of emotional vocabulary or handling methods. Small businesses are beginning to see the value of social media in achieving their objectives (Balan et al., 2017). Recently, Nguyen et al. (2020) proposed exploring user experience in the hotel sector by using the Topic Model, which is also an effective method in analyzing and extracting information from the corpus of customers' opinions. Therefore, the application of machine learning methods and evaluation of the Accuracy is necessary to choose the most suitable method through collected datasets.

The goal of this study is to analyze opinion mining studies and suggest the use of a machine learning approach to exploit consumer comments in Vietnamese. This research applies the knowledge mining method from data collected by automatic programs, including 236,867 reviews from customers on online ordering services and eating places review channels, namely foody.vn and diadiemanuong.com, which are famous for e-commerce websites in Vietnam. Then, data preprocessing was conducted, and machine learning methods were applied to find the best model and predict sentiment scores for the rest of the corpus.

The structure of this paper is divided into five sections. Section 1 describes the necessity of the research. Theoretical bases related to the research are presented in Section 2. In Section 3, the author describes the research method and experimental designs. The research results are detailed in Section 4. Finally, conclusions and future research are presented in Section 5.

Related works

This section focuses on exploring related research in customer opinion mining sentiment analysis, especially in the online service field. The machine learning and lexicon-oriented approaches in some research are also explored and analyzed to form the basis of this research.

Customer Opinion Mining in online services

The development of technology and using social media on a large scale has created opportunities to get useful insights from data without proper schema. Opinion mining in big data is used to categorize customers' opinions with different emotions and gauge customer mood. Opinion mining has gained significant results over time based on many comments available online. Customers have shared their opinions on products and

services in restaurants, schools, hospitals, vacation destinations, etc. The value of a user's comment, review, or rating about some product or service is their thoughts, judgment, psychological or feelings about its quality, appearance, or price. Depending on individual perceptions, opinions can be positive, negative, or neutral. Users may now express their opinions and make them visible to anybody on the internet thanks to social media. Based on that, enterprises can improve their products, services, and marketing strategies, to detect the latest trends opportunities or measure the effectiveness of their marketing activities (Pejić Bach et al., 2019). Currently, the community of scientists has much research on opinion mining methods and the applications of opinion mining at many different levels. In the study of Akila et al. (2020) and Nagpal et al. (2020), the authors have proposed tools and methods to collect and analyze customer comments using machine learning and topic models. In another study by Patel et al. (2020), the author analyzed users' emotions based on the customer rating score of the products and services they used in the food services. From the results of domestic and foreign researches, the author found that there are two popular approaches in opinion mining: (1) Based on machine learning (Kadriu et al., 2019; Khairnar et al., 2013; Le et al., 2017) and (2) based on lexicon (Liu, 2012, 2017; Vu et al., 2017; Li et al., 2019). In addition, to increase the efficiency of the opinion mining method, the research has used a hybrid method combining machine learning and lexicon (Mudambi et al., 2010; Maks et al., 2012; Sun et al., 2017; Yang et al., 2017).

One of the limitations of the machine learning-based method is its dependence on the training dataset size, which is labeled and must be large enough. However, labeled data is often uncommon, especially in some narrowly specialized majors. Most research teams must spend time and cost on labeling the data.

Machine learning-based customer sentiment analysis

Emotions and sentiment are a problem that many scientists are interested in and researched (Akter et al., 2016; Lugović et al., 2016). So, there are different views about the number of emotions. Based on the nature of emotions, emotions can be divided into 2 categories: positive emotions and negative emotions. Based on expression and content, we can divide emotions into six basic categories: happy, sad, angry, surprised, hate, scared. Under the impact of different stimuli in different conditions and circumstances, human emotions sometimes intertwine, mix with others, and coexist simultaneously. And this created a series of other emotions.

For the most part, sentiment analysis was characterized as "the study computation of views, feelings, and emotions represented in the text" (Nagpal et al., 2020). In other words, opinion mining, as a way of obtaining the viewpoint of the person who generated a certain document, has lately been the most popular study topic in general social networks (Pang et al., 2008; Ohana et al., 2009). The importance of sentiment analysis has grown with the rise of social network media such as reviews, discussions forum, and social media. Especially in the era of digital development with the explosion of the internet, a lot of this research has focused on social networking domains (Facebook, Twitter...), as in Dunđer et al., (2016), Krstić et al., (2019). Due to some characteristics of the language on social networks, such as a limited number of characters or emotions depending heavily on what users are reading and listening to, the emotional classification of users in social networks is a challenging issue. Machine learning has been applied and has achieved some success in sentiment analysis (Khairnar et al., 2013; Kadriu et al., 2019).

Lexicon-based customer sentiment analysis

Opinions and comments of customers are natural written form (Liu, 2012). In some research by Maks et al. (2012), Akter et al. (2016) gave some methods and techniques of natural language processing in analyzing opinions and sentiment of customers through online commentary. Previous research mainly focuses on vocabulary – lexicon-based and machine learning-based methods. For the lexicon-based approach, the outcome depends heavily on the quality of the emotional words. In a subtle way, the outcomes of machine learning-based approaches, such as SVM and Nave Bayes, are significantly reliant on feature selection methods, such as n-gram or lexicon-based. The research of Vu et al. (2011) has given ways or reviews that explore words in Vietnamese comments in general, but it is almost absent in favor of the user emotions.

The lexicon-based method of analysis depends on the emotional vocabulary sources. An emotional vocabulary source, which is often understood as a dictionary, is a collection of words expressing emotions, with each word assessed as polarizing by a real number. These dictionaries can be built by hand or semi-hand. The advantage of this approach is that there is no training required since there is no need for labeled data. This method is commonly used for sentiment analysis on common text types: blog posts, comments on film, product, or forums.

The research of Ohana et al. (2009) used the SentiWordNet dictionary to evaluate the polarization of film comments. SentiWordNet is an automatically generated dictionary based on a WordNet database, and the best results get an accuracy of 69.35%. The authors conclude that using a SentiWordNet dictionary is as effective as using a hand-built dictionary. Other research has built their dictionaries based on different sources. Research by Taboada et al. (2011) and Liu (2012) affirms that dictionary building helps to establish a solid foundation for this approach.

Support Vector Machine – A classificational algorithm

SVM is a machine learning taxonomy using the kernel function to map a space of data points that cannot be linearly separated into a new space with error classification. For instruction on SVM and their recipe details, we refer readers to Burges (1998). A detailed treatment of the application of these models for text classification is possible found in Joachims (2002).

SVM is essentially an optimal problem; the goal of this algorithm is to find a space F and the super-plane decision f over F such that the classification error is lowest. Let the sample set $\{(x_1, y_1), (x_2, y_2), ... (x_f, y_f)\}$ with $x_i \in R^n$ belong to two classes of labels: $y_i \in \{-1,1\}$ is the corresponding class label of x_i (-1 represents class I, 1 represents class II). We have, the super-plane equation contains the vector x_i in space: $x_i.w + b = 0$

$$\text{Set } f(x_i) = \text{sign}(x_i.w + b) = \begin{cases} +1, x_i.w + b > 0 \\ -1, x_i.w + b < 0 \end{cases} \tag{1}$$

Thus, in the equation (1), $f(x_i)$ represents x_i's classification into the two stated classes. We say $y_i = +1$ if $x_i \in$ class I and $y_i = -1$ if $x_i \in$ class II. Then, to have a super-plane f we will have to solve the following problem: Find min $\|w\|$ with W satisfying the following conditions: $y_i(\sin(x_i.W + b)) \geq 1$ where $i \in [1, n]$.

Methodology

This section describes the General Model that the research proposes. Followed by steps to preprocess the data, train, evaluate the model, and conduct data analysis with the time factor.

Overview model and methods

The research data was collected for research purposes, containing raw data from the Foody.vn and diadiemanuong.com websites. Before the machine learning procedure, the raw data is preprocessed, sampled, and labeled. Training, validation, and test data are the three types of sampling data. The training dataset is used during the learning process and is used to fit the parameters; the validation dataset is a dataset of examples used to tune the hyperparameters of a classifier. Test datasets are used only once as the final step to reporting estimated error rates for future predictions. Figure 1 is an overview of the research model which we have done.

Figure 1
Proposed Overview Model and Methods
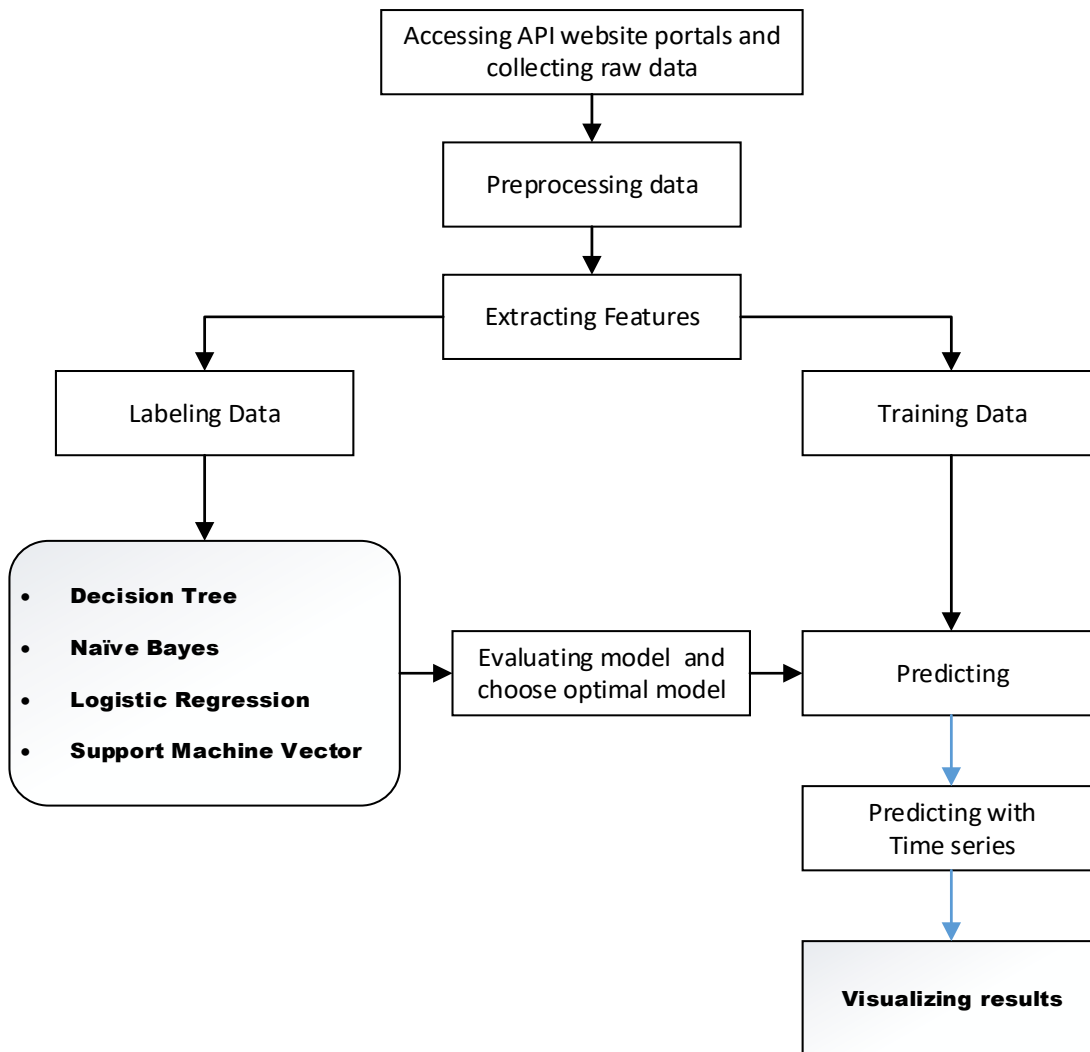
Source: Author's proposal

Data crawling

The Beautiful Soup and Selenium libraries in Python language collect data on the websites. The data collection is based on the Hypertext Markup Language (HTML) structures of foody.vn and diadiemanuong.com. If we want to collect some information data, we proceed to retrieve the data corresponding to the HTML tag containing that information. The result of this step will collect all website data in HTML or TXT formats. This data will be processed in the following steps.

Result of data collecting

The collected dataset had 236,867 records, shown in Table 1, including store name, address, commented customer name, commented time, comment content, rating of a customer for that store. The number of reviews gathered from foody.vn is 214,835 comments; for the diadiemanuong.com is 22,032 comments. This dataset will go into the preprocessing and cleaning step to provide input to the later steps of the models.

Table 1
Results of data crawling

Sources	Number of reviews
foody.vn	214,835
diadiemanuong.com	22,032
Total	**236,867**

Source: Authors' work

Data preprocessing

Collected data is raw unprocessed so that the data may be empty, misspelled, too short, too long, or contain icons. This will affect the analysis results, so we need to clean up the data. The steps are as below:

- **Remove icon and special characters:** special characters do not have any definite meaning, on the other hand, cause interference in the analysis. Convert all to lower case: each character represents a binary sequence in computer memory. Because the upper-case characters will have a Unicode code that is different from the lower case, which has the same semantically, the computer will not be able to distinguish the input data so that the prediction may be affected. Therefore, converting the entire text to lowercase is reasonable for the analysis and prediction system.
- **Transform words to normal form**: conversion to clear words is required for the preprocessing of the data. Comments on Foody (commented by users in Vietnamese) may have acronyms or misspellings. For example, words in Vietnamese: "ko ngon" (not delicious), "vs" (with), "15k" (15,000 VND) ... or data is not normalized, not standardized. This will interfere with the results of the analysis. During machine learning training, the input is "không ngon", but when predicting the output, the phrase "ko ngon" does not appear during the training, so it will be difficult to identify emotional and predictable results.
- **Remove blank/NULL data**: the collected dataset will have a lot of blank data, which does not make sense in the analysis process, causing a waste of storage memory.

Data labeling

Normally, the data labeling in research applying machine learning will be built by hand. However, after randomly reviewing the content of the collected comment dataset and based on the results of the rating (the rating field in the dataset), founding that comments with a rating less than 5.0 have a negative meaning, and vice versa, comments with a rating equals or greater than 5.0 have a positive meaning. To perform the data labeling process before being trained, the research applied the classifying emotions method according to the customer rating (Liu, 2017; Patel et al., 2020) to divide the collected dataset into 2 datasets, labeled according to the following rules:

- Rate < 5: reviews below 5 stars will be labeled negative.
- Rate >= 5: Review comments rated above 5 stars will be labeled as positive.

The labeling results showed that most of the data were positive comments which accounted for 81.9% of the total comments; the negative comments accounted for 18.1% of the total comments, as table 2 below:

Table 2
Labeled data

Type	Number of reviews	% of total
Negative	42,799	18.1%
Positive	194,068	81.9%
Total	236,867	100.0%

Source: Authors' work

Training and Evaluating model

Normally, the efficiency of opinion classification models is evaluated based on four indicators: Accuracy, Precision, Recall, and F1_Score (known as a harmonic average of Precision and Recall in Table 3). They are formulas (2), (3), (4), and (5), respectively. In addition, this research also considers the training time and the predicting time of each model.

Table 3
Confusion matrix

	Predict: Positive	Predict: Negative
Actual: Positive	True Positive (TP)	False Negative (FN)
Actual: Negative	False Positive (FP)	True Negative (TN)

Source: Authors' work

There is,

$$Accuracy = \frac{TN + TP}{TN + TP + FP + FN} \tag{2}$$

$$Precision = \frac{TP}{TP + FP} \tag{3}$$

$$Recall = \frac{TP}{TP + FN} \tag{4}$$

$$F1\_Score = \frac{2 \times Precision \times Recall}{Precision + Recall} \tag{5}$$

Results and Discussion

The results of data preprocessing, training, and model evaluation are presented in this section. Along with that, the results are visualized, and discussions related to the research topic are presented.

Result of training and Evaluating model

This is the most important stage of opinion mining research to determine whether a customer comment is "positive" or "negative". This research applies some classification methods of the Supervised Machine Learning group that are considered the best. Based on the results of the previous research related to the topic, find the most suitable model for the dataset, which is the classified comments. Then, forecasting the unsorted comment data or new comment data arises without retraining.

Table 4 shows the experimental results of the methods. The Accuracy of Decision Tree is 89%, Naïve Bayes 82.5%, Logistic Regression 90%, and Support Machine Vector 91%. In addition, it also shows the training and prediction time of each method. The Decision Tree method has a training time of 1h 4m 32s and a prediction time of 14,300 ms, while the Support Machine Vector (SVM) has a training time of 6,320 ms and a prediction time of 31.25 ms.

Table 4
Results of training and evaluating model

Models	Decision Tree		Naïve Bayes		Logistic Regression		SVM	
	Positive	**Negative**	**Positive**	**Negative**	**Positive**	**Negative**	**Positive**	**Negative**
Precision	0.88	0.97	0.82	0.99	0.90	0.88	0.92	0.86
Recall	1.00	0.37	1.00	0.04	0.99	0.50	0.98	0.64
F1_score	0.93	0.54	0.90	0.08	0.94	0.64	0.95	0.73
Accuracy	89.00%		82.50%		90.00%		**91.50%**	
Training time	1h 4min 32s		1.260 ms		53.700 ms		**6.320 ms**	
Predicting time	14.3 s		66.1 ms		31.5 ms		**31.25 ms**	

Source: Authors' work

A clustered bar chart shows the experimental results of the model in Figure 2 below. In this chart, we can see the column that shows the SVM algorithm's Accuracy is highest with 91,5%.

Figure 2
Results of training and evaluating model (Precision, Recall, F1_Score, and Accuracy)
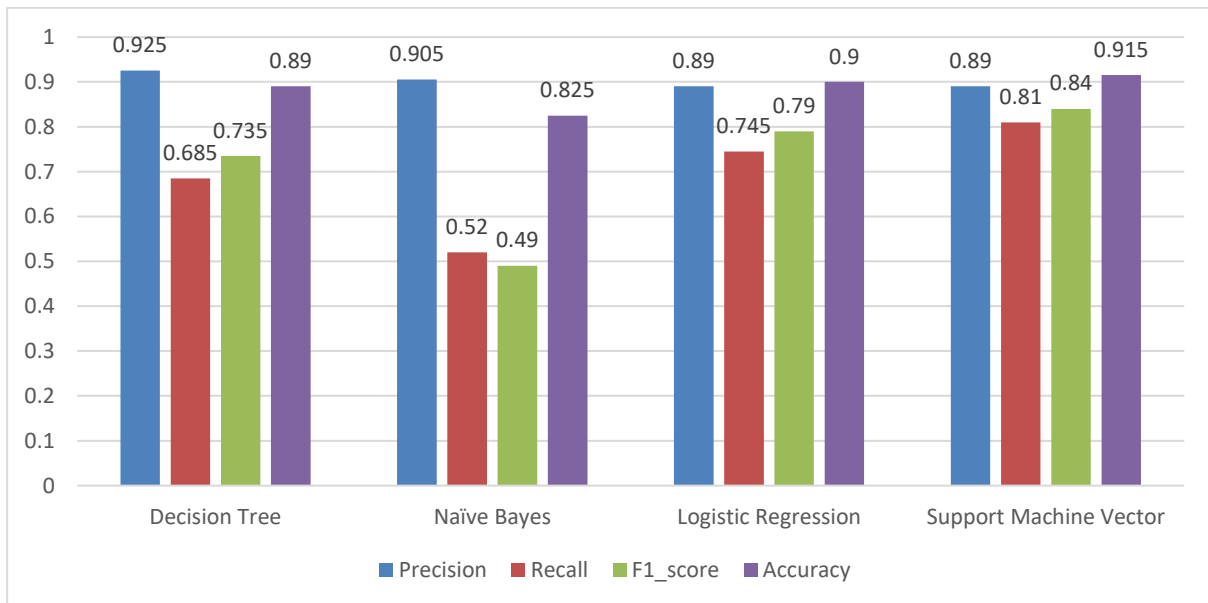
Source: Authors' work

Result of visualization

The visualization results in Figure 3 include the following four charts: Rating by Store, Top stores with a high review, Criteria Scores by Year, and Sentiment by District. Reports are filtered, and information is displayed only in 2020.

The **Rating by Store** chart shows the average customer rating information for each store. In addition, it also shows the average rating of all stores, which is 5.904, through which we can correlate the rating of the store with the average value. For example, "3 Râu" - the fried chicken store has an average rating of 10.00, and R&B milk tea has 9.7.

The **Top Stores** with high reviews chart show the total number of customer comments for each store. The chart shows "Mực nướng Đảo Ngọc", "Baozi - Ẩm thực Đài" are stores that are more interested in and commented on by customers than the rest of the shops.

The **Criteria Scores by Year** chart shows the total customer rating according to the criteria (location, price, quality, service, space). In 2020, the total rating by location is 2366, by price is 2319, by services is 2520, by quality is 2411, and by space is 2452.

The **Sentiment by District** chart shows information about total negative and positive comments distributed by districts in Ho Chi Minh. For example, District 1 has a positive comment rate of 63%, and negative comment rate is 37%, or Binh Thanh district has a positive comment rate of 64%, negative comment rate is 36%.

Figure 3
Dashboard Sentiment Analytics

Source: Authors' work

The Word Cloud chart represents negative and positive keywords, making it easy for viewers to catch up with and compare them. In Figure 4, it's easy to see which words are mentioned the most in customers' comments, and the bigger words, the more mentioned. In the WordCloud_Positive chart, the word "món ngon" (delicious plates) appears most in the customers' reviews. Similarly, in the WordCloud_Negative chart, the word "thất vọng" (disappointed) was mentioned most.
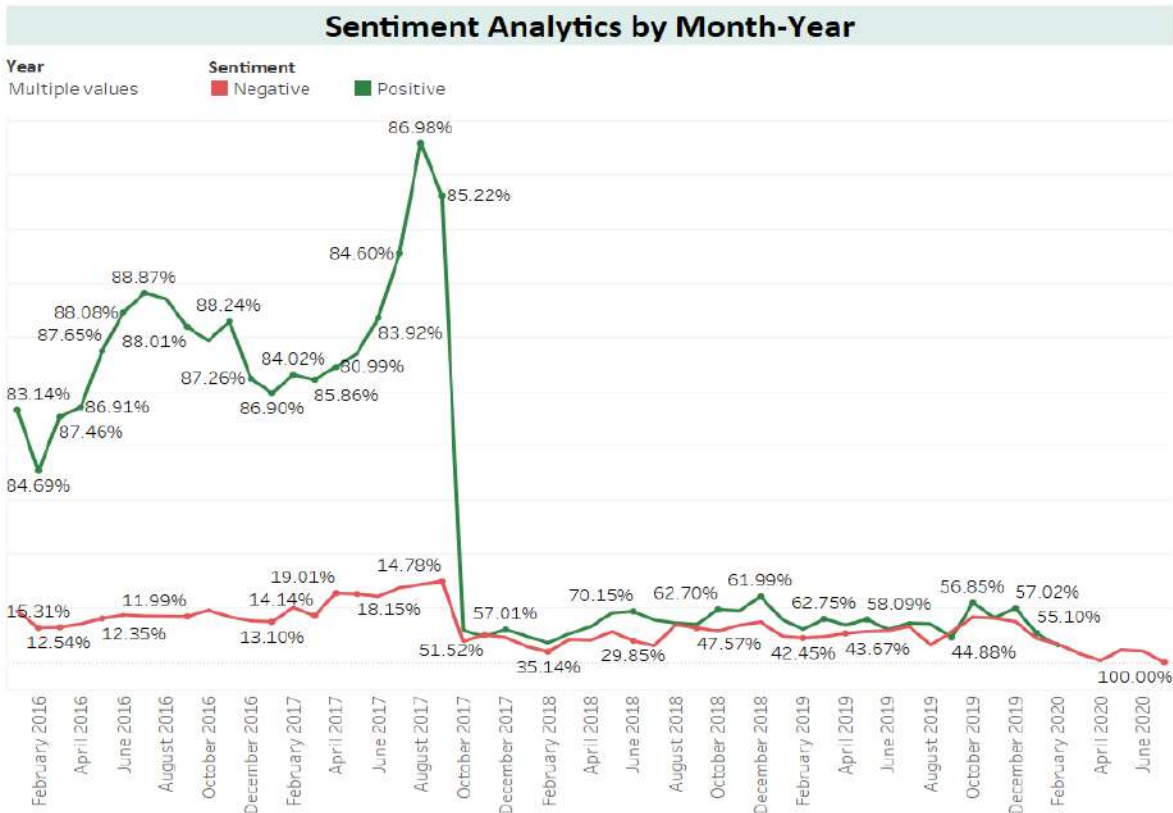
Figure 4

Vietnamese Word Cloud by Positive and Negative

Source: Authors' work

Result of training and evaluating model over time

Figure 5
Sentiment Analysis by Month-year

Source: Authors' work

The research has conducted experiments on the dataset for the SVM method combining the time factor. The results are shown in Figure 5; the Sentiment by Month-

Year chart shows the percentage of positive and negative comments over time. For example, in February 2016, the rate of positive comments was 83.14%, and the negative comments rate was 16.31%; in September 2016, the rate of positive comments was 88.01%, and the negative comments rate was 11.99%. This dashboard lets managers capture customers' emotions very promptly and quickly. This makes a lot of sense in business and management.

Figure 6 below is the accuracy result from 2015-2020 of the SVM method. The chart is the experimental results of the SVM method for the dataset grouped by year. Including 6 datasets (2015, 2016, 2017, 2018, 2019, and 2020). The SVM accuracy for the 2015 dataset was 89%, 2016 was 92%, and 2020 it was 92%.

Figure 6
SVM's Accuracy by year (2015-2020)
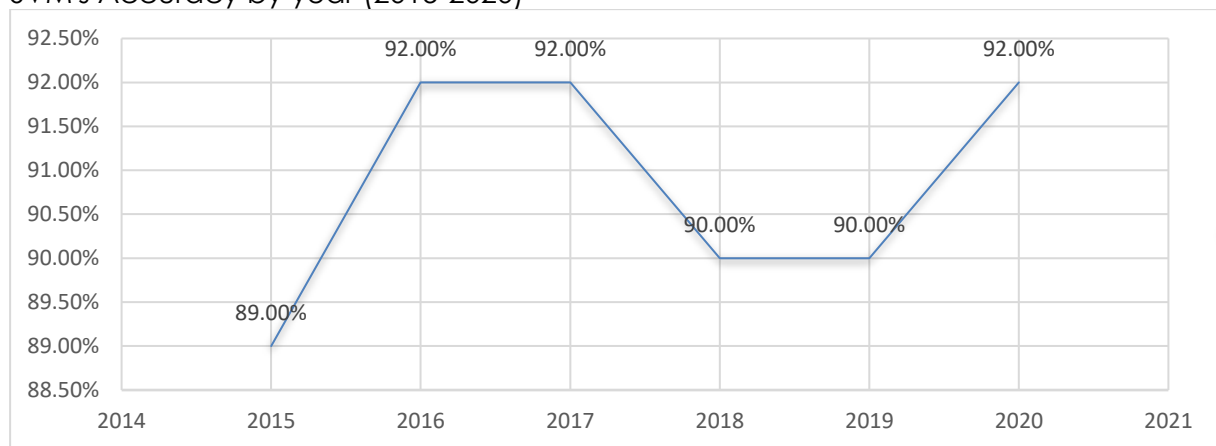
Source: Authors' work

Conclusion

In this paper, the research experimented, compared, and selected suitable machine learning methods to analyze and classify sentiment based on customers' opinions. The applications of the opinion categorization depend on the field, the analysis model, and the source of the collected data. In this research, we have proposed an application solution in natural language analysis, namely, customer sentiment analysis based on comments posted on foody.vn and diadiemanuong.com websites. The solution is tested on many different machine learning methods to compare the pros and cons of the model and select the best model through F1-Score measurement. The research results implemented on the corpus from 2011 to 2020 show that the SVM algorithm has the highest Accuracy with 91,5%. Especially creating visual reports, the analysis combined with the time factor to serve the decision-making needs of businesses. Solving the data explosion problem is to provide customer experience information in locations. The research provides a fundamental architecture in exploiting customer opinions from text data in Vietnamese on social networks, creating the basis for further research in exploiting Big Data in each industry field, creating value for business and consumers. In addition, the research results also significantly contribute to the practical application of social network data mining in the process of understanding users' needs, thereby making appropriate business decisions and management of an enterprise. At the same time, the results also open the application direction for regulators in gathering people's comments on drafts and management policies before being promulgated through social networks. The food and beverage sector will have strategies to develop better services and products to attract better and retain customers. In addition, the

research will be the premise for data analysis applications, using this solution to integrate into applications with the purpose of surveying customer experience feelings for all products and services, especially applying in Vietnamese language processing.

We will expand by installing the system to automatically update data in further research. Data will be automatically extracted from the website and remove duplicate entries before saving to the database. Collect more data from multiple sources and develop research towards big data analysis. The application of analyzing customer opinion reports on the website, especially on mobile devices, helps enterprises more convenient in viewing reports and making better decisions.

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Notes to the Financial Statements: Current State and Improvement

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Abstract

Background: Prior studies have revealed a disclosure problem in financial statements, primarily in narrative reports. Three main problem areas have been identified: insufficient relevant information, too much irrelevant information, and low-level communication. Micro and small entities face the most difficulties. **Objectives:** The main objective of this research is to propose a solution to existing disclosure problems to contribute towards improving the quality of financial reporting of smaller entities. **Methods/Approach:** To improve the reporting model for smaller entities, a survey has been conducted using a structured questionnaire on a sample of non-financial entities registered in Croatia. Based on results interpretations, standardized notes have been proposed. **Results:** 167 respondents have shared their thoughts about current disclosure issues and possible improvements, showing their awareness of disclosure problems and willingness for change. Given their opinions, the proposal has been made. **Conclusions:** The main contribution of the paper is the creation of a proposal for standardized, integrated, and digitalized notes to the financial statements based on the principle of materiality, primarily addressed to micro but also small entities from the non-financial sector. The paper extends previous proposals which did not focus on their structure and digitalization.

Keywords: disclosure problems; financial statements; notes; micro and small entities; standardization; integration; digitalization; the principle of materiality
JEL classification: D22; M19; M41
Paper type: Research article

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Introduction

Financial statements could be defined as partially standardized reports showing a picture of an entity's financial position and business performance. While a balance sheet and income statement commonly have prescribed structure according to the national regulations, notes to the financial statements are usually a non-standardized report. The notes should comprise a summary of significant accounting policies as well as material (significant) information in addition to the positions (items) presented in other financial statements (Commission Regulation (EC), 2008; Financial Reporting Standards Board, 2021; International Accounting Standards Board, 2018). Each accounting standard contains a part of disclosure requirements, which indicates additional information that should be disclosed in the notes if such information is material and not disclosed in other financial statements. According to Garvey et al. (2021), the conceptual framework of International Financial Reporting Standards (IFRS) is based on principles, not on strict rules, meaning that preparers should consider them by making professional judgments to ensure accurate and fair financial statements, but some approach them as if they were applying a rules-based approach. IRFS and national standards of the European Union member states are principle-based standards meaning that financial statement preparers should use the principle of materiality, among others, when disclosing information. The problem of readability and understandability and the choice between disclosure in the notes and disclosure elsewhere was noticed by Parker (1996), who explored the harmonization of the notes in the UK and France. The current practice shows several problems in financial reporting regarding disclosures in the notes. The International Accounting Standards Board (IASB) recognized the problems in financial reporting on the international level back in 2011 when initiated the project Conceptual Framework, which was intended, *inter alia*, to define and clarify the concept of materiality (International Accounting Standards Board, 2013).

In early 2013, the IASB organized the Discussion Forum on financial reporting disclosure attended by various financial statement users, preparers, standard-setters, auditors, regulators, and representatives from prominent organizations already undertaking work in this area. These organizations were The European Financial Reporting Advisory Group, European Securities Markets Authority, US Financial Accounting Standards Board, International Auditing and Assurance Standards Board, The Institute of Chartered Accountants of Scotland, New Zealand Institute of Chartered Accountants (International Accounting Standards Board, 2013). Before the Forum itself, the IASB launched a study on published information in financial reports, which was aimed at international preparers, investors, analysts, and other primary users, to gain an insight into the disclosure problems the real stakeholders face. The main survey results were as follows: (i) over 80% of the respondents emphasised that there is a problem in disclosed information; (ii) over 40% of the respondents agreed and strongly agreed that there is not enough relevant information; (iii) over 60% of the respondents agreed and strongly agreed that there is too much irrelevant information; and (iv) over 50% of the respondents agreed and strongly agreed that there is poor communication (International Accounting Standards Board, 2013).

Since the disclosure problems have already evolved, the IASB realized that a comprehensive project must be launched. In that context, the IASB launched the main project Disclosure Initiative as a part of the general initiative Better Communication in Financial Reporting. Even though the IFRSs are mainly used by larger entities and the IABS's research is mainly focused on the annual report, it is justified to rely on their research as both reports (annual report and notes) are narrative and small entities certainly do not pay more attention to reporting than large ones

(according to which it can be concluded that the same relations apply to notes as to the annual report, e.g., when it comes to quality of reporting).

Unfortunately, even though the IASB finished six out of twelve projects from the Better Communication in Financial Reporting initiative in eight years, the desired result has not been achieved. The disclosure problem is still present and poses a challenge to the accounting standard setters at the national and international levels (Elkins et al., 2018; Hellman et al., 2018; Abad et al., 2020).

Gordon (2019) also points out that one of the accounting topics that can contribute is "research to inform standard-setters". This is precisely the aim of this paper – to propose a solution for the existing disclosure problem to improve the quality of financial reporting. In that context, while the IASB deals with reporting of larger entities applying the IFRSs, the target group of this research refers to smaller entities, i.e., micro and small ones. These two categories account for approximately 95% to 99% of all entities in most economies. The European Parliament and the Council issued the Directive 2013/34/EU, which simplifies the financial reporting of micro-entities. Those simplifications should be transposed into national legislation to be applicable for micro-entities. According to the research taken before the transposition of the Directive 2013/34/EU into the Croatian Accounting act, more than 80% of 535 respondents (subscribers and business partners of Croatian Association of Accountants and Financial Experts) consider that simplification of accounting regulation for micro-entities is necessary (Ptiček et al., 2015).

The research aims to investigate the attitudes of the entrepreneurs, accountants, and managers on simplifying financial reporting for micro-entities because micro-entities had the same obligation regarding financial reporting as small entities, even after transposing some provisions from the Directive. The research was carried out using survey research on a sample of all businesses from the non-financial sector in Croatia. The author uses random sampling with estimation reliability of 99% and a relative estimation error of 2.5%. Based on research results, a proposal for standardization of notes to the financial statements for smaller entities has been structured.

The paper's main contribution lies in the proposed standardized and integrated notes to the financial statements primarily addressed to micro-entities from the non-financial sector. The standardized notes overcome the proposals for simplification made by Ptiček et al. (2015), Žager et al. (2015), and Pavić et al. (2017). Specifically, standardized notes should have interactive content that would lead to each note. The first part of notes should include general information of an entity, which should be linked to the websites (e.g., the official entity website, the entity site at the court register, applicable laws referred to in the notes, applicable accounting standards) and a brief description of the main business activities. To avoid repetitive disclosures of accounting policies and estimates, in the first part of notes and later with financial data, they should be published only once, along with financial data. Accordingly, the second part should summarise all significant financial statements items, correlating accounting policies, estimates, and analytical representations. Using tables, charts, and figures would significantly improve the graphic design of the notes themselves. Highlighting text, e.g., different colors, would make it easier to navigate and search for critical information. All of that should be automated either using Excel sheets or a specialized application.

The final part would comprise additional clarifications, if applicable. Each entity would have an option to choose which case is applicable for them, and each chosen case would be disclosed in the notes. By choosing a case, one would have to write the corresponding amount.

The structure of this paper is as follows. From the respondents ' standpoint, the central part refers to the research regarding the disclosure problems and possible ways of simplifying notes to the financial statements. After the introduction comes the review of the disclosure problems recognized in practice. After the detailed review of disclosure problems, the causes of disclosure problems are discussed briefly. A final proposal before the overall conclusion presents the preparation of standardized and integrated notes to the financial statements primarily intended for micro-entities.

Disclosure in financial reports

There is no doubt that there is a disclosure problem in financial reporting internationally. More than 80% of the respondents to the IABS survey (International Accounting Standards Board, 2013) prove that, as well as the whole set of projects that have been taken by the IASB and eminent international accounting and finance professional organizations under the main initiative Better Communication in Financial Reporting. It is necessary to elaborate on the disclosure problem in detail to find a solution to adequate problem-solving. According to Damodaran (2006), an information disclosure problem "can be created either by the absence of relevant information or the presence of extraneous information".

Disclosure of irrelevant information in financial reports

Irrelevant information is information that does not give new knowledge to its users. When it comes to financial reporting, such information may be the one that is already disclosed in another financial statement, repetitive information in the same statement, or one which is generally known among financial statement users. Neither the repetitive nor generally known information has value for users. Moreover, it is difficult to find relevant information among a significant amount of irrelevant information published. "Management needs to avoid excessive disclosures which could impair competitiveness" (Fung, 2014). According to the IASB survey, over 60% of respondents, among which the most significant share relates to preparers of financial statements, agreed and strongly agreed that there is too much irrelevant information in the financial reports (International Accounting Standards Board, 2013). One might say that a good thing in such a situation is that those who prepare these reports are aware of the existing problem, and the worst scenario would be if they were not aware of the problem.

Disclosure of irrelevant information leads to information overload. Frequent amendments to legal regulations and accounting standards impose many requirements on business entities. To meet all the requirements, entities disclose more and more information in their reports. For instance, the length of the annual report in the United Kingdom increased from 26 pages in 1965 to 75 pages in 2004 (Beattie et al., 2008), while Deloitte UK (2017) reported that the average length in 2016 was 155 pages which makes an increase by six times in 50 years period. However, it is questionable whether the quality increased proportionally. In this regard, Ong et al. (2020) conclude that "policymakers or regulators may consider implementing minimum requirements to reduce the information gap between informed and uninformed investors". The exact parallel could be drawn regarding the notes to the financial statements even though they stand as separate financial statement that is obligatory for all entities regardless of their size. At the same time, the annual report is not prescribed for smaller entities to be prepared.

"Problems in searching and locating information are exacerbated to the extent that individual users have only limited time to absorb information for any given

company" (Barker et al., 2013). In addition, "more disclosures in annual reports may increase the cost of preparing the annual report as well as confuse the investors and eventually affect their investment decision" (Ong et al., 2020).

Lack of relevant information in financial reports

Relevant information is information that has value for its users. Such information is accurate, precise, non-bias, timely, reliable, faithfully presented, comparable, and material (significant). When it comes to accounting standards, they do not directly state which information has to be presented in the notes but that the elementary qualitative characteristics that should be considered are relevance and faithful representation, which means that material (significant) information should be described in more detail. The Conceptual Framework for Financial Reporting (IFRS Foundation, 2021) defines material information as information which "omitting, misstating or obscuring could reasonably be expected to influence decisions that the primary users of general purpose financial reports make based on those reports, which provide financial information about a specific reporting entity". Proper use of the materiality principle requires professional accounting judgments when evaluating which information should be presented in the notes. The IASB survey results point out that there is not enough relevant information disclosed in financial reports (International Accounting Standards Board, 2013). Information overload is more often positively correlated with irrelevant disclosures than relevant ones. In line with that, more comprehensive reports do not always present more relevant information but more often irrelevant and immaterial information. Accordingly, increasing reports length also increased the share of irrelevant information, while the relevant information is hidden or not disclosed.

Many studies tested a relationship between disclosure quality and various entities' characteristics. Most of them positively correlated with disclosure quality and entity size (Mošnja-Škare et al., 2013; Galant et al., 2017; Khan et al., 2018). It has to be emphasized that studies regarding the measurement of disclosure quality differ from various aspects; measurement methods, independent variables, list of items comprising a disclosure index, statistical methods, etc. This does not necessarily decrease their importance and contribution, but researchers must be careful when interpreting their results. In that context, Mošnja-Škare et al. (2013) evaluated the quality of notes to the financial statements upon revenues and expenditure of small and medium-sized entities by assigning grades from 1 to 5. The results showed that 53.1% of small entities have low-quality notes instead of only 9.8% of medium-sized entities.

It is well known that only financial reporting is not sufficient nowadays, but should be enriched by non-financial information that may be disclosed in the notes, annual report, management report, or separate non-financial report. Galant et al. (2017) investigated whether the entity size, among other variables, impacts the voluntary preparation of the non-financial report. As expected, the hypothesis was accepted. Research on non-mandatory disclosure of accounting ratios was taken by Haddad et al. (2020) and proved that the entity size is positively correlated with the disclosure of the ratios. Analyzing the overall sample, only 35% of entities disclosed at least one accounting ratio. Even though neither the non-financial information nor accounting ratios are mandatory to disclose according to the accounting standards, they may be important for stakeholders if they are relevant.

Poor communication in financial reports

Financial and non-financial information should be transparently disclosed in the entity's reports since these reports are the primary communication tool used by stakeholders. Unfortunately, it is not uncommon that communication in these reports is poor and at a low level. Based on received responses from the IASB survey, "in terms of poor communication, many respondents cited internal inconsistency and lack of links and signposting throughout the entire annual report as key problems. For example, segment disclosures are not always consistent with information provided elsewhere" (International Accounting Standards Board, 2013).

When it comes to the notes to financial statements or annual reports, these reports are mainly prepared manually, which causes mistakes (e.g., outdated data, information from the previous year, different values among reports). These mistakes are seen as inconsistencies by users and cause a waste of their time to find accurate information. Besides inconsistencies between financial statements, there are also notes that miss filling a cell in the template prepared for more entities or forget to change some legal information regarding the entity. Nowadays, annual reports are pretty structured compared with those from several years ago, but notes to the financial statements are still unstructured. The reason lies in the entity that prepares them (large ones are aware of the importance of transparent and relevant reporting, while smaller ones usually do not care about reporting as they should). The unstructured notes do not contain the content of the notes, links, or signposting, which causes difficulties in navigating the report itself. Thus, some information is disclosed twice, while others are not disclosed at all. The most common situation is that the notes do not provide information other than those already disclosed in the balance sheet and income statement for micro and small entities. Such notes are prepared only to meet legal obligations, and they are not relevant to anyone, which is the basis of the need for their standardization.

Source of the existing disclosure problems

To find appropriate solutions to improve the disclosure of information in the financial statements, it is necessary to identify the reasons for the disclosure problem. The general reasons for disclosure problems are a lack of time, financial resources, and human resources (i.e., professional staff). Furthermore, Damodaran (2006) emphasizes that lax regulatory requirements in many emerging markets cause incomplete financial statements and, thus, non-disclosure of relevant information. Contrary to that, too much regulation can cause information overload, increasing costs related to financial reporting. According to Farvaque et al. (2011), disclosure rules should differ for companies that differ in size since inappropriate disclosure rules decrease fair competition. Depending on the size of the entity, these reasons have different weights. Micro and small entities lack the most in terms of financial resources and professional staff. Accounting services are usually outsourced and entrusted to external accountants. Micro and small entities usually do not value accounting services sufficiently because, in most cases, they perceive only costs for accounting services since they do not understand accounting and cannot, and even do not want, use its outputs in terms of analysis and planning future operations and business. On the other hand, external accountants struggle with time as they have to have more clients due to the low prices of accounting services, leading to a lack of time to devote to an individual approach to compiling their clients' financial statements. In addition, communication between the external accountant and the entity is necessary for financial statements, particularly the notes to be prepared following the disclosure requirements, based on the principle of materiality.

Although the structure of notes in the Republic of Croatia is not prescribed, continuous development and improvement of technology led to the development of the accounting information systems that automatically prepare notes to the financial statements based on data from other financial statements. In this way, external accountants are entirely relieved of the burden of compiling the notes. Almost by one click, can prepare the notes and other primary financial statements that structure is prescribed. A formal obligation to compile notes to the financial statements is met, but, in such cases, all entities whose notes are generated from the same accounting information system have almost the same disclosures in their notes, which differ only in quantitative data. Such notes contain more irrelevant than relevant data and information, and their purpose, to disclose entity-specific information, is completely lost, notwithstanding the formal obligation is met.

Summarising the above, it can be concluded that, generally, smaller entities prepare financial statements mainly because they require regulatory authorities and do not use professional judgments related to the principle of materiality. Farvaque et al. (2011) agree with this and add that mandatory disclosure does not necessarily require disclosing useful information to third parties. The main reason for too much irrelevant information, not enough relevant information, and poor communication through narrative financial statements is the non-application of the principle of materiality. Non-using professional judgment leads to non-appropriate disclosures.

Methodology

Data

To improve published information in the notes to financial statements, stakeholders' opinion is considered significant input. Research on applying the materiality principle when compiling annual financial statements on a sample of Croatian entities operating in the non-financial sector was conducted. A population consisted of all entities from the non-financial sector registered in Croatia in 2017 who submitted the annual financial statements for the financial year of 2017, a total of 120,081 entities. The research sample was calculated with an estimation reliability of 99% and a relative estimation error of 2.5%. The final sample comprised 5,942 randomly chosen entities and was calculated assuming that each category (micro, small, medium-sized, and large) makes up one separate population to get a more significant sample. The initial sample size for each category of entities was calculated using the formula 1. In addition, a correction of the initial sample size was performed, after which the final sample size of each of the four categories of entities was obtained.

$$n_i = \frac{z^2 \cdot p \cdot (1-p)}{c^2} \tag{1}$$

$$n_k = \frac{n_i}{1 + \frac{n_i - 1}{N}} \tag{2}$$

where: n_i = initial sample size, z = reliability coefficient with a given confidence level (2.58 for a confidence level of 99%), $p \cdot (1 - p)$ = population variance (if population variance is unknown, p = 0.5), c = estimation error expressed relatively, n_k = final sample size after initial size correction performed for final populations, N = population size.

The data were collected from May 2019 to August 2019 since the research was conducted for a doctoral dissertation (Rep, 2020). The primary questionnaire was submitted by 699 respondents (entrepreneurs, accountants, and managers) (return rate of 11.76%). In contrast, the second one, which is analyzed in this paper, submitted

167 respondents (return rate of 23.89% based on the respondents who filled the first questionnaire). 25.15% of the respondents come from micro-entities, 40.72% from small entities, and others from medium-sized and large entities. Since the categorization of micro-entities was introduced in the Croatian Accounting act in 2015, a part of small entities may belong to the group of micro-entities according to the provisions of the Accounting Act. Even though the focus is on improving the notes of the micro and small entities, responses of medium-sized and large entities were considered and analyzed to gain insight into their opinion on the standardization of notes. 53.89% of respondents perform the function of an accountant, and another 12.58% perform other functions in the entity in addition to accounting. The high share of accountants who completed the questionnaire shows their interest in changing the current financial reporting model, emphasizing the notes to the financial statements. The largest share of respondents, 55.09%, have more than 15 years of experience in accounting.

Research Instrument

The research was conducted using a survey method by sending a questionnaire to the entities. In addition to the primary questionnaire, a second one was available for filling after submitting the primary questionnaire. The questionnaire was divided into three parts. The first part referred to the respondents' demographic characteristics, and the second comprised the assertions related to the current model of the notes. The last one comprised the assertions related to improving the current model of the notes. The received questionnaires were analyzed to determine the current state and possible changes in the notes. Two questions were posed to the research participants: (i) attitudes about the existing model of notes to the financial statements; (ii) selection of the possible improvement of the existing model of compiling notes to the financial statements.

Results

Attitudes about the existing model

The respondents were asked to express their opinions on the five Likert scale. According to Table 1, it can be noticed that the respondents are aware that notes to the financial statements contain irrelevant information and that they tend to change the way the notes are compiled. 74.25% of the respondents completely or mostly agree with the assertion that information required by accounting standards is published in the notes regardless of its materiality (significance) (E1). Accordingly, managers do not assess the materiality of information following all principles for conducting professional accounting judgments. This leads to the conclusion that managers support disclosing most of the information under accounting standards' disclosure requirements. 70.66% of the respondents completely or mostly agree that changes in accounting estimates are often not disclosed in the notes and comparative data before these changes (E2).

On the other hand, accounting standards require disclosures in the notes if there is a change in accounting policies and estimates since such disclosures are relevant information for users. 74.85% of the respondents completely or mostly agree with the assertion that notes often do not contain additional data but only those that are already available in other financial statements (E3). Repetition of data and information presented in other financial statements leads to irrelevant disclosures and information overload without more detailed and analytical data. 68.26% of the respondents completely or mostly agree that the notes contain definitions of basic accounting categories (E4). Definitions of accounting categories are written in

accounting standards and should be known to stakeholders who read the financial statements. The purpose of notes is not to define accounting categories, and such definitions are irrelevant information in the notes. Finally, 80.84% of the respondents completely or mostly agree that the standardization of notes in a table would increase the relevance of published information (E5). This leads to the conclusion that the standardization of notes is a preferable way of simplifying the financial reporting model for primarily micro and small entities, which should enhance the quality and comparability of notes to the financial statements between these entities and between reporting periods of each entity. Cronbach's alpha was calculated to evaluate the reliability of the research items E1 to E5 and their consistency. Its value of 0,913 confirms that items in the research instrument are consistent and reliable. In other words, it is justifiable to use the average value of the research items (E_sum).

Table 1
Descriptive statistics at the attitudes about the existing model of notes to the financial statements

	Mean	St. Dev.	Cronbach's alpha
E1. Nowadays, information required by accounting standards is published in the notes regardless of its materiality (significance).	3,74	0,96	0,913
E2. Changes in accounting estimates are often not disclosed in the notes and comparative data before these changes.	3,75	0,93	
E3. Notes often do not contain additional data but only those already available in other financial statements.	3,89	1,03	
E4. Notes contain definitions of basic accounting categories, which is not their purpose.	3,86	1,09	
E5. Standardization of notes in the form of a table would increase the relevance of published information.	4,08	1,15	
E_sum. All statements together (average E1-E5)	3,86	0,89	

Source: According to Rep, 2020, p. 282

Table 2 compares the various groups of companies and respondents according to their characteristics. For example, the average value of the variable E_sum for the not accountants respondents is 3.7379. In contrast, the accountants overall gave higher grades to responses E1-E5, which resulted in the higher value of the variable E_sum. Statistically, significant differences emerge for the following variables: owner, micro size of the company, and the respondent with experience in accounting over 15 years.

Table 2
T-test analysis of the summary variable of the attitudes about the existing model of notes to the financial statements (E_sum) and the characteristics of the company and the respondent

Variable	No	Yes	T-test	P-value
Accountant	3.7379	3.9321	-1.342	0.182
Owner	3.9607	3.6044	2.318	0.022**
Manager	3.8679	3.8590	0.062	0.951
Micro	3.9545	3.6136	2.199	0.029**
Small	3.8059	3.9545	-1.094	0.294
Medium	3.8333	3.9610	-0.794	0.428
Large	3.8662	3.8500	0.0690	0.945
Experience	3.2267	3.9276	-2.969	0.003

*Note: ** Statistically significant at 5%; *** 1%*
Source: Author's work

Possible improvement of the existing model

Respondents were asked to select assertions on improving the existing model of compiling notes to the financial statements to which they agree. Percentages of their responses by assertions are given in table 3, and the full text of assertions is provided in Appendix 1.

Table 3
Percentage of respondents who selected the assertions on the improvement of the existing model of compiling notes to the financial statements

Assertions	% of respondents
A1	70.1%
A2	52.1%
A3	58.7%
A4	67.1%
A5	76.6%
A6	50.9%
A7	70.1%
A8	36.5%
A9	43.7%
A10	50.9%
A11	40.1%
A12	53.3%
A13	74.3%
A14	37.7%
A15	53.9%

Source: According to Rep, 2020, pp. 280-281

Figure 1
Comparison of the respondents who selected the assertions on the improvement of the existing model of compiling notes to the financial statements
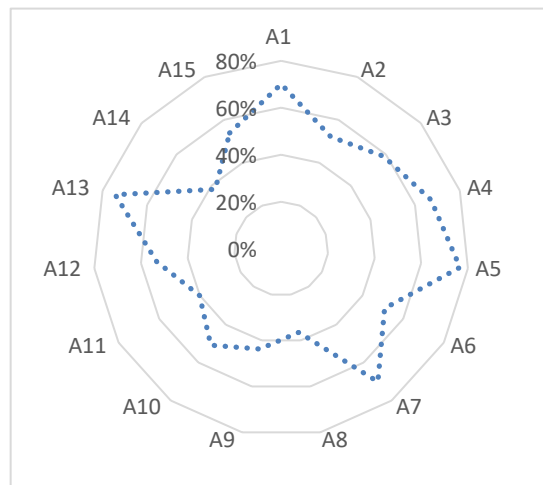
Less than 50% of the respondents agreed with only four assertions. Respondents are unwilling to disclose information about non-current assets whose bookkeeping value is zero, even though the entity still uses these assets. They primarily do not support the disclosure of additional information in the notes or the inclusion of graphs, tables, or charts. Accordingly, it can be concluded that they do not prefer disclosure in addition to the standards' minimum requests. Thus, 43.71% of the respondents think that significant inventory differences should not be disclosed. Since these differences are not presented directly in other reports, disclosing them in the notes is essential. 50.9% of the respondents think that the accounting policies and estimates do not need to be used in entities that apply legal regulations.

Contrary to that, the application of tax regulation does not exclude accounting judgments or, in other words, accounting policies and estimates prescribed by accounting standards. Accounting and tax treatment may differ, but most entities apply provisions prescribed by tax law, and by doing so, do not make accurate estimates covered by accounting standards. That makes business operations and decisions easier, but such financial statements do not present the actual situation of the business.

Agreement with the remaining assertions by most respondents supports awareness of the need to change the financial reporting model, with an emphasis on the notes. Between 50% and 60% of the respondents agree with four assertions. They agree that

it is necessary to explain the positions, such as other business income, other business expenses, etc., if such amounts are significant. Respondents know that it is unnecessary to define accounting categories in the notes since they are already defined in accounting standards. Such disclosures have a significant share in irrelevant information disclosed nowadays. Surprisingly, only 53.9% of them support the further development of digital accounting data processing and financial reporting processes. The cause for such a result could be that further digitalization could make it more difficult and require additional education to process data and create financial reports.

Contrary to that, systematization, integration, and standardization of the notes should simplify the reporting process. To support that initiative, 58.68% of the respondents agree that there is a need to integrate notes with other financial statements in accounting information systems with the possibility of adding specific information for each entity, while 52.1% support integration of all the financial statements in an integrated report to avoid disclosure of the same information in different statements. It is not enough that the notes contain only information already published in other financial statements since accounting policies and estimates should be specific for each entity. That could be reached by standardizing the notes that will disclose only essential and relevant information for each entity. So, the control mechanisms must be included in the compilation of the notes, and that is not the case in existing automated notes.

It does not surprise that 67.07% of the respondents think that the notes should be exempted for micro-entities since their preparation costs exceed their benefits. Their standardization and free-of-charge usage could reverse that relation. 70.06% of the respondents welcome the standardization by confirming that there is a need to define standardized notes for micro and small entities in cooperation with banks, financial and other institutions to relieve these entities of administrative costs and to make the annual financial statements compatible with those requested by banks and other institutions. The same share of the respondents agrees that changes in accounting policies and/or estimates should be disclosed in the notes. Today, no accounting software automatically discloses such changes.

74.25% of the respondents know that disclosing items that the entity does not own is irrelevant since it is readable from other statements. Such notes are massive today and have the largest share in irrelevant disclosures of entities that use existing software for notes compilation. Finally, it is encouraging that the largest share of the respondents who agreed by given assertions think that the principle of materiality should be used in financial reporting to make notes of better quality, rather than disclosing everything stated in accounting standards.

Link analysis of the experience in accounting and the proposed assertions

Link analysis has been conducted to examine the relationship between the proposed assertions and the experience in accounting.

The association rules have been developed using the selected metrics (minimum support value of 0.5, minimum confidence value of 0.5, and the maximum number of items in an item set of 3) (according to Pejić Bach et al., 2020).

Figure 2 presents a Web graph of items generated by link analysis. "Node size indicates relative support for each item, line thickness relative joint support of two items, and color darkness of line a relative lift of two items" (Pejić Bach et al., 2020). It can be noticed that the most critical nodes are related to the experience and the following assertions: A5, A13, A1, A7, A4, and A3. The most vital joint support is for the

same claims, which are the most important. As anticipated, the strength of the relationship between the experience and A13 is presented by the darkest line.

Figure 3 presents a rule graph of items generated by link analysis. "Node size presents relative support of each item, and colors darkness relative confidence" (Pejić Bach et al., 2020). The rule with the highest support is the relationship between the experience and assertion A5, while the relationship between the experience and assertion A7 stands for the highest relative confidence. It can be observed that the rules that contain the item experience are presented with big node sizes, while smaller node sizes exist between the assertions that have been observed as the most important based on the size of the nodes in Figure 2.

Figure 2
Web graph of items generated by link analysis
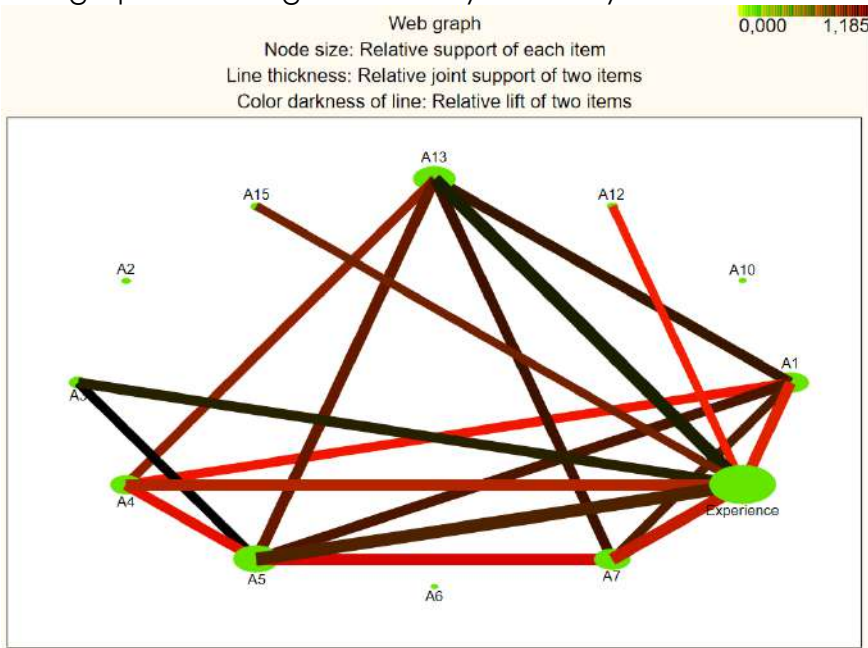
Source: Author's work, based on the internal data source

Figure 3
Rule graph of items generated by link analysis
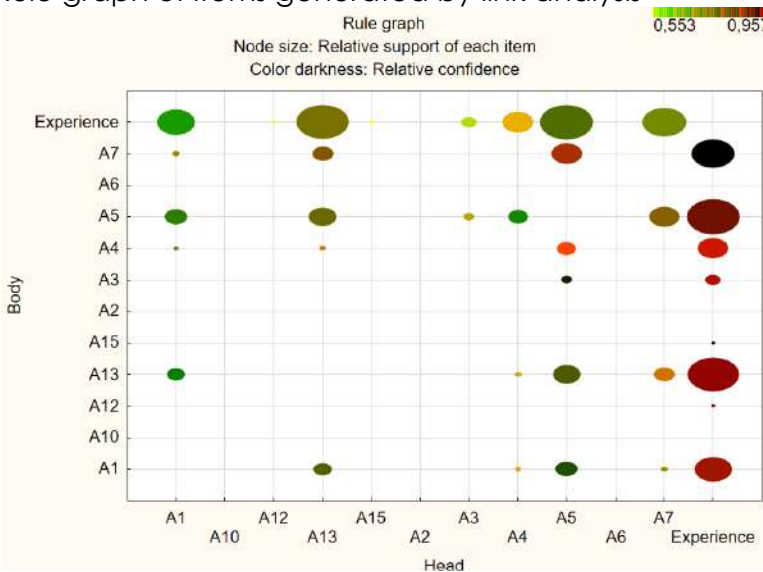
Source: Author's work, based on the internal data source

Table 4 presents association rules with the item Experience in the Body. The first rule shows that 64.67% of all respondents have experience in accounting and agree with assertion A1 (that there is a need to define standardized notes for micro and small entities in cooperation with relevant institutions). On top of that, 71.05% of respondents experienced in accounting agree with assertion A1. The second role shows that 53.89% of all respondents have experience in accounting and agree with assertions A1 and A5 (that the principle of materiality should be used in financial reporting). Additionally, 59.21% of respondents experienced in accounting agree with these two assertions. The remaining roles follow the same pattern. Accordingly, it can be concluded that respondents with experience in accounting agree in a higher percentage with the essential assertions from Figure 2 compared to all respondents (those who have and those who have no experience in accounting). This means that accountants, managers, and owners who have experience in accounting recognize the importance of notes improvement in the form of standardization more than those who have no experience in accounting.

Table 4
Frequent association rules with the item Experience in the Body

Body	==>	Head	Support(%)	Confidence(%)	Lift
Experience	==>	A1	64,67	71,05	1,01
Experience	==>	A1, A5	53,89	59,21	1,02
Experience	==>	A1, A13	53,29	58,55	1,04
Experience	==>	A12	50,30	55,26	1,04
Experience	==>	A13	70,66	77,63	1,05
Experience	==>	A13, A7	55,09	60,53	1,05
Experience	==>	A13, A5	56,89	62,50	1,03
Experience	==>	A15	50,30	55,26	1,03
Experience	==>	A3	55,09	60,53	1,03
Experience	==>	A3, A5	50,30	55,26	1,04
Experience	==>	A4	61,68	67,76	1,01
Experience	==>	A4, A5	52,69	57,89	1,02
Experience	==>	A5	71,26	78,29	1,02
Experience	==>	A5, A7	58,68	64,47	1,05
Experience	==>	A7	67,07	73,68	1,05

Source: Author's work

Proposed structure of standardized notes

Control mechanisms should enable the disclosure of only relevant information in fully standardized, integrated, and digitalized notes. More than 70% of respondents agree that there is a need to define standardized notes for micro and small entities. Guidelines for notes standardization have been proposed to improve the financial reporting model of primarily micro and small entities. The proposed model follows Croatian Financial Reporting Standards (CFRS), emphasizing their (materiality) significance. Generally, the requirements are of reduced volume and are applicable for the financial year starting from January 1, 2021, or later. First notes according to the simplified disclosure requirements are expected in the first half of 2022. It is important to note that disclosure requirements of the CFRSs changed for micro and small entities from the conducted research. Even though the requirements are reduced, micro and small entities still have to disclose information which makes most problems up to date. In this regard, Damodaran (2006) thinks that firms should avoid unnecessary complexity and that new legislation or more accounting rules should not be ensured

since they have unintended side consequences. Following this approach, standardized notes for micro and small entities should be automated, integrated with other financial statements (58.7% of respondents support integration), and free of charge (like other annual financial statements templates prescribed in Croatia).

When proposing a model, it is essential to determine the measurement of the information's significance. Thus, respondents showed awareness that the principle of materiality should be used in financial reporting. For example, it could be required that all information related to financial statement items that account for more than 10% of its parent category have to be disclosed and described in the notes. In this way, items that need to be further explained would be published in prescribed notes and present an individual case for each entity, which would avoid irrelevant disclosures. Such compilation of notes is possible if they are linked to the forms of already prescribed annual financial statements, i.e., the balance sheet and income statement. To relieve micro and small entities of administrative costs associated with compiling a set of financial statements, a practical proposal for standardizing notes to the financial statements is given below. The proposed structure of notes to the financial statements for primarily micro and small entities, based on the respondents' and author's views, are presented in Table 5.

Table 5
Proposed structure of standardized notes to the financial statements for primarily micro but also small entities

Notes to the financial statements of entity XY
Interactive content
General information of an entity with redirecting links incorporated in the text
Significant financial statements' items, correlating accounting policies and estimates, and their analytical representations (using tables, charts, and images where appropriate as well as different color text)
Additional clarifications referring to the CFRS's requirements
The decision on the distribution of profits or coverage of losses and the decision on the adoption of the annual financial statements

Source: Author's work

Standardized notes should have interactive content that would lead to each note. Using such content, users of financial statements would follow the notes more easily. The first part of the notes would include general information about an entity. Still, it would also be linked to the essential websites such as the official entity website, the entity site at the court register, applicable laws referred to in the notes, applicable accounting standards, etc. Such links would simplify readability and comparisons. The first part should also include a brief description of the main business activities once recorded activities change only in their change, not necessarily every year.

It is common to disclose significant accounting policies and estimates in the second part of notes. Such policies and estimates are often disclosed twice in the specific note to which the policy or estimate refers. To avoid such repetitive disclosure, which leads to information overload, it is considered that it would be more transparent to publish information regarding accounting policies and estimates, as well as their changes, along with financial data, in other words, in the notes related to essential items of the financial statements. It is supported by more than 70% of respondents who agree that changes in accounting policies and/or estimates should be disclosed, but not twice. In addition, they are aware that assets that the company does not own should not be presented in the notes (74.3%), meaning only relevant and significant

items should be presented in detail (76.6%). Accordingly, the second part would summarise all significant financial statements, correlating accounting policies and estimates and their analytical representations. Using tables, charts, and figures would significantly improve the graphic design of the notes themselves, even though only 40% of respondents recognize their value. Highlighting text, e.g., different colors, would make navigating and searching for critical information easier. All of that would be automated using Excel sheets or a specialized application.

The final part would comprise additional clarifications, if applicable. Each entity would have an option to choose which case prescribed in CFRSs is applicable for them, and each chosen case would be disclosed in the notes. By choosing a case, one would have to write the corresponding amount. The cases refer, but are not limited, to financial liabilities, liabilities related to pensions and undertakings, advances and loans granted to management, long-term debts, entrepreneur's arrangements not included in the balance sheet, significant events that occurred after the balance sheet date, transactions with related parties. Even though the cases are extensive and complex, most micro-entities do not face such cases. Those who do face them should select a particular case and write its amount, including the possibility to describe each case in more detail. All the other requirements from the CFRSs should be disclosed in the second part of the notes where significant items from other financial statements are disclosed (e.g., all the required data about long-term assets such as purchase value, value adjustments, accumulated depreciation, carrying amount, etc.).

The decision on the distribution of profits or coverage of losses and the adoption of the annual financial statements would also be part of the third part of the notes. That would integrate the notes with these decisions and reduce the necessary attachments to the annual financial statements.

Conclusion

Micro and small entities make up the majority of every economy. To enable them to focus on their primary business, they have to be administratively relieved. One of the identified administrative burdens is compiling annual financial statements, particularly the notes to the financial statements, which compilation costs possibly overcome their benefits. The notes are unprescribed reports which should be of great importance for their users, but there is a problem with their relevance. International and national research (International Accounting Standards Board, 2013; Mošnja-Škare et al., 2013) showed too much irrelevant information, not enough relevant information, and that the communication is on a low level. The main reason why micro-entities compile the notes is to fulfill legal regulations. Unfortunately, such notes do not meet their purpose to give the users valuable information in addition to those presented in other financial statements. To make notes a valuable resource, the principle of materiality has to be applied. By standardizing the notes for micro and small entities, including the mechanisms of materiality principle, the notes could become a valuable statement and replace several other reports (e.g., for banks and other administrative requirements). This is in line with Hunady's et al.'s (2020) conclusion "that business investment in R&D is positively correlated with specific business performance indicators" since the notes' standardization requires R&D activities that could be derived on the national level and would impact all smaller entities. In addition, their standardization would simplify complex tasks, reduce litigation risk, and enhance professional legitimacy, which Madsen (2011) found to be positively and significantly correlated with standardization in accounting.

Conducted research showed that preparers and users of financial statements are aware of the existing disclosure problems and are willing to change notes compilation.

Since prescribing structured notes to the financial statements would refer to almost 99% of Croatian entities, it is necessary to include in this process representatives of the Croatian Financial Reporting Board, relevant professional accounting organizations operating in Croatia, representatives of the academic community in the field of accounting, and professional institutions who require specific information of micro and small entities (such as banks and other financial institutions, the Tax Administration, etc.) because only in this way all the information required from the entities could be included in the notes. Such notes could replace several reports and administratively and financially relieve entrepreneurs.

There is an awareness that the proposed model is not perfect and planned in full detail, but it is a good starting point that could be presented to authorities to boost their awareness and willingness for change. On the other hand, this study could be important for further research, both national and international. Further studies could consider including legal and professional representatives to examine their views regarding disclosure problems and their solving by introducing the structured and digitalized notes to the financial statements integrated with other reports.

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Appendix 1 - Full text of assertions

A1 – There is a need to define standardized notes for micro and small entities in cooperation with banks, financial and other institutions to relieve these entities of administrative costs and make the annual financial statements compatible with those requested by banks and other institutions.

A2 – There is a need to integrate all the financial statements in an integrated report to avoid disclosing the same information in different statements.

A3 – There is a need to integrate notes with other financial statements in accounting information systems with the possibility of adding specific information for each entity since it is not enough that the notes contain only information already published in other financial statements, and accounting policies and estimates should be specific and not the same for all entities (typical case in entities whose accounting is outsourced to bookkeeping services).

A4 – There is a need to abolish the obligation of a compilation of notes to the financial statements for micro-entities, which is allowed by Directive 2013/34/EU as they generate more costs than benefits for those entities.

A5 – The principle of materiality should be used in financial reporting to make better quality notes, rather than disclosing everything stated in accounting standards.

A6 – Accounting policies and estimates do not need to be used since an entity applies legal regulations (e.g., depreciation methods and rates).

A7 – If there is a change in accounting policies and/or estimates, these changes should be disclosed in the notes.

A8 – Purchase costs and accounting estimates used for non-current assets with a carrying amount of zero, which are still used by the entity, should be disclosed in the notes since these assets are not disclosed elsewhere.

A9 – Inventory differences should be disclosed in the notes if their value is significant.

A10 – It is necessary to explain the positions, such as other business income, other business expenses, etc., if the amounts are significant.

A11 – Graphs, tables, and charts increase the readability and understanding of notes and non-financial reports.

A12 – It is unnecessary to define accounting categories such as income, expenses, fixed and current assets, etc., in the notes since they are already defined in accounting standards.

A13 – It is unnecessary to describe in the notes those positions that value is 0.00 (which the entity does not own) and the corresponding tables or charts.

A14 – The notes should preferably disclose additional information that owners/managers consider essential (e.g., additional education, training, investment in information technology, community involvement, environmental policies).

A15 –Digital processes in accounting data processing and financial reporting should continue to evolve.

About the author

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Blended Learning and Student Satisfaction: The Moderating Effect of Student Performance

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Abstract

Background: Blended learning is a new approach to teaching and learning created by combining traditional classroom learning with an online learning platform. In recent years, blended learning has become an increasingly popular form of e-learning. It is particularly suitable for transitioning from completely traditional forms of learning to online learning. **Objectives:** This paper aims to examine the effect of blended learning on students' performance and satisfaction and showcase whether students' satisfaction with blended learning leads to performance improvement. **Methods/Approach:** A quantitative research design has been utilized for data collection, consisting of a questionnaire administered to a sample of three hundred and nineteen (319) students from bachelor and master study programs at South East European University (SEEU) in N. Macedonia. Data gathered through this questionnaire have been analyzed through structural equation modelling (SEM). **Results:** The results show that blended learning influences students' performance and satisfaction. **Conclusions:** Course management and interaction positively impact students' satisfaction and performance. The interaction has a more significant effect on both satisfaction and performance outcomes from blended learning. The main conclusion is that blended learning contributes to students' satisfaction which eventually leads to students' improved performance.

Introduction

Blended learning (BL) is a new approach to teaching and learning. As the name implies, it combines traditional classroom learning with an online learning platform. In recent years, blended learning has become an increasingly popular form of e-learning, and it is particularly suitable for transitioning from complete traditional forms of learning to e-learning. Blended learning has been seen as a new promising approach in online education as it combines conventional face-to-face instruction with some forms of online course delivery (Wu et al., 2010). These authors advocate that students' perception of higher education course delivery has changed due to the new trends in instructional delivery modes influenced by information technologies. As claimed by Okaz (2015), nowadays, students seem to prefer online learning rather than traditional face-to-face learning.

The growth of new technological trends has gone in parallel with changes in the learning process and required new skills and training, especially in higher education (Hoic-Bozic et al., 2008). As a result, many universities have transformed the way of teaching and learning and incorporated online teaching in higher education (Qiu, 2019). The use of information technologies in education has received attention from quite many scholars. (Tselios et al., 2011). Since blended learning entails a mix of face-to-face and online learning, it has been identified as an appropriate alternative for distant learning (Diep et al., 2017). Moreover, many studies have investigated the relationship between blended learning and students' satisfaction (Sadeghi et al., 2014; Sajid et al., 2016; Vernadakis et al., 2012; Wu et al., 2010), indicating a high satisfaction rate among students from this type of instruction. However, as Giannousi et al. (2009) pointed out, despite the consensus that high satisfaction leads to greater motivation and thus to more efficient learning, there has been very little evidence about the direct relationship between student satisfaction and high academic performance. According to a study by Wach et al. (2016), the construct of satisfaction from academic courses has not received much attention from psychologists. It has not been thoroughly analyzed and described. As suggested in this study, the very concept of satisfaction can be further divided into subcomponents, including satisfaction from the academic content, study conditions, stress, etc. Following this logic, blended instruction can be considered from multiple perspectives, including course organization, delivery, conditions, etc., which adds to the complexity of the issue concerning student satisfaction. For this reason, there is a gap in the available literature as very little research has been carried out about the relationship between satisfaction and students' overall performance in courses delivered through blended mode.

Therefore, the current study tried to investigate the relationship between blended learning and students' satisfaction on the one hand and the other hand to determine whether students' satisfaction eventually leads to students' performance improvement. For this paper, performance construct is understood as students' evaluation of their academic achievement according to the standard definition of academic performance as "the quantitative result obtained during the learning process, based on the evaluations carried out by the teachers through objective test evaluations" (Garbanzo, 2007 in Noemy et al., 2017, p. 1105).

The paper is organized in the following way: it starts with introducing the subject matter and contains the study objectives. The following part focuses on the literature review, and the methodological approach is explained in the third part. The findings are presented in the result section, while the last section includes the discussion and conclusions.

Literature Review

Satisfaction with blended learning can improve students' performance in certain areas. For that reason, student satisfaction is considered to be an important factor in measuring the quality of teaching and learning in higher education. Evaluating the factors that contribute to students' satisfaction, possibly further leading to enhanced performance is critical for these institutions. Blended learning is thus seen as an essential factor in students' satisfaction.

Technology has been embedded as a central component in many online learning classrooms in learning platforms for participation, video and audio equipment, computers, and Internet access (Yang et al., 2013). This trend has made higher institutions put efforts in developing a mix of course delivery contents. Therefore, blended learning combines different learning environments, and it combines technology and other traditional teaching and learning methods, resulting in synchronous and asynchronous interactions (Hoic-Bozic et al., 2008).

The traditional, ex cathedra teaching was the main and only way of instruction in higher education institutions for a long time. Nonetheless, the rapid development of information technologies has been the reason for preference of other forms of content delivery. In this way, blended learning becomes a new mode of combining traditional, face-to-face and online learning.

Using the Internet for interaction between students and teachers defines the online teaching. Many universities use blended learning and online delivery to cope with the new challenges in higher education (Zeqiri et al., 2020). Blended learning combines online content and traditional face-to-face delivery. (Heirdsfield et al., 2011). In blended learning, there is a mixture of conventional face-to-face classes and online learning that uses the internet and physical presence in classrooms (Friesen, 2012); it is a combination of online and offline learning (Boelens et al., 2015); blended learning puts together face-to-face classroom activities, technology and media (Picciano, 2006); "hybrid teaching" is another term used in blended learning environment (Verkroost et al., 2008). What is more, many authors speak about a combination between face-to-face and online learning components, when defining blended learning (Drysdale et al., 2013; Huang, 2016). Graham (2013) claims that blended learning combines traditional face-to-face and online learning. Course management is facilitated through blended learning as it enables instructors to combine online and face-to-face course components and resources become accessible to students whenever convenient to them. Besides this, it also assists in organizing the grading as it provides opportunities for collecting data in a given platform and thus helps managing the whole learning process (Rahman et al., 2015). Concerning the relationship between the course management and students' performance, we propose the first hypothesis to be:

- o H1: *Course management influences students' performance.*

Research has also shown that blended learning focuses on a teacher-centred process to become a more student-centred process. Related to this issue, Fadde et al. (2014) claim that blended learning promotes students' independent work. The learning management systems used by higher educational institutions provide conditions for publishing materials and information for students at their high convenience. The literature also provides evidence that online learning both engages and satisfies students (Fisher et al., 2018). As all this is also related to course management and blended learning, our second hypothesis is:

- o H2: *Course management impacts students' satisfaction with blended learning.*

In addition, blended learning contributes to higher students' engagement with course resources and activities (Fadde et al., 2014). A meta-study carried out by Bernard et al.'s (2014) on blended learning in higher education reveals that technology has had an overall positive impact on the learning process. This positive impact might be related to satisfaction, and thus we hypothesize further that:

- o *H3: Course management and performance relationship is moderated by student satisfaction*

In an online delivery context, instructors interact with learners providing feedback and exchanging information. Online delivery also facilitates the learner-learner Interaction by discussing issues related to the subjects of the study (Du et al. 2014). Online learning increases the interaction process between instructors and learners (Jain et al., 2011). Many other studies emphasize that blended learning increases teachers' interaction level with students and that eventually leads to their higher satisfaction (Romero-Frías et al., 2013). Interaction presents a critical experience and an essential component for a thriving learning environment (Graham, et., 2005). Previous research also indicates the critical role of interaction in the learning experience. It is therefore treated as highly significant for the success of online courses (Du et al., 2014). We, therefore, contemplate that:

- o *H4: Interaction influences students' performance with blended learning.*

Graham (2013) advocates that blended learning provides opportunities for more teacher-student Interaction while learner-to-learner interaction positively affects the online learning process and can also impact student satisfaction (Ekwunife-Orakwue et al., 2014). Based on this, we propose the following hypothesis:

H5: Interaction has an impact on students' satisfaction.

Blended learning enables collaborative activities, and the social presence students perceive during the interaction process. A study carried out by Sorden et al. (2013) shows that blended learning facilitates collaboration and social presence, eventually leading to more effective and satisfactory learning settings. This relationship is examined through our following hypothesis:

- o *H6: The relationship between Interaction and performance is moderated by the satisfaction*

Students seem to be more satisfied when courses combine online and face-to-face instructions. Many studies have investigated the relationship between blended learning and students' satisfaction. For example, the results of a study by Kiviniemi (2014) show that 83% of students prefer blended learning, which has also been shown to improve performance. In their study, Martínez-Caro et al. (2011) notice that students have been more satisfied with courses in blended formats than traditional, face-to-face courses. Vernadakis et al. (2012) also claim that blended learning delivery is preferred over conventional instructional format. Their findings suggest that students' satisfaction with learning increases when instructors combine traditional classrooms with online instructions. Moreover, in researching two higher education institutions, Boyle et al. (2003) reveal marked improvements in students' performance in both institutions and students' positive evaluation of blended learning features. Based on this, we propose the following hypothesis:

- o *H7: Satisfaction influences students' performance*

According to the literature review presented above, we propose a conceptual framework that consists of students' performance and satisfaction as dependent variables and course management and Interaction as independent variables. The hypothesized relationship between these variables is depicted in figure 1.

Figure 1
The Conceptual Model
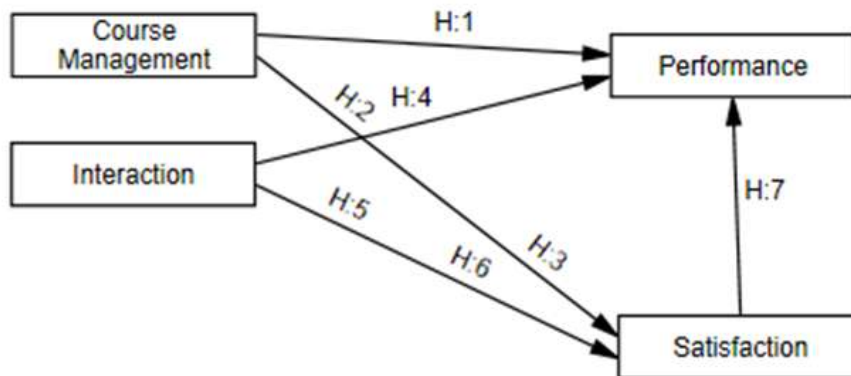
Source: Author's illustration

The findings indicate that the proper combination of online and traditional delivery is an effective methodology in higher education institutions. Blended learning use appears to facilitate this kind of combination of delivery. As proposed by López-Pérez et al. (2011), with the new information technologies, educational institutions are equipped with resources that create new learning environment leading to an improved teaching and learning process.

Research Methodology
Research settings
This study utilized a quantitative research methodology in order to examine students' perceptions of blended learning in higher education. It was conducted at the South-East European University (SEEU) in North Macedonia. The selected university employs Google Classroom (GC), an open-source used as an educational platform for enhancing qualitative blended learning. Four dimensions, each containing their items, were created to develop a research instrument. Thus, the course management dimension (CM) is comprised of 4 items, Interaction (I) of 3 items, Performance (P) of 3 items, and Satisfaction (S) of 3 items. Participation in the survey was voluntary, and students' anonymity was guaranteed. The questionnaire structured in this way was distributed to respondents that had used blended learning in their bachelor or master degree programs. Data were collected from 319 samples by probability sampling technique from January to March 2020.

Research instrument and data collection
A questionnaire survey method was used to collect students' responses. The survey items were developed based on the relevant information from the literature review. The questionnaire was translated into Albanian for better comprehension and more accurate responses. A five-point Likert scale was used (where five denoting strongly agree and 1 = strongly disagree), as shown in more detail in Table1.

Table1
Research instrument description

Construct	Code	item
Course Management (CM)	CM1	The online and face-to-face course components enhance and complement each other.
	CM2	Online learning platforms are favorable for managing and organizing learning
	CM3	Blended learning makes it more convenient for arranging and grading assignments
	CM4	Blended learning makes it more convenient for publishing materials and information
Interaction (I)	I1	Blended learning creates a user-friendly learning environment with teachers
	I2	Blended learning improves the communication and interaction between students and teachers
	I3	The use of blended learning technology encourages me to learn independently
Performance (P)	P1	Blended learning improves my overall performance in courses.
	P2	I think blended learning is the best way of improving students' performance
	P3	I have better grades in classes that combine online and face-to-face instructions
Satisfaction (S)	S1	I feel more satisfied when I study using blended learning
	S2	am more satisfied with this learning experience compared to traditional course settings
	S3	I prefer a combined class with face-to-face and online instructions

Source: Authors' work

The questionnaire provided demographic data of respondents and their attitudes concerning blended learning and their satisfaction. The first part of the questionnaire represents the demographic characteristics of respondents, and the first part combines the demographic profile of participants. The second part has four (4) indicators and has been designed to measure independent variables and the dependent variable. Through the questionnaire, participants have stated their self-perception about blended learning.

Table 2 shows that most respondents belong to the female group with 63.6 % and males with 36.4%. Concerning computer literacy, 24.8% of respondents have excellent skills, 38.2% are perfect, 34.5% are good, 1.9% are poor, and 0.6% have abysmal skills. Concerning respondents' experience with blended learning, 55% have less than one year of experience, 26.7% have 1 to 2 years of experience, 9.4% have 2 to 3 years of experience, whereas 8.8% belong to a respondent group with more than three years of experience. Regarding the respondents' GPA, 7.2% are with 6-7 GPA, 23% with 7-8 GPA, 30.5% belong to 8-9 GPA group, and 29.9% belong to 9-10 GPA group, whereas 9.4% of respondents didn't report their GPA. The majority of respondents, around 54.4%, are in their first academic year, 33.6% in the second year, 5.3% in their third year, and 3.1% in their fourth year of studies, whereas 3.5% of respondents are master students.

Table 2
Respondents Demographic Characteristics

Gender		Frequency	%
	Male	116	36.4
	Female	203	63.6
Computer literacy		Frequency	%
	Very poor	2	0.6
	Poor	6	1.9
	Good	110	34.5
	Very good	122	38.2
	Excellent	79	24.8
Experience with Blended learning		Frequency	%
	Less than one year	176	55
	1-2	85	26.7
	2-3	30	9.4
	More than 3	28	8.8
Cumulative GPA		Frequency	%
	6-7	23	7.2
	7-8	73	23
	8-9	97	30.5
	9-10	95	29.9
	NA	31	9.4
Academic year		Frequency	%
	First-year	174	54.4
	Second-year	107	33.6
	Third-year	17	5.3
	Fourth-year	10	3.1
	Master	11	3.5

Source: Author's calculations based on survey results

Data analysis

Smart PLS 3 and SPSS 20 software have been used for analyzing the obtained empirical data. The gathered data have been analyzed in several steps. A validity test has been conducted to test whether the items describe the context of the construct (Hernaus et al., 2012). Firstly, a confirmatory factor analysis (CFA) has been conducted to test converged validity and discriminant validity (Hair et al., 2016). Secondly, reliability analysis has been conducted using Cronbach's alpha and composite reliability that indicate the internal reliability of the construct. The proposed threshold of 0.70 or greater reliability coefficient indicates good reliability (Hair et al., 2014). SEM technique has been used to evaluate the measurement model and estimate the structural model.

Results and Discussions

PLS-SEM supports a two-step analysis. The first step assesses the measurement model, and the second step analyses the structural equation model (SEM) (Anderson et al., 1988; Shahid et al., 2021).

Assessment of measurement model

The assessment of the measurement model is performed to show how variables come together to represent the theory based on convergent and discriminant validity (Anthony et al., 2019).

Convergent validity

A good model fit also looks at the convergent validity of items, and this test shows how close the items are to each other. Table 3 reveals that values of composite reliability range from 0.866 to 0.938, which indicates that all values have exceeded the recommended value of 0.70. The Cronbach's alpha values range from 0.715 to 0.931, exceeding the proposed value of 0.70. So, an alpha value of 0.70 -0.8 or greater denotes an excellent level of reliability (Ursachi et al., 2015). The average variance extracted (AVE) values differ from 0.561 to 0.732, all over 0.50, recommended by Fornell et al. (1981).

Table 3
Convergent Validity

	Cronbach's Alpha	rho_A	Composite Reliability	AVE
Course management	0.794	0.800	0.866	0.617
Course management* Satisfaction	0.931	1.000	0.938	0.561
Interaction	0.779	0.781	0.872	0.694
Interaction* Satisfaction	0.914	1.000	0.928	0.589
Performance	0.814	0.821	0.891	0.732
Satisfaction	0.715	0.737	0.840	0.638

Source: Author's calculation based on results

Discriminant validity

Discriminant validity is a test that assesses the extent to which the constructs in the model are close to each other or how they differ (Bagozzi et al., 1991). As shown in Table 4, the AVE values exceed the proposed 0.50 loading, indicating that discriminant validity is supported for the construct (Fornell et al., 1981). Besides, the correlation items in any construct should not exceed the square root of the AVE in a single construct (Hair et al., 2010). As shown in Table 5, the discriminant validity testing is supported based on the results.

Table 4
Discriminant validity

	CM	CM*S	I	I*S	P	S
Course management	0.786					
Course management* Satisfaction	-0.305	0.749				
Interaction	0.807	-0.290	0.833			
Interaction* Satisfaction	-0.302	0.901	-0.344	0.768		
Performance	0.700	-0.275	0.735	-0.266	0.855	
Satisfaction	0.687	-0.360	0.724	-0.361	0.730	0.799

Source: Author's calculation using Smart PLS

Assessment of structural model

This study has utilized the Smart PLS Structural Equation Modelling for evaluating the proposed model. The results of the SEM path analysis are shown in figure 2. The path measurement shows that course management R^2 is 0.182, and teacher-student interaction R^2 is 0.334. The course management contributes to 0.295 to satisfaction, whereas, Interaction contributes more with 0.486 to student satisfaction. Finally, the model shows that Satisfaction variance is explained by 55.5 %, whereas Performance is by 64%. Thus, the model has obtained good results.

Figure 2
Structural Equation Modelling
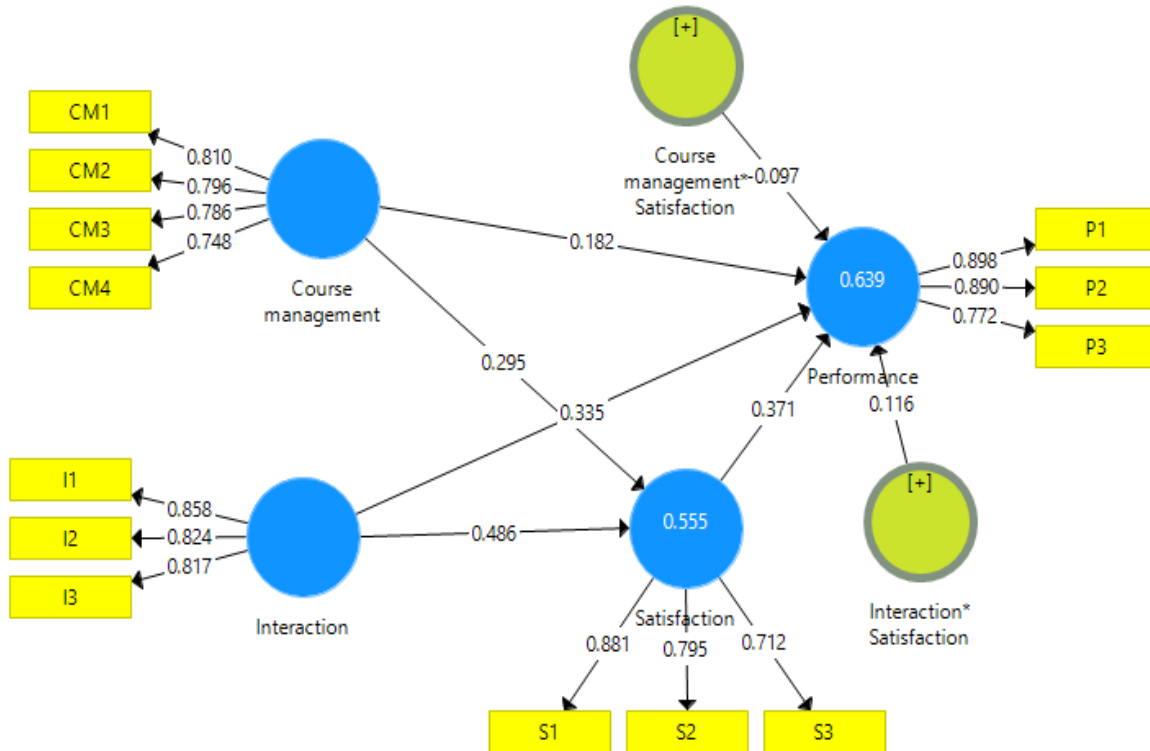
Source: Author's illustration

Table 5 shows factor loading for all items in the construct. As it can be seen, all loadings are more significant than .05., which shows the recommended threshold of average variance extracted (AVE). All item loadings are 0.712 to 0.898; that is over the recommended threshold value of 0.50. The collinearity test is used to test whether the method is biased. According to Kock (2015), the occurrence of a VIF more significant than 3.3 indicates collinearity, and therefore the model construct might be biased. Therefore, if all VIFs from the collinearity test are equal to or lower than 3.3, the model can be considered free of common method bias.

Assessment of model fit

To test the model fit, model fitting parameters have to be tested first: the Standardised Root Mean Square Residuals (SRMR) and the Normed Fit Index (NFI). The SRMR shows the difference between the observed correlations and the model implied correlation matrix whereby values less than 0.8 are considered a good fit (Henseler et al., 2014; Ramayah et al., 2017). The second fit index is NFI which computes the Chi-square value of the proposed model, and values above 0.9 denote an acceptable fit (Ramayah et al., 2017). For this case, the SRMR value is 0.073, which denotes a good fit, and the NFI value is 0.893, which denotes an acceptable fit.

Table 5
Construct items loadings

Construct items	Loadings	Mean	SDEV	T Statistics	VIF
Course Management (CM)					
CM1	0.810	3.82	0.82	38.333	1.625
CM2	0.796	3.83	0.89	31.856	1.638
CM3.	0.786	3.86	0.95	27.74	1.577
CM4.	0.748	4.00	0.81	18.913	1.527
Interaction (I)					
I1.	0.858	3.82	0.86	36.903	1.749
I2.	0.824	3.88	0.92	40.656	1.562
I3.	0.817	3.75	0.90	31.272	1.577
Performance (P)					
P1.	0.898	3.74	0.88	78.257	2.509
P2.	0.890	3.760	0.93	62.617	2.439
P3.	0.772	3.68	0.96	24.969	1.424
Satisfaction (S)					
S1.	0.881	3.89	0.86	57.188	1.779
S2.	0.795	3.73	0.96	31.848	1.428
S.3	0.712	3.89	0.91	17.069	1.369

Source: Author's calculation using SPSS

Testing hypotheses and the moderating effect

A multiple regression analysis with the SEM model has been used to investigate the relationship between course management and Interaction with students' performance and satisfaction. The results show that course management directly affects students' performance and is significantly related to student satisfaction. Table 6 shows that there is a significant relationship between all variables.

The results also show that course management is positively and significantly related to students' performance with path coefficient = 0.182, t = 2.977, p < 0.003, indicating that H:1 is supported. Based on the results, H:2 shows a positive relation between course management and student's satisfaction with path coefficient = 0.295, t = 4.259, p < 0.000, denoting that H:2 is also supported.

Moreover, results from table 5 reveal a significant positive relation between Interaction and satisfaction with path coefficient = 0.335, t = 4.812, p < 0.000, indicating that H:4 is supported. Additionally, results also point out that the Interaction of students with lecturers is highly significantly related to satisfaction with a path coefficient = 0.486, t = 7.164, p < 0.000. Thus, H:5 is supported. Finally, H:7 is also supported because the results reveal a strong relationship between students' satisfaction and performance, path coefficient = 0.371, t = 5.731, p < 0.000.

Finally, the SEM model has investigated the moderating effect of course management and interaction satisfaction on improving students' performance. The moderating variable shows whether it strengthens or weakens the direct effect of exogenous variables on the endogenous variable. Based on the results presented in table 6, we can conclude that satisfaction does not significantly affect course management and student performance. Therefore, based on the results, we can conclude that H:3 and H:6 are rejected, with low T-values of 1.339, respectively 1.705. Hence, If the critical ratios for the difference are smaller than -1.96 to +1.96, we can assume that there is no significant difference between groups.

Table 6
Hypotheses Testing

		Path Coefficient.	STDEV	T-Values	P-Values	Results
H1	Course management -> Performance	0.182	0.061	2.977	0.003	Supported
H2	Course management -> Satisfaction	0.295	0.069	4.259	0.000	Supported
H3	Course management* Satisfaction -> Performance	-0.097	0.065	1.339	0.181	Rejected
H4	Interaction -> Performance	0.335	0.07	4.812	0.000	Supported
H5	Interaction -> Satisfaction	0.486	0.068	7.164	0.000	Supported
H6	Interaction* Satisfaction -> Performance	0.116	0.065	1.705	0.089	Rejected
H7	Satisfaction -> Performance	0.371	0.065	5.731	0.000	Supported

Author's calculations using Smart PLS

Discussion

Higher education institutions have been making many efforts to increase the quality of teaching in their educational premises, which requires analysis of the factors that increase the quality of teaching and learning and factors that contribute to students' satisfaction and performance. Therefore, understanding what method leads to student satisfaction provides an insight into educational institutions to create a more effective learning environment (Wu et al., 2010). Blended learning seemed to be a promising approach in students' satisfaction (Lim et al., 2009) and a preferred instructional form (Melton et al., 2009).

The impact of satisfaction on students' performance improvement has not been thoroughly investigated yet. However, the impact of blended learning on student satisfaction with university online delivery has been studied a lot. Therefore, this study has tried to investigate the impact of blended delivery on students' satisfaction and performance.

The empirical results in this study show that course management seems to contribute to student satisfaction during blended learning. Therefore, the findings from the research support other previous studies that course management in the blended setting is a factor of student satisfaction (Jain et al., 2011; Bernard et al., 2014; Du et al., 2014; Fisher et al., 2018).

In addition, the findings also support the previous finding by other scholars (Graham et al., 2005; Romero-Frías et al., 2013; Du et al., 2014; Ekwunife-Orakwue et al., 2014) that student interaction during blended learning contributes to student satisfaction. Moreover, the findings also support the previous finding by other scholars (Wu et al., 2010; Vernadakis et al., 2012; Graham, 2013; Sadeghi et al., 2014; Sajid et al., 2016) that student satisfaction contributes to student performance improvement.

Finally, the study has investigated whether there is an interaction or a moderating effect of satisfaction on performance improvement. The results demonstrate that satisfaction does not increase the effect of course management and Interaction on students' performance. Finally, the study results support only five study hypotheses and reject two of them.

Conclusions

Summary

Blended learning has been seen as a new promising approach in online education as it combines the traditional way of teaching with some new forms of online learning. Blended learning facilitates course management, and it provides opportunities for students and teachers to interact during the learning process. In addition, blended learning makes it easier to publish resources organize independent work by students, and manage and organize courses, which eventually leads to students' satisfaction with blended learning and their outcome improvement. Therefore, the main conclusion is that blended learning improves students' satisfaction and performance.

Practical implications

This research provides some practical implications for higher educational institutions concerning the impact of BL on students' satisfaction and performance. The findings also suggest that providing students with blended learning contributes to students' satisfaction and performance improvement. Moreover, the results suggest that instructors should manage their courses according to students' expectations. In addition, the research has shed some light on some of the essential factors that students prefer in their learning. BL helps students organize their pace of work, organize their materials, and share information with their peers and instructors. Finally, other higher institutions can use the findings from this research to promote blended learning as a combination of face-to-face and online delivery to increase students' satisfaction.

Theoretical implications

This research also provides some theoretical implications to instructors and higher education management by offering crucial insights on using blended learning to achieve students' satisfaction with this online delivery and reach better results in the learning process. Moreover, the findings also contribute to the existing literature on BL learning in developing countries by providing information about its effectiveness.

Furthermore, the dimensions mentioned in the literature review and this study significantly impact students' learning through BL. Thus, the findings denote the instructor's role in managing the course content, Interaction, and inter-communication through these online formats to create a better and more positive learning environment.

Our findings confirm that learners' satisfaction is based on course management (combining online and face-to-face course components to enhance and complement each other) and Interaction (creating a user-friendly learning environment that contributes to improved communication and interaction between students and teachers).

Limitations and future research directions

The study's main limitation is that the perceptions about blended learning have been considered only from the students' perspective. Multi-group analyses considering the two-sided approach of both teacher and student perspectives could have produced better-correlated results.

It is recommended that more factors that could lead to student satisfaction and student performance improvement are analyzed. Future research can focus on the

new trends in information technologies and on ways to assess the adoption process of students and teachers, considering that the number of these new trends in information communication technologies is constantly increasing. Moreover, future research should be expanded to explore the relationship between student and instructor satisfaction. Finally, gender as a moderating factor can also be included in future research to find out more about the differences regarding technology adoption in a learning environment.

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The Partnership Network Structure of Automakers under Radical Technological Change

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Abstract

Background: Traditionally, dense network structures have dominated partnerships in the automotive industry. On the other hand, previous research in other industries has shown that network structures suitable for radical innovation include weak ties, structural holes and betweenness centrality. **Objective:** The purpose of this research is to empirically analyse the effect of the ongoing and radical change in the business environment within the automotive industry, referred to as CASE (connected, autonomous/automated, shared, and electric), on the network structure of the partnerships of automobile manufacturers. **Methods/Approach:** The methodology of this study is based on the use of real data on partnerships of car manufacturers around the world, analysed using social network analysis methods. **Results/Findings:** The analysis confirms that there is a significant correlation between the degree of the CASE approach, the number of weak ties and the size of structural holes. In addition, several cases showed significant differences in the network structure between new technology ventures and existing legacy technology firms. The findings highlight the insight that the network structure of the automotive industry is likely to change significantly in the future due to technological innovation.

Introduction

The aim of this study is to empirically analyse the impact of rapid technological change on the network structure of corporate partnerships. The network structure involved in corporate partnerships depends on the industrial characteristics and product structure to which the firm belongs. Technological changes affect the industrial characteristics and product structure, such as the composition of components, and the optimal partnership changes. In this study, we focus on the automotive industry, which is currently facing a dramatic technological change called CASE (Connected, Autonomous, Shared & Services, and Electric) (Houdek et al., 2017). The term CASE was originally coined by Daimler AG, but is now widely used in the automotive industry.

In the traditional automotive industry, a network structure of closed and strong partnerships with specific groups of companies has been chosen. When consumers choose a car, the customer value of that car is heavily influenced by characteristics such as concept and brand value, which naturally vary from car to car. A single car is made up of tens of thousands of parts and materials. In order to realise a car's concept and design, it is important to coordinate the many components and materials in an integrated way.

For this reason, each car manufacturer works closely with specific component and material manufacturers in the development, design and production of its products. Each car manufacturer needs to exchange important intellectual property, development and design information in a flexible manner, while preventing it from being passed on to non-partners. To this end, they have strengthened their human and capital relationships with a limited number of unique partners and have formed strong partnerships over time. The result is a closed and cohesive ecosystem in the automotive industry, vertically integrated around the car manufacturers.

On the other hand, in the IT industry, for example, a relatively open and ad hoc network structure of weak partnerships has been chosen. Interface specifications for computers and the Internet have been standardised, many of them are available free of charge, and components are increasingly modular. This has allowed a wide range of players to enter the market and has given rise to countless ventures specialising in particular technologies. Furthermore, it is easy to improve the performance of products, add new functions and reduce costs, making them rapidly more cost-effective for customers. In addition, so-called platform leaders have emerged, specialising in a limited number of technologies, expanding their alliances with various companies and dominating certain business areas. in the IT industry, platformers have taken the lead in forming an open, horizontally linked ecosystem.

However, the development of CASE, the subject of this research paper, is causing a radical change in the traditional automotive product and industry structure, and may foreshadow that the product structure of the automobile will resemble that of IT products. For example, "connected" means that the car will be transformed into an information and communication device." Autonomous driving" means that the core technology of the car will be IT, and the traditional value of "enjoying driving" will be lost. If all cars become like buses and taxis through "sharing", the customer value of owning a car, such as the appearance, design and status of a luxury car, will become meaningless. Car sharing will drastically reduce the total number of cars sold and their value will shift from hardware to services. In addition, the adoption of "electric vehicles" will simplify the structure of the car, significantly reducing the number of components, eliminating the need for integration and coordination between components, and significantly reducing the number of component manufacturers. Existing car manufacturers and component suppliers are changing their strategies in order to

survive. Many are trying to adapt to new technologies and services and to build new industry rules around themselves. Others are refining their existing technologies to differentiate themselves and survive. A number of emerging car manufacturers are also trying to gain dominance by adopting new business models.

The aim of this study is to analyse how the network structure of car manufacturers' partnerships is changing as a result of the current CASE development. As data for the analysis, real data on the partnerships of car manufacturers will be collected and a database for the analysis will be constructed. As a method of analysis, the aforementioned method of social network analysis will be used to analyse the characteristics of the network structure of each car manufacturer and its relationship with the degree of commitment to CASE based on the constructed database.

As the structure of this paper, the research question is firstly presented based on the previous studies in the automotive industry. Next, I present the research design, including analytical and data acquisition methods and the research hypotheses. After that, the research results are presented, and the research hypotheses are verified.

Research question

The research question in this study is whether the development of CASE in the automotive industry will change the inter-organizational relationship from the traditional closed vertical integration type to the open horizontal specialized type like the IT industry. In this section, previous studies on this research question are reviewed.

Relationships between organizations in the automotive industry

The relationships between completed vehicle manufacturers and parts and material manufacturers in the traditional automotive industry have traditionally been closed and cohesive. The Keiretsu system in Japanese companies is typical of this, with vertically integrated organisational relationships with the complete car manufacturer at the top of the pyramid.

There has been a great deal of debate in previous studies as to whether these traditional inter-organisational relationships will change with the development of CASE. In Japan, the automobile industry is a valuable industry with international competitiveness, the industry base is wide, and much employment depends on the automobile industry at large. Consequently, the automotive industry is particularly noteworthy in Japan. For Japanese car manufacturers, inter-organisational relationships, such as those represented by keiretsu, have been recognised as an important source of competitive advantage. Discussions on possible changes in inter-organizational relationships have been active within academic societies for many years.

For example, Murasawa (2010) positions electric vehicles as a modular development and argues that the advantage of car manufacturers is declining. Electric vehicles can be recognised as a product developed and produced by combining electric motors and on-board batteries produced by several component manufacturers. This makes it possible for small companies, such as a neighbourhood car repair shop or an electrical shop, to develop, produce and sell electric vehicles by combining interchangeable components. In the long run, vehicle manufacturers who previously had a large share in the vehicle market may decline.

On the other hand, Saeki (2011) states that the product architecture of a fully electric vehicle has characteristics of an integral type. Saeki argues that electric vehicles are products that require a combination of interchangeable components and complex software-based electronic control, and that software development requires complex coordination. Even electric vehicles require a high degree of

coordination, including software development, between car manufacturers and suppliers. For this reason, it is expected that the completed car manufacturers will continue to retain their current competitiveness and that the completed car manufacturers will reign at the top of the electric vehicle market.

Horizontal specialized inter-organizational relationships

In the IT industry, the core of the horizontal specialized inter-organizational relationship is, as mentioned above, the platform leader. One of the most prominent early studies of platformers was Platformer Leadership by Gawer et al. (2002) and subsequent works analysing Intel's strategy for PCs. In this context, a platform is a product or service that serves as the basis for several complementary companies to make products or provide services. The individual components and software that make up a computer are discrete modules interconnected by an Operating System (OS) or Central Processing Unit (CPU). In such a case, the OS or CPU is the platform. The platform leader acts as an intermediary, bringing together disparate groups of companies to form a unified product or service and promote innovation. Iansiti et al. (2017) foresee a shift in the industry structure of connected cars, with Google and Apple as platformers and automakers as complements.

With regard to the relationship between platforms and innovation, Gawer et al. (2013) define an external platform or industry platform as a product, service or technology developed by one or more firms, on which more firms can build further complementary It is defined as acting as a platform on which more companies can build further complementary innovations in the form of specific products, related services or elemental technologies. Industrial platforms tend to promote and increase innovation in complementary products and services. The more such complementary innovations there are, the greater the value created for the platform and its users through network effects, creating a cumulative advantage for the platform. The increase in complementary innovations makes it easier for rivals and new entrants to be excluded and acts as a barrier to entry. For complementors, for example, as in the case of an independent software vendor partnering with SAP (Ceccagnoli et al., 2012) or a developer producing video games for a specific console (Cennamo, 2016), connecting to a platform can lead to complementary innovations, but also gain access to the platform's customers, either directly or indirectly.

Gawer et al. (2008) highlight the complex trade-off between 'open' and 'closed' innovation, pointing out that while opening up the interface increases the incentives for complementors to innovate, it is important to keep the sources of revenue and profit somewhat proprietary.

Vertically integrated inter-organizational relationships

On the other hand, a number of previous studies have explained the usefulness of integrated inter-organisational relationships, especially when industrial structures are changing in an innovative way.

Chesbrough et al. (2001) discuss a cyclical change model of the dominant product architecture in an industry. According to them, integral architectures are mainly used in the early stages of an industry. At that stage, an integral organisational strategy is crucial because of the relative complexity of problem solving for innovation. Individual modules functioning as semi-autonomous subsystems can flexibly respond to technological changes absorbed within the module. However, in the early stages of an industry, the interface rules between modules are themselves ambiguous and subject to change. Companies that adopt a modular organisational structure are

more likely to be unable to lead or follow innovative technological change because of the lack of breadth of knowledge beyond the modules.

Wessel et al. (2016), citing Christensen's work, provide a case study of electric vehicles and point out that it is important to increase the Interdependence of ecosystems for innovative technological evolution. When major innovations are introduced, it is common to restructure the extended value chain. This is not only because business models are in flux, but also because innovative product designs are often yet to be created. In the early days of a new product, the inventor does not understand how to optimise the different components of the innovation relative to each other. For example, the first car manufacturers needed to tightly control research, design and manufacturing, so that changes to one part of a car often meant changes to the whole car. This is why product development requires a network of interdependent partners. The more dramatic the innovation, the more interdependence may be needed. As the transition to autonomous and electric vehicles continues, a level of interdependence close to vertical integration will again be required. Tesla's cars maintain the most interdependent architecture on the market. It controls every component of the car: the hardware, the software that manages the complex electrical system, and the algorithms and sensors that enable the automated driving functions. This tight control goes even further. Tesla also has its own sales channels, service network and charging network. This integrated model enables the company to meet all the challenges involved in producing electric vehicles capable of autonomous driving and long distances, as well as batteries for fast charging.

Research methods and hypotheses

Research framework
Next, based on the research above question, the research framework of this study on inter-organizational relations is as follows.

The research question addresses the impact of each automotive company's CASE initiatives on inter-organizational relations. However, it isn't easy to quantify how individual automotive firms are engaged in CASE externally. Therefore, I decided to use the externally measurable data as a proxy variable and analyze the relationship between the externally measurable data. In this study, I use the partner information of each firm as the data to be analyzed, which will be described in detail later. As automotive companies engage in CASE, the types of partners they associate with will change. Due to the nature of the industry, CASE is closely related to the IT industry, the information and communications industry, and the electronics industry. In addition, the proportion of software and service businesses will increase compared to hardware businesses. In the case of conventional automobile manufacturers, many of their partners were also manufacturers of automobile parts such as engines and bodies.
On the other hand, as automotive companies move forward with their CASE initiatives, the number of partners, such as IT companies, is expected to increase. As the number of partnerships with companies in the IT industry increases, the network structure of partnerships is also expected to change. Whether the network structure of the partnership is closed and vertically integrated, which has been the mainstream in the automotive industry, or open, horizontally specialized, and platform-type network structure, which is similar to the IT industry. Therefore, the framework of this study is to investigate the relationship between the type of business domain of the partnership firms and the network structure of the partnership for each firm that can be measured externally.

Social Network Theory

In this study, I adopted the social network analysis method to analyze the network structure of the partnership. Before deriving the research hypothesis on the network structure, I first review the social network theory, which is the theoretical basis of the social network analysis.

Social network theory applies various theories about the properties of complex networks in the natural sciences (e.g. small-world, scale-free, cluster properties) to social relationships. By considering people and organisations as nodes and analysing the structure of the networks in which they are connected to other nodes, it is possible to identify how the relationships embedded between people and organisations affect people's thinking and behaviour. Using the methods of social network theory, it is possible to calculate various quantitative indicators to assess the network structure.

One of the leading studies in social network analysis is Granovetter's (1973) "The Strength of Weak Ties", which has been followed by a series of studies. Granovetter (1973) argued that weak ties are most valuable for the diffusion of information across the network. According to Granovetter (2005), there are generally three types of interpersonal ties: strong, weak and no ties. Weak social ties are argued to be responsible for the degree of social embeddedness and structure of the social network, and for the majority of information transfer through the network. Specifically, more new information flows to individuals through weak ties than through strong ties. Since close friends often act in the same circles, the information they receive overlaps considerably with that which is already known to them. Acquaintances, on the other hand, know people in other circles and therefore receive more new information.

y a feature of the sociocentric network. It is an effect that can occur due to the high number of weak ties in the overall social network.

An egocentric network, on the other hand, is a network structure centred on one ego. Organisations are connected by a wide network structure, but each is connected to the surrounding organisation in a different way. The main interest of egocentric network research is the difference in organisational performance due to the network structure around the organisation. The subject of this study is egocentric networks in individual organisations. In the study of ego-centric network structure, we focus on triadic closure, i.e. whether the ego nodes are also connected to the nodes they are directly connected to. If those connected to the actor (ego) are not directly connected to each other, then there is a structural hole between them (Burt, 1992). On the other hand, if two people connected to the actor (ego) are also connected to themselves, then the triad is described as closed. The high density of the ego's network indicates the degree to which the ego's network triad is closed (Phelps et al., 2012).

Burt (2004) classifies ties into Bridging Ties and Cohesive Ties and states that Bridging Ties, which can be widely deployed even with weak connections, effectively search for information. Bridging Ties are defined as ties that connect separated individuals and groups. Its structural features include many bridge ties and a wide range of connectivity; these can be analyzed by indexes such as the number of intervening ties and structural holes. Bridging Ties' strength lies in the widespread dissemination of new, formal, and heterogeneous knowledge, and it is easily linked to radical innovation.

Among the indicators of network structure, centrality is one of the most commonly used indicators in network analysis. It is an indicator of the degree to which each node in the network is in a central position. There are various ways of thinking about what constitutes a central position, and various centrality indices have been proposed (e.g., Bonacich, 2007; Freeman et al., 1979). For example, there is degree centrality, a centrality index that defines the degree of a node as its centrality. Here, the degree is

the number of ties connected to the node. In other words, the more ties a node has with other nodes, the more central a position it is considered to have. In ego networks, the size of the ego network is of equal value. Betweenness centrality is a centrality index based on how a node mediates the relationship between other nodes. It is defined as the proportion of the node's presence on a line connecting pairs of other points. The more a node mediates the relationship between other nodes, the more central it is. A node with high betweenness centrality is considered to be able to control the relationships and information between other nodes.

The following are some recent and relatively highly cited papers that analyze the automobile industry using the method of social network analysis, taking into account the recent rapid technological changes known as CASE. Li et al. (2019) provide technology forecasts for the automotive industry based on network analysis of patent data. Rashidi et al. (2020) provide a multifaceted analysis of the future impact of connected and autonomous vehicles based on a network analysis of bibliographic data. Castro et al. (2020) discuss the automotive industry's energy efficiency based on the paper's network analysis and co-authorship. All of the above are very interesting studies, but their themes and data are different from this study. Other qualitative studies existed, but this study's quantitative empirical studies are considered rare.

Research hypotheses

Next, based on the research mentioned earlier, the research hypotheses were derived as follows. The hypothesis is about the relationship between the change in the type of partnership and the change in the network structure of the partnership. The network structure characteristics were identified based on the theory mentioned earlier of social networks. This enabled us to analyze the network structure using the method of social network analysis and quantify its characteristics as network indicators.

The first simple hypothesis is that the number of partners that the firm associates with will increase as it moves from closed, integrated inter-organizational relationships to open, specialized inter-organizational relationships. As CASE develops, car manufacturers will need to tackle a range of new technological elements that they have not previously covered. For example, even if we consider only electric vehicles, it is necessary to develop various technologies related to the vehicle itself, such as batteries and motors, and to solve infrastructure issues such as charging facilities. Autonomous driving involves a huge number of issues, including the accumulation and analysis of big data, the development of road networks for location information, and the development of communication technology between vehicles. To this end, it is necessary to develop beyond the field of conventional automobile development, such as information and communication technology and artificial intelligence. Issues such as sharing and communication are also driving a change in the automotive revenue model. For car manufacturers, it is not a question of increasing car profit margins and sales volumes, but of transforming into new revenue models, including services and solutions related to mobility. This requires developers to work with a variety of companies, including railway companies and real estate companies, and to target the whole transport system and the whole city. As described previously, with the adoption of CASE, the issues needing to be addressed by automobile manufacturers and the automobile industry will be very broad, and it is expected that the partnership will be broadened.

With the shift to CASE, the issues covered by car manufacturers and the automotive industry are expected to become much broader, and the technical uncertainties will increase. According to the discussion on dynamic capabilities by Teece et al. (1997) and others, strategic decision-making capabilities become important when changes

in the technological environment occur. When the technology is immature and uncertain, extending the scope of the partnership allows multiple technologies, both internal and external, to compete and to choose the better of the two. By working with a range of partners, it is also possible to penetrate their own technical specifications and aim for future standardisation.

Hypothesis 1: The higher the share of CASE-related partners in the total partnerships, the wider the network of partnerships of the automakers.

In addition to the breadth of this network, the diversity of partners is also important in terms of innovation. Innovation is necessary in order to work on unconventional technologies and new businesses. In particular, in order to achieve radical innovation, it is useful to meet with different kinds of knowledge as far as possible from the company's own knowledge domain. Therefore, it is likely that the structural hole effectively promotes innovation. The larger the structural hole, the more opportunities there are for new combinations of knowledge, and the more innovation is promoted.

Hypothesis 2: The higher the share of CASE-related partnerships in total partnerships, the larger the structural hole in the automakers' partnerships.

On the other hand, as an alternative between Hypothesis 1 and Hypothesis 2, the partner's size may not necessarily promote innovation. As for the relationship between a sparse network and superior performance, which are claimed by the theory of structural holes, previous research argues that strong cooperation is important to achieve excellent results (Gargiulo et al., 2009). This is because if the provision cost of the information provider is high, it is difficult to access the information unless the relationship between the actors is strong.

According to a series of research findings on exploration and exploitation starting with March (1991) in the study of organisational learning, if companies become too active in external collaboration, their R&D capacity may decline. A series of studies on absorptive capacity, following Cohen et al. (1990) in their study of organisational capacity, suggests that if a company's own R&D capacity is reduced, its ability to understand and use external knowledge may also ultimately be reduced. In addition, even if the partners are diverse, the probability of success tends to be lower when partnering with a partner whose R&D differs significantly from that of the company (Lane et al., 1998).

Considering CASE, for example, the structure of electric vehicles is much simpler than that of gasoline-powered vehicles, so it is conceivable that a single finished vehicle manufacturer could reduce the number of component manufacturers it deals with. In addition, as mentioned in the previous section, it is assumed that a large number of management resources will be required if one company tries to develop a wide variety of issues. Therefore, no company is likely to attempt to carry out comprehensive and integrated business activities on its own. In other words, while innovation is advancing in the mobility ecosystem as a whole, car manufacturers may be concentrating their development resources on a limited part of the ecosystem.

Hypothesis 3: The share of CASE-related partnerships in total partnerships is not related to the size of the network of partnerships of the car manufacturers, nor the size of the structural holes.

If inter-organizational relationships are moving from vertically integrated to horizontally specialized, there is a further question of whether they are becoming platform-based. This is closely related to the relationships between components or services that make up the product/value chain. By modularising computers and IT products, the division of labor can be facilitated, and individual companies can efficiently conduct R&D by concentrating management resources within their business areas. Suppose new entrants to the market are promoted. In that case, many

companies will innovate in a productive and perishable manner, creating new and diverse products and services and increasing cost performance through competition. These are innovations by the ecosystem (Iansiti et al., 2004). If, as CASE progresses, the number of business areas for automakers and related companies to consider expands significantly compared to the existing automotive industry, it may be difficult for a single company to undertake comprehensive innovation. Rather, it may be advantageous for each company to share innovation autonomously.

In such a horizontally specialised industrial structure, the core company in the ecosystem is the platformer or platform leader (Gawer et al., 2002). Based on their own products and technology standards, platform leaders seek to expand the overall ecosystem by collaborating with firms that offer complementary products and services. Platform leaders therefore try to increase the number of complementary companies as much as possible by appropriately separating their own and their partners' business areas and by working together with them. Thus, making their products and technologies dominant in their industry is an important growth strategy for platform leaders. For example, platform leaders in the IT industry are building new partnerships with thousands of companies and expanding horizontally across existing business lines and industry boundaries. with the development of CASE, the automotive industry could also be reshaped, with companies aiming to become platform leaders.

Such platform leadership is considered a good fit for betweenness centrality among the measures of network structure characteristics. The measure of betweenness centrality allows us to measure how other firms are connected through the firm. If a car manufacturer has a platform leader position in the network of partnerships, the value of the betweenness centrality indicator will be higher.

Hypothesis 4: The higher the proportion of CASE-related partners in the total partnership, the higher the betweenness centrality in the network of automakers' partnerships.

On the other hand, as an alternative to hypothesis 4, even if CASE progresses, the industrial structure may not be modularised and the inter-organisational relationships may not become platform-based. This could be due, for example, to causes related to the stages of the product lifecycle, or to industry-specific characteristics. Technological developments related to CASE are still ongoing, and many products will be put to practical use in the future. In addition, the scope of technological development is not limited to automotive products. Nevertheless, they cover a wide range of fields, including transport infrastructure, residential and commercial facilities in towns and cities, and energy issues. These interact with each other and are likely to require complex coordination. In the initial stages of technological development on such a large scale, it would be appropriate to develop the technology in an integrated manner, working closely with specific companies, rather than through an autonomous division of labour. Later, as the overall composition and the interrelationships of the components become clearer, the phase may shift to one in which standardisation and division of labour are promoted.

It also needs to consider the unique characteristics of the automotive industry. Today's passenger cars are integrated products because they are designed with numerous components coordinated to optimize individual consumers' diverse and ambiguous quality requirements. As CASE progresses, the complexity and individuality of the car itself may decrease. Still, the car will respond to each city's complex and individual demands as part of all means of transportation in the city right. Transportation issues differed from region to region, such as congested urban areas and depopulated rural areas, advanced and aging countries, and countries with immature infrastructure. Suppose individual and optimal solutions are needed to solve

each regional issue. In that case, it may be desirable in the future for the industry to be integrated and for companies to cooperate and coordinate closely.

This inter-organizational partnership situation is considered a characteristic of a network structure with high density. The high density of the network means that all the nodes that make up the ego network are interconnected. The inter-organizational network was dense in the conventional automobile industry because of the close interconnection among a limited group of companies. If integrated inter-organizational relationships are maintained, the density of the network structure of partnerships is likely to remain high even with the development of CASE.

Hypothesis 5: The ratio of CASE-related partners to total partnerships is not related to the density of automakers' partnership networks.

Data

As mentioned earlier, the analysis in this study is based on data on partnerships of car manufacturers. The data on partners comes from FactSet's Supply Chain Relationships database, which collects information on the suppliers and partners of companies around the world, based on public information such as company press releases and information from surveys conducted by FactSet. FactSet Supply Chain Relationships is an additional service of Nikkei Telecom. The data in FactSet Supply Chain Relationships is categorised into suppliers, customers and partners. The data on partners in this study were obtained from the partners.

As candidates for the companies to be extracted, we consulted the industrial yearbooks published by Fourin (2019a, b), a research company specialising in the automotive industry, to compile a list of global car manufacturers. We then searched the FactSet Supply Chain Relationships database to obtain data on all companies included. The total number of companies we were able to obtain was 106 car manufacturers and 901 partners in total.

From the FactSet Supply Chain Relationships database, we obtained the names of car manufacturers and partners, as well as information on partnership type and industry category. The industry category was used to measure how automakers collaborate with their partners on CASE. We then calculated the percentage of CASE-related partners in each automaker's total partnerships. This value will henceforth be referred to as the "CASE ratio".

Network indicators

Network indicators were selected according to each hypothesis, as described below. We then statistically analysed the relationship between the proportion of CASE-related partners in the total number of partners of each automaker. In addition to the statistical analysis of overall trends, case study analysis was carried out for companies with particularly large and small CASE ratios.

The network indicators used to test each hypothesis are as follows. In hypothesis 1, the size of the network is based on the size of the ego network of each car manufacturer. The size is the number of actors (alters) to which the ego is directly connected.

Constraint was used for the structural holes in Hypothesis 2. Constraint is Burt's index (Burt, 1992). It is a measure of the degree of Constraint in a network; the smaller the value of Constraint, the larger the structural hole, indicating that firms are effectively coordinating with various firms. The Constraint of node I to node j is calculated as a weighted sum of the number of paths that directly or indirectly connect the two nodes i and j in the network. The weight is calculated as the ratio of the strength of node i's connection to each node until it reaches j to the strength of node i's connection to

the whole network. One of the nodes is fixed, and the Constraint between it and all other nodes is added together to obtain the Constraint per node. Regarding Burt (1992), this indicator is used as a measure of the structural hole because of the social and economic costs of creating and maintaining strong connections between nodes and the interpretation that the more paths there are to reach other nodes. The more connected these paths are, the less freedom to act.

Hypothesis 3 corresponds to the null hypothesis of Hypotheses 1 and 2.

In the platform of hypothesis 4, we used broker and ego betweenness. These are measures of the brokering of a node, indicating the percentage of connections it brokers between other nodes in the network. Broker provides the number of times and services on the shortest path between two alter egos (i.e. the number of pairs of alter egos that are not directly connected). The nBroker is a normalised measure, a function independent of the size of the ego network. EgoBetweenness is the sum of the proportion of times the ego is on the shortest path between each part of the alternatives. The contribution of an ego to the alter connected via one or more other egos is $1/k$, where k is the number of nodes connecting that pair of alters. nEgoBetweenness is Ego Betweenness normalized by the number of nodes in the ego network.

For Hypothesis 5, density was used. Density is the number of connections between nodes in the ego network divided by the maximum number of possible connections between all the nodes in the ego network. (Wasserman et al., 1994).

The network analysis is based on UCInet ver. 6.6. Borgatti et al. (2002) was referred to the calculation method.

Result of analysis

Data

The number of companies available from FactSet Supply Chain Data, mentioned above, was 106 for car manufacturers and 901 for partners in total.

The main types of partnership were Research Collaboration, Manufacturing collaboration, Joint Venture, In-licensing, Out-licensing, equity Investment, and investors. There was also at least one company in the distribution, marketing, and integrated product offering categorizations.

As it is difficult to categorise each partnership strictly as CASE or not, the ratio of partners in the following industry categories to all partners was used in this study as a proxy variable for the degree of cooperation with partners on CASE. The industry categories are Packaged Software, Electrical Products, Internet Software/Services, Telecommunications Equipment, Electric Utilities, Broadcasting, Information Technology Services, Semiconductors, Electronics/Appliances, Electronic Equipment/Instruments, Electronic Production Equipment, Major Telecommunications, Electronic Components, Internet Retail, Alternative Power Generation, Wireless Telecommunications, Computer Processing Hardware, Data Processing Services, Computer Communications, Electronics Distributors, Specialty Telecommunications, Cable/Satellite TV, and Computer Peripherals.

As a basic statistic, the average CASE ratio for each car manufacturer was 0.18 with a standard deviation of 0.21. For example, a CASE ratio of 0.18 means that 18% of the total number of partner companies belong to the above-mentioned industries. Car manufacturers are working on their own CASE initiatives and many electrical components are already in use. However, if the CASE ratio is low, it can be assumed that automakers are not doing much joint research with partner companies on electrical components, etc., and are simply using them as purchased items.

Network analysis

Next, I calculated the network indicators for the extracted partnership data of each car manufacturer.

First, as a preliminary preparation for calculating the network index, I reconstructed the original database into a combination of two companies each. For example, if company A's partners are company B and company C, I extracted two combinations, company A and company B, and company A and company C. Next, the names of the firms were collated. The unit of analysis in this study is the firm, and the firm name appears many times in the database as a partner of another firm. The same firm name was sometimes spelled differently in the FactSet Supply Chain Relationships database. Therefore, I checked the original data one by one and corrected the names of the same firms to be the same.

The data on the firms' partnerships were then replaced by an adjacency matrix and entered into the UCINet software. As mentioned earlier, each of the network indices was calculated for the Ego network by UCINet. For the betweenness centrality, I used nBroker and nBetweeness to use the normalized values. This is because the original Broker or Betweenness is affected by the size of the ego-network, since the larger the size of the ego-network, the more paths are simply mediated by the nodes under analysis. By normalizing, the degree of betweenness centrality can be compared with other nodes without being affected by size.

Regression analysis

A regression analysis was conducted for each automaker using the percentage of partnerships related to CASE as the objective variable and each network indicator as the explanatory variable. Before the regression analysis, I calculated multi-collinearity indicators such as the variance inflation factor for each network indicator.

As a result, various possibilities of multi-collinearity were suspected. Therefore, a single regression analysis was conducted for each network indicator. The regression coefficients and the significance probabilities of the results of the single regression analysis with each network indicator as an independent variable are shown in Table 1.

Table 1
Results of Regression Analysis of Network Indicators and CASE Ratio

Network index	Regression coefficient	p-value
Size	0.348*	0.038
Constraint	-0.390*	0.019
nBroker	0.241	0.157
nEgoBetween	0.075	0.666
Density	-0.241	0.157

Note: *: 5% significance level
Source: Authors' work

As shown in Table 1, the size of the ego network and the size of the structural hole were significantly related to the proportion of partners associated with the CASE. Note that the magnitude of the Constraint represents the smallness of the structural hole. Since the regression coefficient is negative, the higher the proportion of partners associated with CASE, the larger the structural hole.

On the other hand, betweenness centrality and density were not related to the proportion of partners associated with the CASE.

Case analysis results

Out of all the car manufacturers, two companies with high and two companies with low CASE ratio were selected and the network index of each company was extracted. As a result, NIO and BYD, both Chinese automakers, were identified as automakers with high CASE ratios. On the other hand, Daihatsu and Subaru in Japan were identified as automakers with low CASE ratios. Each network indicator has been standardised (mean value subtracted and divided by standard deviation) for ease of comparison (Table 2).

Table 2
Network Indices of Companies with High/Low CASE Ratios (After Standardisation)

Company	NIO (China)	BYD	Subaru	Daihatsu Motor
CASE ratio	High	High	Low	Low
Size	-1.0	-0.6	-0.7	-0.9
Constraint	-0.6	-0.6	1.2	2.0
nBroker	0.7	0.8	-1.7	-1.5
nEgoBetween	0.9	1.0	-1.2	-1.2
Density	-0.7	-0.8	1.7	1.5

Source: Authors' work

The case study results show that while there is no difference in the network index representing size between the automakers with high and low CASE ratios, there are contrasting results for each of the other indices, with different positive and negative values after standardization. Figure 1 shows the ego-network diagram of BYD described above, and figure 2 shows the ego-network diagram of Subaru.

Figure 1
Ego-network diagram of BYD
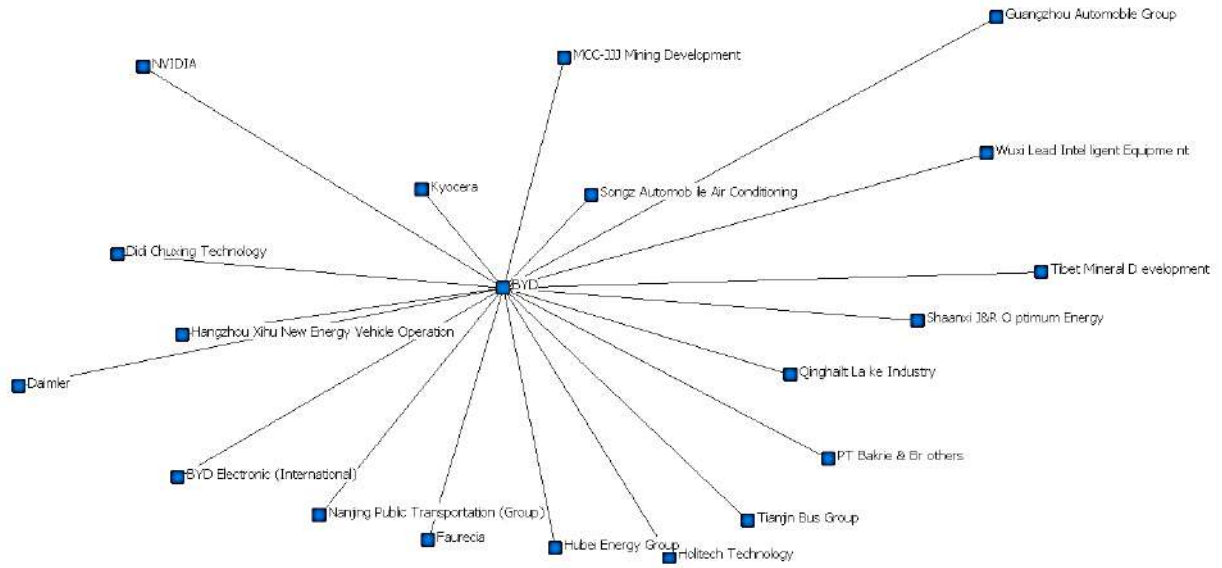
Source: Authors' work

Figure 2
Ego-network diagram of Subaru
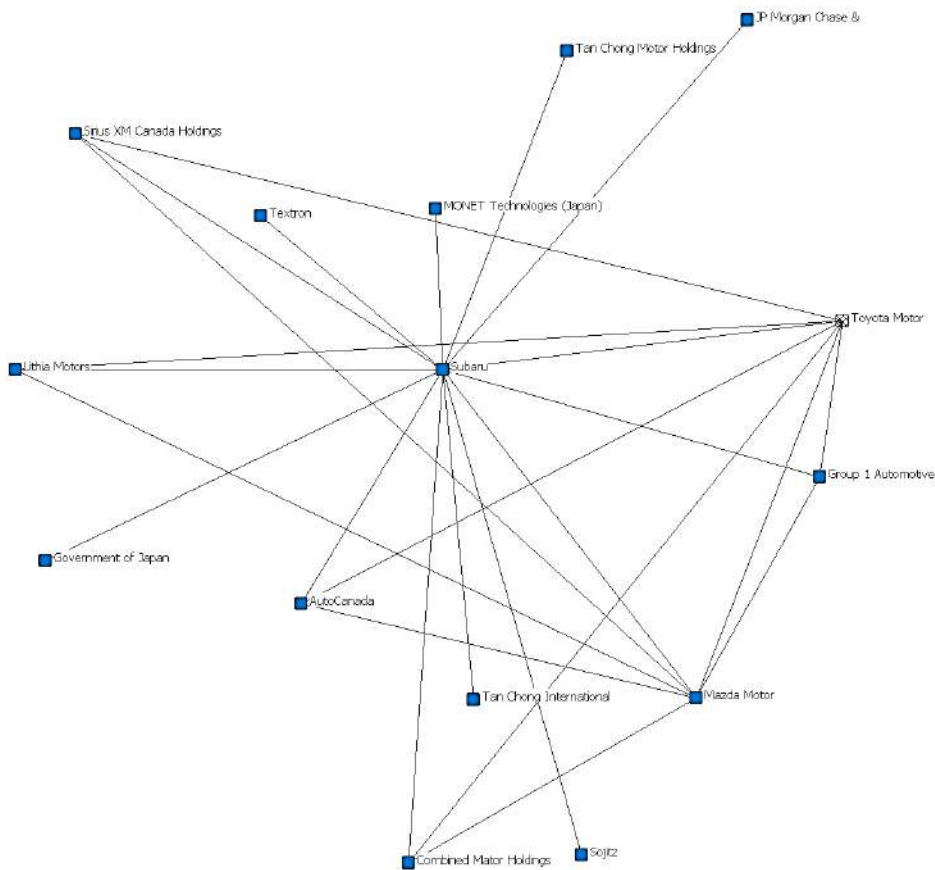
Source: Authors' work

An intuitive comparison of the two diagrams shows that BYD is the medium through which the other firms are connected in the BYD diagram. On the other hand, the Subaru diagram shows that the partners of Subaru are also closely interconnected.

In contrast to the aforementioned statistical analysis of manufacturers as a whole, the results of the statistical analysis of manufacturers as a whole showed that betweenness centrality and density were unrelated to the CASE ratio, but in the case study, some trends were observed that differed from the results of the overall statistical analysis. The reasons for this are estimated in the following discussion.

Discussion

Next, we have verified each hypothesis based on the results of the previous analysis. Firstly, the results of the correlation analysis on the trends of all car manufacturers show that the companies that are promoting CASE have a wider and more diversified range of partnerships. This result supports hypotheses 1 and 2 and rejects the opposing hypothesis, hypothesis 3. A number of car manufacturers are currently expanding their R&D activities by investing aggressively in new CASE areas while maintaining their existing gasoline engine-based vehicles and vertically integrated supply chains. To this end, it is presumed that the network of new partners is being expanded. The expansion of partnerships and the diversification of R&D themes require a large number of resources. The results of our analysis are consistent with these phenomena, as global automakers are currently aggressively pursuing M&A and scaling up their operations in preparation for CASE. Passenger car manufacturers' profitability is expected to decline, and they may be forced to scale up to cover the huge upfront investment in CASE.

On the other hand, the results of the correlation analysis show that horizontal specialisation and platformisation are not correlated with the development of CASE. These facts seem to indicate that the existing vertically integrated organisational relationships have not changed with the development of CASE, as is the trend in the automotive industry as a whole. This trend was the same for both finished vehicle manufacturers and component manufacturers. Therefore, the results of the correlation analysis seem to reject hypothesis 4 and support the alternative hypothesis, hypothesis 5.

For example, the current overall trend seems to indicate a situation that is different from the past experience of the computer industry. In the computer industry, since the 1990s, digitalisation and networking, exemplified by the spread of the internet, has changed the relationship between organisations throughout the industry. The vertically integrated companies that had previously dominated the industry were dismantled and replaced by a horizontal division of labour between specialist companies. The computer industry became an ecosystem industry, sharing a variety of interface standards.

This raises the question of whether inter-organisational relationships in the automotive industry will remain unchanged as CASE progresses. It can be presumed that existing car manufacturers and parts suppliers are trying to extend the life of their current business models as much as possible and maintain their current profitability. In addition, the realisation of autonomous driving and car-sharing in CASE involves companies from many industries, each with different interests. In order to overcome the various difficulties, it is possible to maintain vertically integrated organisational relationships and to continue joint prior investments. Alternatively, another possibility is that the technology development for CASE is vertically integrated because it is at an early stage in its lifecycle. In other words, a possible scenario is that as development

progresses, many of the technologies mature, and various technology standards are established, the relationships between organisations will specialise horizontally.

This is difficult to discern from the results of the current correlation analysis alone, but can be suggested by the results of the case studies. Of the automakers selected as case studies, the two with the highest CASE ratios were both electric vehicle manufacturers from China: NIO (China), a venture company established in 2011, is a promising manufacturer of electric vehicles. BYD was established in 2003 as an affiliate of an automotive battery company and is one of the world's largest producers and sellers of electric vehicles. As a partner, the company has established electric vehicle joint ventures with major companies such as Toyota Motor Corporation.

On the other hand, two Japanese car manufacturers were considered to have low CASE ratios. Both of these companies are small complete vehicle manufacturers and are mainly existing petrol car manufacturers. They also sell some hybrid vehicles, but both companies are part of Toyota Motor Corporation and are presumably receiving technical assistance from Toyota.

Interestingly, when we compared the network indicators for each of them, the results were opposite except for size. Individually, the results show that all four companies have a small network size. This is presumably due to the fact that each company is relatively specialised in new technology electric vehicles and existing petrol vehicles. For Constraint, the same trend as in the overall correlation analysis described above was observed: the smaller the value of Constraint, the larger the structural hole and the more efficient the collaboration with the various companies in the network.

On the other hand, for the Broker, EgoBetween and density indicators, there is no clear trend in the overall statistical analysis, but there is a relatively clear trend in the comparison between the companies analysed in the case study. Each of the selected companies is relatively small and deals almost exclusively with either new or old technologies. It can therefore be inferred that the organisational characteristics of each company are more clearly represented than those of companies engaged in a variety of R&D and business activities.

The results of the case studies suggest that emerging electric vehicle manufacturers with high CASE ratios are building partnership networks using themselves as platforms. This means that they may be in a position to be the platform leader in their network. Since the partners of each company include existing companies as well as new entrants that have become more cooperative as CASE has progressed, we can infer that a relatively loose ecosystem has been formed. In other words, the inter-organisational relationships may be similar to those in the IT industry. On the other hand, traditional car manufacturers with a low CASE ratio form a closed network with a relatively limited number of companies. This may well be a feature of inter-organisational relations in the traditional automotive industry. These two companies are not located at the centre of the network. They are presumably located on the periphery of a network of large partner companies that are expanding and diversifying their business. Let's say that, due to national legislation, internal combustion engine-based vehicles disappear in the future. In that case, the narrow and closed network structure of the past may not be adopted.

The results of this analysis suggest that there are two main types of inter-organisational relationships that the automotive industry could adopt in the future as a result of the development of CASE. The first is a large, comprehensive and relatively closed network centred on existing large companies. The other is a relatively open network in which new technology-based start-ups are the platform leaders. According to the framework of competition between ecosystems presented by Adner

et al. (2016), the former network structure is more suitable when the pace of future technological innovation is relatively slow or when there are large differences in the characteristics of transport demand between regions. This is the inter-organisational relationship which is more suited to a business model in which a group of companies with integrated technology are familiar with each country and region and offer individual solutions.

The latter network structure, on the other hand, would be effective if innovative technologies related to CASE are realised and provided as platform technologies that allow various companies to work together efficiently. It can be assumed that cost performance will rapidly improve for users of transport and that companies based on existing products and technologies will be forced to change. However, these assumptions are only speculative based on the results of the current analysis, and continued research is needed to determine which network structures will become the norm.

Conclusion

In this study, we have created a database on the network structure of partnerships by car manufacturers worldwide and analysed it using network analysis methods, which has led to some useful insights. In response to technological changes in CASE, car manufacturers are increasing the size and diversity of their networks. The case studies also show that inter-organisational relationships in the automotive industry may be shifting from a closed, integrated to a platform-based network structure.

There has been a lot of discussion in newspapers, magazines, blogs and research papers about the impact of the technological innovation known as CASE on inter-organisational relations in the automotive industry. However, their conclusions are not always the same. Moreover, most of them are qualitative case studies and their generalisation is problematic. The contribution of this study is that all the major car manufacturers in the world were included in the analysis and the results of the quantitative study are presented.

One limitation of this study is that CASE is still in progress and the structure of inter-organisational networks in companies may change further in response to future technological changes. As a future task, it is desirable to continuously investigate the changes in the technological environment and their impact. In addition, although CASE was analysed collectively in this study, the impact of the four elements of CASE on inter-organisational relationships may differ (Fujimoto, 2020). Therefore, we would like to consider a method to analyse these elements separately.

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Information System Implementation in Healthcare: Case Study of Croatia

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Abstract

Background: In today's environment, health professionals are overwhelmed by the rapid pace of advancement in both information technology and medical practice. **Objectives:** This paper aims to point out the importance of developing an electronic health record system that will meet the needs of all stakeholders in healthcare, support health professionals' work, and enable continuous quality improvement at all levels and in all healthcare segments. **Methods/Approach:** Non-systematic literature review has been used to develop a discussion on the healthcare systems' usage. **Results:** Close cooperation of participants at all levels is essential for the quality implementation and application of digital solutions in healthcare. **Conclusions:** The paper highlights the factors that contribute to the acceptance of the public healthcare information system in the Republic of Croatia, which is being developed according to the EU regulations.

Keywords: health information system; healthcare; organization and management in health; e-health in the EU; e-health in Croatia
JEL classification: I1M; O39; O19
Paper type: Review article

Introduction

In today's way of doing business, technology is a significant factor in shaping individual organizations. It is a generator of knowledge and innovation, and the level of technology development in a particular organization defines the competitiveness and position of the organization in the market. Technology can be viewed as an internal factor of an individual organization. Raising health services to a new level will not be possible without introducing new digital solutions. Their introduction will enable better health outcomes for patients, improve the efficiency of health systems and realize equal and inclusive access to health services for all. Improving people's health and quality of life and the more efficient organization and better implementation of health services are not possible without innovative digital solutions. Implemented e-health services improve the availability and speed of health services and the safety of patients and health professional's safety. A large amount of data is constantly collected in the health care system. Still, this data is not used regularly to make decisions on efficiency improvement, quality, and effectiveness of health care. Effective management of health data, using digital technologies, provides a quality, well-structured, standardized basis for further development of health services and achieving social solidarity.

The basic health information system of the Republic of Croatia is the Central Health Information System of Croatia, with more than 17,000 users together with a large number of separate information systems in hospitals. Healthcare professionals are the main users of the system. The importance of information and communication technology is expressed in everyday business through better control of the system's functionality as an aid in clinical decision making, resource management, patient management (reservations, appointments, invoicing), implementation, and monitoring of epidemiological sites, and more. An information system can be defined as any system used in business. Its task is to collect, sort, process, store, and distribute data. It does not necessarily have to be supported by a computer (Pavlić, 2011). The public health information system is also known as the health care planning system or the hospital information system. Its development dates back to 1960 when the system's main functions were limited to administrative management (Dezelic et al., 2014).

This paper aims to emphasize the importance of the health information system through its management potential that will result in a good business result. There are high expectations regarding the service they provide as they have to leave a great impression on stakeholders in these challenging times of constant change. In a competitive commercial healthcare environment, negative experiences and poor service indicate inefficiency, higher cost, lower quality of care, and a poor image of the overall healthcare system.

Methodology

Informatization in health care is a current topic that aims to analyze the application of innovative solutions to better and more efficient organization and management of this large system. The paper gives a brief overview of the application concept so far through several temporal features. Special attention is paid to the importance of health system informatization activities viewed through the prism of our country and the EU as a generator of many changes. We are all stakeholders and are viewed as active determinants of the concept. The paper is based on a systematic analysis of previously published relevant international scientific papers in health informatization, legislation, and the application of information and communication technologies. Methods of analyzing the temporal characteristics of a given topic and the impact

on further development through the applied aspect were used. The deduction method was used to conclude the importance of informatization in health care for business results and to determine the multiplicative effect of positive changes on society.

Healthcare information system

As the severity of patients' illnesses increases, medical staff must spend more time on care. The need to apply existing information technology to provide health care assistance has been introduced to improve the quality of healthcare services effectively. The creation of this system involves mainly a set of standards-based on health diagnostics, symptoms, cause, health goals, and measurements.

It is necessary to make certain changes in the system and take strategic steps. Changes should be well defined and gradually implemented, and it is necessary to have an appropriate strategy, clearly defined instructions, and certain foundations for implementing the guidelines. Implementing the guidelines is modern and efficient healthcare available to all, which will be characterized by mobility and openness.

Implementation of the guidelines should include: changing hardware, changing standards, changing protocols, changing platforms, changing codes, changing interfaces, changing portals, changing publications, changing registries, and changing telemedicine streaming. Intensive work is being done to consolidate the institutional framework, strengthen the capacity for rapid primary response (especially in the case of bioterrorism and the like), and better coordinate health promotion and disease prevention.

The combination of the business process through informatization is a health information system that aims to more efficient information management, security of data use, archiving and stored information, and connecting health care institutions. The public health information system mainly implies a set of standards based on health diagnostics, symptoms, cause, health goals, and measurements. Such computerized programs provide nurses with the necessary content, health care plans, and additional functions, including addition, revision, query, and printing (Kern et al., 2017). To obtain a more efficient information infrastructure system, users are offered all professional information. In contrast, within one hospital, they are offered access to specific information and knowledge bases that are important for the specific activity of a specific hospital system. The system also offers an infrastructure for the organization of e-learning systems (Galijačević 2004). Factors influencing the development of information system services are organizational, financial, and market (Wang et al., 2005). The health information system plays a major role in coordination between health system participants and patients.

Suppose state institutions cannot effectively allocate the resources and services. In that case, they provide to citizens, the situation in health care can be further aggravated through the example of the prevalence of corruption in health care (Mihaljek, 2006). There are high expectations in terms of the service provided by organizations as they have to leave a great impression on every user. The health sector consists of a dozen markets in health care and treatment, various insurance forms, medicines; medical equipment; labor market for medical staff, etc. In most of these markets, there is a so-called. Market failures include unfavorable choices, asymmetric information, growing returns, and moral hazards (Mihaljek, 2006).

The concept of the health care system has changed over time. The earliest concept of the health system is the transition from paper to computer data processing. The constant growth of new technologies allows for a constant computing environment and sensor technologies for health monitoring. Implemented information systems

reduce the need for the physical presence of employees, hierarchical control of superiors over subordinates, and direct integration mechanisms, taking into account the fact that they are realized through electronic connectivity. The creation of virtual networks and systems is contributed by a quality management information system that also improves the range of control while reducing the number of hierarchical levels in the organization. Reducing hierarchical levels in an organization is called a shallower organization. The practical application of information and communication technology points to the fact that it encourages development and change in the organization's structure (Cunliffe, 2008).

There are three data sets: electronic health record, electronic medical record, and electronic personal health record (Kern et al., 2017):

o Electronic health record IT module - processes data on the user's health status stored in the system and can be transmitted securely electronically, and their visibility is allowed to the user.

o Electronic medical record IT module - processes only the user's health data stored in the system that can be transmitted electronically in a secure manner.

o Electronic personal health record – the user's health status summarized in a set of data that the user creates and records. They are in electronic form and are freely available to users.

The electronic medical record (EMR), which is at the heart of every health information system, is important for integrating patient data in healthcare. EMR is a medical record in digital form, while electronic health record (EHR) refers to a medical record of an individual patient in digital format. Electronic personal record (EPR) is defined as electronically stored health data of a single unit, uniquely identified by an identifier. EHR systems coordinate the storage and retrieval of individual records. EPR technology includes the individual and comprehensive retrieval, storage, retrieval, transmission, and manipulation of healthcare-related data, particularly clinical, administrative, and biographical data (Borycki et al., 2011).

Due to their availability and easily acceptable form, digital tools have a great opportunity to spread scientific knowledge. People's interest and their active participation in health promotion, prevention, and care, together with rights, guide the development of information systems and give new tendencies. The trend is to involve patients or citizens in the source of information, decision-making, and awareness of responsibility for their health. Technology in the health system creates more efficient and better communication between the patient and the system. It provides quality support in changing lifestyles and taking a more active role in improving their health.

Further development towards an integrated health information system includes a holistic approach to personal habits, physical activities, spiritual and emotional activities, and social support and social networks that would become part of the system. The integration of technological solutions into health systems is especially evident in the configuration of new models of care and the use of health technology assessment to achieve higher quality and sustainability of health services. Through digital solutions and various applications for measuring health parameters, Demands for health services and care can make citizens actively involved in health promotion and manage chronic conditions on their own. The knowledge and skills that employees need to handle a particular technology mutually determine the degree of organization and technology and point to the technological imperative, i.e., the assumption that technology determines all other aspects of the organization (Hatch, 2006).

Development of e-health in the EU

The development of e-health is a program policy systematically implemented by the European Union to develop a new service branch called the e-health care industry. The e-health industry has great growth potential and could become the third industry whose revenues exceed 11 billion. Euro, or about 5% of the total health care budget (Commission of the European Communities, 2007). The European Union gives member states autonomy in creating a health care system under the Treaty of the European Union of Maastricht of 7 February 1992. The goal is to create a European area of e-health as a platform for joint actions in e-health and provide a favorable environment for its development and dissemination (Ostojić et al., 2012). In the European Union, e-health includes information systems in clinical work, information systems in the home care service, personalized health information systems, information health systems for remote patients, support information systems, e.g., billing systems, and integrated regional and national health information networks. Current European Union health policy is currently reflected in the five areas listed below (European Parliament, 2020):

- o Health in all policy areas of the European Union - the "Field to Table" Strategy has been adopted, and the goal of the strategy is to produce sustainable and healthier food. A Zero Pollution Action Plan has been adopted to create a cleaner and healthier living space; Public health funding in EU Member States has been partially addressed through the European Social Fund Plus, which, together with other funds and programs (e.g., the European Regional Fund), will help address open health problems. The EU will fund projects to mitigate the effects of climate change, i.e., solving health problems caused or aggravated by climate change. Due to heatwaves and natural disasters, the number of deaths is undoubtedly rising. Current patterns of human infection have also changed, and it is thought to have been influenced by modes of disease transmission, such as vector insects or water as a medium.
- o Disease prevention and health promotion - The EU has implemented joint activities to preserve and benefit mental health from 2013 to 2018. A uniform legal framework for mental health and well-being was created during the implementation of joint activities. The fight against cancer will also get its legal framework in the form of a Cancer Plan.
- o Changes in society and demographic transition - following new demographic trends, increasing population aging was identified, and in 2016 an Action Plan was adopted, which includes the integration of citizens from third countries.
- o Medicines - the EU-wide Regulation on Clinical Trials and other legislation on medicinal products and in vitro diagnostic medical devices has been in force since 2020. The European Union has monitored the application of these regulations to determine whether the expected results are being achieved. Join discussions on some important issues that have begun, such as the shortage of medicines and vaccines and access to more affordable medicines on the Health Committees.
- o E-health - information and communication technologies address many health issues, including disease prevention, diagnosis, treatment, and health and lifestyle monitoring. The digitalization of the health sector belongs to the EU's digital single market strategy and has great potential. Several measures are implemented simultaneously so that the common market can function. In 2018, the communication on enabling digital transformation in the single digital market in health and care was adopted. This document defines the priorities of the digital healthcare market: secure access of citizens to health data, access to health data by citizens when they are outside their home countries and within

EU countries, and the implementation of personalized medicine through a common European data infrastructure. This allows for pooling in using resources by researchers and other health professionals. The use of shared resources should strengthen the position of citizens towards digital tools (e.g., mobile health solutions) and increase person-centered care - personalized medicine.

The European Health Information Initiative, set up by the World Health Organization (WHO), aims to improve information supporting health policies in the European region. It encourages international cooperation to support the exchange of expertise, capacity building, and harmonization of data collection and reporting processes. EHII operates in six key areas: (i) collecting and analyzing information that deepens the understanding of health and well-being, with an emphasis on indicators; (ii) improving access to and dissemination of health information; (iii) supporting the development of health information strategies; (iv) capacity building; (v) strengthening health information networks; (vi) communication and advocacy.

Development of e-health in Croatia

The informatization of the health care system in the Republic of Croatia began with the health care reform in 1993. The beginning of the integrated health care system began in 1994 under the organization of the Croatian Health Insurance Institute. The system called "e-Croatia" began at the beginning of the 21st century, and as part of this project, the e-health project came to life. The goals of the introduction of e-health were defined as improving the quality of health services for citizens while achieving significant financial savings. The reform provided several organizational solutions to improve the efficiency of the system and improve the quality of health care delivery, such as the informatization of primary health care, emergency care reform, the introduction of national waiting lists, and changes in primary health care payments, which should encourage quality and growth coverage of health services in primary health care (Broz et al., 2014). The computerization of the health care system started with the computerization of primary health care and hospitals. The implementation of the central primary health care information system based on the name NISHI (National Information System on Healthcare Infrastructure) was designed and developed by Ericsson Nikola.

In 2004, Croatia adopted an eHealth Action Plan. The Action Plan aims to implement e-health systems forms the EU system, define interoperability and its objectives, and use health records in electronic form (Barroso, 2015).

The National Health Development Strategy 2012-2020 published an analysis of the situation in the hospital, which states that about 45,000 employees were employed in Croatian hospitals in 2012, of which about 200 were IT, staff. In 2012, 36 hospital wards had separate IT departments, a hospital information system existed in 42 public hospitals, while in 20 public hospitals, there was no central information system (Ministry of Health, 2016).

In 2016, a project was implemented by the Croatian Health Insurance Institute and the Ministry of Health of the Republic of Croatia entitled Preparing a practical basis for building an e-HZZO (engl. Electronic Croatian Health Insurance Organization) system with the aim of better integrating cooperation with another state, interstate, regional and local stakeholders. Efforts were made to connect all stakeholders within the health system for more efficient management and more effective supervision, especially in the management and monitoring financial resources. Health information systems represent the interaction between people, processes, and technology to support management in providing essential information to improve the quality of health services (Ministry of Health, 2016).

The Agency for Quality and Accreditation in Health and Social Welfare existed in the Republic of Croatia until January 1, 2019 (Republic of Croatia, 2018). The purpose of its activities was to accreditation health services in health care and raised the quality of services in the health system through an advisory nature. After the termination of the Agency, its work is completely taken over by the Ministry of Health of the Republic of Croatia. The Agency was involved in an international study to determine the benefits and barriers to empowering patients in the chronically ill population. The term patient empowerment refers to how stakeholders in the health care system help the patients gain control over their own lives and increase the intensity of their actions in the area that is important to the patient. Communication is two-way, and patients have the opportunity to inform doctors by giving them feedback on their health. In the past, patients were passive observers of their treatment, while today, patients actively participate in their treatment and thus consume their rights and duties. The goal is for patients to become equal participants in the decision-making process.

Infrastructures e-health in Croatia

HZZO (engl. Croatian Health Insurance Organization) has created a database that contains data on all insured persons, taxpayers, and health care institutions. The database provides quality to doing business in the Republic of Croatia. The database enables real-time registration and check-out data monitoring and the creation of financial reports on paid sickness benefits, maternity benefits, etc.

The basic health information system of the Republic of Croatia is the Central Health Information System of Croatia (CEZIH). The Croatian Health Insurance Institute is the owner of CEZIH. The CEZIH system has several parts: the central information system and information subsystems of authorized health care providers in the Republic of Croatia. The program's purpose is to support the functioning of health processes in public health, implement special health care programs, and connect all other health information systems that represent an entity for themselves, all to provide appropriate health care to citizens of Croatia. HZO, as the owner of the health information system CEZIH, is an authorized issuer of digital certificates to users. In CEZIH, we distinguish two information systems. The first information system includes primary health care providers (family medicine clinics, polyclinics, pharmacies, etc.), i.e., the primary health care information system. The second system is the information system of secondary and tertiary health care, which refers to information systems in clinical hospital centers, hospitals, hospitals, and institutes. Every working day at CEZIH, all general family medicine clinics, pediatric surgeries, gynecological surgeries, dental surgeries, pharmacies, laboratories, school medicine surgeries, outpatient specialist-consultative health care, and the information system of the Croatian Health Insurance Institute are connected. More than 50 million recipes were recorded in one year. It is considered the central system of storage of health data and information in which standardized data processing is performed at all levels of health care.

NAJS is a national public health information system that provides information services of the Croatian Institute of Public Health and is connected to other institutions. It offers the possibility of managing information and processes in public health and serves to process health data and information in this narrow health segment. It is considered the central system of storage of health data and information in which standardized data processing is performed at all levels of health care.

BIS Hospital Information System 'Integrated Hospital Information System', so-called BIS. BIS has the most users because it has the most employees in hospitals and clinical hospital centers. The system keeps an e-card of patients with whom pharmacies,

laboratories, and the Croatian Health Insurance Fund are connected. Laboratory findings are available, an e-referral and e-prescription can be issued, the patient can be ordered for an examination, and an electronic prescription can be sent to pick up prescription therapy at any pharmacy in the Republic of Croatia (Poje et al., 2019).

HR-DRG – an information system that measures the efficiency of the hospital system, e-guidelines: integrated information system that integrates health guidelines into other e-systems and e-hospital – an integrated information system that is both standardized and interoperable in all public hospitals in the Republic Croatia (Republic of Croatia, 2020).

Obstacles in the further development of e-health

Incompatibility of digital solutions and non-support of data exchange within and outside national systems can be cited as an obstacle to further development of health system informatization. Hospitals, primary health care teams, institutes of emergency medicine, HZZO, etc., have information systems that are not interconnected. General hospitals, specialized hospitals, clinical hospitals, and clinical hospital centers are not interconnected with the hospital information system. In case of transfer of patients from one hospital to another, medical documentation is submitted in paper form. Hospital information systems of some hospitals are not connected to NICE either. Access to and use databases for research and innovation is limited, lacking financial resources and financial incentives. The main goals of health informatization are the following (Republic of Croatia, 2020): (i) improving connectivity and continuity in the health system; (ii) harmonizing and improving the quality of health care; (iii) increasing the efficiency and effectiveness of the health system; (iv) increasing the availability of health care and (v) improving the health indicators planned to be achieved through the implementation of an integrated program consisting of computerization of the central health system and the establishment of an e-hospital system.

The problem with introducing innovations is also a human factor because there are too few employees in the IT departments of health institutions who would identify the necessary innovations within the institution and their implementation. In health care institutions, the current problem is the obsolescence of devices and irregular servicing of devices. Since public health institutions are contracting authorities and subject to public procurement legislation, public procurement can be a health innovation and often a long and complex process involving health, legal, social, financial, and technical actors. The Ministry of Health of 2017 is conducting public procurement procedures. Joint procurement enables more efficient and economical spending of funds. So far, several procedures have been carried out for five procurement categories for 554 groups with a total value of over 1.2 billion kunas (Ministry of Health, 2021). The National Reform Plan sets out measures to improve the efficiency of management in the health care system, which consists of 3 objectives (Ministry of Health, 2021):

o   improve the health care system in such a way that the application of information and communication technologies is systematic, efficient, and prudent and provides an effective way to control costs in health care, increase the availability and quality of health services; The activity required for the realization of this goal is the definition of a strategic framework for the development of e-health and the development of the National Health Development Plan from 2021 to 2027.

o   raising the quality of health care, optimizing the resources of all hospital health systems, and ensuring the financial stability of the health system; activity for the

stated goal is the number of concluded agreements between hospitals on mutual functional integration, which is continuously implemented

o ensuring the financial sustainability of the health system; the activity for the stated goal is to make an analytical study and calculate the costs of major inefficiencies in the health system that have not yet been completed.

E-health and the Covid-19 pandemic

The current challenge facing all levels of health care institutions both in our country and in the world is the pandemic virus Covid-19, which has greatly changed the business. Hospitals have rapidly transformed and adapted their work to the new circumstances to reduce the likelihood of transmitting viral infection. Telemedicine came to life and realized the importance and readiness to invest in IT infrastructure and purchase software programs. The Covid 19 virus pandemic has intensified the application of already developed health information systems that can quickly be digitally transformed into the necessary applications with the required security levels. The Ministry of Health of the Republic of Croatia has published an application for Stop Covid-19. The purpose of using the application is to warn citizens that their contact, which the application has recorded, may be risky. HZZO has created a register of persons in isolation and self-isolation due to infection or exposure to the Covid-19 virus. A call center has been set up for people in self-isolation to get an answer to a question about their illness or status at any time.

The European Commission has adopted a Recommendation on a package of measures for applying technology and data to combat and overcome the crisis caused by the Covid-19 disease. The purpose of the Recommendation is to develop a pan-European approach to the application of mobile applications coordinated at the EU level, as a means to help citizens effectively limit social contacts and as a means to warn, prevent and monitor social contacts, to curb the spread of Covid-19. The European Commission has recommended the exclusive voluntary use of such applications without coercive measures. The European Union is providing a grant under the EU4Health project, i.e., the EU for health, from 2021 to 2027, with investments of 9.4 billion euros. The objectives are to improve the EU's preparedness for major cross-border health threats, to provide a stockpile of medical supplies for emergencies, to mobilize reserve health workers and experts who can be mobilized to respond to health crises anywhere in the EU, to strengthen health threat monitoring and systems to address epidemics and long-term challenges by encouraging disease prevention and health promotion in the context of an aging population, funding the digital transformation of health systems, ensuring access to health care for vulnerable groups and making medicines available and affordable, and affordability and availability of medical products, promoting the prudent and effective use of antimicrobials, promoting medical and pharmaceutical innovation and promoting green production (European Comission, 2021).

The ultimate goal of Croatian e-health is to improve management capacity through more efficient use of data as a basis for decision-making and policies. The selected data can be converted into health information with the appropriate algorithms based on which decisions will be made. Due to the new situation caused by the Covid-19 pandemic, the health care system faced challenges that led to a more intensive adaptation of the health information system to the real needs of the population.

Conclusion

This paper aims to review the development of the health care information system in the Republic of Croatia. The paper presents the principles of development of the information health system, its basic elements and purpose, and historical development. The policy of the European Union created further development of health services in the Republic of Croatia, all to provide comprehensive, timely, quality, and safe services. New digital and mobile applications can create a new future for patients by offering them personalized solutions to manage their health. Preventive health care will reduce the chances of developing potential diseases through protection and early detection to build people's quality of health and well-being.

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The Effects of Electronic Surveillance on Job Tension, Task Performance and Organizational Trust

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Abstract

Background: In contemporary work models, employees use the Internet and electronic devices more than ever. This phenomenon has also changed the way of monitoring employees and generated a new form called 'electronic surveillance'.
Objectives: The central purpose of this paper is to reveal the effects of electronic surveillance on job tension, task performance, and employees' organizational trust.
Methods/Approach: Survey research was applied as a quantitative method to collect data. Surveys were generated as Likert-type scales, and they were distributed by hand because the use of the in-person survey technique was employed throughout the study. The research sample was created using the purposive sampling technique, and it included 228 participants from fifteen different branches of one of the biggest private banks in Turkey. **Results:** Electronic surveillance in the workplace has turned out to have positive effects on job tension and task performance, whereas it harms organizational trust. **Conclusions:** When the degree of electronic surveillance increases, the job tension level of employees tends to increase as well. Additionally, task performance increases when electronic surveillance increases. But this is not the case with organizational trust since electronic surveillance affects it negatively.

Keywords: electronic surveillance; electronic monitoring; job tension; task performance; organizational trust
JEL classification: M12; M54
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Introduction

More and more organizations tend to invest in technology to keep up with the latest product developments and reach their goals and objectives more efficiently. Based on the technology-driven context in companies, employees are more engaged with technological devices. As a natural result of using technology in the workplace more than ever, management monitors employees through electronic devices nowadays. As strong evidence for electronic monitoring and surveillance (e-surveillance), according to American Management Association (2019), employers fired 28% of their employees due to misuse of emails and 30% due to misuse of the Internet in the USA in 2019.

Among the rationales behind using electronic surveillance, there exist (1) to assure the expected productivity (Moore et al., 2017; Urbaczewski et al., 2002), (2) to monitor employee behavior (Abraham et al., 2019),(3) to track performance (Watson et al., 2013) and (4) to sustain worker health and workplace safety (Eivazi, 2011). With the help of computers, phones, cameras, and the Internet, it is possible to track employees in the workplace today. It is clear that there is a need to control employee behavior in organizations, but is it a necessity to use the technological opportunities to keep an eye on employees' every action and behavior? There is a controversy on the positive and negative outcomes of electronic monitoring and surveillance. For example, there are studies about the positive outcomes on labor productivity (Abraham et al., 2019) and objective performance evaluations (Mishra et al., 1998). On the contrary, there is also sufficient research that employees have perceived electronic surveillance to have negative outcomes on health and performance (Abraham et al., 2019), counterproductive work behavior (Martin et al., 2016), increased tension betwixt supervisors and subordinates (Oz et al., 1999), job satisfaction (Carlson et al., 2017) based on psychological reactance theory.

This study it is aimed to search out the effects of electronic surveillance in the workplace on job tension, task performance, and organizational trust of employees. The conceptual basis for these relationships is built on the job demands-resources (JD-R) model (Bakker et al., 2007). It breaks down the job characteristics into two main groups, job demands and job resources (Bakker et al., 2010). Job demands can be taken as contextual aspects, which pressure employees while achieving a job. On the contrary job, resources are the ones that ease the way employees complete their tasks (Bakker et al., 2014).

Electronic surveillance may be taken as both a job demand or a resource based on the staff members' impressions depending on the circumstances. When electronic surveillance is perceived to disrupt personal privacy, it may be a job demand (Moussa, 2015). This is due to electronic surveillance, which causes work pressure and stress for employees (Carlson et al., 2017). But when it is perceived as a tool for increasing the wellness of the employees, by helping them save extra time or supply their performance feedback, it may be taken as a job resource. So at this point, the perceptions of employees about electronic surveillance distinguish a job resource from a job demand.

Theory and knowledge about electronic surveillance in the workplace have mostly relied on conceptual studies of scholars so far. The intended output from this paper is to put forth empirical results, which are still scarce in the literature. Various empirical research is subjected to electronic surveillance and monitoring (e.g., Holland et al., 2015; Martin et al., 2016). But still, there is a need to examine the subject extendedly. This study pays attention to the future research directions of Holland et al. (2015) to put forth empirical outputs about the link betwixt electronic surveillance and trust in the workplace.

After drawing the conceptual framework with a sufficient literature review throughout this paper, the research question of "what kind of effects of perceived electronic surveillance are there on job tension, task performance, and organizational trust of employees?" will be answered because there is still ambiguity about the effects of electronic surveillance on employee behavior in the literature. Therefore, it is aimed to reveal the impact of electronic surveillance on important employee behaviors such as performance and trust. This will be achieved by conducting a quantitative survey research method by collecting data from electronically monitored employees in the workplace. To achieve this, firstly, a detailed background is given. Following the conceptual framework section, the study's methodology will be explained in depth. Afterward, the results obtained from this study will be put forth and discussed before the conclusion.

Background

Electronic Surveillance in the Workplace

Thanks to the highly digitalized work environment, there is an increasing trend to monitor employees electronically. Electronic surveillance in the workplace defines the usage of cameras, computers, telephones, and smartphones to track the behaviors of employees for labor productivity, performance, and health considerations (Lee et al., 2003; Yost et al., 2019). In some studies, electronic surveillance is used together with electronic monitoring (e.g., Allen et al., 2007; Holland et al., 2015). Here, electronic surveillance is used as a form that covers the concept of electronic monitoring.

Electronic surveillance aims to gather data related to worker behaviors and actions. It can be conducted by using computer software (Spitzmuller et al., 2006), sensor technology by smartphones (Abraham et al., 2019), video cameras (O'Donnel et al., 2010), emails (Smith et al., 2009), voicemails, wiretapping, and active badge (Mishra et al., 1998). All of these tools, machines, and equipment are used by management or human resources departments to track and record, for example, performance evaluation, start and end time for work, length of shift, social media usage, internet surfing, necessary/unnecessary phone calls, planned/unplanned and necessary/unnecessary trips outside the workplace, absenteeism, health and sickness, duration of breaks and counterproductive work behaviors such a workplace theft, improper verbal and physical actions and even alcohol and drug use.

The context, which necessitates electronic surveillance on employees, is characterized by human resources managers' need for unbiased data about employees' work-related behaviors and actions, including productivity and performance feedback. Also, when the remote control is needed in such cases of being away from managers or working in virtual organizations or when employees cannot be monitored physically, electronic surveillance turns out to be a solution by management.

Electronic surveillance can affect employees in different ways, depending on how they perceive it (Martin et al., 2016). Here, perceived surveillance explains how employees think about being monitored in the workplace (D'Urso, 2006). According to the JD-R model, when employees perceive electronic surveillance as a stressor, it is taken as a job demand (Demerouti et al., 2001). Moreover, when employees think that surveillance by computer software, emails, or sensor technologies violates their privacy and personal data security, their attitudes and behaviors towards their jobs, managers, and organizations may be negatively affected.

Job Tension

Every day, employees face some stressful situations and calmative ones in the workplace. The concept of job tension is mostly about the stressors present in employees' work. It is present when employees live some difficulties and problems or worry about work-related factors (Lyons, 1971). Additionally, job tension can be defined as "perceived negative results of role perceptions" (Lusch et al., 1990). Because job tension is originated from only work aspects, it is a different structure from the general stress of employees (Pool, 2000).

Most of this tension arises from role conflict and role ambiguity (e.g., Irving et al., 2003; Klenke-Hamel et al., 1990; Schaubroeck et al., 1989). But there are also other antecedents of job tension observed in the previous studies. Among them, there exist; organizational climate (Milner et al., 2007), supervision (Keenan et al., 1984), behavioral integrity and procedural justice of supervisors (Andrews et al., 2015), interpersonal trust (Lau et al., 2006), leader-member exchange (Lawrence et al., 2012) and unethical practices (Weeks et al., 1992).

In this study, to contribute to the management theory, a specific human resources implication, electronic surveillance, is chosen to be an antecedent of job tension of employees. Compared to the other factors, electronic surveillance is perceived more like a job demand and practiced less frequently by the researchers previously. Among the previous studies, Oz et al. (1999) pointed out that electronic surveillance in the workplace creates unwanted tension with both their supervisors and their job. Moreover, Carlson et al. (2017) underlined that technological monitoring and electronic surveillance of employees might increase job tension, boosting turnover intentions.

Based on the literature, electronic surveillance turns out to be a natural job stressor for employees. When employees are subject to electronic surveillance, they tend to have high job tension. For this reason, the first hypothesis is developed as:

H_1: *Electronic surveillance in the workplace is positively related to job tension of employees.*

Task Performance

Today, companies search for ways to improve employees' performance. Human resource managers invest in employees' training and development and use every opportunity to motivate them. This is because high employee performance seems to guarantee organizational effectiveness.

Employee performance is mostly accepted to have a dimensional structure. These dimensions are named in-role and extra-role behavior (e.g., Demerouti et al., 2015, Srivastava et al., 2019; Van Dyne et al., 1998). In-role behaviors are the one's employees practice by their job description. On the contrary, extra-role behaviors consist of voluntary actions beyond job descriptions (Kim et al., 1996). Related to these behavior types, Borman et al. (1997) classified performance into two groups. Task performance is defined as the level of attainment in the technical duties and essential tasks predetermined in an employee's job, whereas contextual performance is about moving beyond core duties and tasks by being more cooperative and helpful, demonstrating extra efforts for the organization's sake (Conway, 1999; Motowidlo et al., 1994).

Generally, electronic surveillance practices are planned to increase the performance of employees in the workplace. To increase productivity, tracking the actions of employees should help them accomplish job-related duties. So, when employees perceive electronic surveillance as a positive input for productivity, their acceptance is more likely to increase (Abraham et al., 2019). And when employees

tend to accept electronic surveillance rather than demonstrating resistance to it, it is more likely to impact their task performance based on previous studies positively (e.g., Bhave, 2014; Goomas et al., 2009). So;

H₂: Electronic surveillance in the workplace is positively related to the employees' task performance.

Organizational Trust

Trust is a term related to an individual's or a group's feeling vulnerable towards the other individual's or party's attributes or behaviors (Pirson et al., 2011). Trust also consists of willingness (Mayer et al., 1995) to take some acceptable risks of the other party's situation (Johnson-George et al., 1982). According to the definition, trust has two parties. When one party trusts another, it is called 'trustor', and the other party, which has been trusted, is called 'trustee' (Jones et al., 2016). In organizations, trust can be directed to the organization itself, managers, and peer employees (Costigan et al., 1998).

Based on the meta-analysis by Dirks et al. (2002), there are separate precedents and consequences of organizational trust. Among them there exist, for example, organizational justice (Lee et al., 2018), leadership (Le et al., 2018), and organizational support (DeConinck, 2010) as precedents. Moreover, among the consequences of organizational trust, there are mainly employee performance (Verburg et al., 2018), organizational commitment (Laschinger et al., 2001), citizenship behavior (Tourigny et al., 2019), and organizational identification (Ng, 2015).

When employees' levels of organizational trust increase, they're in the role, and extra-role behaviors also tend to increase. In this context, it is understood from previous studies that trust is an antecedent of task performance (e.g., Ning et al., 2007). By the same token, when employees trust management, their job-related tension tends to decrease (Bijlsma et al., 2003; Leat et al., 2009).

Lastly, when employees perceive electronic surveillance as a tight control mechanism (Abraham et al., 2019), which damages trust relationships in the workplace, it can negatively affect organizational trust (Tabak et al., 2005). Based on this evidence,

H₃: Electronic surveillance in the workplace is negatively related to employees' organizational trust.

After examining the direct relationships between the variables in the research model, another hypothesis is about job tension and task performance (e.g., Nisar et al., 2020).

H₄: Job tension is negatively related to the task performance of employees.

Additionally, when members trust their organizations, their performance may the potential for an increase in their workplace. For this reason, based on the previous studies (e.g., Li et al., 2018), it can be stated as:

H₅: Organizational trust is positively related to the task performance of employees.

Based on these relationships, the research model of this study is demonstrated in Figure 1.

Figure 1
The Research Model
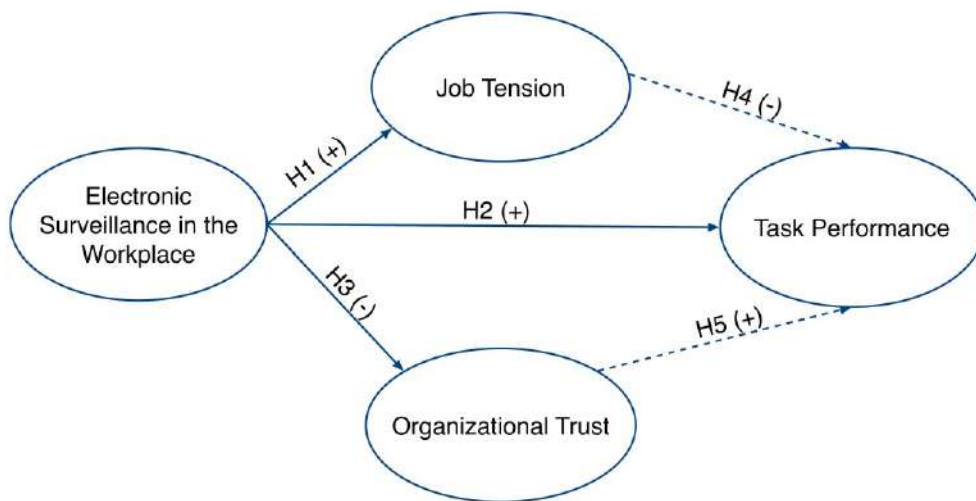
Source: Authors' work

Methodology

Data

In this study, screening (survey) quantitative research technique is employed to analyze data. The sampling method used in the study is the purposive sampling method. Among the types of this method, a homogeneous sampling technique (Etikan et al., 2016) was chosen. The most suitable participants exposed to electronic surveillance were intended to include as participants.

The sample was selected from the banking sector, in which there is intense electronic surveillance. By sampling technique, fifteen branches of a private deposit bank in Turkey were included. The bank branches were chosen based on the largest number of employees. All of the bank branches were located in Ankara province. Surveys were distributed by hand in selected bank branches. Afterward, they were collected in person. Data were collected between June 18th, 2019, and October 21st, 2019. There were 228 participants out of 341 who accepted to fill out the survey forms. So there is a response rate of 66% that falls into the category of Response Rate 1 (RR1) according to the American Association for Public Opinion Research (AAPOR).

According to AAPOR (2015), the category of response rate 1 is calculated as "the number of complete surveys divided by the number of completed surveys, plus the number of refused, non-contacts and others plus all case of unknown eligibility". All participants face electronic surveillance mostly by their tablets and partially by personal computers, cameras, emails, and smartphones. The descriptive statistics are present in Table 1.

Table 1
Descriptive Statistics

	n	%
Gender		
Female	134	59
Male	94	41
Age		
21-30	61	27
31-40	82	36
41-50	58	25
>50	27	12
Education		
Associate	16	7
Graduate	174	76
Postgraduate	38	17
Workplace Tenure		
<5 years	54	24
5-10 years	96	42
>10 years	78	34
Total	228	100

Source: Authors' work

Research Instruments

For electronic surveillance in the workplace, the eight-item measure of Abraham et al. (2019) was employed. By the items present in the measure, the 'to what extent' statement was added to the beginning of this survey section. Moreover, the word 'tablet' was included in the questionnaire for the third and sixth items. Example items areas "I am working with a PC, a tablet or a notebook." and "I am using a smartphone, a tablet or a navigation device for orientation when on business trips." The seven-point scale from 1 (never) to 7 (all the time) was employed. To assure the reliability for all of the measures adopted, the coefficient of Cronbach's alpha was calculated, and it was obtained as .92 for electronic surveillance measures.

Moreover, to assess job tension, we chose the questionnaire generated by House et al. (1972). One of the five items is "I work under a great deal of tension." We found Cronbach's alpha value .88 in this measure.

Also, we employed a measure originated by Goodman et al. (1999) to estimate task performance. This seven-point scale is in the form of self-report, and one of the nine items was as "I am competent in all areas of the job, and I handle tasks with proficiency". Moreover, Cronbach's alpha value for this scale was .81.

Additionally, next scale is for organizational trust. It was formed by Searle et al. (2011) as a seven-point scale. Sample items were "My organization would never deliberately take advantage of employees" and "My organization is guided by sound moral principles and codes of conduct." Alpha value was calculated as .85. All of the items of the measures are present in Table 2.

Table 2
Research instrument

Construct	Code	Item
Electronic Surveillance in the Workplace	ESW1	"I am working in a highly automated work environment."
	ESW2	"At my workplace, rooms and entrances are video monitored."
	ESW3	"I am working with a PC, tablet, or notebook."
	ESW4	"I am using electronic ID cards to access rooms or payments in cantinas."
	ESW5	"I use social networks such as Facebook, LinkedIn, and Xing for professional purposes."
	ESW6	"I use a smartphone, a tablet, or a navigation device for orientation when on business trips."
	ESW7	"The location of the components and goods I work with is recorded throughout the work process."
	ESW8	"I am using devices or work clothes that transmit wireless information."
Job Tension	JT1	"My job tends to affect my health directly."
	JT2	"I work under plenty of tensions."
	JT3	"I have felt fidgety or nervous as a result of my job."
	JT4	"If I had a different job, my health would probably improve."
	JT5	"Problems associated with my job have kept me awake at night."
	JT6	"I have felt nervous before attending meetings in my department."
	JT7	"I often take my job home with me because I think about it when doing other things."
Task Performance	TP1	"I achieve the objectives of the job."
	TP2	"I meet the criteria for performance."
	TP3	"I demonstrate expertise in all job-related tasks."
	TP4	"I fulfill all the requirements of the job."
	TP5	"I could manage more responsibility than typically assigned."
	TP6	"I appear suitable for a higher-level role."
	TP7	"I am competent in all job areas, and I handle tasks with proficiency."
	TP8	"I perform well in the overall job by carrying out tasks as expected."
	TP9	"I plan and organize to achieve the job's objectives and meet deadlines."
Organizational Trust	OT1	"My organization is capable of meeting its responsibilities."
	OT2	"My organization is known to be successful at what it tries to do."
	OT3	"My organization is doing things competently."
	OT4	"My organization is concerned about the welfare of its employees."
	OT5	"Employees' needs and desires are important to my organization."
	OT6	"My organization will go out of its way to help its employees."
	OT7	"My organization would never deliberately take advantage of its employees."
	OT8	"My organization is guided by sound moral principles and codes of conduct."
	OT9	Power is not abused in my organization.
	OT10	"My organization does not exploit external stakeholders."

Source: Abraham et al., 2019; Goodman et al., 1999; House et al., 1972; Searle et al., 2011.

Results

Data obtained with the help of the survey method were firstly validated and then analyzed by several sequential statistical methods. Before distributing the surveys to the employees, introductory meetings were held with both the employees and the branch managers as a pilot study to validate the content.

First of all, to assure the convergent and discriminate validity; exploratory and confirmatory analyses were applied on all of the research instruments together. Using IBM SPSS 22.0 Statistical Package, a factor analysis with varimax rotation was applied. According to the results, each of the items in the research instruments was turned out to be higher than .50, which was a limit suggested by Field (2000), constituting a one-dimensional structure for all of the separate research instruments (Tabachnick et al., 2001). Moreover, the reliability analysis was achieved by employing Cronbach's alpha coefficients, and according to the results, it was understood that the items demonstrated internal consistency. The results are shown in Table 3.

Table 3
Standardized Factor Loadings

Item	Standardized Factor Loadings	Cronbach's alpha
ESW1	0.853	0.92
ESW2	0.934	
ESW3	0.781	
ESW4	0.870	
ESW5	0.752	
ESW6	0.912	
ESW7	0.675	
ESW8	0.827	
JT1	0.920	0.88
JT2	0.852	
JT3	0.870	
JT4	0.760	
JT5	0.684	
JT6	0.835	
JT7	0.730	
TP1	0.628	0.81
TP2	0.739	
TP3	0.814	
TP4	0.820	
TP5	0.981	
TP6	0.870	
TP7	0.747	
TP8	0.694	
TP9	0.788	
OT1	0.730	0.85
OT2	0.851	
OT3	0.872	
OT4	0.743	
OT5	0.682	
OT6	0.710	
OT7	0.830	
OT8	0.917	
OT9	0.837	
OT10	0.763	

Source: Authors' work

After conducting validity and reliability analyses, we calculated the correlation coefficients to examine the relationships between determined variables. Since we found a linear relationship between normally distributed variables in this study, the Pearson correlation method was chosen to figure out the relationships. The results are shown in Table 4.

Table 4
Correlation Coefficients between Variables

	Mean	SD	1	2	3	4
Electronic Surveillance	4.08	1.13	-			
Job Tension	3.95	1.21	0.64***	-		
Task Performance	4.22	0.95	0.38***	0.11***	-	
Organizational Trust	3.61	1.40	-0.43***	-0.27***	0.39***	-

Note: *** p<0.001., SD: Standard deviation.
Source: Authors' work

According to the results obtained from the correlation analysis, firstly, there exists a moderately positive and significant relation between electronic surveillance and job tension (r=0.64, p<0.001). Following that, electronic surveillance is turned out to be positively correlated with task performance (r=0.38, p<0.001), whereas negatively with organizational trust (r=-0.43, p<0.001). Additionally, job tension has a positive relationship with task performance (r=0.11, p<0.001) and a negative relationship with organizational trust (r=-0.27, p<0.001). Lastly, it is seen that organizational trust and task performance are positively correlated (r=0.39, p<0.001).

And lastly, to estimate the structural model and goodness of fit indices, structural equations model fit was used and tested by using IBM SPSS AMOS 24.0 statistical package program. By the related literature (e.g., Marsh et al., 2006; Schermelleh-Engel et al., 2003), the overall fit of the research model was determined, beginning with assessing the chi-square statistics. After obtaining an insignificant chi-square, a wide range of fit indices was examined to test the model's overall fit. These fit indices were indicated based on the suggestions made by Hooper et al. (2008). The results signal that the obtained values of fit indices are very good, as shown in Table 5.

Table 5
Results of Fit Indices for the Research Model

| RMSEA	CFI	NFI	NNFI	GFI	χ^2 /df
0.065	0.905	0.963	0.978	0.966	1.812
<0.080*	>0.90*	>0.95*	>0.95*	>0.95*	<2.0*
*Reference Values are based on Hooper et al., (2008) and Hu and Bentler (1999).					

Note: RMSEA: Root Mean Square Error of Approximation; CFI: Comparative Fit Index; NFI: Normed Fit Index; NNFI: Non-Normed Fit Index; GFI: Goodness of Fit; χ^2: Chi-Square; df: Degree of Freedom.
Source: Authors' work

After obtaining satisfactory results of fit indices values for the research model, as the next step, the structural equation model was set, and hypotheses were tested by examining the signs, statistical significance, and amount of variance explained for the parameters. The results of the structural equation model are present in Figure 2.

Figure 2
Test Results of the Structural Equation Model
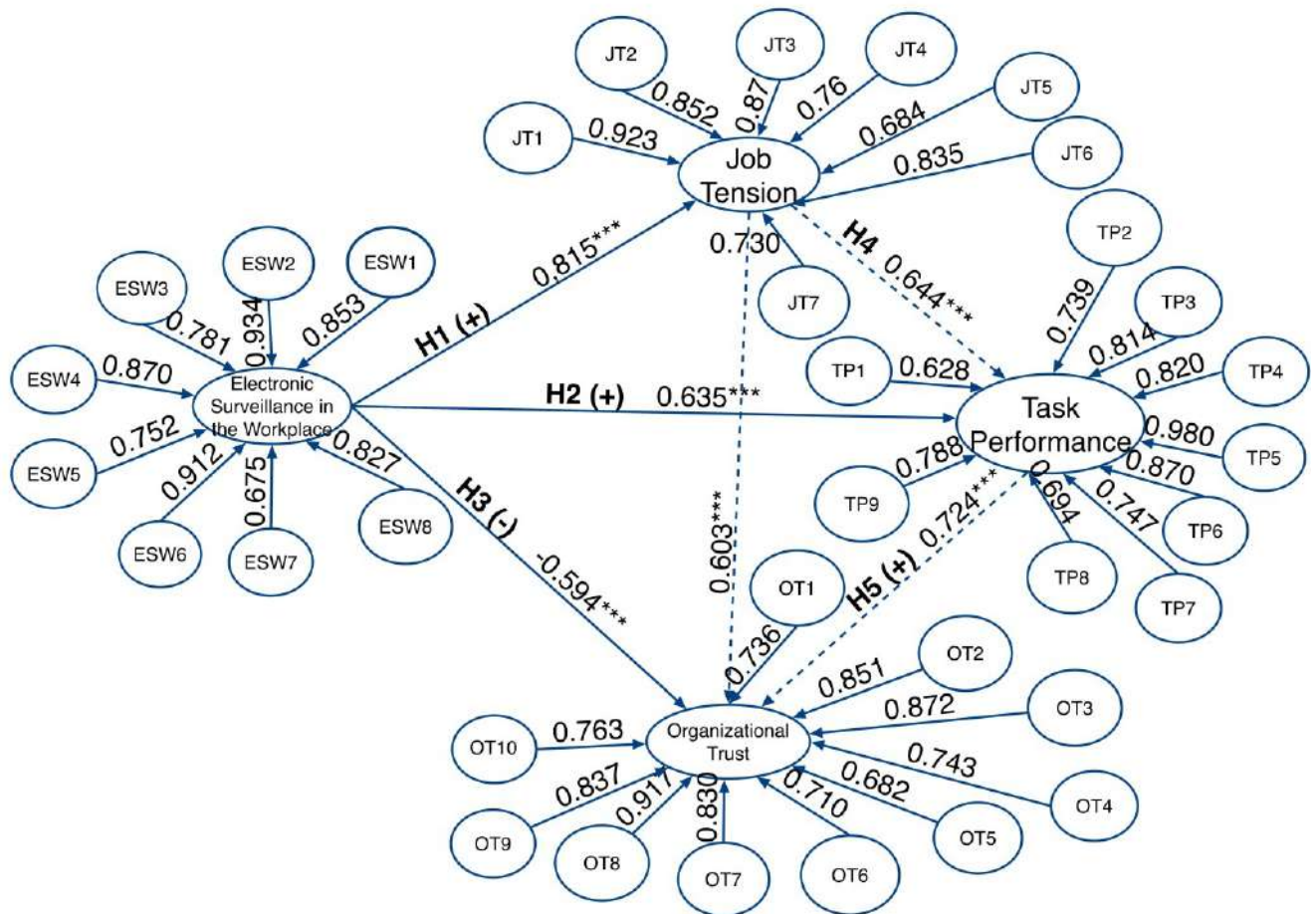
Note: *** p<0.01.
Source: Authors' work

As seen in Figure 2, H₁ that proposes the positive link between electronic surveillance in the workplace and job tension is supported since the coefficient is 0.815 at a 1% significance level. Additionally, the adjusted R^2 value was 0.524, which explained the 52.4% variations in this relationship. Also, the following hypothesis H₂ suggests the positive relationship between electronic surveillance in the workplace and task performance is supported since the coefficient is 0.635 at a 1% significance level. The adjusted R^2 value was 0.448, which explained the 44.8% variations in this relationship. H₃, which offers the negative relationship between e-surveillance and organizational trust, is supported because the coefficient is -0.594 at a 1% significance level. The adjusted R^2 value was found .394, which explained the 39.4% variations in this relationship. Following them, H₄ is not supported since the coefficient is 0.644 at a 1% significance level. The adjusted R^2 value was found 0.322, which explained the 32.2% variations.

On the contrary to the results obtained from previous studies, job tension caused a positive impact on task performance due to the source of tension in the workplace. The tension is based on the electronic controlling tools, and it is understood that, in the name of performance, it was perceived as a job resource rather than a job demand by the employees. But it should be kept in mind that this may be a specific

situation for the banking employees under electronic surveillance. Lastly, H5, which represents the positive link between organizational trust and task performance, is supported because the coefficient is .724 at a .01 significance level. The adjusted R^2 value explained the 41.9% variations in this relationship.

Discussion and Conclusion

Summary

In this paper, it was intended to put forth the effects of electronic surveillance in the workplace on selected employee outcomes. As previously stated in this study, it is understood that electronic surveillance positively impacts both job tension and task performance, and in contrast, it hurts the organizational trust of employees.

The effects of electronic surveillance are revealed by conducting a quantitative survey research technique in this study. According to the results obtained from data analysis, it is figured out that when the degree of electronic surveillance in the workplace by using computers, tablets, cameras, emails, and smartphones increases, employees' job tension also increases. When they feel close tracking by electronic devices, they are more likely to feel job tension. This positive relationship was also observed by Aiello et al. (1993). They have noted that employees with an external locus of control have higher stress levels than those with an internal locus of control. Normally, when job tension increases, job performance is expected to decrease. According to the results, it is obvious that when the degree of electronic surveillance increases, employees' task performances also increase. This may be due to the employees' worries about being monitored and their performance evaluations. Previous studies revealed that task performance of employees completing routine tasks increased, whereas task performance of employees completing complex tasks decreased (e.g., Aiello et al., 1995; Griffith, 1993). Since the employees who participated in this research were doing complex jobs in the banking sector, their increased level of performance is notable.

The last result shows the relationship between electronic surveillance and employees' organizational trust. It is turned out to be a negative relationship between these two variables. This result is consistent with the one obtained by Snyder (2010), who indicated a similar decrease in trust in organizations when their emails are monitored by management. It is due to a decrease in employees' trust in their organization stemming from the negative perception of electronic monitoring. Employees' level of organizational trust may have deteriorated because they may have perceived electronic monitoring techniques as a means of violating privacy.

Contributions to the literature

So far, scholars have made contributions to the theory by mostly concentrating on the effects of electronic surveillance on counterproductive work behaviors (e.g., Jensen et al., 2012; Martin et al., 2016). These studies highlighted the negative effects of electronic surveillance. But with this study, it has been understood that there are also positive effects of electronic surveillance on employees, such as improving their task performances in the workplace.

The positive effect of electronic surveillance on job tension was previously proposed by Carlson et al. (2017). This study also aimed to test that relationship practically. And according to the results, a positive effect has been proven between electronic surveillance and job tension. In this manner, electronic surveillance may be added to the literature of the JD-R Model as another new aspect of job demand.

Moreover, this research attempts to reveal the relation between electronic surveillance and task performance, which is another scarcity in the literature. Lately, there has been only the research of Yost et al. (2019) on the effect of contextual performance rather than task performance, and they have found a negative relationship between these variables. On the contrary, performance has turned out to be positively related to electronic surveillance in this study.

Lastly, it is understood from the results that contrary to the findings in the literature (Pool, 2000), job tension has a positive relationship with task performance. This may have occurred because of the characteristics of the participants. Since most of them are young and adaptive to use technology, they might have felt job tension stemming from electronic surveillance up to a constructive limit to do their best in their tasks. This type of job tension positively affects task performance rather than a negative one.

Practical implications

Especially under the Covid-19 circumstances, new forms of work, mostly based on remote work, have become a key factor for organizations to survive. Having roots in times before the Covid-19 pandemic, electronic surveillance has also become a necessity in today's organizations. But how can employers help employees adapt to this type of monitoring without negative perceptions? This study gives important clues for this situation.

Since electronic surveillance creates some stress on employees, it is expected to impact employees' job tension positively. Employees feel uncomfortable about being tracked while working, which causes job tension in the workplace. Managers can overcome this problem by only using electronic surveillance for constructive feedback without violating personal privacy. Managers should be clear to employees about electronic surveillance standards, rules, and procedures.

Moreover, a remarkable point from this study is that electronic surveillance hurts organizational trust levels of employees. This may be due to a debate between control and trust. When employees feel that e-surveillance is a tool used to track and control employees more closely, they may assume the organization does not trust in them. As a result, they also tend to trust less in their organization. According to Abraham et al. (2019), when organizational members constructively comprehend electronic surveillance, they may develop positive attitudes towards it, which causes more beneficial employee behaviors in the workplace. To solve this problem, managers should communicate with employees about e-surveillance transparently. They should tell employees why it is necessary and where it is used to resolve trust issues.

Consequently, this study has understood that employees tend to obey norms and procedures more under electronic surveillance. Although this situation creates job tension among employees, it has a constructive effect like improving their task performance. As stated before, electronic surveillance is formed and used in such a way that helps employees do their job more effectively. It is a very useful tool for increasing job performance.

Limitations of the study

Firstly, the sample included in this study was chosen purposively to include the most relevant participants to electronic surveillance. Participants should have been faced with these types of implementations; otherwise, the results would be meaningless. Also, the sample is chosen from one company, which is an extra limitation.

Additionally, employee number in the sample makes the results unable to be generalized.

Furthermore, although the questionnaires used in the study are valid and reliable, there is an important weakness about them, and it stems from their being self-evaluated. Especially, another limitation emerges since the measure used for task performance is self-evaluated. The general rules and conditions of the bank selected for this study made it unable for managers to evaluate their subordinates' task performance for scientific research.

Future research directions

Although numerous studies on electronic surveillance and its effects on employee-related outcomes, there is still a substantive need for new research. First of all, to overcome the limitations of this study, in the future, researchers should reach a more diversified research sample and electronic test surveillance in the workplace in more than one sector to generate a comparison between them.

Secondly, since today's definition of the workplace is changing, future studies may concentrate on virtual workplace electronic surveillance. The importance of this type of surveillance has increased due to the work conditions under the Covid-19 pandemic.

Lastly, there shoud be studies revealing the link between electronic surveillance and behavioral outcomes like; organizational commitment, job satisfaction, job motivation, job performance, and organizational antecedents and consequences like; organizational justice, organizational support, etc. Researchers may build their theoretical framework using psychological reactance theory and privacy protection motivation theory. After conducting empirical studies, they may contribute to the existing knowledge and theory about electronic surveillance.

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The Co-innovation Bingo: An Object-Oriented Networking Mechanism to Foster Coupled Open Business Innovation

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Abstract

Background: A firm's cooperative strategies are a fundamental issue in the search for business growth avenues, but a system that eases the emergence of coupled open innovation appears to be missing. **Objectives:** This paper describes a business networking tool to foster coupled open innovation emergence. **Methods/Approach:** We adopted a methodology based on design science comparable to grounded theory because solutions emerged by testing a design artefact with companies. **Results:** We designed and tested an artefact designed as a game to encourage participants to meet as many partners as possible. It is based on collaborative innovation mechanisms and gets inspiration from fields such as organization design, service design, and prospective design. The proposed artefact comes as prescriptive rules that support managers' open innovation opportunity elicitation. **Conclusions:** From a practical point of view, we contribute by helping companies find emergent open innovation opportunities. From a theoretical point of view, this artefact is part of an emergent theory of object-oriented coupled open innovation mechanisms.

Introduction

Due to the complexity of products, services, and ultimately of customers' needs, thinking about a firm's cooperative strategies is a fundamental issue in the search for business growth avenues. Indeed, the World Economic Forum stated that collaborative innovation between companies "can […] foster new growth through new products and non-market considerations that enable the evolution of entire systems" (World Economic Forum, 2015). Therefore, we define inter-firms' collaborative innovation as 'ad hoc innovation,' involving changes in competencies, technologies, and interactive construction of new outcomes (Castaldi et al., 2010; Gallouj, F. and Weinstein, O., 1997).

Nature of the problem: Innovation's capacity in SMEs

Entrepreneurs seek partners to carry out innovations and develop markets. The relationships sought are of different types: entrepreneurs sometimes seek short-term relationships (swinger) and sometimes long-term relationships (keeper). Entrepreneurs can find themselves in these identical processes with different objectives. In addition, their needs and capacities evolve. Hence, the diversity of professional and thematic networks, representative of a profession or aimed at commercial objectives, creates uncertainty for the entrepreneur who wishes to find an alliance partner to elicit or produce innovation.

According to M&BD Consulting (2016), 94% of SMEs surveyed see innovation as an essential factor in ensuring the sustainability of their business, and 56% use creativity methods. However, 78% have neither a formal idea generation process nor a formal idea evaluation process, and 50% of the respondents practice occasional innovation. It is also interesting to note that more than 50% of companies practice open or collaborative innovation through customers, suppliers, or clusters. The authors conclude that "efforts to improve the innovation process must be oriented towards creativity through the involvement of employees and the provision of tools" aimed at 1) raising awareness among leaders and managers on the need to involve all employees in the innovation process and 2) provide leaders and managers with tools that allow them to generate ideas from which future innovations will flow.

New types of innovation artefacts are needed by the organizations

According to Rothwell (1994), the current generation of innovation responds to a significant change in the market, such as economic growth, industrial expansion, intensification of the competition, resource constraints, etc. This fifth generation of innovation is based on the networking model, allowing flexibility, customized activities, and constant and rapid innovation. Indeed, accession to resources to innovate is strongly limited regarding the high cost or the high specialty that specific resources require. This situation improves the need and the use of networking and partnering. For example, access to a large and safe online storage space or computing power can be expensive to develop in-house. Companies that are not specialized in those activities will be well advised to externalize those activities.

This new generation of innovation is completed by practices of companies capturing ideas in several processes of open innovation (Chesbrough, 2003), such as outside-in, inside-out, or coupled innovation (Gassmann & Enkel, 2004). Moreover, forms of open innovation could be defined as open ecosystems, open innovation through acquisitions, open patent systems, or open-sourcing (Bogers et al., 2019). Among those best examples,

most innovations are based on dynamic capacities such as sensing, seizing, and transforming innovation opportunities (*ibid*). Companies must develop internal conditions to identify and capture value from open innovation (Vanhaverbeke and Roijakkers, 2015).

The innovation support in Switzerland does not focus on inter-firms cooperation

According to our previous survey of 500 entrepreneurs in French-speaking Switzerland, entrepreneurs are looking for solutions to support creativity and the development of non-technological innovation, particularly in the service sector. The business services of the Regional Innovation Systems (RIS) in Switzerland mainly offer help to create a business plan, training, legal and accounting services, market studies, help with exporting or finding foreign partners, help in e-business and information and communication technologies, advice on the development of new products and services, help in finding financing from banks, help in raising funds from business angels and venture capitalists, recruitment and human resources consulting, networking of entrepreneurs or mentors [unpublished data]. Some initiatives encouraging creativity are emerging, such as hackathons (Flores et al., 2019) and other intergenerational creative events [unpublished data]. But a lack of understanding of the factors of choice and the decision conditions of the actors remains.

Our analysis of the 3 biggest innovation support organizations in the French-speaking part of Switzerland shows that very few services toward cooperative strategies are proposed so far.

On the one hand, the partners' research services are based on the work of the coaches able to advise entrepreneurs in choosing a cooperative organization. On the other hand, previous research [unpublished data] showed that participation in hackathons or "ideathons" does not guarantee to find a cooperation partner.

The business network services need a framework to support their inter-firms 'cooperation strategies

Nevertheless, Zeng et al. (2010) find significant positive relationships between inter-firm cooperation, cooperation with intermediary institutions, cooperation with research organizations, and innovation performance of SMEs, of which inter-firm cooperation has the most significant positive impact on the innovation performance of SMEs.

The Business Network International (BNI) states that in Switzerland, it generates 327 million CHF in one year across 2'645 members and 84 Swiss chapters, thanks to the weekly networking events (BNI, 2020). This characterizes the aim of the classical business clubs, as known as bringing together people with the same interests to share experiences and ideas and create new commercial relations. To our knowledge, rare are traditional business clubs providing innovation actively.

Recently, the international network of Impact Hubs has fostered a global community devoted to promoting entrepreneurship as a driver for positive change (Impact Hub, 2020). With 16'500 members in more than 55 countries, the network aims to "gain access and insight into social innovation by co-creating locally rooted, globally connected programs and events". The impact ambition target goes from corporate innovation to ecosystem development (Impact Hub, 2019). The Impact Hubs organize recurrent

resource resource-sharing among their members, which promotes the emergence of innovation.

Figure 1 classifies the main offers of the innovation support organizations in Switzerland. Classification has been made on criteria of several cross-or support (organization/individual or collective support) and the purpose of the support (marketing or innovation). The detailed data are presented in Appendix.

Figure 1
Classification of Swiss innovation support organization

Source: Authors' contribution

The need for prescriptive rules and solution-oriented knowledge

The need for identifying action mechanisms and the consideration of contingency factors is unveiled by literature, especially in the fields of open innovation, such as outside-in innovation, and of coupled open innovation, as open innovation with complementary partners (Gassmann & Enkel, 2004; Bogers et al., 2019, Vanhaverbeke, W. & Roijakkers, N., 2015). Moreover, the literature shows a need for prescriptive rules and recommendations for action (Van Aken, 2005; Gregor & Jones, 2007; Chauvet & Chollet, 2010) at the formation phase of the alliance and specifically regarding the identification of the stage of the emergence of the collaborative innovation opportunity. Several researchers propose a theoretical model to support the coupled open innovation elicitation (Grèzes et al. 2020).

The use of gamification as a lever for action

According to Deterning (2011a; 2011b), "gamification" is the "use of game design elements in non-game contexts". This definition refers to a game where the user is oriented towards achieving predefined objectives. The game elements refer to a solution integrating principles specific to the game sphere without becoming a game on its own. Its purpose is to influence the behavior of the players. Game elements are divided into game mechanisms and game dynamics. For example, game mechanisms are points, challenges, levels, rankings, gifts, virtual goods and spaces, and charity; game dynamics

are rewards, status, achievements, competition, self-expression, altruism. Finally, gamification is used in non-game contexts, such as business contexts.

Gamification aims at generating business results by playing on user engagement and participation. It can potentially lead to any form of participation, such as watching videos, listening to audio files, looking at photos, reading an article, filling out a form, posting on forums, visiting websites, taking quizzes, sharing personal information, evaluating products, creating content, participating in discussions, voting on content, etc.

The drivers of gamification are based on the generic motivational levers from psychology: reward, status, self-fulfillment, self-expression, competition, and altruism. To compare the main mechanisms of gamification with the motivational levers, BunchBall (2010) produced the following matrix illustrating the ability of gamification to play on all the human motivational levers (see Table 1 below).

Table 1
Basic interactions of human desires and game elements

Game mechanics	Human desires					
	Reward	Status	Achievement	Self-expression	Competition	Altruism
Points	●	○	○		○	○
Levels		●	○		○	
Challenges	○	○	●	○	○	○
Virtual goods	○	○	○	●	○	
Ranking		○	○		●	○
Gifts and charity		○	○		○	●

NB: Black dots represent primary desires satisfied by a particular game mechanism; White dots represent other affected areas.
Source: BunchBall (2010)

Research gap

Plenty of solutions exists to create commercial relationships and find a partner, such as business clubs, commercial chambers, dedicated hubs, or events aiming to share knowledge such as conferences, research institutes, or business school events, or events aiming to unveil innovation opportunities such as Hackathons. Nonetheless, a system that combines these features toward the emergence of innovation appears to be missing. Hence our research question is: **How to foster the emergence of inter-firms' coupled open innovation?**

The rest of the paper proceeds as follows. We first present the methodology and artefact we used, then present the results of the quasi-experimentation before discussing the findings and conclusions.

Methodology

We built a prototype (Co-innovation Bingo) based on constructs from a literature review on coupled open innovation mechanisms. We adopted a methodology based on design science (Gregor, 2007) and comparable to grounded theory because solutions emerged by testing a design artefact with companies.

Components of our design theory

According to Gregor (2007), to provide explanations and predictions and be testable, a design theory must rely on eight components. The six core components are: the purpose and scope, the constructs, the principle of form and function, the artifact mutability, and the testable propositions; the two additional components are: the principles of implementation and the expository instantiation. We build on Grèzes et al. (2020) to use their constructs and establish the logic of our pragmatic inter-firm interaction artefact. Table 2 below shows the anatomy of our design theory.

Table 2
Anatomy of the "Co-Innovation Bingo" Artefact

Purpose and scope	Foster discovery of innovation opportunities and the emergence of alliances between professionals
Constructs	a) Joint/Shared Vision b) Joint/Shared Resources c) Joint/Shared Market
Principle of form and function	a) Vision of the project leader b) Underused resources owned by one participant c) Noncompetitive markets that are accessible by one participant
Artifact mutability	a) Project description b) Playing card c) Limited tokens
Testable propositions	a) The project description supports linking professionals (P01) b) Playing card supports stages of completion (P02) c) Tokens materialize exchanges (P03)
Justificatory knowledge	a) Vision for sustainable partnerships (Nidumolu et al. 2014) b) Dynamic capabilities for alliances (Das 2000) c) Service dominant logic for innovation (Vargo et al. 2008)
Principles of implementation	a) Personal gamecard material with limited resources b) Human game orchestration during the event c) Sharing contact details & analyzing results with network analysis
Expository instantiation	Professionals networking events

Source: Author's contribution

Elements of motivation: the gamification

To generate participation, game mechanisms were used, such as a playing card and tokens, time constraints, limited resources, to support game dynamics such as competition, egoism, altruism, rewards (Groh 2012; Bunchball 2010).

Participation conditions (artefact conditions)

Before the event, participants are invited to describe their vision and starting resources with a preliminary questionnaire (name, activity) to receive their game card and the game points. An alternative to entering the game is to describe a project on a new game card and take a series of game points at the event's entry.

Game Rules (interaction conditions)

Participants are invited to discuss with their neighbors to identify which project they could invest points. They can invest game points in the projects they want and get points regarding resources, markets, and vision to create a consortium. The goal is to totalize 9

points: 3 resources, 3 market accesses, and 3 visions. The low number of points assures simplicity and quick wins. Figure 2 below shows the Bingo cardboard.

Figure 2
Co-Innovation bingo Cardboard
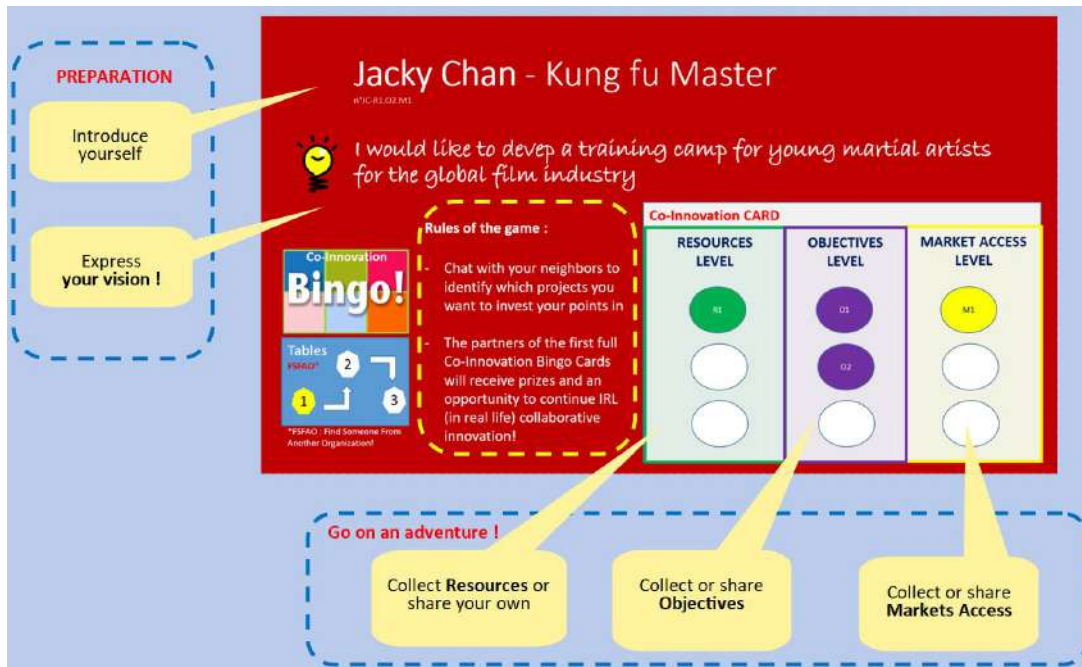
Source: Author's contribution

Artefact description and testable propositions
Accordingly, we state the following testable propositions and settle the circumstance of a quasi-experiment. The Co-Innovation Bingo:
- P1: allows extracting new ideas from a set of existing insights in less than 60 minutes
- P2: has a setup time of fewer than 5 minutes and an overall cost of fewer than 5 euros/ participant
- P3: allows visualizing how participants interacted using a dynamic network of ideas

Description of the quasi-experiment: TEDx Martigny 2019
The quasi-experiment allows settling an interventional study to evaluate the causal impact of an intervention on a population without random assignment (Gribbons et al., 1997). We tested our artefact during the TEDx conference in Martigny in 2019. The general conference topic was "Together", and the attendance reached around 250 participants, including volunteers.
   The event was short, and the cadence of the game was handled as follows:
- online preregistration for the game is possible during conference registration
- 90 minutes of pre-conference available to record spontaneous registrations and distribute play materials
- 45 minutes of mid-conference for networking session (active play)

- 105 minutes of post-conference time for the networking session (active play), participant interviews, and collection of game cards.
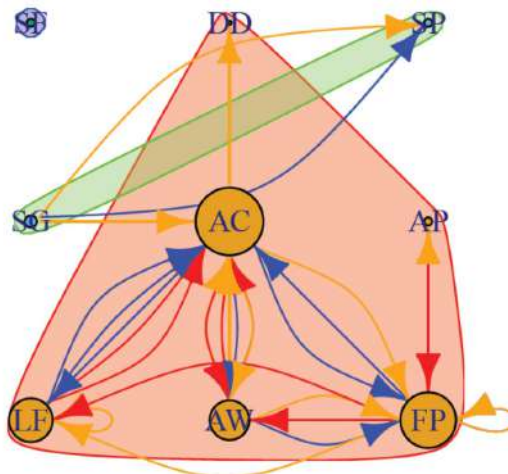
Results

In the remainder of this section, we present first the quantitative results, followed by the qualitative results, and a summary of the quasi-experiment results.

Quantitative results

In this section, we present the quantitative results regarding participation, the mechanisms and dynamism of gamification, the interaction results, and the nature of the exchanges.

- **Participation:** Among twenty-one registrations, fourteen registrations were spontaneous during the on-site check-in, and seven were online preregistrations. Among those twenty-one registrations, eight persons were active players.
- **Results in terms of mechanisms and dynamics:** The experiment allowed thirty formal exchanges. Among nine returned playing cards, seven playing cards had interactions, and one playing card was complete (the winner).
- **Interaction results:** The thirty total interactions were accounted on eight playing cards, representative of eight unique receivers and seven single transmitters. Only one game card returned empty. Figure 3 below illustrates the interactions' network.
- **Nature of the exchanges:** Among the total interactions, we enumerate thirteen resource exchanges, nine objectives exchanges, eight market exchanges, and five self-sharing elements.

Figure 3
Participants' interactions' Networks

Note: Type of relation: Red arrow = Market sharing; Orange arrow = Resource sharing; Blue arrow = Vision sharing; Colored surface = Clusters
Source: Author's illustration with RStudio (libraries: iGraph, rMarkDown)

Qualitative results

In this section, we present the synthesis of the interviews of the participants during the experimentation regarding good points and areas of improvement.

General comments
- "It's a great concept!"
- "Who's in the red card club?"
- "I'll get rid of my stickers!"
- "It's hard to find the contestants in this crowd!"
- "That's great; it works!"

Good points
- "Easy to understand."
- "It's a good opportunity to meet people."
- "It helps you learn things, meet people."
- "It makes you think about what you can share."
- "It's also useful to meet people who didn't have boxes."

Areas of improvement expressed by players (individual quotes)
- "The explanations on the cardboard are not enough."
- "A session to present everyone's visions would be a plus."
- "Cardboards are not visible enough."
- "Not useful if you know people or are introduced to certain people."
- "Depends on people's natural ability to reach out to others."

Quasi-experiment results

Every testable proposition was validated: The project description supported linking professionals (P01), playing card supported stages of completion (P02), tokens helped to materialize exchanges (P03). Moreover, the artefact allows extracting new ideas from a set of existing insights in less than 60 minutes (P1). The artefact had a setup time of fewer than 5 minutes and an overall cost of fewer than 5 euros/ participant (P2). The artefact visualizes how participants interacted using a dynamic network of ideas (P3; see Figure 3).

Discussion

According to Davis (1971), "all interesting theories, at least all interesting social theories, then, constitute an attack on the taken-for-granted world of their audience". Consequently, this section is split into two statements regarding what we consider interesting: the impact of organization and composition and the impact of co-relation and context.

## *Organization and composition toward simplification*

The organization of the artefact seems to be structured and simple, but its simplification allows the unstructured emergence of partnership opportunities. Indeed, the frontier objects of collaborative innovation are reduced to three elements (resources, vision,

markets) proposed by Grèzes et al. (2020) are useful to simplify the emergence of pertinent shared objects and coupled open innovation opportunities.

Moreover, the simple composition can be compared to the aggregation of heterogeneous elements of the business model canvas (Osterwalder et al., 2010). Indeed, the three doors belong to a single business model as "meta-building blocks", allowing potential future partners to discuss the other blocs of the business model. Each construct of the three doors (Joint/Shared Vision, Joint/Shared Resources, Joint/Shared Market) represents a "meta-block" of the business model as a possible source of co-innovation/coupled open innovation (see Figure 4). One technique mutualises costs, one technique increases turnover with a combined offer, and one technique engages partners in a joint process of redefining strategic positioning.

Figure 4
The three doors as "meta-building blocks" of a generic business model
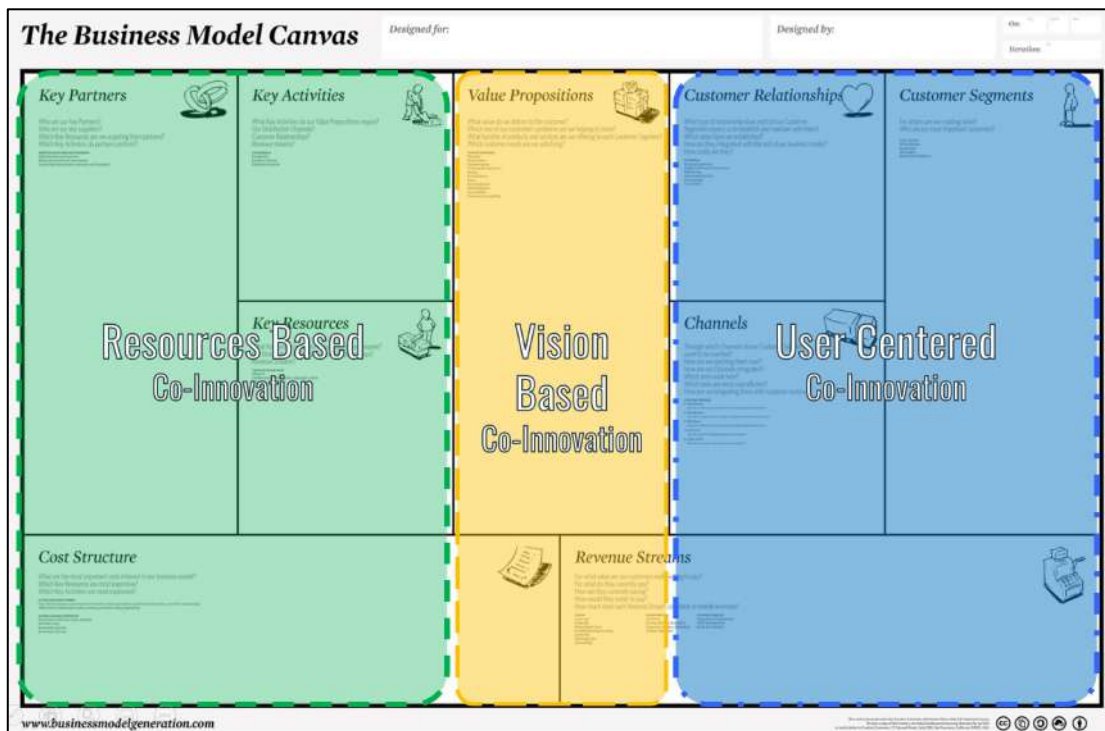
Note: Each construct of the three doors (Joint/Shared Vision, Joint/Shared Resources, Joint/Shared Market) represents a "meta-block" of the business model as a possible source of co-innovation/coupled open innovation
Source: The authors adapted from Osterwalder and Pigneur (2010)

Moreover, not every gamification mechanics was used, and participants were excited to engage in new relationships. Limited time reinforced this effect. The artefact takes advantage of points (tokens), challenges (to complete the gamecard), virtual goods (resources, markets, and vision), and gifts (opportunity to exchange resources, markets, and vision). Those elements had a positive impact on the networking activities. Our solution is innovative in offering an object-oriented networking mechanism to innovation support organizations (see Figure 5 below).

As the current generation of innovators responds to a significant change in their economic environment (Rothwell, 1994), simple tools that quickly foster networking innovation opportunities can reach strategic importance in a regional or national competitive scope. Therefore, this kind of quick and gamified artefact is especially suitable for the current profile of innovators.

Figure 5
Classification of Swiss innovation support organization and positioning of our solution
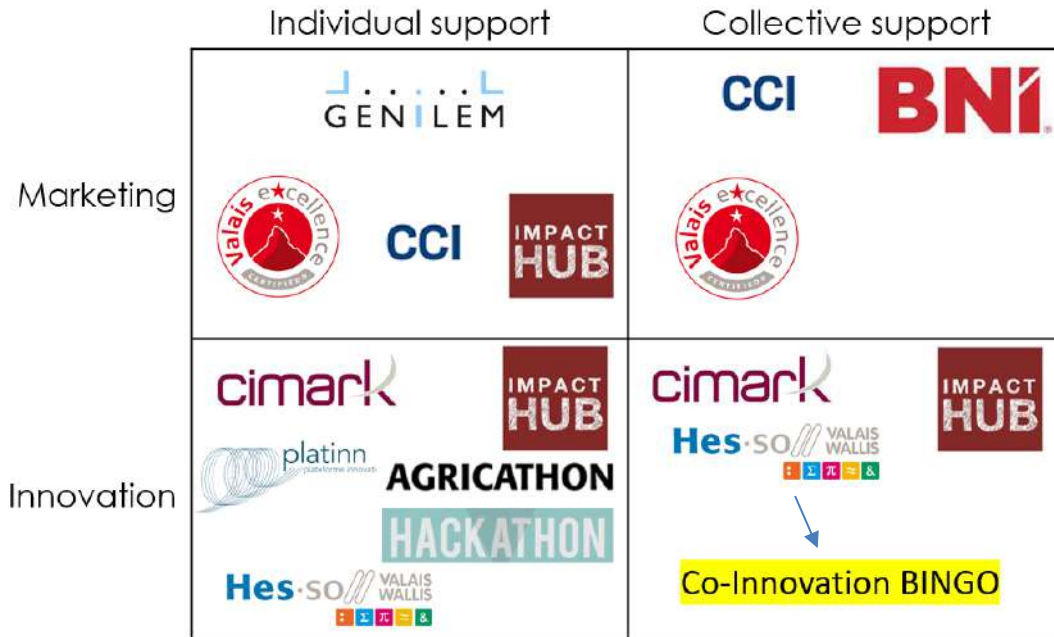
Source: Authors' contribution

Co-relation & contextuality foster the emergence of innovation

The building blocks and the interactions with unknown people are interdependent to foster the emergence of relations. Projects are changing according to emergent relations and propositions.

Only when you read about the projects that you know if you have something to share; you cannot do it in advance, according to the emergence theory (Clayton et al. 2006). The Co-innovation Bingo can lead to several types of emergencies: the synchronic emergence because the appearance of the property occurs at different, undefined times; the weak emergence in case of a simple sharing of resources or market access; the strong emergence when creating new objectives and redefining the needs for resources and access to markets.

Conclusion

The Co-innovation Bingo allowed participants to share information and create alliances in a limited time and space and for a very low cost. This artefact is useable during the break between two conference sessions. People can identify valuable assets only once they reach enough information about the contact person's project.

The artefact allows researchers to trace the circulation of the tokens through the participants and rank the players.

The game allows gathering a database of projects, specific resource holders, and specific market access holders. To improve the usability of the database, Participants could/should clarify the nature of the resources and markets they share. Then, with more data in the database, it will be possible to print personal profiles and connect people based on current and previous data. Moreover, as the sessions progress, a network modelling tool could report emerging relationships. The effects over time regarding the perennity of the consortium remain to be observed. Unfortunately, we could not evaluate the effectiveness of the partnerships after the experiment, and these effects will have to be tested on another sample.

We have already applied the model internally within an organization. We plan to continue the quasi-experiments internally and externally and continue the analysis of the link between this model and the business model and the value chain. Other applications are being tested, such as internally within an organization.

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Appendix

Table A1
Services' comparison of the Swiss innovation support organisations

Cimark	Platinn	Genilem
http://www.cimark.ch/	https://platinn.ch/	https://genilem.ch/
Innovation in your SME	**Business**	**Diagnosis**
Development of new products/offers	Increased sales	Innovative elements of your project
Diversification and extension of market	Diversification of supply	Idea potential to business
Business processes/organization	Strengthening customer relationships	
Adapting the strategy	Project validation and implementation	
	Evolution of the strategy	
Start-up	**Organisation**	**Accompanying**
Professional coaching	Increasing productivity	Coach in business development
Support for funding	Control of flows and processes	Leadership, strategy, positioning and sales
Help to create business plans	Optimal use of resources	Building and expanding your network
Providing space	Adequacy to the strategy	Strategic thinking, mentoring sessions
Access to networks of specialists	Cost optimization	
Networking	**Cooperation**	
Support for potential customers	Potential analysis	
Networking (BtoB or BtoC)	Partnership creation	
Accompaniment at trade fairs	Access to public funds	
Search for academic partners	Setting up of cooperation projects	
	Negotiation of cooperation contracts	
Management	**Finance**	
Program management	Financing strategy and due diligence	
Tender management	Network of investors and funding sources	
Cluster animation	Investor relations	
Technology valuation	Negotiation and fundraising	
Intellectual property, patent management		
Technology transfer agreements		
Market rating		
Technical feasibility		
Events		**Formation**
Thematic information sessions		Information sessions
Hackathons, ideathons		Intensive courses
Workshops		Workshops

Source: Author's comparison

Table A2
Comparison of different knowledge sharing and networking artefact

	Commercial relationship	Partnerships to discover/enter markets	Innovation results sharing	Knowledge sharing
Business Clubs (BNI, AEVEX)	Yes	Yes		
Innovation Conferences (TEDx, Jiyu)			Yes	Yes
Commercial Chambers events (Petits déjeuners)	Yes	Yes		
Research institute events (Entremets)			Yes	Yes
Business School events (Hackathon)				Yes
Professional Associations events				
Impact hubs events (Resources sharing events)	Yes	Yes		Yes

Source: Author's contribution

Table A2 (continued)
Comparison of different knowledge sharing and networking artefact

	Problem-solving Features	Innovation alliance development	Innovation opportunity discovery
Business Clubs (BNI, AEVEX)	Yes		
Innovation Conferences (TEDx, Jiyu)		Yes	
Commercial Chambers events (Petits déjeuners)			
Research institute events (Entremets)			
Business School events (Hackathon)	Yes		Yes
Professional Associations events			
Impact hubs events (Resources sharing events)		Yes	

Source: Author's contribution

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The Intertwined Functions of Advanced Information Systems and Management Control Practice in a Municipal Context

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Abstract

Background: Advanced, integrated information systems such as an enterprise resource planning (ERP) system have nowadays come to play such a crucial role for organizations and functions such as management accounting and control that in many cases, they would not function without the support of these systems. Public sector operations in general and municipal operations, in particular, are complex and require a lot of resources. Because of this, the managers working within this context need the support of advanced information systems to a large extent. **Objectives:** This paper aims at understanding how these new systems and their users, accountants, and controllers, perceive the opportunities they bring in a municipal setting. **Methods/Approach:** Out of 290 Swedish municipalities, 97 participated in the survey. **Results:** The results show that these systems have come to play an important part in working with management accounting and control issues. **Conclusions:** One conclusion that could be drawn from this study is that information supported by advanced information systems has become such an important necessity that management accounting as a function or phenomenon would not work without it. Therefore, the interdependency between information systems and management accounting and control practice could be described as intertwined.

Keywords: advanced information systems; management accounting and control practice; public sector
JEL classification: D22; M41
Paper type: Research article

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Introduction

Advanced information systems such as enterprise resource planning (ERP) have changed how work is done and how operations are run in a modern company. They have become so crucial for an organization that it is hard for a business process to run smoothly without digital support. These systems also change the way managers in general work with information and how functions such as management control can plan for and monitor performance differently. The advanced integrated systems also lower the cost of operations, reduce cycle time, and increase customer satisfaction, including its effects on competitive advantage (Spathis et al., 2004). This makes it even more important to understand how these systems affect control functions in general but shapes and reshapes how the accounting function supports and transforms how integrated accounting information is used within the organization (Chapman, 2005).

Presenting and analyzing accounting and management control information most often comes from a predetermined structure, for example, the structure of a financial statement that frames and puts restrictions on what kind of information is possible to present and analyze. By implementing and using ERP systems and advanced information systems and integrated use of data and information sources, new ways of understanding the information not previously thought of opens up (Quattrone et al., 2001). The ways an accounting and management control function works with, for example, financial figures and calculations change when ERP systems are implemented (Bredmar, 2017a), and new forms of non-financial performance measurement and profitability analysis are possible (Spatis et al., 2004). Implementing and working with modern, integrated, advanced information systems brings new possibilities and options to managers through new dynamic reports presented, for example, through dashboards and digital interfaces. Still, it also brings new opportunities to the accounting and management control function (Bredmar, 2017b).

This paper aims at understanding how its users, the accountant, and the controller perceive these new systems and the opportunities they bring. The intertwined functions of advanced information systems and management control are presented and discussed. Issues like how ERP systems support management accounting tasks and decision making, along with how well new systems are customized to the organization and its needs, constitute the basis for this kind of understanding. The value of the system and its ability to contribute to the company's competitive advantage in many ways builds on the ability to tailor information systems function, not to the technical advances but the needs of different functions in an organization, such as accounting and management control. For these systems to become what they were meant to be, an even deeper understanding of how users perceive the systems needs to be developed, which is the aim of this paper.

Theoretical outline

There are several purposes that, in one way or another, need to be met when investing in advanced information systems from a management control perspective. One that increases efficiency is that these systems, such as SAP, eliminate routine work (Scapens et al., 2003). This is especially true in an accounting context where cost clerks and accounting personnel previously did manual work such as cost calculation, which is now done automatically within the systems. More advanced calculations and advanced analysis reported information and performance measures to have the opportunity to become forward-looking, which could improve the information value for the management control function. The more advanced analysis and the added value the reports bring make it even more important for management accountants to assist and support other managers in understanding and supporting actions taken

based on the reports. This is something that Scapens et al. (2003) noticed. "*... the experience in BM (Europe) indicates that managers needed the support of management accountants, initially in understanding the information provided by the SAP system and then in utilizing the information for management purposes. ... Within BM (Europe), we observed a widening of the role of the management accountants, and at the same time a reduction in the size of the accounting function.*"

For an IT project of this kind to become successful, the right stakeholders within the organization must decide upon what features and functions need to be supported. The easiest and most simple way of dividing the stakeholders in this kind of project is to group stakeholders with a background within the financial department and those with other experiences and preferences, working in other departments (Hyvönen, 2003). When buying and implementing an ERP system, the financial department is more interested in getting a "best of bread" system where other departments are looking for a more common solution. This could be explained by the previous experience that traditionally has come with CFOs being responsible for buying software and early digital solutions. The purpose behind buying and implementing a specific system is to reflect previous experience and understandings that come with working within a certain department.

At its simplest level, the ERP system needs to support and be able to handle an increased volume of transactions. This is especially true when dealing with large volumes of financial and management control data and information (Booth et al., 2000). "*These benefits can be seen as arising from the greater process standardization, efficiency and automation of ERP systems, which are the state-of-the-art in terms of high-volume transaction engines*" (Booth et al., 2000).

On a more general level, an ERP user benefits more from compiling better reports, for example, for decision making, especially when the reports are within the area of management accounting. Even though these new systems bring an opportunity to do even more advanced data analysis, methods and techniques that management accounting functions build on have not changed to the same extent as these systems have evolved. Even though digital support has brought new opportunities (Booth et al., 2000), the value an advanced information system such as an ERP system brings is mainly based on how the user perceives the system's benefits and opportunities. In a management process, this could be based on what kind of accounting information the system provides the manager with, which could provide the manager with more flexible information and reporting generation (Spathis et al., 2003). This could also bring improved quality when it comes to financial statement reports. These systems have become a necessary tool for companies to become and remain competitive, and they are not merely a strategic move or decision anymore. Due to their function in a modern organization, they have become a strategic necessity. And from one point of view, a management accountant needs to develop increased skills within IT and systems to be able to benefit from these new systems fully.

Since the systems have become more and more important for an organization and its strategic, competitive position, whether the systems should be customized for the organization or if the organization should adapt to the system arises. From one perspective, these systems make it possible to change the ways an organization is managed and re-engineer activities to increase efficiency. "*It is plausible that ERP system implementations require a re-organization of business processes and organizational structure but most importantly a change of management style and culture*" (Wood et al., 2001).

There is a recognition that ERP systems contribute to a companies performance (Botta-Genoulaz et al., 2005). In many ways, the implementation of an advanced

information system, such as the integrated information system, changes and transforms the organization as such and, in particular, the ability to monitor and control the operations. Labor productivity is, for example, becoming more and more dependent on these systems and the changed business practices. Real-time information increases the organization's transparency and, by doing so, also increases the ability to plan for and analyze deviations. Hunton et al. (2003) conclude that adopters of ERP systems outperformance non-adopters when it, for example, comes to return on assets and asset turnover. The cost of customizing an ERP system should then be compared to the calculated benefits, for example, in increased performance that comes with the new opportunities that the system brings.

In working with the management control function with the support of an advanced information system, management accounting and control issues are no longer dealt with within the accounting and finance function domain, 'if it ever was' as Dechow et al. (2005) state. Traditional informational hierarchies become obsolete, and the focus on interaction and distribution enhances management control across many organizational places and management functions. One could then argue that these systems have a little or moderate impact on management accounting and control since it is now done in other parts of the organization, decoupled from the accounting and financial department (Dechow et al., 2005). The intertwined function of advanced information systems and management control becomes embedded within the management function, bringing it closer to the operation and contributing to a deeper understanding of planning and control and performance management.

One challenge that organizations who start an ERP project aiming to invest in a larger integrated digital information system meet are that in many cases, the traditional solutions previously bought are based on a stand-alone solution where different business functions have their digital support and software (Bredmar, 2017a). In transforming from this way of looking at digital support and digital information systems, it has been noted that accountants tend to favor the stand-alone systems to the ERP systems, which in a way becomes a contradiction since many of the benefits that come with integrated systems lays per see in the ability to integrate different data sources. For the information system to have a new and improved impact on management accounting and control, it needs to be integrated; if not, it will have little or no impact on transformed management accounting techniques (Granlund et al., 2002).

There is a call for more in-depth research on the intertwined relation between integrated information systems and management accounting functions (Rom et al., 2007). This is especially true when specialized software supports specific management accounting functions and techniques. In many ways, these advanced techniques depend on digital support so that they would not function if digital support were absent. This also brings a new role to the accountant where new methods and insights need to be dispersed throughout the organization. But in the end, more research is needed to show how these new systems and a changed management accounting function are improving organizational performance. When done right, the fit between integrated information systems and management accounting practice could improve the understanding of how good performance is generated.

Methodological considerations

Based on the theoretical outline, 20 survey questions were formulated that evaluate and describe the respondent's understanding and experience of the intertwined function of advanced information systems and management control in different ways and dimensions. The questions are presented in appendix 1. A web-based survey tool

was used, and an email with a short introduction to the study and a link to the survey was sent out to the 290 Swedish municipalities. The subject line said that the mail should be forwarded to the CFO. Out of the 290 tentative respondents, 97 answered the survey. The survey questions began with some questions about the municipal background, trying to establish the size and character of the municipal. The following 20 questions were stated as propositions that the respondent answered with a number based on the Likert scale 1-7. For this paper, the answers have been analyzed using nine cross-tables, whereby relations between questions have been established and viewed.

Results

From a more general perspective, the respondents consider their information systems important for running smooth business operations (see Figure 1). However, the answers indicate that the organizations do not have entirely customized systems even though their ambition was that they should be entirely customized to their needs. The majority of the respondents that if their information systems are important, they have been customized to a certain degree.

Figure 1
The importance of IS and its customization

		IS importance for an efficient operation (Q19)							
		1	2	3	4	5	6	7	Tot
An IS customized for the operation (Q 20)	1				1				**1**
	2				2			1	**3**
	3				2				**2**
	4		1	1	5	6	3	3	**19**
	5		1	1	4	8	9	5	**28**
	6					5	9	13	**27**
	7					2	2	6	**10**
	Tot		**2**	**3**	**13**	**21**	**23**	**28**	**90**

Source: Authors' work

Similarly, there is what could be understood as a form of correlation between if the information systems are important and how employees use or approach the systems, see Figure 2. The statement (Q12) that it is hard for employees to use the systems is not approved, and the answers are somewhat lower. An interesting observation is that the main numbers of answers are in the middle, so the respondents are a bit hesitant when it comes to employees' ability to use and take advantage of the systems.

Figure 2
The importance of IS and employees' ability to use it

		IS importance for an efficient operation (Q19)							
		1	2	3	4	5	6	7	Tot
IS usage resistance among personal (Q12)	1							1	1
	2			1	2	4	2	4	13
	3		1		3	1	9	5	19
	4			1	6	6	4	6	23
	5				2	9	6	10	27
	6		2	1		2	1		6
	7					1	1		2
	Tot		3	3	13	22	23	27	91

Source: Authors' work

From a management accounting perspective, the answers show that it is highly important to have integrated information systems, with most answers centered on numbers 5 and 6, as shown in Figure 3. This could be contrasted and compared with the statement (Q6) that their integrated information system supports their management accounting function to a large extent. These answers show a slightly lower focus where answers 4 and 5 are at the center.

Figure 3
Integrated IS and its importance and support of MA

		Integrated IS importance from an MA perspective (Q16)							
		1	2	3	4	5	6	7	Tot
Integrated IS supports MA (Q6)	1				1	1		2	4
	2			1	2	3	2	1	9
	3			2	3	3	3	1	12
	4		2		4	8	6	3	23
	5		1		2	7	6	3	19
	6				2	6	6	3	17
	7						1	2	3
	Tot		3	3	14	28	24	15	87

Source: Authors' work

Similarly, the answers show that the respondents largely use the information systems to produce decision-support information and reports, see Figure 4. The answers focus on the focus that integrated information systems are important for management

accounting and that the systems are used to deliver decision support. Almost none of the respondents' answers are on the lower left side of the pivot table, which should have indicated the opposite.

Figure 4
Integrated IS, decision support, and MA

		Integrated IS importance from an MA perspective (Q16)							
		1	2	3	4	5	6	7	Tot
Questionable support from IS for decision making (Q13)	1				1	2	1	4	8
	2		1	2	3	9	10	4	29
	3				5	7	7	1	20
	4		1	2	6	3	2	3	17
	5			1	1	7	2	1	12
	6		1			1	2	1	5
	7							1	1
	Tot		3	5	16	29	24	15	92

Source: Authors' work

Suppose a more personal perspective is applied and compared to if the IS supports decision making the answers are a bit more dispersed, as shown in Figure 5. Here, the respondents state that the integrated IS is important for individual management control work, focusing on answers 5 and 6. But there is a tendency, not that strong, though, that there are outliners in all corners, both in the high left and right corners and in the lower left and right corners. At the same time, there is a quite strong focus in the center around 5 and 6 in the columns and on 2 and 3 in the rows, which shows the same strength since the statement for the rows is reversed with a negative notion.

Figure 5
Individual MC work, decision making, and IS importance

		Integrated IS importance for individual MC work (Q3)							
		1	2	3	4	5	6	7	Tot
Questionable support from IS for decision making (Q13)	1	1				5		2	8
	2		2	1	4	9	10	3	29
	3			3	1	10	5	1	20
	4		2	5	2	4	4		17
	5	1			3	3	4	1	12
	6	1			1		2	1	5
	7				1				1
	Tot	3	4	9	12	31	25	8	92

Source: Authors' work

In Figure 6, where two different statements that in a way build on each other, the respondents show a bit of hesitation, and the answers are focused in the middle on both axels. The answers for the statement (Q1) proposing that their information systems are up to date and suitable for the operations the focus is on numbers 5 and 4. In the same way, respondents answered in the middle, numbers 4 and 5, when it comes to the idea that the information systems have great potential but are not user friendly. The single most answered combination is 5 and 5, both in the middle of the Likert scale.

Figure 6
IS potential and suitability

| | | Up to date IS suitable for the purpose (Q1) | | | | | | | |
		1	2	3	4	5	6	7	Tot
Great potential in IS but not user-friendly (Q17)	1				1		1		2
	2		1	1	2	1		1	6
	3		1	3	5	4	2	1	16
	4		3	5	3	12	10	2	35
	5	2			2	16		1	21
	6			1	5	2	3		11
	7					1			1
	Tot	2	5	10	18	36	16	5	92

Source: Authors' work

When asked if the integrated systems contribute to the development of the management accounting function, the answers are focused around 5 and 6, which might reflect the respondents, support for that statement (Q2), shown in Figure 7. These systems do not seem to be standard, but rather they are customized to specific needs in the organization (as stated in Q8). There is a somewhat causal relation between lower answers and higher answers relating to the two statements in the pivot table.

Figure 7
Customization IS and its ability to contribute to MA development

| | | Integrated IS contributes to developing MA (Q2) | | | | | | | |
		1	2	3	4	5	6	7	Tot
New IS is standard system with little customization (Q8)	1			1			1		2
	2		1	1	2	1	2		7
	3		1	1	2	6	5	2	17
	4		4	3	5	8	5	1	27
	5			2	2	6	9	2	21
	6	1	1		3	4	4		13
	7		1			1	2	1	5
	Tot	1	8	8	14	26	28	6	92

Source: Authors' work

Once again, the answers show a somewhat hesitating pattern when it comes to the need to search for the right information (Q15) and the ability of the information system to produce novel information (Q11); see Figure 8. The focus in the pivot table is in the middle of numbers 4 and 5 on both axels.

Figure 8
Information overload and the ability to produce new information

New IS brings with it access to information we didn't know of (Q11)	Information-overload makes it important to select the right information (Q15)							
		1	2	3	4	5	6	7	Tot
1								
2	2				1		1	4
3	1		2	4	4	1		12
4	1	1	3	12	4	3		24
5	1	5	5	3	10	6		30
6		3	1	3	7		1	15
7				1	1	3		5
Tot	5	9	11	23	27	13	2	90

Source: Authors' work

As shown in earlier tables, the respondents state that their information systems are suitable for their needs, but the answers on the statement (Q4) saying that the information systems could deliver more value and be of more use is more diverse, see Figure 9. More than one-third of the answer agrees with the statement and thinks that the system could be of more use for them.

Figure 9
IS suitability and its ability to deliver more value

Our IS does not deliver maximal benefits (Q4)	Up to date IS suitable for the purpose (Q1)							
		1	2	3	4	5	6	7	Tot
1							3	3
2	2			1	1	2		6
3				2	4	2	1	9
4			4	5	9	3		21
5			2	3	7	4	1	17
6		3	2	5	9	3		22
7		2	2	2	5	2		13
Tot	2	5	10	18	35	16	5	91

Source: Authors' work

Discussion

Several different functions phenomena like advanced information systems and management control practice could be discussed based on the results presented in this paper. Firstly there is the issue of the value of information. In Figure 5, the results show that integrated information systems are an important part of management control work. At the same time, the respondents do not question its ability to support decision-making. In the same way, table 6 shows that the respondents think their systems are more or less up-to-date and fulfill their purpose. This aligns with Quattrone et al. (2001) reasoning about the value and understanding of the information to the organization and its users. The respondents think that their information systems are a suitable means for their work with management control.

Similarly, the answers show that if the respondent thinks it's important to have an integrated information system that supports management accounting, it also confirms that their systems support management accounting and control functions. However, the focus shown in Figure 3 is in the middle around numbers 4, 5, and 6 on both axels, which could also be interpreted as if the respondent did not fully use the advanced systems for management accounting purposes, or that other sources were more important when it came to the use of the integrated systems. Nevertheless, none of the respondents indicated low numbers, but there was a tilt over to the higher numbers. In a way, this supports Scapens and Jazayeri (2003) and their idea that advanced systems increase efficiency within the accounting function and bring new ways of understanding information value.

Booth et al. (2000) also state that these advanced systems have contributed to the ability to compile more interesting and useful reports. And from a decision-making perspective table, 4 shows that the respondents agree that information systems are important for management accounting, and it is not questionable when it comes to supporting decision making. On the other hand, Figure 8 could be interpreted as if the respondents know what they get from the systems, they are not overloaded with information, and the information is not new to them. The focus among the answers is at the center, around numbers 4 and 5. None of the respondents have answers at the far end of the scale, and they might have hesitated when answering the statements and then settled with a number in the middle.

From one important perspective, these advanced systems need to be aligned with and customized to the organizational needs and their purpose with the systems, all the way from a management accounting function out into the organization (Wood et al., 2001, Botta-Genoulaz et al., 2005, Dechow et al., 2005). This idea is supported among the respondents. For example, the answers presented in Figure 1 indicate that the respondents think the information systems are important for an efficient operation and that the information systems are customized to the operation. Even though it seems like several of the respondents are working with standard systems, not fully customized, they say that the systems contribute to developing management control as a function, as shown in Figure 7. But then again, from another perspective, as shown in Figure 9, the answers show the respondents think that the systems could deliver more, and at the same time, the systems are up to date and suit their purpose.

Conclusion

Public sector operations in general and municipal operations, in particular, are complex business that needs a lot of resources. In that sense, it becomes interesting to reflect on and study how users in this complex setting understand and experience the intertwined functions of advanced information systems and management control.

This paper has in many ways confirmed that. As discussed earlier, information has become such an important commodity that management accounting as a function or phenomenon would not work without it. It brings an even more efficient organization, and even if standard systems are used, they could contribute to new evolving management accounting functions. And from an individual management control perspective, the systems are considered important, and they bring support to decision making.

Even though this study has not been asked, one could argue that the advanced, integrated systems have come to fill such an important function for management accounting and control, so these functions probably would not have worked as efficiently without the support of these systems. From another perspective, one could also argue that the systems have found their true value within management accounting, bringing with it the ability for individual managers outside the management accounting realm to participate in traditional management control activities such as performance measurement and management, planning, and control. These systems, and the intertwined function with management accounting as they have come to play, could be compared to a backbone and a nervous system in the organization (Macintosh, 1994), making management accounting more accessible to individuals within the organization and by doing so empowering them.

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The Appropriate Work Environment for Older Employees: The Case of Slovenia

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Abstract

Background: The increase in population life expectancy in developed economies is also reflected in the aging of the workforce; therefore, enterprises should create an appropriate work environment for all employees, emphasizing the older ones. **Objectives:** The major objectives of this paper are to establish the impact of appropriate working conditions and training programs for older employees on their work motivation, as well as to establish the latter's impact on the older employees' work engagement in Slovenian medium-sized and large enterprises. **Methods/Approach:** Structural equation modeling explored the links between four constructs – appropriate working conditions, training programs, work motivation, and work engagement. **Results:** In Slovenian enterprises, appropriate working conditions and training programs for older employees positively impact their work motivation. Moreover, the work motivation of older employees positively impacts their work engagement. **Conclusions:** These findings can be useful for employers or managers for developing targeted employee motivation and employee engagement programs to leverage the talents and dedication of older employees.

Keywords: appropriate work environment; older employees; enterprises; structural equation modeling
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Introduction

European countries are characterized by declining mortality and low birth rates, resulting in an aging population (Soja et al., 2020). According to Bal et al. (2016), demographic changes influence the workplaces; enterprises are therefore looking for ways to develop an appropriate work environment for age diverse employees, especially older ones.

Finding ways in which people can stay motivated and involved in their work at different stages of life is an ever-increasing challenge (Zaniboni et al., 2014). According to Rožman et al. (2017b), Bal et al. (2016), an appropriate work environment for older employees is the key to competitive business performance because an appropriate work environment with appropriate work conditions positively impacts work motivation leads to higher work engagement of older employees. A basic condition for successful leadership is to support a high level of motivation regardless of age. Also, according to Vasconcelos (2018), work engagement is key to achieving the companies' goals, and this also applies to older employees. Therefore, we created a structural model of an appropriate work environment for older employees with which employers contribute to the increase in work engagement of older employees.

According to Korsakienė et al. (2017), employers should create an appropriate work environment for the elderly because motivated employees achieve higher levels of work engagement (Korsakienė et al., 2017). To have age-diverse employees motivated and engaged in the workplace, employers need to determine which work conditions are appropriate for their employees because all employees of different ages do not experience job characteristics in the same way (Zaniboni et al., 2014; Rožman et al., 2017b). This can be illustrated by the conclusions of Zacher et al. (2017) and Truxillo et al. (2012) that younger employees will find a high diversity of task more useful than older ones, because they do not yet have experience with the various tasks. In contrast, older employees have already acquired them. Thus, older employees "might see task variety as a burden" (Zacher et al., 2017). They must complete tasks that do not focus on their specialized expertise and existing experience, which leads to lower work motivation. This should also make the variety of tasks more interesting for younger employees compared to older ones. The authors analyzed what form of training programs is interesting from the point of view of older employees. Still, they did not analyze if training programs have a significant positive impact on work motivation. Therefore, in our research, we analyzed if training programs have a significant positive impact on the work motivation of older employees.

Also, Zacher et al. (2009) found out that workplace autonomy has a positive and stronger effect on work motivation among older than younger employees. Previous research has shown that "poor physical work environments or badly designed and demanding work conditions" (Nilsson, 2017) lead to lower work motivation and engagement (Nilsson, 2016, 2017; Forma et al., 2005; Siegrist et al., 2007). Also, previous studies have found that maintenance of good health of older employees is conditional on moderate work, more time to rest, and limited working hours (Nilsson, 2016; Forma et al., 2005; Siegrist et al., 2007). Decreased cognitive ability of older employees often does not depend on aging, but on lifestyle factors, lack of motivation, and negative expectations (Nilsson, 2016; Mather, 2010; Salthouse, 2000). The authors mentioned above analyzed some aspects of working conditions on the motivation of older employees. In our research, however, we added several different aspects of working conditions and analyzed how they affect the work motivation of older employees.

Previous research has also shown that the employees who feel that the enterprise pays attention to them see their work as satisfactory, which leads to higher work motivation (Nilsson, 2016, 2017; Siegrist et al., 2007). The attitude of employers or managers to older employees has a positive impact on work motivation and work engagement (Nilsson, 2016, 2012, 2011). The above-refereed authors analyzed some factors that lead to increased work motivation. In our research, however, we took a step further: we analyzed if work motivation has a significant positive impact on older employees in enterprises in Slovenia. There are many definitions of work engagement and older employees, but researchers have not delved into designing an appropriate work environment for older employees and their work engagement. This paper, therefore, seeks to examine the effects of the work environment on the work engagement of older employees. Slovenian enterprises have not yet developed such a model to increase the work engagement of older employees. The major objectives of this paper are to establish the impact of appropriate working conditions and training programs for older employees on their work motivation and the impact of work motivation on the work engagement of older employees in medium-sized and large enterprises in Slovenia. While previous authors analyzed the data with descriptive statistics (Zacher et al., 2017; Truxillo et al., 2012; Nilsson, 2016) and linear regression (Frese, 2009), we used structural equation modeling to explore the links between these four constructs.

The contribution of our study is reflected in the created model of appropriate work environment for older employees with four constructs, appropriate working conditions for older employees, training programs for older employees, work motivation of older employees, and work engagement of older employees. Ilmarinen (2006) describe which training programs are appropriate for older employees, Bal et al. (2016) describe appropriate working conditions, Claes et al. (2008) describe which factors lead to higher work motivation of older employees, and Korsakienė et al. (2017) describe the importance of work engagement of older employees. Our research combined the constructs mentioned above in a structural equation model. The second contribution of this research is in testing the validity of the created structural equation model. In addition, by examining the impacts of the influential factors on the appropriate work environment for older employees, we gave recommendations for individual development plans, including career planning, training and development programs, and public policy related to age management.

The paper consists of six sections. The introduction is followed by the literature review, which also justifies the setting of the hypotheses. Then the methodology used is described. The next part of the paper contains the results of the empirical survey, followed by the discussion on the results of hypotheses verification. The paper concludes with a summary of research and conclusion, comparison with previous research, description of practical implications, paper limitations, and further research possibilities.

Literature Review

Appropriate Work Environment for Older Employees

Vasconcelos (2018) summarizes that employers should focus on creating workplaces that fit into the personality profile and preferences of older employees. In addition, employers can enhance the well-being and health of older employees by redesigning jobs toward reducing the workload (Vasconcelos, 2018). Moreover, Nahrgang et al. (2011) and Magnavita (2017) emphasize that older employees have more serious but less frequent workplace injuries than younger employees. Programs with the following dimensions: (1) the work environment, (2) work arrangements and work-life balance, (3) health promotion and disease prevention, and (4) social support (Uhunoma et al., 2020; Lichtenthaler et al., 2016; Silverstein, 2008) should be implemented. Creating friendly workplaces for age-diverse employees and promoting the working ability of older employees increase the enterprise's competitiveness and performance. Employers who do not provide appropriate programs and policies to create a suitable workplace for older employees will face adverse effects on quality and productivity (Ilmarinen, 2006). Thus, employers who support the workability of employees increase productivity, sustainable business practices and competitiveness (Rožman et al., 2019, 2017a).

Appropriate working conditions and training programs for older employees

Appropriate working conditions, which should be available in all enterprises, improve the management of older employees and their motivation to work (Bal et al., 2016). Enterprises need to provide appropriate working conditions to enable older employees to perform their work tasks successfully and remain efficient and productive in achieving the organization's goals. Therefore, attention should be paid to measures and the progress of good practices in managing older employees in the workplace and thus achieving a favorable working environment for them (Ilmarinen, 2012; Claes et al., 2008). Lichtenthaler et al. (2016) summarize a positive relationship between appropriate working conditions for older employees and their work motivation. Rožman et al. (2017a) found that the motivation of older employees is reflected in the possibility of flexibility in the workplace, the possibility of autonomy at work, the possibility of working at their own pace, good relationships between employees, and respect between employees. Therefore, the following hypothesis is proposed:

H1: Appropriate working conditions have a significant positive impact on the work motivation of older employees in large and medium-sized enterprises in Slovenia.

Employers usually see older employees as an obligation instead of being used as a valuable resource. Employees who have 10-20 years to retirement are not included in the plans for training which hurts their work motivation (Davies et al., 2017). Due to negative stereotypes, older employees often have fewer opportunities for development, which is reflected in fewer training opportunities and development opportunities (Zwick, 2015). Older employees can learn new things. Learning does not depend on age, but the learning process changes with age. Therefore, for older employees is crucial to have access to training and equal opportunities to learn new skills and abilities (Ilmarinen, 2012) that increase their work motivation (Zwick, 2015). Hence, it is proposed:

H2: Training programs have a significant positive impact on the work motivation of older employees in large and medium-sized enterprises in Slovenia.

Work Motivation and Work Engagement of Older Employees

Job design influences older employees' motivation. Lichtenthaler et al. (2016) highlight that low levels of work resources (e.g., social support, job autonomy) and demanding work needs (e.g., opportunities for work and development) on the one hand, and high levels of hindering job demands on the other, mean lower motivation for older employees, and this leads to lower work engagement. As job creation contributes to employee motivation and health, organizations need to adapt jobs to an aging workforce (Parker, 2014). Jobs with low job resources and hindering job demands deplete the mental and physical resources of employees, and consequently the energy and health of employees (Truxillo et al., 2012). This negatively impacts older employees' work motivation and reduces their work engagement (Bakker et al., 2014). Uhunoma et al. (2020) point out that work engagement is expected not only to improve employee and organizational performance and customer engagement, but also the financial health of an enterprise. Rich et al. (2010) emphasize that engaged employees do their job better and are more innovative than non-engaged employees.

Furthermore, engaged employees have better health, experience positive emotions, are more satisfied, more energetic, and more creative in their work. Eldor et al. (2016) found a significantly positive correlation between employee work motivation and employee work engagement. Thus, the following hypothesis is proposed:

H3: Work motivation has a significant positive impact on the work engagement of older employees in large and medium-sized enterprises in Slovenia.

Methodology

Research instrument

Questionnaires for employers and older employees contained closed questions in statements on a Likert-type scale, where 1 = I completely disagree, 2 = I do not agree, 3 = I partially agree, 4 = I agree, and 5 = I completely agree. In the questionnaire, employers answered the questions about appropriate working conditions for older employees and training programs, and older employees answered the questions about work motivation and work engagement.

Items for the 'appropriate working conditions for older employees' construct were formed by Ilmarinen (2006). This construct was described with eleven items, as shown in Table 1. Four items for the 'training programs for older employees' construct were formed by Davies et al. (2017). The 'work motivation of older employees' construct was explained with eleven items, formed by Kooij et al. (2008). The 'work engagement of older employees' construct included twelve items, formed by Robinson et al. (2004). The items included in the research instrument are presented in more detail in Table 1.

Table 1
The items included in the research instrument

Construct	Item
Appropriate working conditions for older employees (Ilmarinen, 2006)	In the company, we take care of the workload reduction of an older employee in the workplace by work transformation.
	Obligation for management of older employees on all company levels prevails in the company.
	In the company, we encourage changes in connection with older employees.
	We take care of the improvement of working conditions for older employees.
	Older employees are offered the flexibility of working space (working from home or a remote location).
	We offer older employees a flexible workday (we leave it to the employees to choose for themselves within the given frames of the time for start and end of work).
	We enable older employees to job share (two or more employees share the tasks and responsibilities of one full-time post).
	We allow older employees to work part-time.
	We enable older employees to work variable working hours (similar to a flexible workday, only that in this case, there is no main workday or a defined number of hours that need to be performed in a reporting period).
	In the company, we integrate older employees in strategy planning and initiatives to manage older employees.
	Age diversity has to be connected with the company strategy for equality and diversity in the company.
Training programs for older employees' (Davies et al., 2017)	The company carries out training and education programs tailored specifically for older employees.
	In the company, we provide older employees with technology training.
	In the company, we provide older employees with training in foreign languages.
	In the company, we offer career development opportunities.
Work motivation of older employees (Kooij et al., 2008)	The employer gives us compliments for the well-done work.
	The employer gives me the possibility of flexibility in the workplace.
	The employer gives me the possibility of autonomy at work.
	The employer allows me to provide diverse tasks.
	The employer allows me to do my work at my own pace.
	The employer gives me the possibility of advancement.
	The employer gives me the possibility for training and education.
	In the company prevails the possibility of equal treatment of employees by age.
	The company prevails the possibility of cooperation with other employees and the allocation of work.
	In the company prevail good relationships in the workplace.
	In the company, intergenerational cooperation is established, thereby reducing the burden on the workplace.
Work engagement of older employees' (Robinson et al., 2004)	I do my work with passion.
	I am engaged in the quality of my work.
	I am engaged in achieving successful business results.
	I feel a connection with the company in which I worked.
	I am aware of the importance of innovation for our company, and I am helping to develop the company.
	I trust in my colleagues and the manager.
	I feel that my work and job are important.
	I am proud to be employed in this company.
	I believe in the successful development and operation of our company.
	I would not leave the company, even if I could get another job opportunity.
	I feel very good at my workplace.
	I feel like a "part of the family" in the company.

Source: Ilmarinen, 2006; Davies et al., 2017; Kooij et al., 2008; Robinson et al., 2004

Data

In the medium-sized and large enterprises involved in the research, we surveyed employers and older employees over 50 years of age. In most cases, the lower age

limits that define an older employee are 45 (Brooke, 2003) or 50 (Ilmarinen, 2001). The enterprises were included in the sample based on their size, determined by the Slovenian companies act CA-1 (2017). According to Slovenian companies act CA-1 (2017), medium-sized enterprises fulfill two of the following criteria: (1) there are no more than 250 employees on average in a business year, (2) NET revenues from sales do not surpass 40.000.000 EUR and (3) the value of assets does not surpass 20.000.000 EUR. Large enterprises have more than 250 employees on average in a business year, their NET revenues from sales surpass 40.000.000 EUR, and the value of assets surpass 20.000.000 EUR. Simple random sampling was used to design a final sample of enterprises. Based on the random selection, 1.000 enterprises were included in the sample, of which 472 enterprises (i.e., employers) responded (the response rate was 47.2%). The number of participating older employees was limited to 4 per enterprise. Thus, 1.086 older employees participated in this survey. The sample of employers regarding the enterprise size is as follows: 51.9% were from large enterprises, and 48.1% were from medium-sized enterprises. According to the same control variable, the structure of the sample of older employees is as follows: 54.3% of older employees were employed in large enterprises, and 45.7% of them were in medium-sized enterprises. Data collection was implemented by the method of electronic and written questioning.

Statistical methods

We established the justification to use the factor analysis based on the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO ≥ 0.5) (Kaiser, 1974) and Bartlett's test of sphericity (BTS). Then we analyzed factor loadings ($\eta \geq 0.5$), commonalities of variables ($h > 0.4$), and eigenvalues of factors ($\lambda \geq 1.0$) (Tabachnick, Fidell, 2013). We checked the reliability of measurements with Cronbach's alpha coefficient (Chronbach, 1951). We examined average variance extracted (AVE) and composite reliability coefficients (CR) as part of the convergent validity. Also, we followed the criteria according to Kock (2019): AVE > 0.5, CR > 0.7 and CR > AVE. We used variance inflation factors (VIF), considering the criterion VIF < 5.0, to check the multicollinearity in the model (Hair et al., 2010). The quality of the structural model was measured by the R-squared, adjusted R-squared coefficients, and the Stone-Geisser Q-squared coefficient. We examined the predictability value of the structural model. Acceptable predictive validity in connection with an endogenous latent variable is suggested by $Q^2 > 0$ (Kock, 2019). To test the structural model, we used the following quality indicators and criteria according to Kock (2019) and Tabachnick et al. (2013): average path coefficient (APC, $p < 0.05$), average R-squared (ARS, $p < 0.05$), average adjusted R-squared (AARS, $p < 0.05$), average block variance inflation factor (AVIF < 5.0), average full collinearity VIF (AFVIF < 5.0), goodness-of-fit (GoF ≥ 0.36), Simpson's paradox ratio (SPR ≥ 0.7), the R-squared contribution ratio (RSCR ≥ 0.9), statistical suppression ratio (SSR ≥ 0.7), and nonlinear bivariate causality direction ratio (NLBCD ≥ 0.7).

Path coefficients of causal links (γ) and indicators of Cohen's effect (f^2) indicating the small (0.02), medium (0.15), and large (0.35) effect sizes (Kock, 2019; Tabachnick et al., 2013) were used to test the hypotheses stated in this research. We used the Statistical Package for the Social Sciences (SPSS) and WarpPLS software to analyze the data. According to Kock (2019), SEM models linear or nonlinear connections between constructs. The outputs of the processing of our model by WarpPLS indicate the nonlinearity of connections.

Validity

The values of convergent, discriminant, and nomological validity indicators are presented in Table 2.

Table 2
Indicators of validity

Constructs	Cronbach's a	CR	AVE	R^2	Adj. R^2	Q^2	VIF
Appropriate working conditions for older employees	0.958	0.964	0.694	(-)	(-)	(-)	1.573
Training programs for older employees	0.901	0.931	0.772	(-)	(-)	(-)	1.679
Work motivation of older employees	0.964	0.969	0.739	0.472	0.436	0.484	2.553
Work engagement of older employees	0.984	0.985	0.848	0.451	0.443	0.462	2.364

Source: Authors' work

Table 2 shows that the values of the latent variables' R^2, adjusted R^2, and Q^2 coefficients were greater than zero and thus indicates that the model has nomological validity. The authors also confirmed the convergent validity for all the constructs studied: composite reliabilities (CR) for the studied constructs exceeded the required lower bound 0.7, AVE values were greater than 0.5, and all CR values exceeded AVE values. Multicollinearity is not problematic in this model because the VIF values are lower than 5.0, ranging from 1.573 to 2.553.

Results

The obtained KMO values and the results of Bartlett's test of sphericity indicate that it is justified to use a factor analysis for each of the constructs considered: appropriate working conditions for older employees (KMO = 0.945, BTS: Approximate Chi-Square = 12712.4, df = 55, p < 0.001), training programs for older employees (KMO = 0.838, BTS: Approximate Chi-Square = 2771.177, df = 6, p < 0.001), work motivation of older employees (KMO = 0.947, BTS: Approximate Chi-Square = 12799.392, df =55, p < 0.001), work engagement of older employees (KMO = 0.961, BTS: Approximate Chi-Square = 21971.451, df = 66, p < 0.001)). All commonalities of the variables we used to measure individual constructs were higher than 0.40. All factor loadings were higher than 0.50 and significant at the 0.001 level; therefore, we have not eliminated any variable. The one-dimensional factor solution was obtained; their eigenvalues were greater than 1. All measurement scales proved high reliability. The values of Cronbach's alpha were, namely, 0.949 for appropriate working conditions for older employees, 0.900 for training programs for older employees, 0.963 for work motivation of older employees, and 0.982 for work engagement of older employees. Further, 77.6% of the total variance was explained by the 'appropriate working conditions for older employees' factor, 77.2 % by the 'training programs for older employees' factor, 73.9% by the 'work motivation of older employees' factor, and 'work engagement of older employees' explained 84.9% of the total variance.

We verified the data consistency within the research model with several model fit indices. Average path coefficient (APC = 0.610), Average R-squared (ARS = 0.792) and average adjusted R-squared (AARS = 0.791) were all statistically significant (p < 0.001). With values lower than 5.0, the average block variance inflation factor (AVIF = 1.962) and average full collinearity VIF (AFVIF = 3.260) are suitable. The value of the goodness-of-fit indicator (GoF = 0.777) indicates that the model fit is highly

appropriate. The values of nonlinear causality direction ratio (NLBCD = 1), statistical suppression ration (SSR = 1), R-squared contribution ratio (RSCR = 1) and Simpson's paradox ratio (SPR = 1) are equal to the ideal value. The authors can therefore confirm that the data will fit the research model.

The verification of hypotheses is facilitated by Figure 1, which is the conceptual model, complete with the values of path coefficients, and Table 3, which presents the results of SEM in more detail.

The results in Table 3 show that in large and medium-sized enterprises in Slovenia, appropriate working conditions for older employees impact their work motivation positively (AWC→WM = 0.682, p < 0.001); the value of Cohen's coefficient (f^2 = 0.573) is greater than 0.35 and thus indicates a high impact. In addition, training programs for older employees have a positive effect on their work motivation (TP→WM = 0.326, p < 0.001); the value of Cohen's coefficient (f^2 = 0.259) is between 0.15 and 0.35, indicating a medium effect size. Moreover, the work motivation of older employees has a positive effect on their work engagement (WM→WE = 0.694, p < 0.001), and the effect of latent predictive variables is of high strength (f^2 = 0.582). The results show that there is a nonlinear connection between the individual constructs.

Figure 1
Structural model of appropriate work environment for older employees
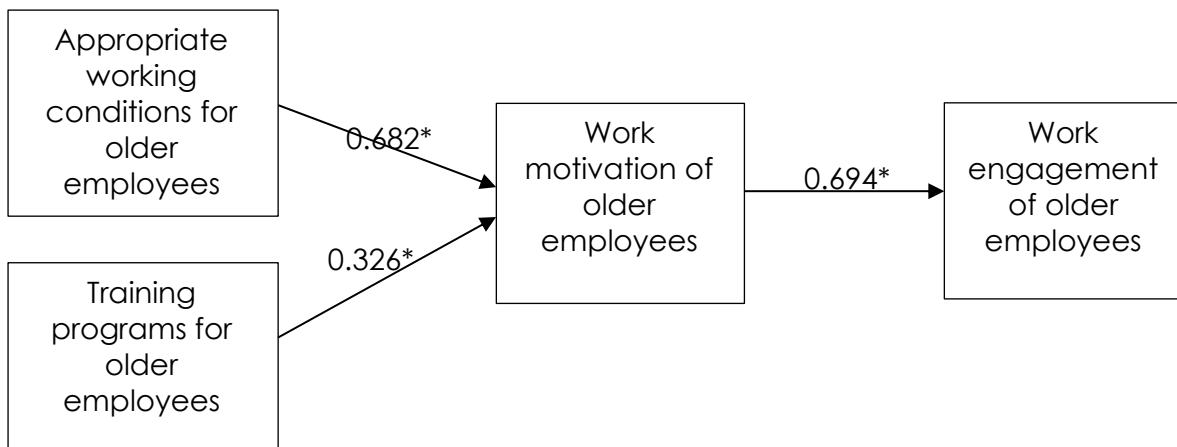
Note: *p < 0.001
Source: Authors' work

Table 3
SEM results

Hypothesized path	Link direction	Shape of link	Path coefficient (γ)	Effect size (f^2)	Standard error
AWC→WM	Positive	Nonlinear	0.682*	0.573	0.029
TP→WM	Positive	Nonlinear	0.326*	0.259	0.030
WM→WE	Positive	Nonlinear	0.694*	0.582	0.028

Note: *p < 0.001; AWC – appropriate working conditions for older employees; TP – training programs for older employees; WM – work motivation of older employees; WE – work engagement of older employees
Source: Authors' work

Discussion

The presented results confirmed all three hypotheses, H1, H2, and H3. We found that appropriate working conditions for older employees and training programs for older employees positively impact their work motivation in large and medium-sized enterprises in Slovenia. This matches the conclusions of Lichtenthaler et al. (2016), Bal et al. (2016), Parker (2014), Ilmarinen (2012), Silverstein (2008) and Kooij et al. (2008). The authors found a positive relationship between appropriate working conditions and work motivation of older employees, as well as between training programs for older employees and their work motivation. Nahrgang et al. (2011) and Magnavita (2017) found out that work motivation positively impacts the work engagement of older employees, which we also confirmed for large and medium-sized enterprises in Slovenia. Our previous research (Rožman et al., 2017a) also showed that autonomy at work, respect among employees, the possibility of working at their own pace, flexibility in the workplace, equal treatment of employees by age, and good interpersonal relationships in the workplace contribute to the motivation of older employees. Therefore, employers should create appropriate work conditions for older employees, which leads to higher work motivation, and consider that work motivation differs among age-diverse employees. Also, our previous research (Rožman et al., 2019) showed that employers do not implement many training programs for older employees. On the other hand, this research found that training programs for older employees positively impact their work motivation. According to Ilmarinen (2001), skills and competencies differ between generations. Also, transferring tacit (silent) knowledge of older employees to younger generations is important. The strongest combination of competencies in the workplace is based on different generations' different strengths (see, e.g., Ilmarinen, 2001). From this point of view, enterprises should pay more attention to appropriate approaches for older employees. This way, employees are working motivated, leading to increased work engagement, which is in line with our findings.

The contributions to the theory

The contributions to theory are reflected in the effects of work environment on older employees work engagement and in the created model of appropriate work environment for older employees with four constructs which are appropriate working conditions for older employees, training programs for older employees, work motivation of older employees and work engagement of older employees. A healthy and friendly work environment gives older employees opportunities to share ideas for the enterprise's success that can help the enterprise to grow. A positive work environment makes older employees feel good about coming to work, motivating them to sustain themselves throughout the day. Therefore, they are fully motivated and engaged in their workplace. It is therefore necessary to deal with the employee engagement as the part of the business strategy that focuses on keeping employees engaged throughout the employment relationship.

Implications for practice

Implications for practice are reflected in developing employee engagement to leverage the talents and dedication of older employees by employers or managers. Employers can use the findings to develop or create an appropriate work environment with appropriate working conditions and training programs for older employees to help older adults make smooth career and life transitions. This leads to higher work motivation and works engagement. Appropriate working conditions should include, for example, the flexibility of working space (working from home or a remote location),

flexible workday (employer leave it to the employees to choose for themselves within the given frames the time for start and end of work), job share (two or more employees share the tasks and responsibilities of one full-time post), allow older employees to work part-time, variable working hours (similar to a flexible workday, only that in this case there is no main workday or a defined number of hours that need to be performed in a reporting period).

We suggest the following approaches to employers in creating an appropriate work environment for older employees: creating appropriate working conditions for older employees, organization of working time tailored to the elderly, reducing the workload of older employees in the workplace, additional training and education, specifically for the elderly, mentoring schemes designed as a program, with an emphasis on the exchange and transfer of knowledge and experience, which contributes to intergenerational connections between employees.

In Slovenian enterprises it is necessary to change the mindset of older employees. Work motivation can significantly increase if enterprises promote active aging and create an appropriate work environment for older employees. This leads to an increase in work engagement of older employees. The social inclusion of all employees, including the elderly, and their contribution in the enterprise are essential for its success.

When developing appropriate approaches for older employees and their work engagement in enterprises, it is necessary to take into account that the aging of employees reduces the ability to perform physically demanding tasks. This means that the complexity of work tasks must be adjusted. Some appropriate working conditions include flexible hours, job sharing, teleworking, and providing health benefits. Having flexible policies and practices will enable the enterprise to maintain an encouraging work environment for older employees.

Training and education of all employees, including older employees, are also crucial for the enterprise's success. To improve the conditions of older employees related to education and training, appropriate learning methods are needed, such as the flexibility of learning hours due to a lower decline in concentration and thus increase the willingness to participate in such training. According to Ilmarinen (2012), older employees can learn new things, and the learning process changes with age (Ilmarinen, 2012). There is a need to introduce specific learning programs related to training and education for older employees, as they have different knowledge needs than younger employees. When educating or training older people, the enterprise must pay attention to their life and work experiences, interests, and motives. Each enterprise should help older employees acquire the skills to adapt to new work practices and changing technologies.

The research findings can help employers or managers reduce workload in the workplace by work transformation. From this perspective, the enterprise will more encourage changes in connection with older employees and integrate older employees in strategy planning and initiatives for the management of older employees, leading to higher work engagement of older employees. Furthermore, the employer should consider intergenerational methods to bring older employees training and development opportunities that they can use. Reverse mentoring, networking, and intergenerational cross-training may be of more interest to employees of all ages than traditional training classes.

Moreover, employers or managers can use the findings to consider ways of encouraging older employees to think of training and development as relevant to them. Individual development plans that include career planning may help older employees rethink what skills they need to gain or sharpen to remain at top

productivity as long as they want or need to work. This contributes to increased work motivation of older employees. Some examples of training and development programs that employers or managers can use include on-the-job training in specific technical skills used in day-to-day work, participation in project teamwork, special tasks/projects to stimulate learning, and e-learning. Also, public policy should demand stronger age management. There is a need for an active labor market and social protection policies to raise employment levels among older employees and create a healthy and friendly work environment for older employees. These implications for practice thus ensure more equal opportunities for employees of different ages, which strengthens work motivation and engagement.

Conclusion

In this paper, we found that appropriate working conditions for older employees and training programs for older employees positively impact their work motivation in large and medium-sized enterprises in Slovenia. In this paper, we also found that the work motivation of older employees positively impacts their work engagement.

Previous research showed statistically significant differences in work motivation of age-diverse employees and that work motivation has a positive impact on work engagement, which is in line with our research. In addition, our research highlights the effects of the work environment on older employees in the case of Slovenia, which has not yet been studied.

The workforce is aging, and the number of older employees in enterprises increases. The results of our research contribute to a new view of the proper management of older employees and to increase their work engagement. Employers or managers can use the findings to create an appropriate work environment with appropriate working conditions and training programs for older employees, which can increase the work motivation of employees as well as work engagement. Recommendations for individual development plans, including career planning, training, development programs, and public policy, can contribute to creating an appropriate work environment that positively impacts the work engagement of older employees.

Our study is limited to employees who are older than 50 years. In addition, the study carried out is limited to medium-sized and large enterprises in Slovenia. Moreover, the limitations of our research refer to the four constructs included in the structural model (Figure 1). Possibilities for further research refer to analyzing constructs among age-diverse employees in two different countries (for example, Croatia and Slovenia) and examining the differences between age-diverse employees.

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Market Structure Development in a Regulated Market: The Case of the EU Rating Agencies

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Abstract

Background: The motivation for this article is the observation of political and private efforts to establish an EU-based rating agency as a counterweight to the three major agencies and observe other approaches to increase competition in the rating market. **Objectives:** This article aims to analyse the potential regulatory impact of the oligopolistic situation on the European Union (EU) rating market in the regulation imposed on the agencies. **Methods/Approach:** Selected key figures are applied to observe if and how the dominance has changed. The different rating service range offered by the registered rating agencies in the EU is also considered in the analysis. **Results:** The research results show that new agencies potentially impact the EU rating market. While the three major rating agencies still dominate the market, they do so within a changing environment. **Conclusions:** The employment of external ratings is significant in the financial sector. Ratings provide relevant information on the default risk of financial instruments and assess the solvency of issuers. The market for external ratings thereby can be classified as oligopolistic. Turbulences during the financial crisis of 2008 triggered stricter regulation of the credit rating agencies. Such regulation has now been in force for a good decade.

Introduction

The market for external ratings is dominated at the global and EU levels by the three large credit rating agencies Standard & Poor's (S&P), Moody's, and Fitch Ratings ("Big Three"[1]). The purpose of a credit rating is to assess the default risk of financial instruments. In addition, a rating may provide a relevant assessment of the ability of an issuer to meet future payment obligations. Therefore, a rating for issuers facilitates access to the capital market as it contributes significantly to transparency for investors. The use of external ratings has been established as a regulatory requirement, in particular with the framework of Basel II (Basel Committee on Banking Supervision, 2004) and the equity capital regulations contained therein. This framework had been adopted in the EU. External ratings have thus gained importance by providing input for the supervision of financial institutions. In the financial crisis, the rating agencies and the oligopolistic market structure have been criticized for incorrect ratings. Stricter regulatory provisions are also followed at the EU level to strengthen competition among rating agencies, diversification, and transparency (Beck et al., 2010; Deipenbrock, 2010; Brieger, 2012; Blaurock, 2012; Blaurock, 2013).

In addition to the focus on ratings of financial instruments, the importance of sustainability ratings has recently been growing. With the Green Deal for the EU, the European Commission emphasizes its efforts to achieve the climate goals. The issue of sustainability is to be included in all EU policy areas. Considerable investments are necessary to achieve the climate goals, and hence, funds need to be directed into this area. This is also linked to the importance of sustainability ratings, which are currently largely unregulated compared to financial ratings (European Commission, 2019; Autorité des marches financiers (AMF), Autoriteit Financiële Markten (AFM), 2020). Thus, it will be important for the established rating agencies to prepare and offer sustainability ratings. Significant activity can already be traced.

Based on the regulatory efforts and the associated intent to increase competition on the one hand and reduce the dependence on external ratings on the other, this article analyses the competitive situation in the EU rating market. Selected key figures check whether the market structure has changed over a specified period. Associated with this is whether regulation has brought about a change in the oligopolistic market structure. This article is based on a contribution to Entrenova Virtual Conference 2020 (Meeh-Bunse et al., 2020).

The following chapter explains the evolution of the oligopolistic market structure with the major dominance of the Big Three. The empirical analysis shows the market situation over time. Then, in the next chapter, potential competitive alternatives in the rating market are discussed. The conclusion summarizes the essential findings and provides an outlook on further research opportunities in this subject area.

The oligopolistic market structure

An important aspect of the prevailing market structure lies in the regulatory institutionalization of ratings for the financial markets. For the first time in 1936, the US "Controller of the Currency" stipulated that purchasing securities that are largely speculative and do not meet a certain standard is prohibited. The governing body did not publish a more detailed definition but referred in a footnote that the terms used can be found in recognized rating agencies' manuals (Harold, 1938).

Much later, in 1975, the recognition as U.S. Nationally Recognized Statistical Rating Organization (NRSRO) was awarded for the first time by the U.S. supervisory authority

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[1] The term "Big Three" in this context refers to the rating agencies Standard & Poor's, Moody's and Fitch Ratings.

Securities and Exchange Commission (SEC). Consequently, only ratings of companies with NRSRO status could be used to determine banks' capital requirements. In this context, the SEC directly determined the agencies S&P, Moody's, and Fitch Ratings (U.S. Securities and Exchange Commission (SEC), 2005). The basis of the market-dominant position was thus laid for regulatory purposes. Since 1975, for over 25 years, until February 2003, the SEC has granted NRSRO status to four other agencies, which, however, had been merged or been taken over (U.S. Securities and Exchange Commission (SEC), 2003). Accordingly, only three large NRSROs existed sustainably until then. At this time, Dominion Bond Ratings Service (DBRS) (February 2003) and A.M. Best Company, Inc. (March 2005) became other agencies recognized as NRSROs by the SEC. They entered the market of regulatory recognized agencies (Langohr et al., 2008). Currently, nine rating agencies are registered as NRSROs (U.S. Securities and Exchange Commission (SEC), 2020). With the so-called "Credit Rating Agency Reform Act" (U.S. Credit Rating Agency, 2006), enacted in 2006, rating agencies were able to register with the US Register SEC as a "Nationally Recognized Statistical Rating Organization" (NRSRO) instead of being nominated. The law made it possible for smaller rating agencies to register under certain conditions, opening the market to many rating agencies.

The EU Rating Regulation (European Union, 2009) entered into force at European Union (EU) level three years later in 2009. The regulation aims to ensure a high level of consumer and investor protection by applying common quality requirements for ratings given within the EU. The regulation also stipulates that a rating agency must apply for registration to be recognized as an external rating agency (External Credit Assessment Institution (ECAI)). Thus, the status as ECAI represents the European Union counterpart to the NRSRO of the U.S. SEC. The European Securities and Markets Authority (ESMA) (Regulation (EU) No 1095/2010), established on January 01, 2011, has powers over credit rating agencies with regards to registration and ongoing supervision. The admission requirements and the necessary associated information for the registration of rating agencies can be seen as an obstacle to entering the rating market. Newly established rating agencies are particularly affected because they do not yet have sufficient experience and the necessary organizational requirements. However, the regulation for the registration of rating agencies enables exemption from certain information details or requirements. Given the demand for more competition on the rating market, high entry barriers for start-up agencies have been intended to be avoided (European Union, 2012).

A second important aspect of the oligopolistic market structure is that the effectiveness of ratings can only be observed ex-post. Consequently, taking the rating into account when regulating or making investment decisions requires trust in the solvency analysis. The agencies can acquire this trust through many years of experience, using statistically valid methods, and correct credit ratings in the past (Haar, 2009). This results in a reputation for the quality of the rating, which is crucial for the agencies' success. The historical development and the aspect of reputation illustrate the difficult successful market entry of new rating agencies and their establishment in the market. Once an issuer has decided on obtaining a rating from an agency with a corresponding reputation, any change in agency or unsubscribing is potentially questioned by investors. The assumption may be made that a possible "downgrading" should be avoided, which will force a concentration effect on the rating market (Lerch, 2010).

Empirical analysis

With the EU Rating Regulation of 2009 and its amendments in 2011 and 2013, numerous objectives and sub-objectives are pursued. Besides high consumer and investor protection, the promotion of competition, independence from rating agencies, preventing the excessive use of ratings by market participants, and a regular rotation of rating agencies are cited. In particular, the 2013 amendment aims to strengthen competition between rating agencies and to encourage the use of smaller ones. For example, by Article 8c of the current EU Rating Regulation for Structured Financial Products (SFI), issuers are required to request double ratings to guarantee a second, independent rating (European Union, 2013). Article 8d also determines the selection method when mandating rating agencies for SFI.

Consequently, if an issuer commissions at least two rating agencies to issue a rating for the same structured financial product, one of the two commissioned rating agencies may have a maximum market share of 10 percent (European Union, 2013). A structured financial product is a financial product "that consists of one or several baseline values and a derivative component" (Bundesanstalt für Finanzdienstleistungsaufsicht, 2014). Therefore, traditional financial products such as corporate bonds are exempt from this double rating (agency) requirement. The SFI market segment is the second-largest contributor to revenues at Moody's, though, after the corporate finance segment (Moody's, 2018).

These regulatory measures at the EU level clarify, among other things, efforts to increase competition on the rating market while reducing the dominance of the three major rating agencies. From this, the research hypothesis can be derived whether the EU regulatory provisions affect the oligopolistic market structure of the rating market and the market shares of the Big Three:

- o *Since the EU Rating Regulation came into force, the market shares of the three major rating agencies and the oligopolistic market structure of the rating market in the EU have remained unchanged.*

The research hypothesis aims to analyse the dominance or the oligopolistic market structure of the rating market at the level of the EU. To test the hypothesis, key figures from the overall rating market and the three major rating agencies are determined over a certain period. The time series analysis represents the revenues of the Big Three on the EU market, amongst other things. The market share of the respective rating agency is also shown over time. The analysis relates to the rating agencies registered by ESMA to operate on accredited regulatory status within the EU. The analysis results can be used to validate or refute the hypothesis. First, the revenues of the Big Three are presented.

Figure 1 essentially shows a continuous increase in revenues over the observation period. S&P and Moody's, in particular, have been able to increase their revenues in recent years significantly. Fitch Ratings remain constant with a slight increase at the end of the observation period. However, with these data, it should be noted that the European Union market for the three major rating agencies is not consistently narrowed down in terms of revenues in the respective annual reporting segments. S&P reports the revenue for the European region, whereas Moody's reports the revenue of the EMEA (Europe, Middle East, Africa) economic area. Fitch Ratings, on the other hand, refers to its registered rating agencies in the EU when reporting revenues (McGraw Hill Financial et al., 2013-2019; Moody's, 2013-2019; Fitch Ratings, 2012-2020). The latter agency has published the so-called EU Transparency Report since 2012 for 2011. Moody's (from 2010) and S&P (from 2015) also publish such a report, which is likewise a basis for assessing the market situation (market shares) in the EU and confirms

the authors' argumentation and hypothesis (McGraw Hill Financial et al., 2015-2019; Moody's et al., 2010-2019). A trend is discernible.

Figure 1
Revenues of the Big Three in reporting segments including the EU 2011-2019
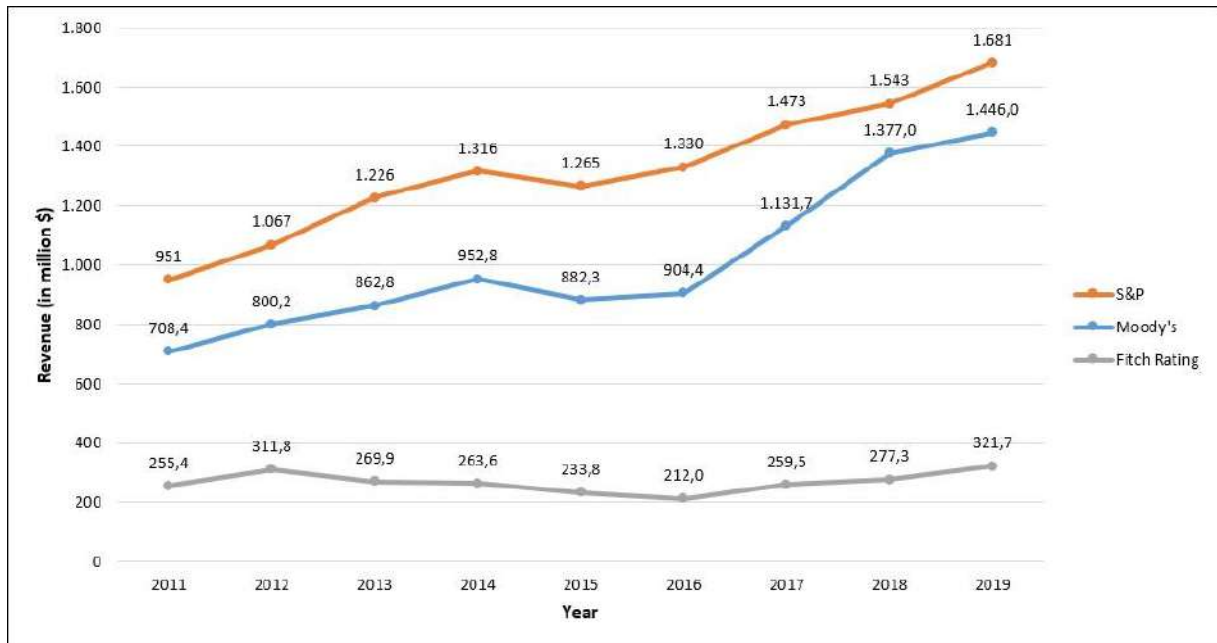
Source: McGraw Hill Financial et al., 2013-2019, Moody's et al., 2013-2019, Fitch Ratings, 2012-2020.

Another key figure that reflects the competitive situation of the rating market in the EU is the number of rating agencies registered by ESMA. As ESMA only started its work on January 1, 2011, the data published by the institution only is available from 2012 onwards. Figure 2 shows the number of registered rating agencies, with the three major rating agencies being grouped under "Big Three" and the other agencies under "Others".

Figure 2, based on the sheer number of registered rating agencies, does not suggest that the rating market has an oligopolistic market structure but suggests healthy competition. In addition to the three major rating agencies, over 20 other agencies are active on the market. Throughout 2012, other agencies entered the market, on average one agency per year. It should be emphasized that not all rating agencies offer all rating services. It is rather that the majority of these agencies only offer certain rating services (European Securities and Markets Authority, 2019). Despite the number of rating agencies, the existing oligopolistic market structure is based on a further key figure.

In addition to the presentation of revenues over the period and the number of registered rating agencies in the EU, the market shares (here based on annual revenues in the EU) are another important key figure for analyzing the competitive situation. The three major rating agencies are shown individually and accumulated, whereas all other registered agencies are summarized again under "Others".

Figure 2
Number of registered CRAs in the EU 2012-2019
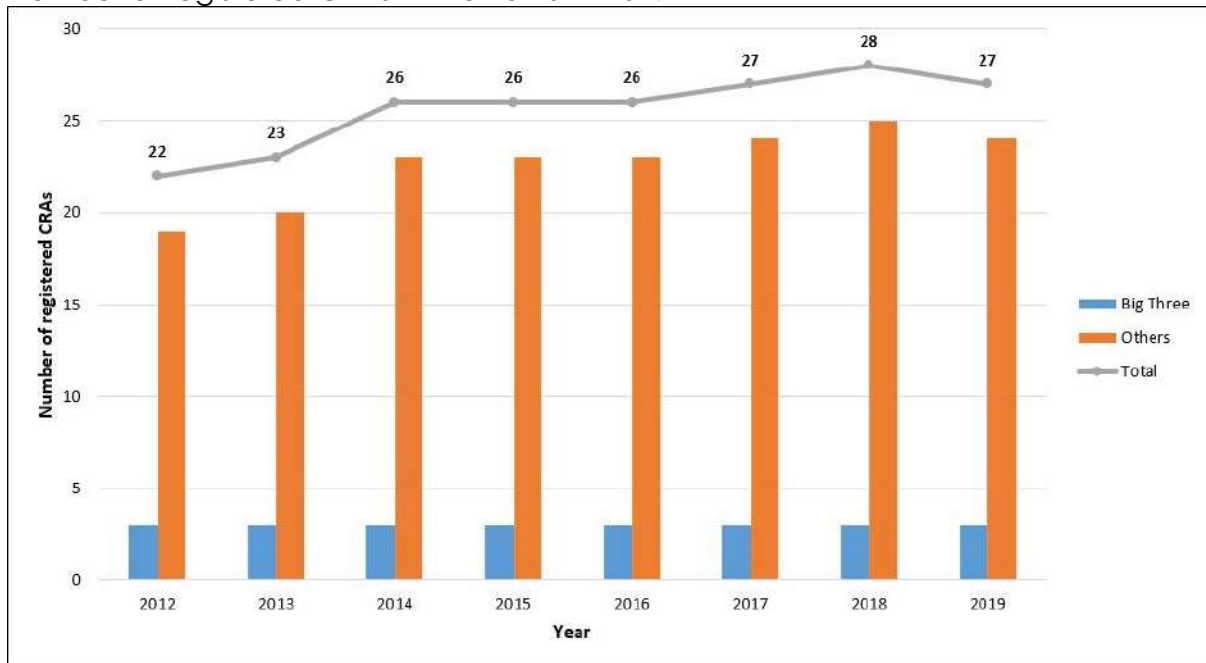
Source: European Securities and Markets Authority, (2013-2020)

The analysis of the market shares from Figure 3 shows (in contrast to the number of rating agencies) the large market share of the Big Three and the oligopolistic market structure. S&P, in particular, was able to increase its market share over the period under review from 2012-to-2019. Overall, the three major rating agencies have a market share of over 90 percent, and in contrast, the remaining agencies pooled have less than ten percent market share. It is noteworthy here that the number of rating agencies, according to Figure 2, has increased. Still, the market share ("Others") has decreased with 2012 as the reference year while showing a slight increase at the end of the observation period.

In comparison to the revenues generated (Figure 1), for which S&P and Moody's showed significant increases at the end of the period under review, it can be seen in connection with the market shares in the EU that the revenues increases tend to have been achieved outside the EU. Otherwise, the respective market share of the corresponding rating agencies in Figure 3 would potentially have increased similarly.

The further analysis focuses on the rating service range offered by the registered rating agencies. This indicates the existing oligopolistic market structure concerning rating segments. If only or mainly the Big Three offer the full rating service range, this reinforces the existing market power as there are no or few alternative full-service providers on the supply side. The rating service range offered by the registered rating agencies in the EU are the five subsequently specified types (European Securities and Markets Authority, 2020): Corporate: Non-Financial, Corporate: Financial, Corporate: Insurance, Sovereign and Public Finance, Structured Finance.

Figure 3
Market share of registered CRAs in the EU 2012-2019
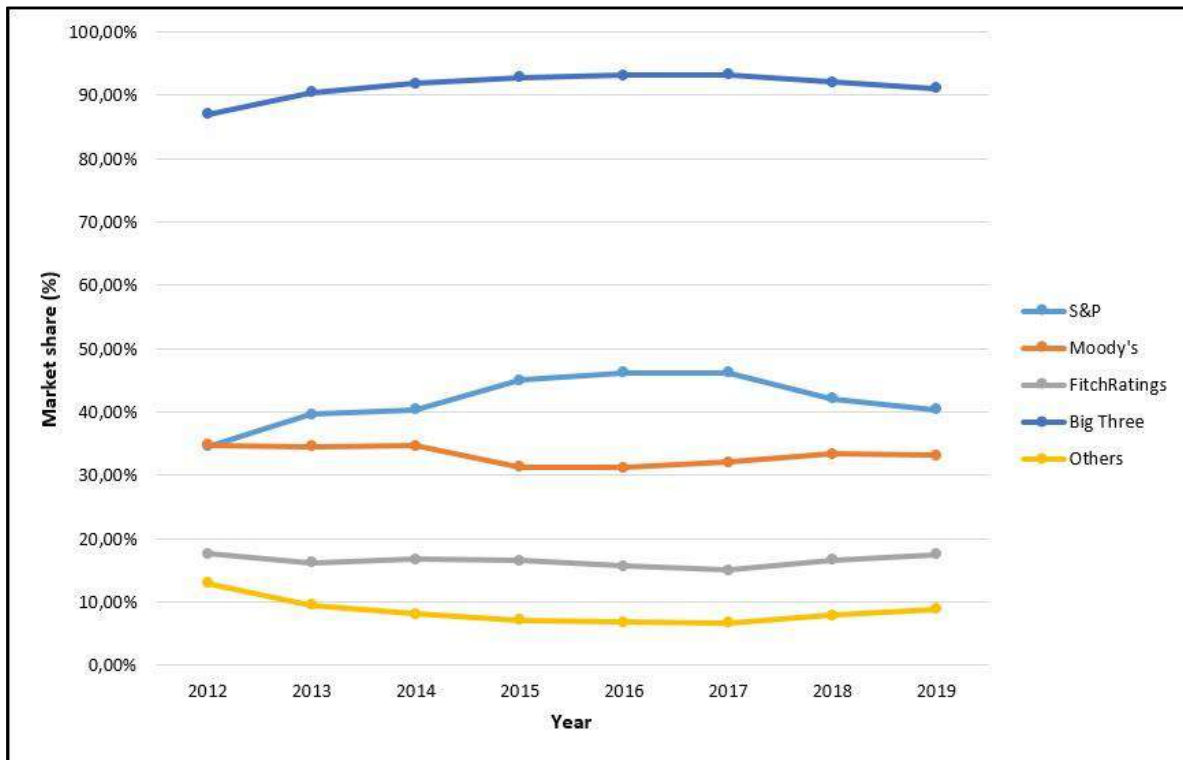
Source: European Securities and Markets Authority, 2013-2019.

Table 1 shows how many registered rating agencies were full-service rating agencies from 2016 to 2019 and how many specialized in one to four types of the service range. The classification is drawn on the "Big Three" and "Others".

Table 1
Types of credit ratings offered by EU registered CRAs

Types of credit ratings offered by CRA						
CRA	YEAR	5	4	3	2	1	Total CRA
Big Three	2016	3	-	-	-	-	3
Others	2016	4	4	3	4	8	23
Big Three	2017	3	-	-	-	-	3
Others	2017	4	5	4	4	7	24
Big Three	2018	3	-	-	-	-	3
Others	2018	4	5	4	4	8	25
Big Three	2019	3	-	-	-	-	3
Others	2019	5	4	3	4	8	24

Source: European Securities and Markets Authority, 2017-2020.

It can be seen that little surprise, the Big Three offered all of the five rating type services mentioned above permanently. In comparison, within the other rating agencies ("Others"), mainly a third of the group members, all under regulation and official acknowledgment, offered just one of the five rating type services. Table 1 also shows that in addition to the Big Three, there are up to five other rating agencies that also

offer the complete range of rating type services. Thus, in addition to the Big Three rating agencies, other providers have the full range of rating type services in their portfolio with an increasing tendency in number.

Interpretation of the results

The starting point of the empirical analysis was the investigation of the competitive situation of the rating market in the EU. From this, the research hypothesis was derived as to whether the entry of the EU Rating Regulation being in force was associated with a change in the market shares of the Big Three and the oligopolistic market structure.

Relevant key figures from the rating market were analyzed to answer this question. First of all, the revenues of the Big Three over the observation period from 2011 to 2019 are shown concerning different delimitations of the European Union market. The results show that S&P and Moody's revenues, in particular, increased considerably in the period. S&P revenues have increased by a total of 77 percent since 2011. The rating agency Moody's almost doubled its revenues. The main revenue increases of Moody's and S&P have been achieved outside the European Union (taking into account the market shares in the EU). Fitch Ratings was able to increase revenues by a total of approx. Twenty-six percent over this period. The reported revenues of the Big Three refer to a different definition in regional segment reporting. In conjunction with the analysis of market shares, the trend is that the revenues of the Big Three in the EU have remained on a constant level. A stagnation or general decline in revenues of the Big Three in the period under review, which could indicate lower market power or increased competition, cannot be identified with this key figure, though.

Furthermore, the number of rating agencies registered in the EU by ESMA has been considered since 2012. The numbers show that in addition to the Big Three, there are 24 other rating agencies in 2019. The total number has increased since 2012 from 22 registered agencies to 27 rating agencies in 2019. This means an increase of approximately 23 percent over the entire period and an average of approximately four percent or one rating agency per year.

The additional inclusion of the market share indicator illustrates, in particular, the competitive situation in the rating market. The results over the observation period from 2012 to 2019 show the expected clear dominance of the Big Three with over 90 percent market share. The slight increase in the number of rating agencies does not affect that they lose market share on a larger scale, and all smaller rating agencies together only have a market share of less than ten percent in the EU. The prevailing oligopolistic market structure can be determined based on this key figure.

Taking into account the results of the empirical analysis, it can be stated about the formulated hypothesis that since the entry of the EU Rating Regulation came into force, the dominant market shares of the Big Three have remained largely unchanged, and the associated oligopolistic market structure has pursued to exist in the EU. To date, efforts to strengthen competition and reduce the dominance of the Big Three associated with the EU regulation have not been achieved. Consequently, the hypothesis formulated at the beginning can be validated.

However, an important and, in the authors' view, significant condition precedent for reducing the market power of the Big Three can be seen in the number of full or almost full-service rating types competitors and its development. Here, the tendency is up, even still on a low level.

It can be said that the oligopolistic market structure and the associated market power of the Big Three continue. Alternative endeavors always have to assert themselves on the market and, according to the authors' view, will find it difficult to form a

competitive alternative. This includes, for example, a network of small rating agencies (Meeh-Bunse et al., 2014). However, efforts with a chance to be operational should continue to be promoted based on self-commitment or regulation, as is already the case with the current EU Rating Regulation and, for example, the associated commissioning of double ratings for issuers of SFI. In the long term, according to the author's view, other rating agencies could assert themselves on the market and build up the necessary reputation leading to more competition and improved market efficiency.

In the context of global sustainable development and the Green Deal of the European Union Commission, the aspect of "sustainability rating" is gaining considerable importance. This can be seen as a further pillar of the rating services offered. Notably, to date, such sustainability rating is not (yet) in the scope of EU Rating Regulation. Hence, the substantially reinforced non-financial reporting within EU accounting regulation has not found its way into the EU Rating Regulation. A substantial part of a rating opinion is based still on financial reporting figures. Accordingly, to the authors' view, the portfolio of regulated rating services and rating agencies active under the regulation should be expanded to include sustainability ratings. With such enhancement and based on the above-mentioned political efforts, there is the potential for the new providers to increase their types of services offered and increase their market share. Hence, this could cause pressure on the existing oligopolistic market structure. Smaller rating agencies would build up a respected reputation in this then regulated service type. They could establish themselves as trustful market competitors to the current "Big Three" in the medium to long term. Of course, this approach also comes with the risk of counteracting a healthy market structure. At least one of the Big Three, namely Fitch Ratings, has already been pushing hard into the sustainability rating service field.

On the one hand, this is assessed positively by the authors. In our view, sustainability awareness is promoted within the rating opinion addressee group. On the other hand, the oligopolistic market structure could expand to sustainability ratings. Regulating this service type by including it into the existing EU Rating Regulation could stimulate concentration. However, the Fitch rating approach focuses on credit default risk triggered by sustainability aspects and less on an issuer's degree of sustainability (Dow, 2020).

Conclusion

The dominance of the major rating agencies S&P, Moody's, and Fitch has been historically established by two features. The first is anchoring their ratings in regulatory procedures primarily implemented by the United States SEC and its forerunner authority, a related registration as an NRSRO in 1975, and subsequent developments. The oligopoly thus solidified over decades. As the second feature, the dominant position can be explained by the reputation of the agencies, which results from their many years of experience. The reputation is reflected in the preference of financial market participants. Credit ratings of issuers, their financial debt, or debt-related instruments can commonly only be broadly beneficially utilized on the financial markets if these are Big Three opinions.

With the ambitions in promoting sustainable development at the global and European Union level, another important potential role is about to land on the lap of rating agencies. Considerable investments are seen necessary to achieve the climate goals on the one hand. On the other hand, established business models have been or may be disrupted while new business models have been invented, impacting issuers' and financial instruments' default probability. Sustainability ratings are a suitable choice for

assessing whether and to which extent an underlying investment project takes relevant aspects of sustainable development into account or how resilient and/or impactful an issuer is to sustainable change. Such rating opinions offer investors the opportunity to be supported in allocating their funds, taking into account sustainability aspects. Therefore, the range of EU Regulated Rating service types should be expanded to sustainability ratings at a good pace after profound consideration of regulation structure. This allows new providers to establish themselves and move towards the role of serious competitors of the Big Three with or without expansion of rating type service. There has been no experience and reputation in this field for decades, as it is with the financial rating service. Sustainability ratings and reports have been recognized in the near past only.

Additionally, there is not yet neither an established methodology nor established measures. Also, the double materiality viewpoint must be instituted as an innovative approach (Verhey, 2020). The authors see it important for new providers and smaller rating agencies to take advantage of this opportunity.

This article analyses the competitive situation of the rating market in the context of EU regulation under limitations. A directly measurable influence of the EU regulations on the competitive situation represents the limits of this article, though. The article is also limited to certain indicators for assessing the competitive situation. Further indicators can be identified and analyzed in future research projects about the EU rating market. Research is also needed to develop and promote further alternative service models to enter the rating market. This could reduce the dependence on the Big Three while it has again to be emphasized that the regulator had strongly caused their dominance. Ideas like a rating cooperative (Meeh-Bunse et al., 2012), a public rating agency, or a network of smaller rating agencies need to be further researched, assessed, and/or promoted.

In summary, it can be stated that bare regulatory requirements neither do automatically change the competitive situation nor that the oligopolistic market structure is necessarily changed as a result. Ex-ante regulatory action expectedly has to be impactful in achieving the political goals. Ex post-implementation of such action consequently needs to be controlled. The biggest difficulty for the small rating agencies will be to build up the necessary reputation and the associated trust in a rating judgment. The creditworthiness opinions require broad acceptance of the financial market participants, which will probably only be possible over a longer period or recourse on valid existing and available data (Meeh-Bunse et al., 2012). New market potentials, such as sustainability ratings, also offer new providers and the already registered smaller rating agencies the opportunity to specialize in this area and, consequently, establish themselves further on the rating market. Building up the necessary reputation catching up to the Big Three is conceivable in this context. The reduction of the current oligopolistic market structure could be reduced, taking into account the actions on sustainable development and the associated framework conditions. However, self-commitment or regulation would have to set the matrix for sound development.

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Motivational Factors and Retention of Talented Managers

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Abstract

Background: In a contemporary fast-changing world, companies are facing growing global competition, volatile markets, altered workforce structure, and another technological reshifting, which generates enormous pressure on them to improve their business performance and imposes the necessity to highlight practices of talent management more seriously. **Objectives:** In this study we explore interrelations between attraction/work motivational factors and talent retention, observed through talent engagement. **Methods/Approach:** The methodology in this research focuses on the comprehensive resource-based view and encompasses quantitative analysis based on data gathered from talented managers in Bosnia and Herzegovina. **Results:** The research results unveiled that talents were attracted to work for current companies primarily because of: good salary and company goodwill. The top three prevalent work motivational factors for talents included: (1) comfortable work environment, (2) enough autonomy and creativity in working and deciding, and (3) work-life balance. Furthermore, talent motivational factors related to talent retention in a statistically significant positive way. **Conclusions:** This study furnishes available talent research and theory by relating attraction/work motivational factors to talent engagement; and by introducing the fundamental motivational factors which are of monumental importance for retaining talented managers in Bosnia and Herzegovina.

Introduction

Determined and motivated talented employees, who are sincerely interested in achieving positive results and long-term success, are one of the ubiquitous challenges for companies worldwide. As the most valuable and volatile firm's asset, talents enable organizations to sustain substantial advantage and power with their experience, expertize, and durability. To successfully manage employees and accomplish the organizational mission or goals with the least resources (including disposable human resources), proper motivational incentives must be used (Forson, 2012). On the one side, providing needed and proper motivation to employees is one of the managers' significant and complex tasks on different levels. On the other side, managers also need to be constantly motivated to work the best they can. Hence, the workers' expectations and needs should be identified by employers as well as managers, along with what stimulates them to become more productive (Rodriguez, 2015).

Most of the research studies have been focused on exploring motivation among employees, giving very little or insufficient attention to what motivates talented managers – what is the subject of this research. It was traditionally considered that the money factor, viewed through higher salary and extra payment, encourages most employees to work more efficiently and perform better outcomes. Rather than non-financial rewards, Yousaf et al. (2014) asserted that financial rewards motivate and retain employees more effectively. However, how long does it last to increase managers' salaries, and is it connected to sustainable motivation in the modern business world? Although financial rewards and competitive compensation systems are essential ways for organizations to make known their dedication to retain talent, yet they are not the best means of doing so (Ott et al., 2018). Despite higher additional salary offers, other factors such as bad leadership practices often result in managers and other employees searching for other jobs, making them realize that they can be paid better and treated better in the other work and other organizations. Lorincová et al. (2016) highlighted that, besides an equitable appraisal process and a basic salary, also working hours, enjoyable work environment, job security, recognition from supervisors and pleasant teamwork are significant motivational aspects for managers.

In accordance with pronounced talent shortage nowadays, motivating talents to start and stay working for one company is becoming more critical. It requires companies to advance their talent management systems since the competition has become more innovative and elusive, demographic changes are more unfavorable and magnifying, and the lack of appropriate talents and their demand has constantly been growing. Majority industrialized countries will experience a considerable gap in talent availability when the boom generation retires, statistically speaking (World Economic Forum, 2010). Ongoing challenges likewise involve quick technological progress, huge organizational changeovers, and volatile environments with the tendency towards continuous economic turmoil (Johennesse et al., 2017). Less structured and progressively unsteady career ladders have resulted from adapting to changing job markets and environments, causing workers to plan their careers on their own (Ott et al., 2018). Additionally, multi-generational and multi-ethnic workplaces have become a necessity for employers, causing employers to find a balance between various workforces (Tlaiss et al., 2017). Managers have the upper hand over firms actually, and the new reality for the companies is that: a competitive advantage comes from talented people; they are scarce, mobile, have a short commitment, and expect a lot more from their organizations (Michaels et al., 2011). Individual-level drivers can also accelerate talent departure due to their valued skills in demand and higher confidence about his or her ability to get employed in another place (Wei,

2015). If the firm's leaders provide limited scope for talents to apply and develop their skills, it is not surprising that talents become increasingly interested in leaving it.

The business landscape in Bosnia and Herzegovina is confronted with growing "brain-drain syndrome", characterized by experienced, competent, and skilled employees who seek better opportunities away from the homeland, which contributes to further declining talent availability. This challenge represents a huge issue for companies of all sizes not to become victims of talent shortage. Simultaneously, it represents an enormous opportunity for companies to think proactively and develop an efficient talent strategy that will make them competitive and sustainable for the long term in their environments. Therefore, companies need to address critical risks with the current/near future situation in Bosnia and Herzegovina to retain the best employees through improved talent management practices. Since various motivational factors influence employees' and managers' decisions to work for the particular companies, our study aimed at identifying the critical attraction and work motivational factors for talented managers in Bosnia and Herzegovina; and relate them to talent retention.

A resource-based conceptual framework (Singh et al., 2021) that identifies key competencies to build long-term competitive advantage is taken as a theoretical platform for research conducted. When analyzing the critical segments of a company that it can rely on when creating a platform to improve its competitive position, it can use a filter through which the company can examine the main features of the resources and competencies within a company. These filtering criteria consist of questions related to the value, rarity, possibility of imitation, and possibility of substituting a particular resource, competence, or combination. In this research, we examined managers from domestic private companies that showed successfully running the business to grow total revenue and profitability as the prerequisite for expectation they are talented managers. We tested how different aspects of motivation impact talented managers' retention in Bosnia and Herzegovina companies.

According to Hatum (2010), to be successful, talent management strategies must be regarded as an interrelated process that combines talent attraction, development, and retention dimensions. Taking into account that each dimension has its own distinctive qualities, its coordination is essential for ensuring cohesiveness of the whole process and the firm's success. Through the mentioned research, different constructs were measured to examine their relations. The critical constructs in our research are related to the motivation of talented managers as independent variables, and they are complex composite measures that rely on two dimensions where the first includes Attraction motivational factors for talented managers is construct created from 7 items and the second dimension named Work motivational factors for talented managers is construct created from 13 items. Our research aims to relate the motivation of talented managers to their willingness to stay in the company in the long run period and to be highly committed to performing their tasks as a prerequisite for building long-run competitive advantages and extraordinary business results. Complex composite constructs such as the second-order construct named practice of talent management that consider a definite number of simplified measured dimensions were used in Yener et al. (2017). In this sense, as the third construct that plays the role of a dependent variable in this research, the talented managers' retention construct, is a second-order construct consisting of several dimensions based on measuring several indicators and their averaging. This second-order construct's main dimensions are created from talent satisfaction, talent identification, commitment, talent loyalty, and talent performance dimensions.

This paper incorporates five subsequent sections. Firstly, a broad literature review covered various studies regarding motivation, motivational methods, talents definition, and attraction/motivational work factors for talents. Next, the talent retention concept is introduced through the dimension of talent engagement. It is followed by the research framework formulation, hypotheses development, and methodology presentation. Afterward, research results are discussed with their theoretical and practical implications. Finally, key conclusions are demonstrated, including the study's limitations and directions for further research.

Literature Review

What does motivation imply?

Motivation has been viewed from different perspectives in the literature. The definition of motivation provided by Maduka et al. (2014) is guided behavior directed by an individual's intended will in order to achieve certain goals. It means that an employee is motivated if they have driving internal/external stimulation and is willing to efficiently and effectively complete work tasks. Another study has discussed motivation as an internal desire inside an employee to complete his/her tasks on account of the fact that they are interesting and complement their interests (Hanaysha, 2016). An exciting definition was earlier stated by Coetsee (2011), who depicted a motivated employee as someone who would be willing to work really hard to accomplish the goals of the organization, concerning their satisfaction needs. When employees are motivated, they are more likely to willingly and eagerly extra effort into doing and executing tasks to achieve exceptionally successful goals (Moran, 2013). The task of motivating employees is one of the most paramount aspects of leadership, as motivation is what transforms employee's abilities, skills and knowledge into real work behavior and results in the job (Stamov Roßnagel, 2017). Leaders in an organization must be oriented to discover talent motivation by carefully listening to talents' suggestions, bright ideas, and particular issues they deal with, and by periodical research what talent's job and career aspirations and interests are. Leaders simultaneously need to provide to talents, needed resources, support (by encouraging, inspiring, trusting, and developing them), and active involvement in decision-making that will enable them to do the work remarkably and co-create with talents positive and purposeful work environment.

Various established motivational models can be valuable for leaders to positively influence managers' motivation by compiling and effectively using a comprehensive set of its tools. Leaders need to assess and apply the combination of the right tools that reflect two-sided comprehension of motivation and the factors that significantly increase motivation. The following section covers some core motivation methods that leaders can use as a sophisticated and highly effective set of tools to promote their employee and managers motivation.

Motivation methods

There are various financial and non-financial ways that companies worldwide have been using to improve and boost managers' and other employees' motivation. To discover the best motivator of each manager, companies need to reveal and gain a profound understanding of what is indeed meaningful in their lives.

Most of the research studies are focused on what motivates employees without specifically emphasizing managers' positions. Financial incentive was considered the most influential and powerful motivator for a long time, in a way that how hard and long enough managers work for the one firm. Consequently, their wage would increase. Dessler (2014) identifies financial incentives as remuneration or rewards given

in monetary compensation form to workers who overpass in advance defined productivity norms. Financial incentives commonly appear under three forms (salaries/wages, bonuses, and merit pay). Managers' enthusiasm regarding income might be inspired by attractive assigned contracts or stimulated by potential growth in permanent salary. Since managers do not simply view a salary as a monetary expressed amount but also as a level of value and appreciation an employer places on them, it can significantly impact an employee's overall performance. Authors Bullock et al. (2015) showed that salaries are a vital factors in motivating employees and ensuring their loyalty and sincerity throughout diverse business sectors. Security role, viewed as security concerns regarding payroll guarantees by the employer that salary will be regularly and by appointment paid to employees, is also of enormous importance because living needs are essential and one of the strongest motivators for workers. Regarding security role as a motivation factor in developing countries, (Rahimić et al., 2013) found out that regular and timely payments represent an essential motivation factor for workers in Bosnia and Herzegovina enterprises. Employers may develop serious psychological and physical disruptions of their workers if they let down in fulfilling the security requirements and their physiological needs (Werner et al., 2012). Regarding bonuses, they are viewed as an additional amount of money given to an employee on his/her existing salary.

Non-financial motivational factors, which cause psychological/emotional satisfaction and a more profound sense of happiness, motivate managers to work much better, be more dedicated, and transmit positive energy in the workplace. When it comes to non-financial job motivation components, Jansen et al. (2014) found out seven significant intrinsic motivational factors for middle-level managers: autonomy to perform the task, recognition for achievement, training & development, promotion, support from top management, challenging work, and participation in the decision-making process. Additionally, Wziątek-Staśko (2015) revealed in her research study that flexi-time has a key motivational role for the lowest level managers in Europe, while motivational factors for top-managers included "well-organized work", and "participation in firm's management process and personal influence on organizational matters of key importance". on the previously presented review of the literature, it is evident that within this research study both, financial and of course non-financial motivational factors need to be taken into consideration such as psychological contract contents.

Defining the term "talent"

To name someone talent in the business world opens many dilemmas on which capabilities, characteristics, and competencies that specific person shall possess. An extensive literature regarding human resource management (HRM) contains a variety of approaches to talent definition (Gallardo-Gallardo et al., 2013). Typically, talent workers are recognized as those who are actively contributing to accomplishing a business objectives and strategy and ensuring the organization's competitiveness (He et al., 2011). Talents are universally comprehended as workers who have enormous potential to accomplish high goals (Tansley, 2011). It has also been studied the particular skills required for managing and guiding talented individuals, as it is focused on identifying employee potential so that they can assume key strategic (top management) roles in organizations (Boštjančič et al., 2018). Authors Claussen et al. (2014) addressed four eminent domains of attributes that are of enormous importance for thriving management: expertise, experience, social network, and social capital. In illustrating the "talent" model Boštjančič et al. (2018) used several of the characteristics emphasized by HR specialists, such as: strong motivation, an eagerness to learn,

proactive behavior, acquisition of novel knowledge quickly, curiosity, self-initiative, aspiration and desire for development. In their study, authors also found out that talent comes from demonstrating values, possessing personal qualities, and performing outstandingly at work for a defined period of time (Boštjančič et al., 2018). For talent to perform at its best, he/she must possess three attributes: „competence x commitment x contribution" (Ulrich et al., 2012). A person's skill set, values and knowledge determine their competence level in their field (McDonnell et al., 2011). Commitment to do something is another fundamental element of talent, which denotes the way individuals can best fulfill their role within an organization by using their competences (Gallardo-Gallardo et al., 2013). An individual's contribution is measured in terms of the value they bring to their job role as a result of their competence and commitment (McDonnell et al., 2011).

Attraction motivational factors for talents

Corporate brand is viewed as a significant concept linked to talents' attraction and retention because its value perception gets enlarged with the rise of its popularity and qualities (Wallace et al., 2012). For a company to attract talent, it is necessary to focus on six themes: "reputation and image, strategic vision, organizational culture, identity, corporate social responsibility, work, and surrounding environment" (Saurombe et al., 2017). Alnıaçık et al. (2014) concluded in their research study that the concept of employer brand attractiveness isn't universal and the value that employers place on it differ across nations. They also found out that "Recognition/appreciation from management", "Having a good relationship with colleagues" like social value; as well as "An above-average basic salary" viewed as positive economic impact, presents the key features of a good employer in the talents' eyes (Alnıaçık et al., 2014). In their study, Botha et al. (2011) aimed at designing a model – how to brand employer in order to improve attracting and retaining talents, and found out that employers who attract talents have established target group needs. They put significant emphasis on communicating an attractive firm's brand message. Kellyservice (2013) surveyed 100 businesses and discovered that attracting talent encompassed a variety of components: salary packages, firm culture, benefits, styles of recruitment, staff attrition, social networking and work-life balance. Compensation attracts employees in different ways and employee benefits, especially flexible benefits, enable them to fill open positions quicker and have an effect on applicants' interest in the position (Barber et al., 2000).

External human resource marketing through brand communication can be linked to internal human resource marketing to highlight some company and make it targeted in providing value tailored to what recruiters look for (Oladipo et al., 2013; Rampl and Kenning, 2014). The prime information channels utilized for forming talent perception and job seekers' behavior should also be considered while making a firm's attractive job offers (Stoynova et al., 2017). According to Stoinova (2016) and Dehlsen et al. (2009), job seekers trust more information from family members, friends or acquaintances about the employers, while sources like online tools and media sources are deemed little trustworthy.

Work motivational factors and talent retention

Work motivation has enormous importance in retaining talents. Talent retention, viewed through different strategies, activities, and practices for preventing the talents attrition, enables avoiding a high cost associated with losing a firm's talents (such as direct costs through talent employing and training; and indirect costs by losing thorough know-how, expertise or valuable networking among workers upon leaving

firm). Research studies have shown that motivation positively impacts employee retention (Mgedezi et al., 2014), but retention rates differ due to certain factors (Glen, 2006). Shah et al. (2018) revealed in their study among banking sector employees that intrinsic motivation (the aspect of the job which enhances internal satisfaction – like appreciation, new work challenges) and extrinsic motivation (such as pay, bonus, promotions) substantially and strongly impact workers retention. The question emerges: "what are the key motivators that make talents achieve great results and make them stay with the company?". Patriota (2009) determined a chance for advancing career and job full of challenges as top motivators for retaining workers. Organizations shall openly communicate a clear message on career growth opportunities and demonstrate that it is indeed available through diverse ongoing practices (for example, internal job boards, succession planning, and career roadmaps). Regarding determinants that influence employee retention, Rodrigues Ataide Silva et al. (2019) found that training policy is the most critical factor in retaining employees. Talent training, which is focused on developing talents' today and future needed skills, can bring many advantages for talents – like empowerment for taking on new challenges according to updated and upgraded skills, and increased talents' feeling of being valued, essential and constituent part of an organization, what is showed by verily care, support and commitment of their employer to their development. Rodrigues Ataide Silva et al. (2019) also emphasized that the following factors were related to employee retention: competitive salaries and additional benefits - such as transportation, subsidized meal, and health plan. Sandhya et al. (2011) pointed out that employee retention can be practically achieved through their motivation by career development/particular reward program, open communication, performance-based bonus, recreation facilities, and gifts. Sudhakaran et al. (2019) showed in their employee retention model that technology professionals' self-willed attrition can be reduced by pay, benefits, work-life harmony and supportive work environment. Among the other critical factors for talents retention stand out: how good the leadership is, collaborative work, promotional chances, workplace learning and acknowledgement (Oladipo et al., 2013; Stoinova, 2016).

Talent engagement as the primary dimension of talent retention

As a significant ongoing process in an organization, practices/policies relating to employee retention aim to ensure that employees remain in an organization until the project is finished or for the longest possible period time (Kaewsaeng-on, 2016). Considering conceptual dimensions of „retaining talents", Wahyuningtyas (2015) suggested that retaining talents include career planning, succession planning, and talent engagement. Career planning is a process that dynamically and systematically links talented employees' abilities and desires with their career goals and existing or potential position within the company. Succession planning refers to the proactive process of future leaders' excellent preparation to easily replace the current ones. Talent engagement occupies an organization a central place since the proper motivation drives key players to achieve continuously better success. Five components make up employee engagement: "employee satisfaction, employee identification, employee commitment, employee loyalty, and employee performance" (Kumar et al., 2015).

Employee satisfaction can be seen as an employee's positive expectations regarding his/her complete work, existing work environment, and what makes him/her happy with the natural and present job circumstances. Companies need to ensure that employee satisfaction is high among the workers because it is a precondition for

increasing outputs, reactivity, services for customers and quality (Sageer et al., 2012). Employee identification with one company arises as a result of bond between worker-organization and everything connected to it, often by taking personally and proudly company matters. Kumar et al. (2015) emphasized that when workers express identification with a firm, their commitment is significantly higher than if they don't, which encourages them to go beyond their work requirements. Authors also highlight that the development of employee commitment comes over time as the outcome of the shared experience, and it is often an antecedent of loyalty (Kumar et al., 2015). Employee performance can be linked to their positive outputs (for example, increased quality, sales, and profitability of the firm's goods/services and boosting customer interactions and feedback).

In this research paper, the focus was on the employee engagement developed by Kumar et al. (2015), as the critical dimension of talent retention (which is for this paper called "talent engagement" to make the better link with other examined variables; and its variables are named for the same purposes: talent satisfaction, talent identification, talent commitment, talent loyalty, and talent performance).

Research framework

We conducted this study with the prime aim to determine whether there is a relationship amongst talented managers' motivation and their retention within companies in Bosnia and Herzegovina. In addition to this, as a foundation for empirical research a conceptual model is created (see Figure 1).

Figure 1
Conceptual model
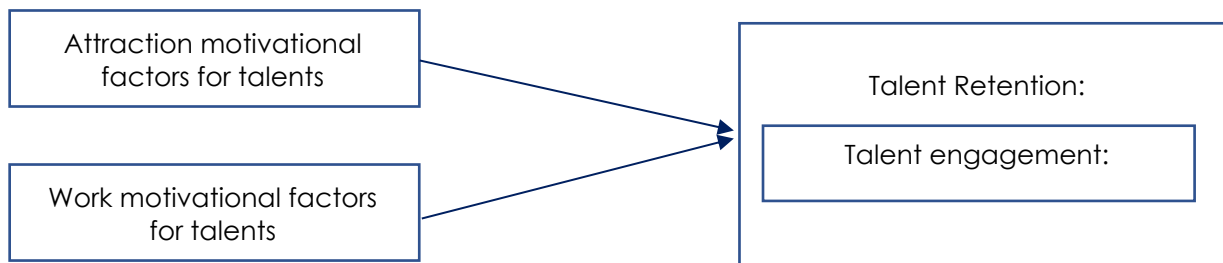
Source: Author's illustration

The conceptual model presented in Figure 1 is made up of two sections: attraction/motivational work factors for talents and its influence on talent engagement – one of the main elements of talent retention (Wahyuningtyas, 2015). Based on the presented conceptual model, this article's succeeding research propositions and hypotheses were identified. Based on previous research that is very scarce in this area, it is possible to develop many research propositions. This paper focuses on two essential and, in this way, hitherto unexplored relationships in domestic companies. The first research proposition (RP1) problematizes the relationship between the construct Attraction motivational factors as an independent variable and the construct talent retention as a composite construct as a function of the dependent variable. It assumes a positive independent variable's effect on the dependent variable. The second research proposition (RP2) problematizes the relationship between the construct Work motivational factors, as the second independent variable, and the construct talent retention as a composite construct as

a function of the dependent variable and assumes a positive independent variable's effect on the dependent variable. Based on the above research proposition for this paper, it is possible to formulate two research hypotheses, as follows:

- o H1: Attraction motivational factors in small and medium private companies directly influence talent retention.
- o H2: Work motivational factors in small and medium private companies directly influence talent retention.

Methodology

Research instrument

The independent variable is talent motivation, which is observed through attraction and work motivational factors for talents. The dependent variable indicators of talent retention are composed of five employee engagement dimensions proposed by Kumar et al. (2015), which were called "talent engagement" dimensions for this paper, or individually: talent satisfaction, talent identification, talent commitment, talent loyalty, and talent performance.

The research instrument (questionnaire) encompassed four parts.

The first two parts were designed to measure independent variables (attraction and work motivational factors). The attraction motivational factors included seven items, while the motivational work factors involved thirteen items. Authors formulated the scales for both motivational factors, and they were measured with a five-point Likert scale, where respondents were asked to declare if the offered statements motivate them or not (1 – Demotivates me; 5 – Absolutely motivates me).

The third part of the questionnaire measured the "Talent Retention" dimension, which involved 20 items developed by Kumar et al. (2015) to appraise construct "talent engagement". This measure contains five elements: "talent satisfaction, talent identification, talent commitment, talent loyalty, and talent performance" (Kumar et al., 2015). A 5-point scale was applied to evaluate the talent's overall experience with the current organization (score 1 = the lowest; score 5 = the highest score).

The fourth part of the questionnaire incorporated items concerning talents' demographic characteristics as control variables (gender, age; educational level; and managerial function). Gender variables were assessed as binomial variables (1-Female; 2-Male), while the other control variables were coded in numbers (for example, age variables: 20-40=1; 41-60=2; 60-70=3). Details of the complete research instrument are displayed in Table 2. Reliability analysis was applied to discover the internal consistency of variables, demonstrated in Table 1.

Table 1
Reliability statistics

Variables	# of items	Cronbach Alpha
Attraction motivational factors for talents	7	0,893
Work motivational factors for talents	13	0,931
Talent engagement	20	0,964

Source: Author's work

Internal consistency analysis uncovered that the alpha value for attracting motivational factors for talents was 0.893, N=7, whereas the alpha value of work motivational factors for talents was 0.931, N=13. The value of alpha for talent engagement was 0.964, N=20. Considering that every variable has a Cronbach's Alpha value greater than 0.7, it further proves that they all have outstanding reliability in addition to high internal consistency.

Table 1
Research instrument explanation

Construction	Code	Item
		Independent variables
Attraction motivational factors	AMF_1	Good salary for an applied managerial position
	AMF_2	Good job offer with benefits package from the company's top management
	AMF_3	Company's strong brand
	AMF_4	Company goodwill
	AMF_5	Recommendations from friends/acquaintances
	AMF_6	Attractive published job advertisement with the application for a job
	AMF_7	The need to get a job in own profession
Work motivational factors	WMF_1	Earning extra money in addition to salary (for achieved results)
	WMF_2	Comfortable work environment
	WMF_3	Opportunities for a promotion to a better position
	WMF_4	Enough autonomy and creativity in doing the job and deciding
	WMF_5	Flexibility in work
	WMF_6	Work-life balance (work that provides enough time for everything)
	WMF_7	Business pieces of training and educations
	WMF_8	Support and mentorship from leaders
	WMF_9	Performance-based rewards
	WMF_10	Recognition and implementation of my ideas
	WMF_11	Indirect financial rewards (paid car fuel)
	WMF_12	Indirect non-financial rewards (own office, mobile phone)
	WMF_13	Base salary increase
		Dependent variable – Talent retention/engagement variable (Kumar & Pansari, 2015)
Talent satisfaction	TE_1	As a result of my well-done job, I receive recognition
	TE_2	At work, I feel close to my colleagues
	TE_3	Working at this company makes me feel good
	TE_4	I feel secure about my job
	TE_5	I believe that the leadership cares for managers and other employees
Talent identification	TE_6	I'm proud to tell others about employment
	TE_7	I have feelings of ownership
	TE_8	I feel a sense of pride
	TE_9	I consider the brand success to be my own
	TE_10	I treat organization like family
	TE_11	I say "we" rather than "they."
	TE_12	Praise for the brand feels like a personal compliment to me
Talent commitment	TE_13	As my knowledge of the brand increases, I am more committed to delivering the brand promise
	TE_14	I am very dedicated to fulfilling the brand promise
	TE_15	This organization means a lot to me personally
Talent loyalty	TE_16	I would be content to continue working for this organization for the rest of my career
	TE_17	I have no intention of moving to some other company
	TE_18	Having competency in delivering on the brand promise drives my intention to remain in this company
Talent performance	TE_19	My performances were better than expected in my last appraisal
	TE_20	I believe this organization has a greater opportunity for improving performance
		Control variables
Gender		Female, male
Age		20-40, 41-60, over 60
Educational level		High school, Bachelor degree, Master degree, PhD
Managerial function		Sales manager, Financial manager, Project manager, Branch Manager, General manager/Director, Other managerial functions

Source: Author's work, dependent variables modified and adapted by Kumar et al. (2015)

Data

The sample includes 51 key talented managers (as decision-makers) in Bosnian-Herzegovinian enterprises. The selection of talented managers followed the principle proposed by (Ulrich et al., 2012), who illustrated talents as individuals who are enormously committed to work, possess the required competencies, and splendidly contribute to excellent results. Managers were chosen from 27 companies (17 firms - service sector; 10 firms – commerce sector) following previously mentioned criterion of talents (questions about work commitment, competencies, and achieving great performances were the part of an online questionnaire). The sample of companies was selected randomly based on the small and medium companies from the agency "TRON Systems", which professionally collects diverse data about companies operating in Bosnia and Herzegovina. The sample size is adequate because the number of particles of any of the variables does not exceed five and the number of structural guidelines in the model is also less than five (Barckley et al., 1995).

Table 3. presents the demographic profile of the managers. Talented managers were approximately equally represented concerning gender in the observed sample (51% of female talents and 49% of male talents). Regarding the age group, the majority of talented managers fit in the young/middle-aged category (76% of 20-40 years old managers); 22% of managers belonged in the category of 41-60 years old, and only 2% of managers were more than 60 years old. Analysis of educational level showed that 88% of managers possessed university diploma, while some of the talents (12%) finished solely high school. In terms of managerial functions, talented managers mostly worked as sales/project managers (55%), and the next biggest group worked on strategic managerial positions (32%).

Table 3
Talents demographic profile

Variables		Frequency
Gender	Female	51%
	Male	49%
Age	20-40	76%
	41-60	22%
	Over 60	2%
Educational level	PhD	2%
	Master Degree	55%
	Bachelor Degree	31%
	High School	12%
Managerial function	Sales Manager	31%
	Project Manager	24%
	Financial Manager	4%
	Branch Manager	16%
	General Manager/Director	16%
	Other managerial functions	9%

Source: Author's work

Statistical analysis

Analyses of collected data included descriptive statistics, exploratory factor analysis, and linear hierarchical regression models to determine statistical significance between individual groups in the sample.

The constructs of our research study were formed so that for each attitude according to the Likert scale, the mean value was calculated for each subject (or sub-dimension) concerning each item that forms a particular construct. The final

construct was calculated as the grand arithmetic means of the mentioned items (Anderson, 2012). After that, considering the central limit theorem, we assumed that variables have a normal distribution. For testing hypotheses and correlation, the regression ratio amongst the independent and dependent variables can be used by parametric tests.

Results

Correlation analysis

The results of the Pearson correlation analysis demonstrate that the moderate relationships exist between attraction motivational factors and talent engagement variables (talent satisfaction (r=0.398), talent identification (r=0.483), talent commitment (r=0.434), talent loyalty (r=0.373) and talent performance (r=0.477)), and the p-values indicate that the relationships are significant. Furthermore, a stronger correlation between work motivational factors and many talent engagement variables (with talent satisfaction r=0.741; talent identification r=0.723; talent commitment r=0.735 and talent performance r=0.728) p-values for all these relationships show that these relationships are significant. Considering motivational work factors and talent loyalty, the r=0.423 indicates a moderate correlation between these two variables, and the p-value indicates that the relationship is significant. The correlation results imply that attraction and work motivational practice leads to talent retention in companies in Bosnia and Herzegovina.

Exploratory factor analysis

The authors carried out exploratory factor analysis to examine the data structure and extract and check the dimensions of talent attraction and work motivational factors. Results acquired from the Kaiser-Meyer-Olkin test (higher than 0.5) and Bartlett's tests (statistical significance at 1%) showed that the data were adequate for factor analysis.

Table 4. demonstrates an outcome of Varimax rotation, where two motivational factors were extracted with eigenvalues higher than one, as proposed in our introductory research instrument. Attraction and work motivational factors explained 70.14 % of the observed variance, and all examined variables within two motivational factors were retained because they had values greater than 0.5.

Research results indicated that talented managers considered many factors before working for current companies (salary amount, special offers, company goodwill, company name/brand). Three factors were evaluated slightly above other factors: (1) good salary; (2) company goodwill; and (3) good job offer with benefits package. Besides the three prevalent attraction motivational factors, firms need to seriously combine four more elements into their talent management strategy to attract the best talents, which are as follow: company brand, getting a job according to talent's profession, recommendations from friends/acquaintances, and attractive published job advertisement with the application for the job.

This research also showed that many work motivational factors must be applied in talent management strategy to make talented managers stay to work for the present-day company. The top three most crucial work, motivational factors for talented managers, were: (1) a comfortable work environment, (2) autonomy and creativity in work and business was deciding without being constantly monitored and overwhelmed with new tasks, and (3) a work-life balance.

Table 4
Factor analysis of motivational factors

Dimensions	Variables	Mean	Components	
			AMP	WMF
Attraction motivational factors	AMF_1	4.51	0.867	
	AMF_2	4.28	0.813	
	AMF_3	3.81	0.775	
	AMF_4	4.35	0.825	
	AMF_5	3.62	0.711	
	AMF_6	3.54	0.686	
	AMF_7	3.73	0.752	
Work motivational factors	WMF_1	3.78		0.674
	WMF_2	4.45		0.845
	WMF_3	4.02		0.733
	WMF_4	4.33		0.821
	WMF_5	4.12		0.772
	WMF_6	4.31		0.814
	WMF_7	3.92		0.711
	WMF_8	4.14		0.789
	WMF_9	3.65		0.661
	WMF_10	4.29		0.803
	WMF_11	3.84		0.708
	WMF_12	3.65		0.655
	WMF_13	3.94		0.724
Eigenvalues			4.236	2.785
% Explained variance			42.461	27.683
Cumulative % explained variance			42.461	70.144

Notes: Extraction method - Normalisation of the „Principal Components Rotated Method" (Varimax with Kaiser). Source: Authors' work

Regression analysis

Linear hierarchical regression models' analysis was undertaken for ascertaining the models' reliability and significance of statistical relationships between the control variables, independent variables (attraction motivational factors for talents and work motivational factors for talents), and dependent variable (talent engagement). Three models were determined to comprehend better how attraction and work motivational factors influence talent retention (viewed through talent engagement, which was calculated as the grand arithmetic means of its sub-items) (Anderson, 2012).

The first model (AMF model) involved only attraction motivational factors; the second model (WMF model) included only work motivational factors; while the third model (AMF + WMF model) encompassed a combination of the attraction and work motivational factors. F-values for all three models were extremely high, which confirmed that the overall models were statistically significant (for example, the third model had an F calculated value (105,499; p value=0.000), which surpassed F critical value).

Table 5. demonstrates the results of three diverse linear hierarchical regression analyses. The first regression model, which incorporated attraction motivational variables and control variables (AMF model), explained 41.1% of talent engagement variance, with a positive and statistically significant influence of attraction motivational factors. The second regression model that encompassed solely work motivational variables and control variables (WMF model) explained 52.4% of talent

engagement variance, with a significant influence of managerial function and a positive influence of motivational work factors. The third model (AMF + WMF model) confirmed the obtained results of the previously mentioned two models concerning the impact of attraction and worked motivational variables (as independent variables) and contributed to a high increase in the interpretation of the variance over the AMF model (ΔR^2 = 0.52), and likewise with a high increase in the interpretation of the variance over the WMF model (ΔR^2 = 0.398).

The central hypothesis predicts that "attraction and work motivational factors have a positive statistically significant influence on talent engagement". The results point out that every variable of attraction motivational factors (ß=0.375; p=0.000) and work motivational factors (ß=0.681; p=0.000) have a strong positive influence on talent engagement. The models strengthen attraction and work motivational factors in predicting talent retention (viewed through talent engagement). Based on the obtained results, the central research hypothesis is accepted.

Table 5
Estimated linear hierarchical regression models (AMF model vs. WMF model vs. AMF + WMF model)

	Dependent variable: Talent retention/engagement					
	AMF model		**WMF model**		**AMF + WMF model**	
Variable	**b**	**p-value**	**b**	**p-value**	**b**	**p-value**
Constant	0.274	0.000**	0.265	0.000**	0.203	0.000**
AMF	0.371	0.001**	-	-	0.375	0.000**
WMF	-	-	0.677	0.000**	0.681	0.000**
Control variables:						
Gender	0.065	0.133	0.088	0.219	0.201	0.135
Age	0.099	0.173	0.135	0.157	0.111	0.148
Educational level	0.147	0.138	0.097	0.114	0.103	0.121
Managerial function	0.189	0.122	0.412	0.023*	0.324	0.035*
Model reliability						
R	0.641		0.724		0.965	
R²	0.411		0.524		0.931	
Adj. R²	0.407		0.518		0.927	
n observations	51		51		51	

** Statistically significant at 1%.
* Statistically significant at 5%.
Source: Authors' calculations

Discussion

Theoretical implications

The first part of this research study was dedicated to discovering the critical attraction/work motivational factors for talented managers in Bosnia and Herzegovina. In terms of attraction motivational factors for talents, it is demonstrated that talents mainly were attracted to the company with a good salary, company goodwill, and good job offer with benefits package. Regardless of these three factors, companies must seriously combine five more variables into their talent management strategy to attract the best talents, which are as follow: company brand, getting a job according to talent's profession, recommendations from friends/acquaintances, and attractive published job advertisement with the job application. Alnıaçık et al. (2014) also found out that "an above-average basic salary" as an economic benefit is among the most significant motivational factors for talents. Considering other

attraction motivational aspects such as company goodwill and company brand, its importance vary in different countries – for example, viewing a firm as a "Humanitarian organization that gives back to society" is placed on higher rank in Turkey than in other European countries (like Latvia) (Alnıaçık et al., 2014). In addition to the attraction motivational factors as predictors for talent retention, companies need to incorporate into their overall strategy also work motivational factors for talents, with particular emphasis on the following motivators: (1) comfortable work environment, (2) enough autonomy and creativity in doing the job and deciding without being constantly monitored and overwhelmed with new tasks, and (3) work-life balance. Work motivational factors showed how valuable were "non-financial" job aspects for talented managers work attachment, which can be explained by talents' "not so satisfying previous work experiences" – where they were – for example, working under colossal pressure or in the quite bad work environment which also influenced their health and private life. Even though "making extra money in addition to salary (for achieved results)" was expected to be as one of the most substantial motivational factors in developing countries, it was on the top of the three most minor motivational factors. The other two least-motivational factors incorporated guidance that indicates which performances will be rewarded and indirect non-monetary rewards (for example, standalone office, laptop, mobile for business purposes). On the other side, "Base salary increment" – as other monetary motivational factors, was placed higher on the list (in eighth place), which indicates that talented managers greatly expect it, depending on the time spent in the firm and offered promotion on the higher position. Wziątek-Staśko (2015) discovered in her research study other intangible motivational factors that dominate among managers of different levels in European companies (for example, "job security" and "flexitime" were prevalent factors for lowest level managers; while "promotion opportunities" had the highest rank among medium-level managers).

The second part of this research was to explore a positive and statistically significant influence of talented managers' motivation factors on their retention within current companies. Regression results showed that attraction/work motivational factors positively influence talent engagement as the core component of talent retention and its five sub-elements: "talent satisfaction, talent identification, talent commitment, talent loyalty, and better talent performance". Regarding previous research studies, Dinh Do et al. (2020) found in their study that working motivation (viewed only through getting rewards, performance feedback; and getting praised for the excellent work) had an impact on talent retention (which was observed through similar statements as we used for measuring talent satisfaction and talent loyalty – for example: "I enjoy working for this organization"; and "I have no intention of leaving this organization"). In line with our study, which had a broader talent retention construct than other studies, if a firm's leaders apply a combination of attraction and work motivational factors for talented managers, it leads to their retention. Talents are more satisfied with work (where they receive recognition for the well-done job; and feel highly secure about their job); satisfied with their fellow workers (talents feel close to fellow workers), and in general satisfied with a company (talents feel good about working at present companies).

Furthermore, attraction/work motivational factors impact ongoing talented managers' identification with the company (which results in pride in telling others about their employment, treating the organization as a close family, and feeling the brand's commendation as a personal compliment). Additionally, two-folded motivational factors indicate that the firm will deliver its brand promise through solid talent commitment. The mixture of attraction/work motivational factors further leads

to talent loyalty expressed through talent's contentment to spend their career in the current company; and the absence of talent's intention to leave the firm and start working for another organization. Finally, attraction and work motivational factors influence talent performance through continuous performance improvement.

Practical implications

Using data collected in Bosnia and Herzegovina, this study sheds light on talent management phenomenon with regard to talented managers' crucial motivational factors and employee retention. Additionally, it stimulates further investigation of this very subtle area using a wide range of scientific backgrounds. In order to gain a deeper understanding of managing human resources and organizational behavior (with special emphasize on talent management), a multidisciplinary, holistic approach must be applied. The results of this study highlight the importance and value of talented managers for complete company success and the difficulties in their retention. In other words, companies in developing countries should prioritize talent management and place a focus on attracting talents, their development/learning, sufficient motivation and retention, knowing that the whole organization will grow and learn from them throught knowledge sharing and setting clear examples. Lastly, developing nations rarely conduct research on talent management or talent development, and our analysis of the literature recognized that problem. We conducted this research to contribute to this field and additional specific explanations.

The research results provide direction to the policymakers to think about ensuring for some companies with distinguishing talent management practices economic and social initiatives and incentives because that will reduce the trend of a human resources drain in general, and especifically, high skilled workers and talented managers drain from developing countries. Future research should consider the influence of the fourth industrial revolution and digitalization on the strategy of talents management in companies in sense of using a combination of empathetic artificial and emotional intelligence for improving quality and transparency in these processes as prerequisite for a higher level of attraction and retention of talented managers. Finally, upgrading these processes will generate better organizational effectiveness for companies and different additional benefits for all the rest stakeholders, in general.

Conclusions

This research article was oriented towards exploring crucial motivational factors for talented managers that trigger them to resolutely choose to work for a particular company and the factors that make them attached to the same company. Another objective of this research study was to discover whether different attraction and motivational work factors significantly impact talented managers' retention (viewed through their engagement). This research study demonstrated that talents are typically picked to work for present-day companies in Bosnia and Herzegovina because of the following motivational factors: good salary and company goodwill. Besides the excellent salary, talented managers simultaneously expect an excellent offer from the firm's leaders to accept the specific job according to their set standards and prospects. Following previously conducted research studies, where "firm's brand" was the primary factor in attracting exceptional talents, outcomes of this study suggest that talented managers in Bosnia and Herzegovina also consider this aspect for the final decision. Still, it is not among the leading ones.

When it comes to working motivational factors which stimulate talents to work notably better and stay for a long-term in one company, the top three motivational

factors were singled out which make talents performing the job successfully: (1) comfortable work environment, (2) enough independence and creativity in doing the job and deciding without constantly overseeing and giving tasks, and (3) work-life balance (a job that gives plenty of time for everything). The factors as mentioned earlier suggest that talent motivation is a profoundly complex matter which requires, as a prerequisite, the respectable package of entering motivational elements (like – good salary/good overall firm's offer, company brand, and goodwill), which must be further upgraded with abundant individually tailored work motivation factors (such as comfortable work environment, independence/creativity in work) that can significantly prevail in retention of valuable talents.

Research results confirmed that talented managers' motivation has a positive statistically significant influence on their retention. Accordingly, motivated talents exhibit a higher level of loyalty, identify more strongly with the company, possess more commitment and generally show greater work satisfaction levels - what simultaneously improve their performances. However, the companies must be aware that there is no undying loyalty today, and they must upgrade their strategies every day systematically and subtly to keep their talents. The contribution of this study is immensely high for human resource managers and leaders in companies in developing countries if they want to retain their best managers and other necessary staff. This study gave a valuable and enormous contribution to the current motivation and talent management theory.

In this research, it is possible to recognize a few main limitations. The first limitation is that this research sample was relatively small and wasn't analyzed by the industry and business segments. Another limitation is that some relationships between variables are simplified, as other motivation elements are not included, such as power, inspiration, and organization climate. Further limitations arise from the respondents' psychological peculiarities and attributes not considered during the analysis and interpretation of research results.

Future research directions for this area could test the influence of some external variables as moderators such as post-conflict traits and transitional traits of Bosnia and Herzegovina society to better explain talented managers' motivation and engagement commitment in the researched companies. Additional directions are focused on increasing sample size, leading by this way to more accurate analysis and results with greater reliability with regard to some central relations that were tested and features of respondents that were treated. An additional factor that could be considered to widen this research is the liberalization and openness of EU countries to the talented managers and employees from Bosnia and Herzegovina and other SEE countries. In the contemporary and future context, it would be good to consider the impact of some additional external COVID 19 pandemic elements to explain relations between variables in this research.

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The Citizen Observatory: Enabling Next Generation Citizen Science

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Abstract

Background: Citizen science offers an attractive paradigm for addressing some of the complex problems facing society. However, translating the paradigm's potential into meaningful action and sustainable impact remains a formidable challenge. Historically, the citizen science landscape was fractured into silos of activities; nonetheless, it has demonstrably delivered credible results. An innovative concept of the Citizen Observatory offers a tractable means of mitigating many of the recurring issues that historically afflicted citizen science initiatives, thus empowering a new generation of citizen scientists. Citizen Observatories may be regarded as open, standardised software platforms for community-based monitoring of any phenomenon of interest. **Objectives:** This paper seeks to validate a Citizen Observatory in a traditional citizen science context, that of butterfly recording. **Methods/Approach:** A case study was undertaken in a UNESCO-designated Biosphere Reserve. **Results:** A community of citizen scientists successfully recorded various observations concerning butterflies, their feeding behaviours, and their habitat. The resultant dataset was made available to the local government environmental agency. **Conclusions:** The Citizen Observatory model offers a realistic basis for enabling more sustainable participatory science activities. Such developments have implications for non-government organisations, businesses, and local governments.

Introduction: Why Citizen Science Matters

Contrary to public perception, many well-known scientists, such as Darwin and Franklin, undertook their research personally; as pointed out by Silvertown (2009), the age of professional science is a relatively recent development. Though the recent surge of interest in Citizen Science (CitSci) and similar crowdsourced methodologies is remarkable at first sight, there is a long tradition of public engagement in scientific endeavors – the annual Christmas day bird count organised by the National Audubon Society in North America and running for over 100 years is one such exemplar. Reasons attributed to this growth in interest include an increased awareness of environmental issues, recognition of the potential for CitSci by governments and scientists, coupled with a desire to influence public policy. Many benefits accrue from public participation in science – increased scientific literacy, social capital, and environmental democracy amongst others; one of the most pertinent motivations for such participation is the urgent necessity to confront the paradoxical post-truth attitudes that currently prevail. Establishing *Communities of Scientific Practice* that involve multiple stakeholders from different disciplines but with synergistic objectives offers one approach to countering such attitudes (Bouma, 2018). Recent developments in Information & Communication Technologies (ICT) have proved transformative, representing a paradigm shift in how many CitSci programs are implemented.

Transitioning from traditional paper-based CitSci to one based on mobile technologies is ongoing; nonetheless, the smartphone is easily the platform of choice in CitSci today. However, the net result is one of a fragmented landscape. Apps for all kinds of CitSci increase, but an agreed, standardized vision of how best to support the CitSci community is lacking. This paper considers one model of a shared ICT infrastructure and methodology of CitSci, that of the Citizen Observatory (CO).

At the launch of the smartphone era – the iPhone was launched in 2007, the paper was the default medium for data collection and publication in CitSci. The potential of technology was acknowledged; nonetheless, the twin challenges of accessibility and keeping up with rapid technological change were identified, as was a need for well-designed and standardized methods of data collection (Silvertown, 2009). Previously, the need for public dialogue and engagement with science was recognised (Irwin, 2001). Motivated by these observations, this paper seeks to define what may be termed next generation CitSci. The CO methodology is considered with this context and validated through a small case study in a UNESCO biosphere reserve.

This paper is structured as follows. Limitations of conventional CitSci are first considered. How the CO methodology remedies some fundamental limitations is then outlined. A report on the design and implementation experiences of a prototypical CO platform is immediately presented. A reflection on the entire experience is then provided, after which the paper is concluded.

Literature Review & Problem Definition

It is in the realisation of the potential of CitSci that its most significant impact will be manifested. At the same time, the benefits of empowering local communities are acknowledged; it is ultimately in tackling "wicked problems" in a global context (Ellwood et al., 2017) that is of most relevance. According to Theobald et al. (2015), the growth of CitSci "represents unprecedented opportunity and potential to contend with global changes with local observers". Despite phenomenal progress in remote sensing technologies, CitSci remains a critical and tractable approach for the

widespread in-situ monitoring necessary to cover the planet's biosphere at the necessary spatial and temporal resolutions (Pereira et al., 2010).

The taxonomic bias remains pervasive in the research literature; to remedy this problem, it has been suggested that scientists should develop societal initiatives based on CitSci (see, e.g., Troudet et al., 2017). As the biology, conservation, and ecology domain represent the predominant focus of endeavors by the CitSci community (Kullenberg et al., 2016), a significant body of expertise could be leveraged. The provision of CitSci data may ease multiple competing hypothesis testing, for example, an issue identified as problematic in ecology and evolutionary biology (Betini et al., 2017). Longitudinal CitSci initiatives may also provide a basis for mitigating Shifting Baseline Syndrome (Soga et al., 2018).

Monitoring progress towards achieving the UN Sustainable Development Goals (SDGs) poses significant challenges; crowdsourcing, CitSci is one dimension, has been proposed as a critical element for achieving the SDGs (Flückiger et al., 2016). Though the potential of CitSci in ecological and environmental monitoring is significant (McKinley et al., 2017), CitSci is broadly under-utilised, thus limiting its potential to deliver meaningful impact (Barrie et al., 2019; Hicks et al., 2019; Theobald et al., 2015).

Concerns & Limitations

A disruptive paradigm, CitSci must at once seek both to challenge and complement conventional norms in scientific and policy decision-making. If CitSci is to succeed, certain obstacles, perceptions, and even prejudices must be confronted. Many issues hinder the uptake of CitSci; for this discussion, the effective resolution of four key issues is a prerequisite for increasing the impact of CitSci.

Data Quality

Issues relating to provenance and integrity are recurring themes when the use of CitSci-derived data is discussed. It must be emphasised that within CitSci contexts, data may be of a category depending on the use case - qualitative, quantitative, economic, environmental, and so forth. Transparency, conflicts of interest, and lack of clarity around the methodology for data collection generate legitimate concerns about data collected by amateur scientists (see, e.g. Nature, 2015); in fairness, it should be noted that such issues are also frequently present in the professional community. Indeed, the implicit assumption that data collected by professional scientists represents the baseline through which CitSci data can be reliably compared has been challenged (Specht et al., 2018). In principle, it is reasonable to expect the adoption of protocols and quality control measures such as those that would exist in conventional scientific practice; in reality, the nature of CitSci programs makes quality assurance a problematic proposition to effectively implement consistently.

The debate concerning the credibility of data gathered by the CitSci community is ongoing; research presents contradictory findings. Van der Velde et al. (2017) demonstrated that CitSci could broaden coverage and increase sampling frequency but without compromising data. In contrast, MacKenzie et al. (2017) observed disparity in volunteers' self-assessed and actual species (plant) identification skills, and consequently, their project is now almost entirely reliant on observations from trained staff.

In the case of species identification, a popular task in many CitSci projects, conventional wisdom suggests that citizen scientists are generally competent at identifying higher-order taxonomic categories whilst identifying rarer species is best left to professional taxonomists. Yet, as Chandler et al. (2017a) pointed out, this generalisation does not always hold as an experienced layperson may be more

familiar with specific taxa or what is most likely in certain locations. The smartphone has proved transformative for species identification; by searching a local database of high-quality images, species can be quickly identified and subsequently recorded. A photograph offers supporting evidence and allows for subsequent independent validation. Such validation is vital for the sustainability of project outputs as, ultimately, the consequences of unverified data and poor quality-control may lead to inappropriate conservation and policy measures (Vantieghem et al., 2017).

Lack of Support for Open Science
Open Science (Nosek et al., 2015) is an ongoing initiative that seeks to make the results of scientific endeavours accessible to all; open data is one critical dimension that envisages data being made available without copyright or any other restrictions. While it is often assumed that data produced by the CitSci community are freely available, this is often not the case as the community can face hurdles in making their data open and freely available (Fox et al., 2019; Pearce-Higgins et al., 2018). A study by Groom et al. (2017) of datasets in the Global Biodiversity Information Facility (GBIF) (https://www.gbif.org/) indicated that datasets from the volunteer community are amongst the most restrictive in the way they could be used. In many cases, datasets lacked licensing information; as the authors pointed out, this is not a proxy for open data and thus compromised the potential of the data in policy and commercial use cases. Several reasons underpin this situation.

In many cases, an intermediate organisation has custodianship of the data; though making the data publicly available may align with the organization's mission, practical issues such as leveraging funding and commodification may act against this. Another explanation may be found in the different expectations of scientists and citizens. Data are primary for scientists; for citizens, education is often foremost (Jollymore et al., 2017). By their nature, CitSci projects to date have in the main tended to be short-term rather than longitudinal in scope; thus, the need to deliver a project legacy through ensuring the sustainability of its outputs is not always a strategic objective.

Ad-hoc approach to Citizen Science
Outside of well-known CitSci initiatives, the predominant approaches are generally ad-hoc in nature. This is both a strength and a weakness, a strength in that such approaches promote innovation and demonstrate agility, and a weakness as CitSci initiatives tend to be local and temporally focused. Indeed, the diversity of CitSci projects suggests that there can be no single model that will guarantee a successful outcome; nonetheless, successful initiatives tend to share common traits (Cardoso et al., 2017). In the case of Invasive Alien Species (IAS), it has been recommended that initiatives should seek to "build on and strengthen existing user communities but at the same time, coordinate and aggregate validated CitSci data on IAS to open repositories" (Cardoso et al., 2017). The lack of a coordinated approach hinders the potential and impact of CitSci; how best to deliver effective coordination in practice remains an open and urgent question. One approach is that of a city center that "would create, organise and synthesise centralized repositories of volunteer collected data" and serve as centers for excellence in CitSci (Bonney et al., 2014).

Global Variation of CitSci Adoption
Though the potential of CitSci is widely acknowledged, in practice, there are vast differences in the ability of projects to deliver impact (Newman et al., 2017). A lack of local capacity has been identified as the most significant obstacle to adequate monitoring (Schmeller et al., 2017). This situation leads to an uncomfortable

observation that successful CitSci initiatives tend to be linked to well-funded organisations and are mostly restricted to Europe and minority world countries (Chandler et al., 2017b). Therefore, low-income countries of the majority world are at a disadvantage. This situation contributes to significant gaps in datasets from various biodiversity-rich regions; such regions are often remote, underpopulated, and have less network coverage and infrastructure. Remedying this imbalance is essential. CitSci initiatives in majority-world countries exist; for example, Liebenberg et al. (2017) consider interface design for non-literate trackers using the well-known CyberTracker Platform. Nonetheless, building CitSci capacity in the majority world remains imperative.

## *Conventional Approaches to Citizen Sciences*

Though some CitSci initiatives are bespoke, many seek to leverage various tools, mainly ICT-based, that are publicly available. To highlight one such tool, iNaturalist (https://www.inaturalist.org/) is archetypical for biodiversity monitoring; it consists of an App for capturing observations in the field, facilitates the sharing of data via GBIF, and is supported by an active social network for discussing observations and developments. As an example, the iNaturalist model has been recommended as a suitable tool for assessing the status of palms, a plant with a high risk of extinction (Gardiner et al., 2016). Zooniverse (https://www.zooniverse.org), a virtual CitSci platform, supports the online classification of data. The Citizen Science Toolkit (http://www.birds.cornell.edu/citscitoolkit/toolkit) offers a compilation of resources to help initiate and manage new projects; CitSci.org (http://www.citsci.org) offers a suite of tools that help with all aspects of the design, implementation, and management of CitSci projects. SciStarter (https://scistarter.com/) is a portal of CitSci projects that is searchable by location and interest; this allows members of the public to sign up for projects.

Nonetheless, despite the significant adoption of ICT in the last decade, the problems alluded to above continue to afflict CitSci. Addressing these problems in their totality demands a multi-actor transdisciplinary approach and the development of an open, sustainable model to empower the next generation of citizen scientists.

Methodology - The Citizen Observatory

A Citizen Observatory (CO) (Figure 1) may be described as "the citizens' observations and understanding of environmentally related issues and, in particular, as reporting and commenting on them within a dedicated ICT platform" (Liu et al., 2014). The rationale for COs is to raise environmental awareness whilst promoting and enabling communication between communities, scientists, and decision-makers. Contributors are protected from data management's intricacies, allowing them to focus on what is of interest – data collection, analysis, and collaboration. A CO encapsulates a CitSci approach but with one crucial difference; the CO seeks to enable the collection, management, and publishing of data using a *verifiable scientific methodology* but without the expectation of necessarily contributing to science per se. Instead, the emphasis on COs is often influencing policy definition; see Grainger (2017) for a detailed treatment of the CO. It must be emphasised that a CO does not seek to replace conventional CitSci platforms; rather, it seeks to complement their strengths but to remedy the problems identified earlier. Thus, a CitSci initiative could conceivably incorporate a CO for data collection, management, and publication; online platforms could then be harnessed for participatory data analysis if required. Four key issues that the CO seeks to address are now described.

Figure 1
A Model of a Citizen Observatory
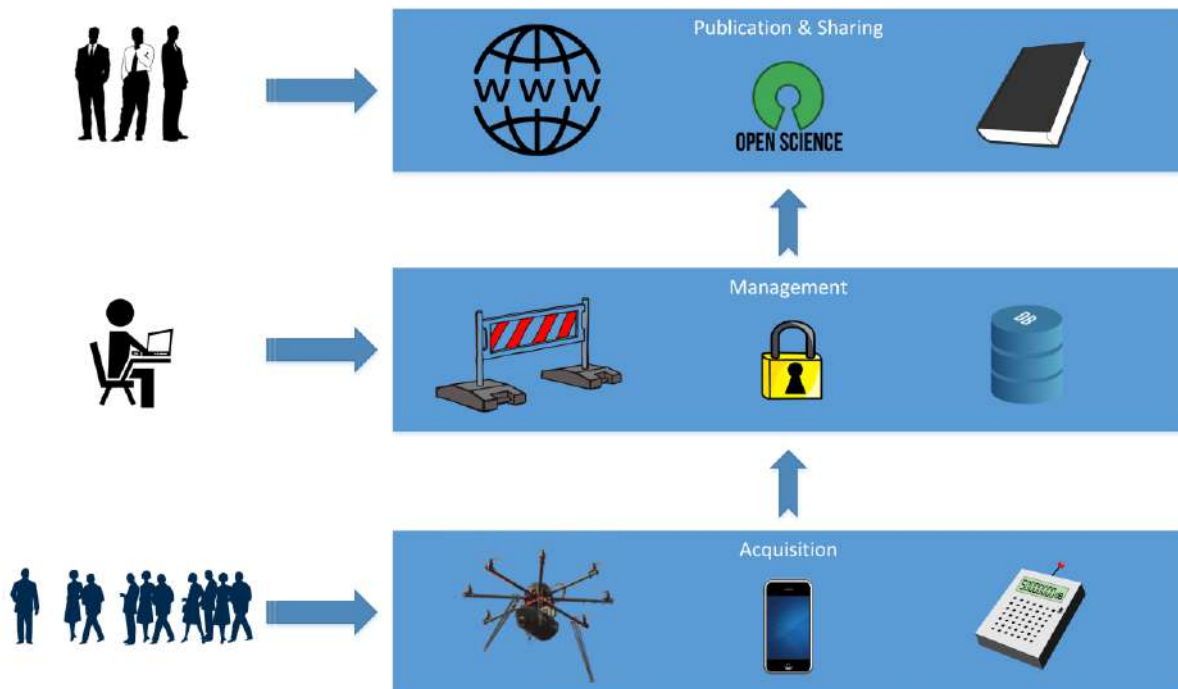
Source: Author's illustration

Data Quality
Projects within COs are, by definition, collaborative and co-creative; in this way, the data needs of various stakeholders – science, policy, and so forth, maybe holistically addressed. As the CO would generally provide a suite of shared services for data management, the focus is directed on the data collection exercise as activities undertaken during collection, as well as the experience of participants, represent the primary determinants of data quality. A careful balancing of data contributors and data consumers is fundamental to the design of monitoring networks, such as envisaged by COs. It is of primary importance that data within the CO corpus is not compromised by the admittance of low quality or rogue data. Training of volunteers is one popular approach to mitigating this concern in conventional CitSci programs; this may be augmented with automated approaches to outlier identification in COs.

Open Data
Making data open requires planning, effort, and understanding the many legal issues relating to data protection. In Europe, the General Data Protection Regulation (GDPR) harmonizes data protection and privacy across the EU, strengthening individuals' rights and awareness about these rights whilst increasing the obligations on organisations, including Non-Governmental Organisations (NGOs). Secondly, an understanding of semantics and metadata is necessary to ensure that data is meaningful to potential end-users. A third issue relates to standardised formats and data licenses. It is unrealistic to expect a deep understanding of these three issues on the part of the general public; thus, a challenge for a CO is in helping communities understand the importance of standardisation of format, license, metadata, and the rules that govern data protection.

The uniqueness of each project makes data publishing a formidable challenge. In the case of ecology data, GBIF and Darwin Core are obvious candidates when publishing datasets in standardised open formats; WaterML might be the preference in a water-monitoring project. Several initiatives seeking to harmonise data and metadata management in the CitSci domain are ongoing, for example, the Citizen Science Association (https://www.citizenscience.org/). The degree to which COs enable citizen scientists to address the omnipresent issues of standards compliance and licensing of data via, for example, Creative Commons licenses will probably be the critical determinants of whether COs will be adopted and utilised going forward.

Coordination
COs offer a focal point making coordination and orchestration of projects possible. Projects may be clustered around several dimensions, for example, a single geographic area like a river catchment; alternatively, they may focus on monitoring a particular phenomenon, for example, the presence of frogs, across a wide geographic space over extended periods, thus supporting longitudinal studies. COs are an apt solution where there is a requirement for a cluster of diverse projects that are best delivered via a common ICT infrastructure.

Inclusivity
COs may be deployed and configured quickly to deliver agile citizen-enabled data collection solutions. There is a need for WWW and wireless connectivity, but this need not be 24/7. Infrastructure limitations can be circumvented with careful planning; mobile broadband networks are only available to 67% of the global rural population (ITU, 2016), but other issues, including literacy, will invariably arise. Integration with established networks such as GEOBON - Group on Earth Observations Biodiversity Observation Network (https://geobon.org/) or DataONE - Data Observation Network for Earth (https://www.dataone.org/) offers options for leveraging state-of-the-art facilities for sharing data.

Role of a Citizens' Observatory
COs do not seek to replace existing platforms; rather, they seek to complement and augment them. Furthermore, COs do not proscribe the adoption of specific technologies; for example, COs do not advocate Cloud computing as distinct from any other technical solution. Design choices are the prerogatives of those working with domain experts who understand the intricates of the domain, the pragmatic constraints in which the CO must operate, and the profile of those who will both produce and consume the data. COs demand that all data be augmented with an appropriate suite of metadata such that its genesis and provenance be determinable, allowing for its publication for subsequent consumption through compliance with appropriate international standards.

To illustrate one interpretation of how a CO might operate in practice, a case study is now presented that reports on the authors' initial experiences of collaborating with a local community to design and deploy a CO.

Results - Prototyping a Citizen Observatory in a UNESCO Biosphere
The World Network of Biosphere Reserves (WNBR) comprises 714 biosphere reserves in 129 countries. Biosphere designation, the prerogative of UNESCO, demands active community engagement in the management of the biosphere, envisaging such

engagement as a prerequisite for sustainability; thus, biosphere communities represent prospective highly-motivated citizen scientist groups and potential end-users for COs. Remote location, sparse communities, and ecological diversity pose many challenges but make biospheres ideal locations for prototyping COs.

To demonstrate the viability of the CO concept, a pilot case study was designed and undertaken in Penparcau, a suburb of Aberystwyth, within the Dyfi biosphere in mid-Wales. The objective was to enable local communities to influence Land Management Plans (LMPs); such plans significantly affect local wildlife conservation. Following consultation with stakeholders that included the Welsh Government, the West Wales Biodiversity Information Centre (WWBIC), the Conservation Officer from Ceredigion County Council (CCC), a local NGO, and the Penparcau Community Forum, citizens were tasked with recording a suite of observations of butterfly and larval food plants. Butterflies are good environmental indicators with knowledge of their distribution and abundance helping to inform local land management.

Traditionally, butterflies are surveyed by a strict walking of a transect; however, without adequate training, this type of surveying risks alienating potential participants, reducing participation, and, therefore, the associated volume of data collected. Surveys of butterfly populations using CitSci have been documented in the literature (see, e.g. Lewandowski et al., 2017; Schultz et al., 2017). In terms of Apps, iRecord Butterflies (https://butterfly-conservation.org/8803/irecord-butterflies.html) is an exemplar and the preferred App of the Butterfly Conservation - an organisation that runs three of the world's largest butterfly and moth recording schemes.

An analysis of iRecord, and other Apps designed for ecological monitoring, indicated that none enabled the collection of that particular dataset on butterflies and their larval food plants necessary to influence local land planning in the biosphere. This situation of pre-existing Apps not quite meeting the needs of local operating conditions, it is suspected, is an unfortunate but recurring theme in many CitSci initiatives; maximizing the use of pre-existing, often open-source, solutions are desirable, but structures are needed that discover suitable Apps seamless and transparent. Furthermore, Apps should be available under appropriate open licensing conditions such that they can be modified in response to local data requirements. A future strategic objective for COs must be the identification of pragmatic solutions to this problem.

An initial version of the *Penparcau Butterfly Survey App* was created using services provided by the COBWEB CO platform (Higgins et al., 2018). This App was iteratively developed in response to feedback and a deeper understanding of local requirements. The first iteration focused on recording larval food plants. Table 1 outlines the tasks and questions that the observer was asked to respond to. The subsequent iteration of the App-enabled the opportunistic recording of butterflies that, invariably, would be found near such food plants; see Table 2 for the additional questions asked in this release. A final release of the App invited the completion of some questions relating to the habitat itself; Table 3 outlines these questions. The survey was completed by members of the local Penparcau Community Forum (https://penparcau.cymru/) over three months, in cooperation with, and under the guidance of, a local ecologist working with the West Wales Biodiversity Information Centre (WWBIC). She subsequently logged the resultant dataset with the Local Environmental Records Centre (LERC).

Table 1
The first element of the "Penparcau Butterfly Survey" focused on larval plants

Task	Question	Modalities	Comment
1	What plant have you seen?	o Grasses o Nettle o Ivy o Holly o Garlic Mustard /Hedge Garlic o Bird's Foot trefoil o Ladys Smock o Thistle o Burdock o Clover o Alder buckthorn o Dock or Sorrel o Other	If "Grasses", the option to complete T1.1, that is, classify the type of grass, is then requested. If "Other", the option of specifying the plant is given via T1.3. For any option selected, apart from "Grasses", completion of T1.2 is requested.
1.1	What type of grass?	o Mown/grazed o Short o Very green grass o Rough o Maybe grazed o Tousled o Overgrown o Lots of wildflowers o Meadow	
1.2	Does the plant have any flowers?	o A few (1-10) o Some (10-15) o Lots (> 50)	
1.3	Do you know what plant it is?		If known, the name of the plant is specified via the soft keyboard on the mobile device.
2	How confident are you that it is thus plant	o Confident o Ok o Not confident	For all plants identified, the option of specifying a confidence indicator is given.
3	Take a photo of the plant you have seen.		A photo of the plant will allow subsequent independent verification.
4	How big an area does the plant cover?	o Less than 1m^2 (Bath towel) o Between 1 to 5 m^2 (Picnic blanket size) o More than 5 m^2 (larger than picnic blanket)	An estimate of plant abundance is requested.
5	Was there a butterfly within 5 meters of the plant?		The presence of a butterfly will trigger a further series of tasks.

Source: Author's work

Table 2
Once a larval plant has been recorded, augmenting the observation with one on butterflies, should one be in the vicinity of the plant, is then available.

Task	Question	Modalities	Explanation
1	Can you take a photo of the butterfly?		It will be automatically timestamped and geotagged on successfully taking a photograph, and the subsequent tasks will be completed.
2	What kind of butterfly did you see?	o Brimstone o Clouded Yellow o Comma o Common Blue o Gatekeeper o Green-veined White o Meadow Brown o Orange Tip o Painted lady o Peacock o Red Admiral o Ringlet o Small Tortoiseshell o Small White o Specked Wood o Small Copper o Wall o Large Skipper o Other Butterfly	If "other butterfly" is selected, T2.1 is triggered.
2.1	Do you know what kind of butterfly it is?		If known, the option of specifying it via a textbox/soft keyboard is offered.
2.2	How confident are you that it was this kind of butterfly?	o Confident o OK o Not Confident	A self-assessed metric of confidence in the observation, noting that the photo may be subsequently used for independent validation.
3	What was the butterfly doing?	o Resting o Feeding o Flying o Other	A standard typology of possible behaviors is offered for selection.

Source: Author's work

Table 3
The option of answering some questions on the prevailing habitat is then available.

Task	Question	Modalities	Explanation
1	Would you like to record more information that would be useful?	o Yes o No	Noting that time may be at a premium for the observer, the option of recording some additional information is offered. If "No", data is saved, and the App terminates.
2	How would you describe the habitat the plant was found in?	o Woodland o Paths and Hedgerows o Farmland o Gorse o Grassland o Water o Urban	
2.1	Type of woodland?	o High (Flowers, shrubs, etc.) o Medium (Bracken) o Low (Bare earth)	
2.2	Type of Farming?	o Crops o Grazing for animals o Grassland	
2.3	Type of Grassland	o Mown/Grazed o Rough o Overgrown (meadow/wildflowers)	

Source: Author's work

Discussion and Conclusion

Relations to previous findings

A key motivation for COs is to remedy the fragmentation of CitSci initiatives and reduce the need for ad-hoc developments. Environmental monitoring is the predominant domain of CitSci endeavors, as testified by a courtesy examination of the research literature. Though only a point example in butterfly monitoring, it can be reasonably conjectured that many CitSci campaigns in the broad environment domain could be recast as citizen observatory initiatives, with all the potential benefits that would unfold.

Learning is synonymous with CitSci; likewise, the need for volunteer training is a recurring theme in the literature. There can be little doubt that in migrating to a CO platform, the volunteer population's technological literacy would need to exceed a certain threshold. What is less considered is the need for education and training at all levels, including the sponsorship or organisational levels. In treating citizen scientists as mere data collectors, a disservice is occurring, and an opportunity is being missed. To maximize their work's impact, citizen scientists need to understand an eclectic range of issues ranging from ethics to data licensing. Likewise, those initiating campaigns need to ensure that the participants are well-schooled in the project's objectives and that they see data collection as just one essential step in a complete process.

Concluding Remarks

COs offer a model through which a new generation of CitSci and community-based monitoring initiatives may be enabled in communities worldwide. The vision for COs goes well beyond addressing the limitations of conventional CitSci approaches. The overall goal must be to deliver one cornerstone for sustainable global monitoring initiatives; the success of such initiatives depends on developing coherent, standardised, and decision-relevant systems (Rosenstock et al., 2017). Such a development has a particular resonance for biodiversity and conservation, given the importance of CitSci in these activities (see e.g. Isaac et al., 2014), and maximizes the use cases for CitSci by communities, scientists, and policymakers. Experience from the Dyfi Biosphere suggests that the CO model is valid and that the technologies are in place for its practical realization. Nonetheless, the human element, including training and usability dimensions, and the role of the CO within the context of pre-existing CitSci initiatives, merit further research.

Looking forward: a more strategic contribution may be manifested both in enabling more longitudinal studies by the CitSci community and enabling initiatives in geographical regions that, until now, have not had the resources to engage in community-enabled participatory monitoring programs. Furthermore, COs offer government agencies opportunities to facilitate community inclusion in policy definition as well as opening commercial opportunities through the development of disruptive and innovative business models.

Research limitations and future research directions

This study is small-scale and exploratory. It demonstrates proof of concept; however, citizen involvement outside of data collection was limited. Moreover, an automated protocol for publishing and sharing data is needed. Such developments demand the involvement of those organisations charged with repository maintenance. In the medium term, seamless publication of citizen-derived data is unlikely; however, publishing data compliant to an internal standard is tractable.

In the longer term, a key challenge is to ensure that the CO model continues to evolve. Thus, as has been acknowledged elsewhere, there is a need for open, user-friendly platforms that are reusable and reconfigurable (De Wilde et al., 2020). While the focus to date has been on the citizen and the scientist, other stakeholders must be considered. Such stakeholders include the local communities and local government agencies. Globally, the potential of COs as enablers of sustainability and local democracy merits detailed investigation.

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Entrepreneurial Orientation, Strategic Networking, and Croatian SMEs Performance: A Configurational Approach

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Abstract

Background: Many studies on entrepreneurship indicate an affirmative entrepreneurial orientation (EO) and small firm performance interrelationship. However, the empirical results are inconclusive, especially when firms face certain contingencies. **Objectives:** Strategic networking and environmental dynamism are important to SMEs' performance; therefore, the goal of this study is to apply a configurational approach for developing a model that promotes the roles of strategic networking and environmental dynamism as moderating variables in the EO-performance relationship. **Methods/Approach:** For determining which model fits the data best, a moderated linear regression analysis was used as an analytical method to test the proposed hypotheses. Specifically, configurational, contingency and universal models were examined. **Results:** Results reveal that a configurational model provides a statistically better explanation of variance in performance compared to both contingency and universal models. **Conclusions:** By adding strategic networking to the EO-performance relationship, our study helps explain why some firms, although restrained with internal resources, can still achieve entrepreneurial projects since required resources can be acquired from external network partners. Limitations of this study encompass the sample size, the use of a subjective scale, questioning of only one representative of the firm, and the short-term aspect of the study.

Keywords: entrepreneurial orientation; strategic networking; configurational approach; SME, Croatia
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Introduction

Increasing performance is the main focus and the main challenge of every organization, and it also remains one of the most challenging research areas for business scholars today. The general tendency of product and business model life cycles contraction (Hamel, 2000) and uncertainty make this challenge harder. Because of these conditions, companies can no longer rely on long-term competitive advantages and long-term profits. Nevertheless, they need to adapt to uncertain conditions by constantly seeking new opportunities. There is no doubt that the companies that want to improve their business performance need to adopt an entrepreneurial attitude, otherwise known as Entrepreneurial orientation (EO).

EO has become a popular measure of entrepreneurial activities within an organization (Wales et al., 2020; Anderson et al., 2015; Ireland et al., 2009). We can look at EO from three perspectives. The first and most popular is EO as a multidimensional approach that includes innovativeness, risk-taking, and proactivity in competitive behavior (Miller, 1983; Covin et al., 1989). The second perspective assumes the covariance among many dimensions, including autonomy and competitive aggressiveness (Lumpkin et al.s, 1996). This perspective also defines dimensions that are relevant for describing the entrepreneurial company and that are at the same time contextually dependent. The third perspective suggests that EO is recognized as a concept that includes organizational configuration, entrepreneurial top management style, and new entry initiatives (Wales et al., 2020).

No matter the definition of EO we use, there is always the question of conditions in which the EO of the company will bring the best results. This paper investigates the relationship between EO and small firm performance, moderated by strategic networking and environmental dynamism. Instead of using a contingency model or two-way interaction between EO and small firm performance, we will be using a configurational approach. Unlike the contingency model, the configurational approach allows a simultaneous assessment of EO and variables in the small firm's internal and external environment. The internal environment variable refers to strategic networking, while the external environment variable refers to environmental dynamism.

Limited access to resources presents one of the common problems that small companies especially face. Therefore, company networks are considered an essential resource (Obeng, 2018). Also, changes in the environment call for strategic alliances, partnerships, and cooperation (Jiang et al., 2016). By joining strategic networks, companies can access capital and other missing resources. Also, the decisions made by entrepreneurs or managers are moving from just the individual company because of their awareness of other companies positions in terms of knowledge on market conditions, available resources, and functional capabilities (Soto-Acosta et al., 2016). This paper chose strategic networks as an internal variable and moderator because of their importance for small businesses.

The external moderator variable is presented with environmental dynamism. Dynamism presents one of the main characteristics of the environment, expressing a degree of turbulent, unpredictable, and rapid change (Deng et al., 2019). A highly dynamic environment is characterized by changes in demand, regulation, technology, and (or) competitors (Anseel et al., 2007). Also, according to the same source, information is often obsolete, unavailable, or inaccurate in such environmental conditions.

The paper opens up with the literature review related to EO and small firm performance and the concepts of strategic networking and environmental dynamism. Four hypotheses were developed based on the configurations of the

previously stated concepts that address the extent to which strategic networking and environmental dynamism influence the relationship between EO and small firm performance. Afterward, the research method was discussed, followed by hypotheses testing and discussion of the results based on the data obtained from small and medium-sized enterprises in Croatia. The paper concludes with the implications for research and management, limitations, and potential future research in clarifying the EO – performance relationship.

Literature review and hypotheses

EO and performance

When considering EO, we will use the most common definition, which sees EO as a multidimensional approach that includes the characteristics of risk-taking, innovativeness, and proactivity in competitive behavior (Miller, 1983; Covin et al., 1989; Guth et al., 1990; Zahra et al., 1995). Risk-taking is defined as utilizing capital for ventures with uncertain outcomes (Wiklund et al., 2005), often demonstrated by companies that engage in non-traditional approaches and tactics. Innovativeness is defined as the ability to attempt and engage with the novel through ideas, experiments, and other creative processes, allowing the company to veer away from established practice (Lumpkin et al., 1996). Proactiveness is defined as an attitude in which the individual, and in extension the company, is prepared to anticipate, act and react to future conditions of the marketplace, which allow the company to quickly respond to situations, taking advantage and beating competitors (Lumpkin et al., 1996). These three characteristics assist in differentiating firms between entrepreneurial and non-entrepreneurial. The entrepreneurial business is defined as taking risks, engaging in innovation, and is generally characterized by its proactivity (Miller, 1983). Businesses can capture new opportunities by using these characteristics, outperforming their competition and producing better performance (Zahra et al., 1995). Entrepreneurship research suggests a positive relationship between EO and small firm performance (Zahra, 1991; Zahra et al., 1995; Wiklund, 1999; Wiklund et al., 2005; Bauweraerts, 2019; Jiang et al., 2018; Kohtamaki et al., 2019), as a firm's entrepreneurial behavior unequivocally results in a financial increase (Miller, 1986; Lumpkin et al., 1996; Wiklund et al., 2005).

Even while studying the EO characteristics one-on-one, the results show that each character has positive results. Traditional strategies often lead to high performance, but risk-taking can introduce variation, eventually being more profitable (March, 1991; McGrath, 2001). Innovation is often viewed as the engine of economic growth, allowing for increased performance and financial development (Schumpeter, 1934; Brown et al., 1998). Proactiveness allows companies to get the upper hand over their competitors regarding prices and targeting market segments (Zahra et al., 1995). Thus:

H1: EO has a universally positive effect on small firm performance.

The configurational approach to the relationship between EO and small firm performance

Many studies demonstrate the positive relationship between EO and small firm performance. However, the idea of such a causal relationship may be oversimplified and misleading (Wiklund et al., 2005). Empirically, research results are inconclusive, as Smart et al. (1994) demonstrated, who could not link EO and performance. It is even argued that specific entrepreneurial strategies may result in poor performance (Hart, 1992).

When studying the relationship between EO and small firm performance, context must be considered, as the relationship between the two is complex (Lumpkin et al., 1996). Therefore, the external environment and the organization's internal characteristics must be considered when assessing the relationship between EO and performance, which arises two additional assessment options. The first is a two-way interaction by using contingency models. This interaction can be between EO and the external environment (Covin et al., 1989; Zahra et al., 1995; Wiklund et al., 2005; Frank et al., 2010; Lee et al., 2013; Bauweraerts, 2019) or between EO and the organization's internal characteristics (March et al., 1963; Zahra, 1991). The second assessment option is a three-way interaction using a configurational approach, which allows for the concurrent assessment of EO and internal and external environments (Wiklund et al., 2005). Therefore, this paper uses the second option.

The premise of the configurational approach is that companies need to adapt their attributes to the environment to outdo their competitors (Ketchen et al., 1993). When using the configurational approach, organizations create configurations by clustering certain elements such as strategy, structure, process, and environment (Meyer et al., 1993). This approach better understands performance by determining similarities from separate but consistently similar sets of firms (Miller, 1996). Previous research emphasized that the relationships between environment, structure, and strategy can be problematic, especially when considering that aligning resources to the external environment can cause essential failures when developing strategies in organizing resources for matching opportunities and threats within the external environment (Zajac et al., 2000).

This study focuses on strategic networking rather than focusing on specific internal resources because it can allow a firm to compensate or complement its lack of resources and competencies (Adler et al., 2002; Baum et al., 2000; Parida et al., 2010; Mu et al., 2017; Jiang et al., 2018). Configurations are empirically represented by three variables concurrently (Baker et al., 1993; Dess et al., 1997; Miller, 1988); in this paper, such will be determined by the interaction of EO, strategic networking, and environmental dynamism.

The interaction of EO and the environmental dynamism

Research on business model innovation also investigates the role of the external environment (Pateli et al., 2005; Waldner et al., 2015), emphasizing uncertainty and innovative opportunities for business model development (Ağca et al., 2012). In previous research, environment represents a moderator between EO and small firm performance (Lumpkin et al., 2001; Wiklund et al., 2005), with dynamism and hostility being two standard dimensions of the environment (Lumpkin et al., 2001; Moreno et al., 2008; Wiklund et al., 2005). Due to its wide acceptance in business model innovation, environmental dynamism is also used in this study (Martinez-Conesa et al., 2017; Schneider et al., 2013).

Environmental dynamism is characterized by turbulence, more specifically by changes in innovation on industry level and market trends, and high volatility of customer and competitor behavior (Dess et al., 1984; Miller, 1987). Within this dynamic environment, entrepreneurial-oriented strategies are more likely to be successful (Miller, 1990). Also, this environment creates ideal competitive circumstances for entrepreneurial companies, which are innovators, anticipate demand, and adjust to it (Lumpkin et al. 2001). This environment requires a company to make high-risk decisions and be innovative (Miller et al., 1978, Kreiser et al., 2010). Furthermore, this environment compounds innovation and growth strategies (Moreno et al., 2008).

Finally, environmental dynamism positively influences more proactive businesses (Lumpkin et al., 2001).

For example, companies in dynamic growth environments had a positive EO-performance interrelation, while those in a static or underdeveloped environment had a negative relationship (Zahra, 1993). Similarly, innovating companies thrive in turbulent environments (Miller, 1988). Thus:

H2: Environmental dynamism moderates EO-small firm performance interrelation.

The interaction of EO and strategic networking

Implementing EO needs resources that can also be acquired through strategic networking, other than by traditional means. It is vital for small companies because, with this mechanism, they can overcome resource challenges that otherwise they may not have been able to (Lee et al., 2001). This relationship needs to be diverse so that firms can obtain a diverse gamut of resources in knowledge, competence, etc. (Adler et al., 2002; Baum et al., 2000). By carefully managing their network relationships, firms can better obtain open and broad network resources essential to their business operations (Hughes et al., 2007). Because of the uncertainty they face, this approach is particularly successful for companies with EO (Dess et al., 1997; Hughes et al., 2007).

As a strategy, EO urges companies to be proactive when searching their environment for resources and opportunities, eventually offering them relationships with helpful organizations and institutions (Li et al., 2011). Therefore, companies that use EO are more likely to identify a need for resource acquisition that they can pursue through networking opportunities (Teng, 2007) and succeed in this networking search. They can find and identify additional opportunities (Wales et al., 2013).

Furthermore, innovation EO further urges companies to acquire information about their environment leading to a more proactive approach to finding opportunities (Jones et al., 2006; Kollman et al., 2014). As mentioned, implementation of EO requires a lot of external resources, and this process is a risky activity since it requires effort and expenditure (Wiklund et al., 2003). Therefore, strategic networking will enhance the company's risk-taking ability and willingness to bear uncertainty. Also, engaging the strategic networks allows proactive companies to use a 'step-ahead' tactic (Morgan et al., 2003) and take advantage of the first move (Lumpkin et al., 1996). Such an approach would help the company to gain leverage in resource acquisition opportunities. Thus:

H3: Strategic networking moderates EO – small firm performance interrelation.

The configuration of EO, strategic networking, and environmental dynamism

A moderating role of environmental dynamism is proposed in hypothesis 2. Hypothesis 3 suggests that strategic networking has a moderating role in the interrelation between EO and small firm performance. Nonetheless, research on configurational models contends that companies configured on multiple constructs outperform others that only use two constructs. In line with the configurational research, the interaction of all three constructs is examined.

The configurational approach determines that businesses can most successfully benefit from EO when it takes an active approach to business, when the environment it operates in is dynamic, and when it participates to a high degree in strategic networking. The most harmful effect on performance is their inability to strategically network in a stable environment. Therefore, these lead to the following hypotheses:

H4: EO, strategic networking, and environmental dynamism explain small firm performance.

H4a: Small firm performance is highest within SMEs with high EO, high strategic networking, and a dynamic environment.

H4b: Small firm performance is lowest within SMEs with high EO, low strategic networking, and a stable environment.

Research method

Sample

Data was found in the database of the Financial Agency Fina, which is the leading provider of financial and electronic services in Croatia. For data selection, the definition of European Union small and medium-sized enterprise was relied on. Therefore, a random sample of firms was selected from two different categories. The first had between 1-49 employees, while the second had 50-249. The data sample consisted of 2,000 randomly selected small and medium-sized enterprises contacted in December 2019 and January 2020. Of these, 851 received and opened the electronic questionnaire, while 202 firms responded to the questionnaire from this group and correctly replied via e-mail (i.e., a response rate of 10,1%). Out of the firms that participated in this research, 145 were micro and small (71.78%), while 57 were medium-sized firms (28.22%). Considering the industry, 66 firms operate in the manufacturing sector (32.67%), while 136 firms operate in the service sector (67.32%). From sample demographics point of view, 51.49% of the respondents were firm owners, 21.29% directors, and 27.23% managers, where 89.11% of the respondents had worked for the firm for more than five years, while 79.21% had more than seven years of the working experience with the firm.

Variables and measures

A seven-point Likert-type scale was used to measure small firm performance. This modified method was developed by Gupta et al. (1984). In this subjective scale, participants are asked to rate the importance of sales growth, market share, and market development to measure their business performance, ranging from 'not important to 'extremely important. That was followed by a second question indicating participant satisfaction with their achieved performance on the first set of indicators, using another seven-point Likert-type scale, ranging from 'not satisfied' to 'highly satisfied'. The scores of the first question on 'importance' were mathematically adjusted by summing up to 1, thereby minimizing potential individual bias (Naman et al., 1993). They were then multiplied with the 'satisfaction scores' to produce a weighted average performance index. This index has a mean of 3.74, a standard deviation of 1.42, a range of 6.86, and Cronbach's a value of .86.

Entrepreneurial orientation (EO) was measured using Covin et al. (1989) seven-point Liker-type questions scale for assessing innovativeness, proactiveness, and risk-taking. The EO score has a mean of 4.33, a standard deviation of 1.21, a range of 5.78, and a Cronbach's a value of .77.

Strategic networking (SN) was measured using Allen et al. (1990) scale for assessing commitment, Garbarino et al. (1999) scale for assessing trust, Hansen et al. (2008) scale for assessing reputation, Sivadas et al. (2000) scale for assessing communication, and Eriksson et al. (2007) scale for assessing cooperation. All these five scales were based on seven-point Liker-type questions. The strategic networking score has a mean of 5.27, a standard deviation of 0.91, a range of 4.67, and a Cronbach's a value of .77.

Environmental dynamism (ED) was measured using Miller et al. (1982) scale based on seven-point Liker-type questions, where environmental dynamism score has a mean of 3.80, a standard deviation of 1.18, a range of 5.50, and a Cronbach's a value of .65.

For determining the size of the firm, respondents were asked to select whether they had less than ten employees (micro firm), 10-49 employees (small firm), or 50-250 employees (medium-sized firm), which corresponds to the European Union definition of small and medium-sized enterprises. Regarding the industry in which they operate, respondents were asked whether their main line of business was manufacturing or service. The firm's size and industry may influence performance due to different organizational and environmental characteristics exhibited by the firm (Wiklund and Shepherd, 2005), which is why these two variables were included as controls.

Analysis

Moderated linear regression analysis was used as an analytical method to test the proposed hypotheses, according to the approach developed by Wiklund et al. (2005) and Zhang et al. (2007). All variables have been mean-centered since research shows this can improve the interpretability of results. Further robustness tests have been applied, where Durbin-Watson statistic and maximum Cook's distance were well below critical values. Moreover, multicollinearity diagnosis was applied to determine the absence of multicollinearity, where all variance inflation factors (VIF) were below 2, which is far below the maximum threshold of 10. A non-response analysis and common method bias analysis have been performed. It showed no significant differences between early and late respondents, meaning that this study did not present a non-response bias. Since Eigenvalues were greater than 1, we can state that common method bias was unlikely to be a severe concern in this study.

Empirical data and analysis

The means, standard deviations, and correlations of the variables are shown in Table 1, where the correlations among the independent variables are relatively modest, ranging from -0.214 to 0.470. More precisely, EO and performance have a statistically significant positive correlation coefficient (0.423), same as strategic networking and performance (0.415), and firm size and performance (0.224). When looking at correlations between two-way interaction terms and small firm performance, only two-way interaction between strategic networking and environmental dynamism has a statistically positive correlation coefficient (0.146) with performance. The three-way interaction term between EO, strategic networking, and environmental dynamism has a statistically significant positive correlation coefficient (0.350) with performance.

Table 1

Means, S.D.s, and correlations (n = 202)

	Mean	S.D.	1	2	3	4	5	6	7	8	9	10
1. Firm size	2.00	.756	1.00									
2. Industry	1.67	.470	-.214**	1.00								
3. EO	4.33	1.21	.074	.062	1.00							
4. ED	3.80	1.18	-.103	-.042	.368**	1.00						
5. SN	5.27	0.91	.068	.054	.290**	.231**	1.00					
6. Performance	3.74	1.42	.224**	.083	.423**	.011	.415**	1.00				
7. EO x ED			.020	-.045	-.019	.145*	.126	.067	1.00			
8. EO x SN			-.011	.003	-.100	.135	-.104	-.033	.410**	1.00		
9. ED x SN			.008	.026	.143*	.295**	-.021	.146*	.454**	.448**	1.00	
10. EO x ED x SN			.093	.068	.425**	.425**	.384**	.350**	.273**	-.107	.156*	1.00

*Notes: *P < 0.05; **P < 0.01*
Source: Authors' work

Table 2 provides the results of the hypothesis testing, whereby the result of each hypothesis test is shown in its respective column. Model 2 answers the first hypothesis, model 3 answers the second and third hypothesis, while model 4 answers the fourth hypothesis. For hypotheses testing, control variables were first added (model 1 in table 2), then the independent variables (the universal model in model 2, table 2), then the two-way interaction terms (contingency model in model 3, table 2), and lastly the three-way interaction term (configuration model in model 4, Table 2).

Table 2
Small firm performance: universal, contingency, and configurational model (n = 202)

	Model 1 Control variables		Model 2 Universal model		Model 3 Contingency model		Model 4 Configuration model	
	β	S.E.	β	S.E.	β	S.E.	β	S.E.
Control variables								
Firm size	.478***	.132	.319**	.114	.302**	.113	.261**	.112
Industry	.415*	.213	.212	.182	.181	.181	.123	.179
Main variable								
EO			.443***	.076	.430***	.077	.374***	.078
Moderating variables								
Enviro. dynamism (EE)			-.223**	.078	-.286***	.080	-.359***	.083
Strat. networking (SN)			.518***	.096	.553***	.098	.499***	.098
2-way interactions								
EO x ED					-.015	.060	-.070	.062
EO x SN					.004	.082	.060	.083
SN x ED					.229***	.094	.230**	.093
3-way interactions								
EO x ED x SN							.154**	.057
R²	.068***		.339***		.365***		.388***	
Adjusted R²	.059***		.323***		.338***		.359***	
ΔR²	.068***		.271***		.025***		.023***	

*Notes: *P < 0.10; **P < 0.05; ***P < 0.01*
Source: Authors' work

Firm size and industry, as control variables, explain 6.8% of the variation in performance (P<0.01). As the second step of the analysis, the universal effect of EO, strategic networking, and environmental dynamism on small firm performance, account for an additional 27.1% of the variation in performance (P<0.01). As it can be seen from the model 2 in table 2, both EO (β = 0.443, P < 0.01), and strategic networking (β = 0518, P < 0.01), have statistically significant positive relationship with small firm performance, while external environment (β = -0.223, P < 0.05), has statistically significant negative relationship with small firm performance, which supports hypothesis 1. In other words, there is enough evidence to confirm that EO has a universally positive effect on Croatian SMEs performance.

Contingency model, model 3 in table 2, explains for additional 2.5% of the variation in performance (P<0.01), and only two-way interaction between strategic networking and environmental dynamism is statistically significant (β = 0.229, P < 0.01), while the other two-way interactions are not. Therefore, the second and third hypotheses are not supported. In other words, there is not enough statistically significant evidence to

confirm that environmental dynamism and strategic networking moderate the interrelations between EO and small firm performance. Figures 2 and 3 provide further evidence not supporting previously stated claims, i.e., hypotheses 2 and 3.

Inclusion of the three-way interaction between EO, strategic networking, and environmental dynamism as part of the configuration model, model 4 in table 2, significantly increases explained variance by 2.3% (P<0.01) and has a statistically significant positive relationship with performance (β = 0.154, P < 0.05), which in turn supports hypothesis 4. More precisely, model 4 provides enough statistically significant evidence to confirm that EO, strategic networking, and environmental dynamism configurations can explain small firm performance.

We plotted the interaction effects of two-way interaction terms (figures 2, 3, and 4) and the three-way interaction term (Figure 1). Strategic networking and environmental dynamism values were set at one standard deviation above and below the mean, while the range of values for EO was entered (Cohen et al., 2003). Therefore, following the outlined procedure, figure 1 illustrates the three-way interaction effect of EO, strategic networking, and environmental dynamism on small firm performance under the following configurations: (a) high strategic networking, high environmental dynamism, (b) high strategic networking, low environmental dynamism, (c) low strategic networking, high environmental dynamism, and (d) low strategic networking, low environmental dynamism.

Figure 1 shows that all lines slope upward. Small firm performance increases with EO increase regardless of strategic networking and environmental dynamism conditions. This finding provides additional support for hypothesis 1. It is vital to notice that small firm performance increases with increasing EO at a faster rate for firms operating in a stable environment and with a high degree of strategic networking than for all other combinations of strategic networking and environmental dynamism; thus, hypothesis 4a is not supported. Otherwise said, there is not enough evidence to support the notion that small firm performance is highest amidst firms with a high degree of EO, a high degree of strategic networking, and operating in a dynamic environment than other configurations.

Moreover, figure 1 does not support hypothesis 4b. We hypothesized that firms with a low degree of strategic networking and a stable environment would perform worst, which is not the case since firms with a low degree of strategic networking and operating in dynamic environments are relatively worst performers. Based on our analysis, the highest performing configuration is high EO, high strategic networking, and low environmental dynamism.

Figure 1
EO x Strategic networking x Environmental dynamism
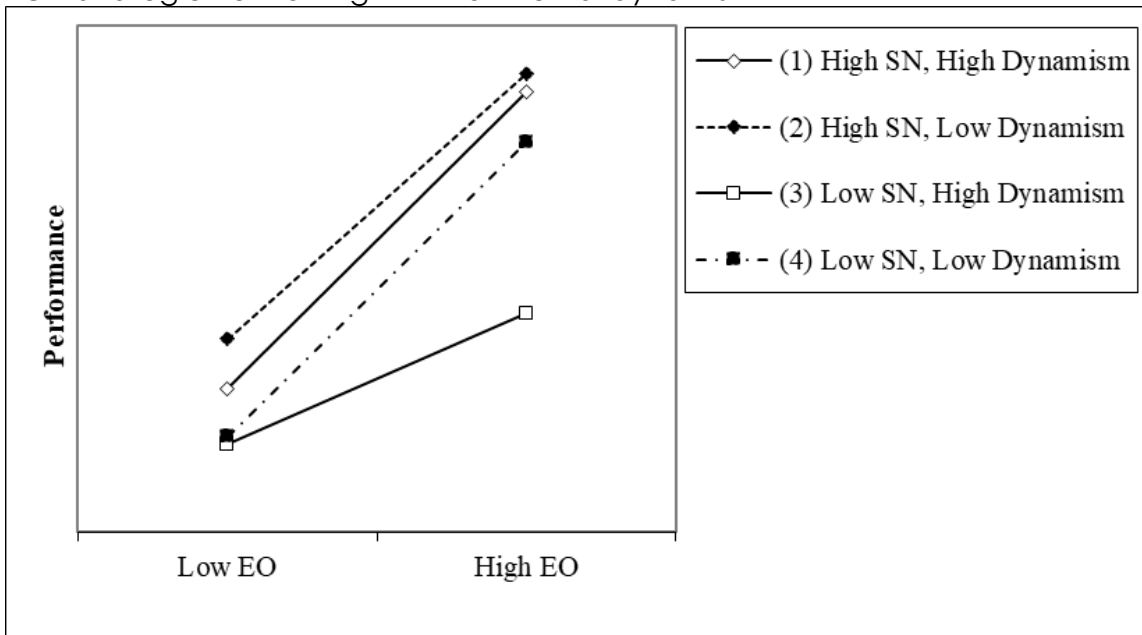
Source: Author's illustration

Figures 2 and 3 provide additional evidence that interaction effects do not exist between EO, strategic networking, and environmental dynamism. In contrast, figure 4 supports the interaction effect between strategic networking and environmental dynamism when linked with firm performance.

Figure 2
EO x Environmental dynamism
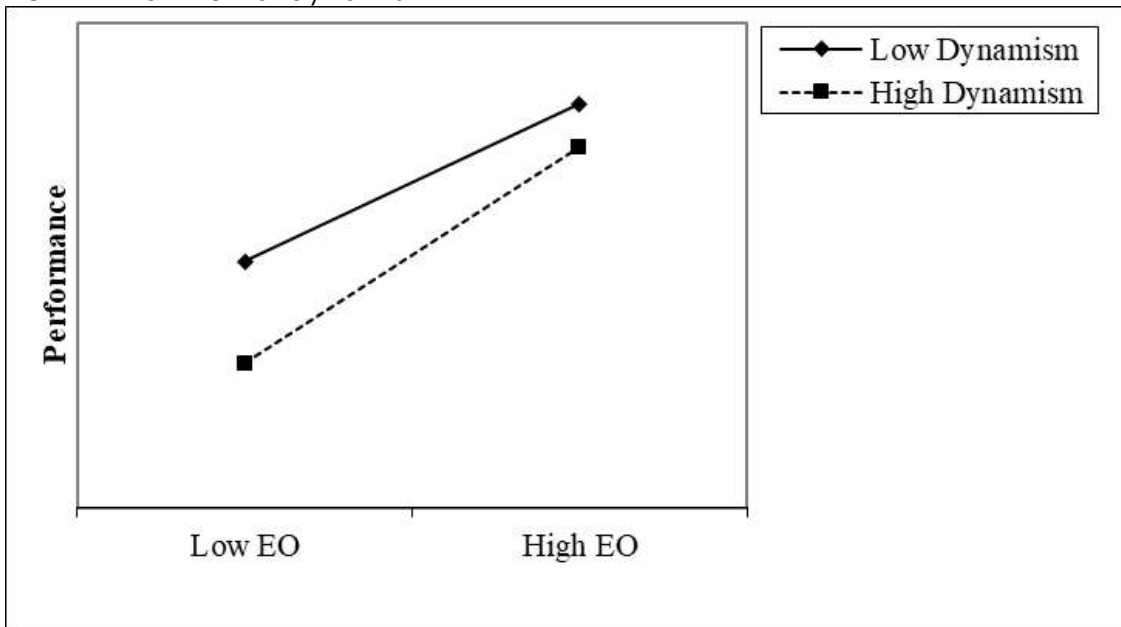
Source: Author's illustration

Figure 3
EO x Strategic networking
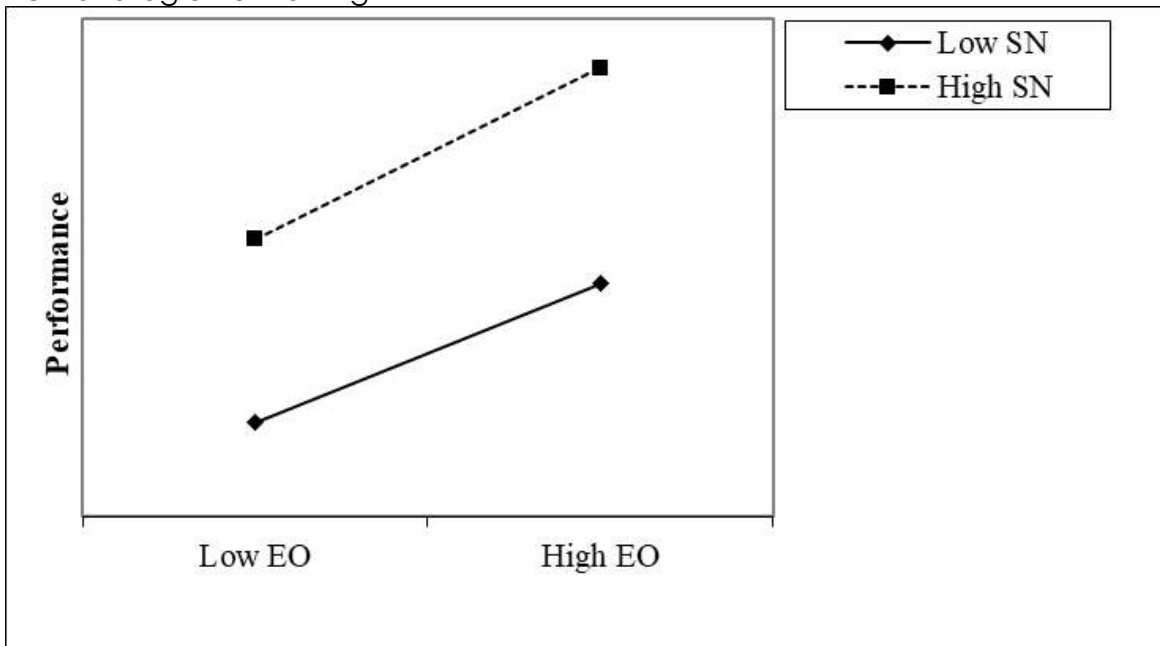
Source: Author's illustration

Figure 4
Strategic networking x Environmental dynamism
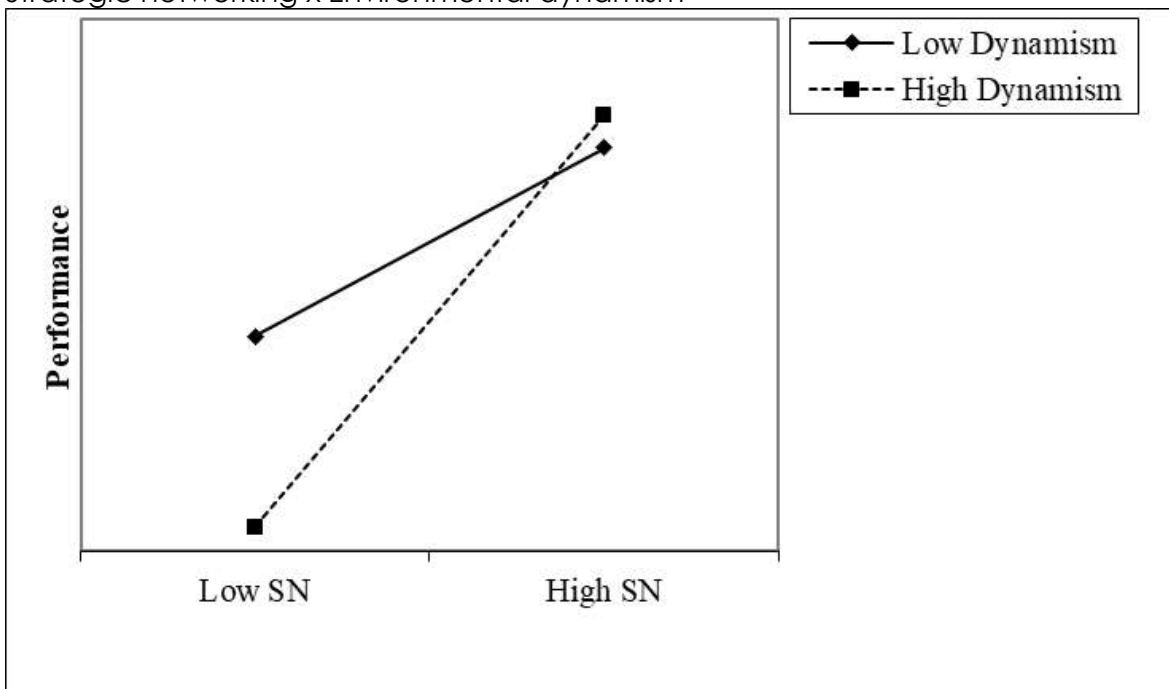
Source: Author's illustration

Discussion and conclusion

Based on the conducted analysis, we can summarize the following results of our study. First, our analysis confirmed two of our hypotheses:

- H1: EO has a universally positive effect on small firm performance.
- H4: EO, strategic networking, and environmental dynamism explain small firm performance.

We confirmed the universal positive effect of EO on small firm performance as it was already previously done by Zahra (1991), Zahra et al. (1995), Wiklund (1999), Wiklund et al. (2005), Bauweraerts (2019), Jiang et al. (2018), and Kohtamaki et al. (2019). Also, we confirmed that configurations of the following elements could explain small firm performance - EO (Wiklund et al., 2005; Frank et al., 2010; Bauweraerts, 2019), strategic networking (Parida et al., 2010; Mu et al., 2017; Jiang et al., 2018), and environmental dynamism (Wiklund et al., 2005; Frank et al., 2010; Lee et al., 2013; Bauweraerts, 2019).

Second, our analysis did not confirm the following hypotheses:
- H2: Environmental dynamism moderates EO-small firm performance interrelation.
- H4a: Small firm performance is highest within SMEs with high EO, high strategic networking, and a dynamic environment.
- H4b: Small firm performance is lowest within SMEs with high EO, low strategic networking, and a stable environment.

Even though the analysis showed the universal positive effect of EO on small firm performance, the moderating role of environmental dynamism was not proven. In other words, we can say that there is no proof that companies with EO in dynamic environments will achieve higher small firm performance than the companies in static or undeveloped environments. This conclusion is in line with the results made by Wiklund et al. (2005), Frank et al. (2010), and Bauweraerts (2019), but opposite to the research results by Zahra (1993) and Lee et al. (2013), which implies that companies in dynamic growth environments have a positive EO and small firm performance interrelationship.

Moreover, even though we confirmed that small firm performance is composed of EO, strategic networking, and environmental dynamism, it is not proven that these elements present a better construct than other configurations. Our results indicate that the supreme business performing configuration includes high EO, high strategic networking, and low environmental dynamism.

Lastly, our analysis showed that when combined with EO, a configurational approach provides a better explanation of small firm performance then both the contingency and the universal models. That confirms the thesis by Miller (1996), Wiklund et al. (2005), and Bauweraerts (2019) that you can better understand performance by using the configurational approach.

Implications for research and management

Our study's main contributions are the following. Firstly, our study provides empirical support of the EO and strategic networking concepts and their positive influence on small firm performance. Secondly, our study proposes and tests a configurational model which provides further insight into the relationship between EO and small firm performance. Due to the significant positive results, our study further confirms that a configurational approach provides a better concievement of the EO and small firm performance interrelationship than the two-variable contingency models. Lastly, by adding strategic networking to the interrelationship of EO and small firm performance, this paper adds to the discussion why some firms, although restrained with inhouse resources, can still achieve entrepreneurial projects since required resources can be acquired from external network partners. This research approach could potentially entice other researchers to explore further the role of strategic networking and its antecedents on the EO-performance relationship while simultaneously adding other environmental factors to the investigation.

While devising their strategies, small firm owners and managers should bear in mind that simply increasing the EO of the firm would not "per se" lead to better performance; rather, they should take into consideration other internal and external factors, such as in this case strategic networking and environmental dynamism. Management should not rely solely on developing a particular combination of entrepreneurial postures or trying to devise only one better strategy than the alternatives. Instead, management should combine the specific firm's entrepreneurial posture with the best fitting competitive strategy. Therefore, it is vital to understand that the configuration amidst EO, strategic networking, and dynamism yields the highest returns. This research showed that the best performing configuration is a high EO, strategic networking, and a low environmental dynamism.

Moreover, when summarizing the findings regarding each configuration, managers should keep in mind that the two best performing configurations are those with high EO and high strategic networking, while the two lowest are with high EO and low strategic networking. Further confirmation for these claims can be found by analyzing the direct effects of each observed variable on firm performance. Lastly, it should be noted that EO and strategic networking directly and positively affect small firm performance, while environmental dynamism does not. Instead, firms operating in highly dynamic environments realize lower performance than their peers operating in a more static environment.

Limitations and future research

Our study has the following limitations. The first is the size of the sample. Even though the questionnaire was sent to 2,000 addresses, we received only 202 responses. Although this number was enough to conduct this analysis, future studies should be done with larger samples. Second, because the collected data is based on subjective scales, there is always the problem of respondents' subjective perceptions. Although Venkatraman et al. (1986) proved a high level of correlation between subjective and objective measurements, in future research, priority should be given to objective measurements, especially in terms of performance measures. Third, another limitation of the study is questioning only one firm representative. Several representatives should be included to get a better picture of the firm's position. Finally, the fourth limitation represents the short-term aspect of the study since the research is based on observations that took place at one point in time. Therefore, recommendations for future studies would include conducting a longitudinal study. Future research could also investigate the configuration of each of the EO antecedents, strategic networking, and environmental dynamism to explore its impact on small firm performance further. Moreover, future research should include other internal or contextual variables, such as new ventures, generational involvement in the case of family firms, network resource acquisition, market orientation, etc. Also, future studies could develop more complex models to explore moderating roles of other external and internal variables, especially in other business cultures.

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Capital Market Returns and Inflation Nexus in Croatia: Wavelet Coherence Analysis

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Abstract

Background: Hedging against inflation assumes instruments such as gold, stocks, fixed income securities, and real estate. There still exists a lack of appropriate strategy to hedge against inflation. **Objectives:** This paper examines the possibilities for hedging against inflation in Croatia offered by the Zagreb Stock Exchange indices. **Methods/Approach:** Based on monthly data from January 2000 to September 2019 and using a wavelet coherence approach, this paper brings the results across time and frequency domains. **Results:** Empirical results suggest that inflation was a leading variable in a statistically significant positive correlation between the inflation rate and Crobex returns in 2007-2011. The relationship between Crobex10, Crobis, and Crobistr returns on one side, and the inflation rate on the other side has statistically significant correlations only in specific and different periods, in which respective returns are a leading variable. **Conclusions:** The results imply that hedging against inflation is rather problematic under current Croatian capital markets conditions. Zagreb Stock Exchange indices could serve as a hedge against inflation for some periods but not during the whole observation period.

Keywords: inflation; hedging; wavelet analysis; stock market index
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Introduction

Financial cycles can be analysed concerning structural changes over time in which different time horizons are used to identify investment opportunities (Umar et al., 2020). Herein an interplay between financial and business cycles is important, and the ability to mitigate risk by hedging against inflation (Wang et al., 2020). Different commodities and stocks can save value and serve as an inflation hedge (Bampinas et al., 2016; Ivanov, 2017).

Although even in low inflation periods, hedging against inflation is important, opposing research on the topic emerged. By examining the Dow-Jones Industrial Average index as an inflation hedge, Johnson et al. (1971) did not find its hedging ability in three US inflationary periods. Bulent Gultekin (1983) did not find a positive relationship between rates of return on stocks and inflation when examining their relationship in 26 countries in the period after WWII. Neither did Spierdijk et al. (2015), who studied inflation hedging possibilities of the US stock, bonds, and T-bills. Their research found connection inflation and stock is more positive for the pro-cyclical stock than noncyclical stock after the 1980s; it possesses no hedging properties. After 2008 two factors occurred: (1) stock had started to portray hedging abilities in various economies (Spierdijk et al., 2015; Cifter, 2015), and (2) a decline in the number of firms that hedge against inflation (Bampinas et al., 2016). These factors affect firms' risk management abilities, especially in small open economies such as the Croatian economy.

Furthermore, the Eurozone stock market returns show almost perfect integration (Fernandez-Macho, 2012), stating that Croatia, currently in ERM II, and its firms could lose from lack of investment in their risk management capabilities. Risk management is especially important in a pre-crisis period. Mansor's (2011) study showed that the ability of Malaysian stock to hedge against inflation was only effective in the pre-crisis period. As stock returns are dependent on the time horizon and are country-specific (In et al., 2013), this paper studies the possibilities for hedging against inflation in Croatia offered by the Zagreb Stock exchange' indices (ZSE). Four ZSE indices are examined: Crobex, Crobex10, Crobis, and Crobistr. This study uses a wavelet coherence analysis to decompose inflation-stock indices nexus by time horizons. It aims to depict the variations in stages between leading and lagging variables (Ramsey et al., 1995; 1998). Following the research mentioned earlier, the issue of hedging against inflation on a capital market presents an ongoing topic with ambiguous empirical support. Empirical results seem to depend on the time being observed and the country or group of countries considered in research. This paper makes a step ahead and put some light on small and open European country. The linkage between inflation rates and capital market returns may be different. Hence, considering the nature of the relationship, this research employs a wavelet-based approach to reveal properties of the relationship across time and frequency domains. The results contribute to the ongoing discussion in empirical and theoretical literature while providing suggestions to investors interested in the Croatian capital market.

Scientific research of this paper adds to the previous literature on inflation hedging abilities of stock returns. Our paper is consistent with the late research of Johnson et al. (1971) and Mansor (2011), who confirmed that stock returns could serve as an inflation hedge. We add to the existing literature by examining the leading and lagging variables in a specific period using a new empirical approach, a wavelet-based analysis. Our analysis adds to a theoretical discussion about which actors incite inflation based on reviewed period.

The following section of the paper reviews the relevant literature in the field. Subsequently, the methodology is explained, and the results are illustrated and

described. Finally, the paper concludes with relevant research findings, limitations, and calls for further research.

Literature review

Hedge against inflation reduces the risk of an investors' real return stemming from ambiguity about the upcoming price changes (Branch, 1974; Bodie, 1976). *"A complete hedge against inflation is defined as an asset where the nominal returns vary in a positive one-for-one way with inflation"* (Tarbert, 1996). Gold was examined as an inflation hedge (Chua et al., 1982; Dempster et al., 2010; Ghosh et al., 2004; Wang et al., 2011; Beckmann et al., 2013; Mensi et al., 2016), commercial property (Tarbert, 1996), common stocks (Alchian et al., 1959; Oudet, 1973; Bodie, 1976), real estate securities (Liu et al., 1997), oil (Ivanov, 2017) and other commodities (Zaremba et al., 2019).

Keynes's (1936) and Fisher's (1930) views state that the nominal value of the firm is equal to inflation; hence, it does not induce change in real terms, thereby contradicting the classical macroeconomic theory (Hong, 1977). In Keynes and Fisher's view, firms gain through inflation as it enables them to liquidate their debts with depreciated money, enabling creditors' losses to become the debtors' gains (Alchian et al., 1959). Keynes and Fisher's view is based on the propositions that: (1) firms are debtors and (2) interest rates reflect biased estimates of the future course of the increase in prices. In contrast, investment advisors state that common stocks' value does not significantly change in either direction due to inflation, while bond investments incur losses, which was confirmed by the German inflation following WWI, the Austrian and French inflations of the 1920s, Chilean inflation, and the US WWI and WWII stock price indices. Alchian et al. (1959) state this is especially true for banks, which are the largest debtors and ought to gain from inflation, but whose owners incurred real losses during the abovementioned periods of inflation. Tobin (1965) illustrates a positive real stock prices-inflation connection. Namely, a rise in inflation implies money devaluation, which results in pulling out of capital investments. In his research, Fama (1981) used negative affiliation among stock prices and inflation to portray that the nominal stock returns-inflation connection is an outcome of inflation (Gallagher et al., 2002; Bhanja et al., 2019). Hence, based on the asset returns-inflation rates interaction, the matters of data and methodology impede definite comparison of most studies and restrict a consensus on the relationship between asset returns and inflation rates (Arnold et al., 2015).

Geske et al. (1983) state that contrary to the economic theory, stock returns point to events preceding an increase in monetary expansion and, hence, are negatively related to expected inflation and unexpected inflation. Namely, money demand and counter-cyclical money supply form a basis for adverse stock return-inflation connection (Kaul, 1987). Furthermore, Schotman et al. (2000) show that regardless of negative relation with unexpected inflation, stock can be used to hedge against inflation contingent on the expected investment return periods. In the case of Chinese post-WWII hyperinflation, Zhao (2017) also differentiates between expected and unexpected inflation between 1945-1948 depicting differences between full and partial inflation hedge respectively, making the Fisher hypothesis applicable. Consequent research on the relationship between stock returns and inflation in China using a wavelet analysis shows a negative relationship in the intermediate periods.

In contrast, the relationship between short and long periods is different (Gu et al., 2013). Generally, the Fisher model is majorly applicable, suggesting the usage of stocks as an inflation hedge (Gu et al., 2013). On the other hand, Durai et al. (2009) examined the negative relationship between real stock returns and inflation that contradicts the

Fisher hypothesis for the Indian economy using wavelet analysis, according to which Fama's hypothesis of an adverse relationship between stock returns and inflation is confirmed for the long investment periods, and is ambiguous for the other investment periods. Wavelet analysis was also used to examine the relationship between stock returns and inflation in Pakistan by using monthly data between 1961 and 2012 (Tiwari et al., 2015). For longer periods, the study found that stock returns and inflation are positively related if using consumers' price change as inflation determinant and not when producers' price inflation is utilized; hence, indicating the long-term hedging ability. Pre- (1960-1990) and (1991-2014) post-structural economic reform experiences in India analysed by wavelet analysis of frequency-based causality suggest that stock returns are not connected to inflation across various investment periods lending support to stocks as instruments of hedge against inflation (Bhanja et al., 2019). However, monthly data from 1994M5 to 2014M11, analysed by spectral and wavelet techniques, did not portray substantial pro-cyclical inflation-stock returns linkages, depicting stock returns as inadequate inflation hedge in India (Bhandari et al., 2018), in addition to non-decisive evidence of inflation hedge of stocks in South Africa (van Rooyen et al., 2019). Moreover, Tiwari et al.'s (2019) wavelet analysis of the UK, the US, India and South Africa's inflation-stock returns links confirms frequencies and periods links, but abandons stock returns as an inflation hedge, whereas the example Islamic stock returns portrayed in Haniff et al. (2018) confirms them for shorter investment periods, i.e., those not exceeding 3 years, the FTSE Bursa Malaysia Emas Shariah Index, as constituent returns can be used as an inflation hedge, while investment periods exceeding 3 years are detrimental to investment returns.

Additionally, Albulescu et al. (2017) analysed the U.S. sector stock indices from 2002M7–2015M10. They found that inflation and its uncertainty negatively impact stock prices in the long run, as opposed to the well-known Fisher effect. Namely, for various sectors' stock indices, a negative effect of inflation perished following the start of the recession. In detail, a negative effect of uncertainty is visible in the short investment periods, with no significant effect on stock prices, apart from the consumption indices. In the case of Croatia, we are only familiar with the research of Benazić (2013), who tested the Fisher hypothesis using a vector error correction model and confirmed its existence for the long investment periods. Hence, inconclusive research on stock indexes implies the research gap, which should be explored and tested in the Croatian case.

Methodology

Research data

This study uses data containg different indices retrieved from Zagreb Stock Exchange (ZSE) and inflation index (HICP) retrieved from Croatian National Bank (CNB). Timespan differs for different indices due to data availability. The considered time series development is depicted in Figure A1 (see the Appendix), and descriptive statistics of the observed time series are presented in Table A1 in Appendix. The observed series was first transformed into (natural) log returns and analysis performed on a transformed series.

Analysis

Kang et al. (2019) employed the wavelet coherence to analyse the co-movement between Bitcoin and gold. Ferrer et al. (2016) followed a wavelet-based analysis to establish the association between Interest rate and stock returns. Some previous papers employed wavelet coherence analysis to examine the relationship between

stock returns and inflation rates (Bhanja et al., 2012; Bhandari et al., 2018). Firstly, the Morlet wavelet is defined in equation (1):

$$\psi^M(t) = \frac{1}{\pi^{\frac{1}{4}}} e^{i\omega_0 t} e^{\frac{-t^2}{2}} \tag{1}$$

where t represents time and ω_0 central frequency. After, the continuous wavelet transforms presented in equation (2) were employed to transform each considered series.

$$W_x(\tau, s) = \frac{1}{\sqrt{s}} \int_{-\infty}^{\infty} x(t) \overline{\psi\left(\frac{t-\tau}{s}\right)} dt \tag{2}$$

Where $x(t)$ Represents time series under consideration and s represent scale while τ represents location determining the position of the wavelet. Based on the wavelet transform defined in equation (2), considered time series $x(t)$ is decomposed in terms of wavelets. Based on the transformed time series, the paper studies the size and significance of the local correlation between the two time series under consideration. To examine the size and significance of the local correlation between the two observed time series, cross wavelet transform and cross wavelet power must first be explained. The cross wavelet transform of two-time series $x(t)$ and $y(t)$ is given in equation (3):

$$W_{xy}(\tau, s) = W_x(\tau, s)\overline{W_y(\tau, s)} \tag{3}$$

Where $W_x(\tau, s)$ represents continuous wavelet transform of the observed time series $x(t)$ and $\overline{W_y(\tau, s)}$ denotes complex conjugate continuous wavelet transform of the observed time series $y(t)$. The cross wavelet power is represented as $|W_{xy}(\tau, s)|$. Eventually, the squared wavelet coherence coefficient is presented in equation (4):

$$R^2(\tau, s) = \frac{\left|S\left(s^{-1}W_{xy}(\tau,s)\right)\right|^2}{S(s^{-1}|W_x(\tau,s)|^2)S\left(s^{-1}|W_y(\tau,s)|^2\right)} \tag{4}$$

Where S represents a smoothing operator, similar to Pearson squared correlation coefficient, the squared wavelet coherence coefficient ranges from zero to one. Furthermore, wavelet coherence analysis provides phase differences between considered time series. Wavelet coherence phase difference was identified following equation (5):

$$\varphi(\tau, s) = tan^{-1}\left(\frac{\Im\left(W_{xy}(\tau,s)\right)}{\Re\left(W_{xy}(\tau,s)\right)}\right) \tag{5}$$

where $\Re$ represents the real part, and $\Im$ imaginary part of the cross wavelet transform in equation (3). Arrows illustrate the phase difference. A zero phase difference indicates that the considered time series are positively correlated and move together. The arrows pointing right indicate a positive correlation, whiles the arrows pointing left represent a negative correlation. The arrows pointing up to indicate that the first time series leads the second by a right angle, and the arrows pointing down indicate that the second time series leads the first by a right angle. Consequently, the arrows can indicate a combination of positions.

Validity

To provide insights into the validity of results, the standard Pearson correlation coefficient was first calculated. Comparison of the empirical results from the standard correlation approach and wavelet-based approach illustrates the validity of the wavelet-based approach and its advantage over the standard approach.

Results

As illustrated in the section entitled Research data and methodology, correlation coefficients were calculated firstly, and results were summarized in Table 1.

Table 1
HICP Rate and Index Returns

|	**HICP&Crobex**	**HICP&Crobex10**	**HICP&Crobis**	**HICP&Crobistr**
Pearson cor. coef.	0.1247825	0.06476976	0.04339767	0.3193913
t-statistics (p-value)	2.0201 (0.04441**)	0.70804 (0.4803)	0.61585 (0.5387)	3.2152 (0.001805***)

Note: ** statistically 5%; *** 1%
Source: Authors' estimates

Table 1 indicates a low but significant correlation between inflation rate and Crobex index returns while holding a significance level at 5 %. A slightly higher and more significant correlation was found between Crobistr returns and inflation rates, while Crobex10 index returns and Crobis index returns were not significantly correlated with inflation rates. However, the correlations might depend on the time and frequency domain. So, Figure 1 illustrates wavelet coherence between inflation rates and Crobex10 returns.

Figure 1
Inflation Rates in Croatia and Crobex 10 Returns

**Wavelet Coherence: HICP rate vs CROBEX10 returns**
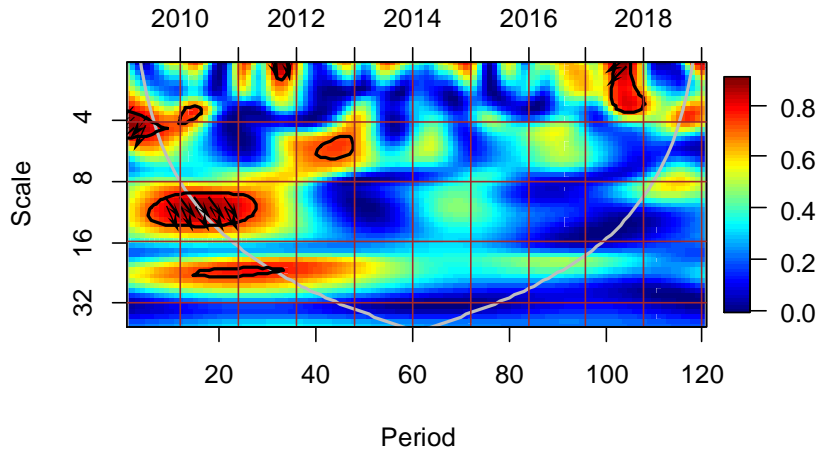
Source: Authors' estimates

As illustrated in Figure 1, the comovements between inflation rates and Crobex10 returns were more prominent at lower frequencies than before 2012. The CROBEX10 returns were the leading variable, and the correlation was positive. The comovements between CROBEX returns and inflation rates in Croatia are illustrated in Figure 2.

Figure 2
Inflation Rates in Croatia and Crobex Returns

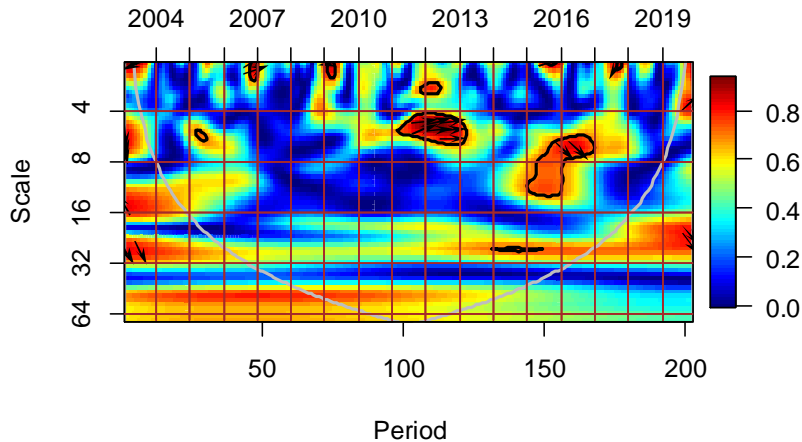**Wavelet Coherence: HICP returns vs CROBEX returns**
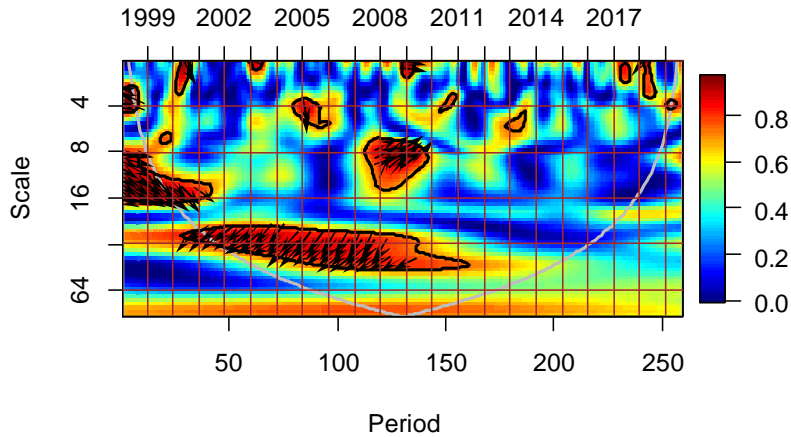
Source: Authors' estimates

   As illustrated in Figure 2, significant comovements were found before 2011. Crobex returns were the leading variable at the lower frequencies domain. Before 2001, the correlation was positive. Afterward, the sign of correlation depends on the frequency domain. The correlation was positive at higher frequencies between 2007 and 2011; the inflation rate was the leading variable, and Crobex could serve as hedging instruments for short periods. However, the correlation was negative at lower frequencies, and the CROBEX returns variable appeared as the leading one. Recalling Table 1, the standard correlation coefficient was positive and low. Therefore, relying on a standard correlation coefficient might indicate a misleading conclusion. The comovements between the inflation rate and Crobis returns are depicted in Figure 3.

Figure 3
Inflation Rates in Croatia and Crobis Returns

**Wavelet Coherence: HICP returns vs CROBIS returns**

Source: Authors' estimates

Following Figure 3, significant comovements were found between 2011 and 2013, with inflation rate as a leading one and positively correlated with Crobis returns. Furthermore, the comovement was significant and positive between 2015 and 2017, while the Crobis returns were the leading variable. Figure 4 presents wavelet coherence between inflation rate and Crobistr.

Figure 4
Inflation Rates in Croatia and Crobistr returns

Wavelet Coherence: HICP returns vs CROBIStr© returns
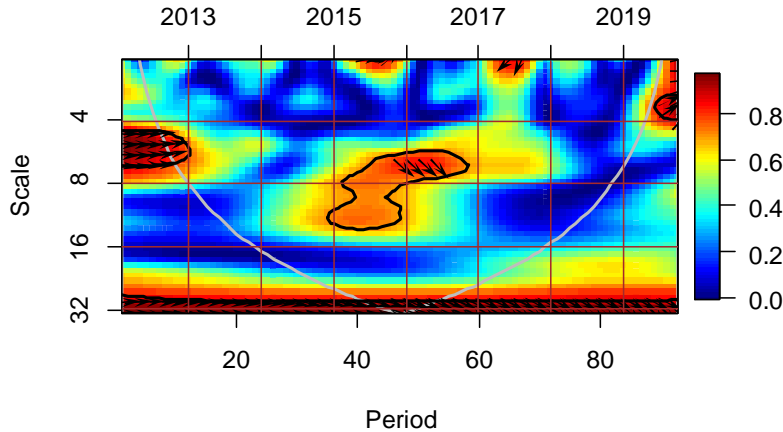
Source: Authors' estimates

Following presented in Figure 4 Crobis returns and inflation rates were almost perfectly correlated before 2013. A correlation between 2015 and 2017 and Crobistr was the leading variable.

Discussion

Theorethical implications
As mentioned in the introduction of this paper, empirical literature points out ambiguous conclusions regarding the linkage between inflation rates and capital market returns. Hedging against inflation is defined as an asset where the nominal returns vary in a positive one-for-one way with inflation (Tarbert, 1996).

Although Keynes (1936) and Fisher's (1930) views that the nominal value of the firm is equal to inflation, i.e., not causing a change in real terms as firms gain through inflation that enables them to liquidate their debt with depreciated money, it challenges the classical macroeconomic theory, which states that creditors lose convert to debtors' gains (Alchian et al., 1959). On the other hand, investment advisors state that common stocks' value does not significantly change in either direction due to inflation, while bond investments incur losses. As we are challenged with the inconclusive views, our paper attempted to inspect the causal relationship between inflation rates and capital market returns, both equity and debt-based, in the case of Croatian, i.e., Zagreb's, stock exchange market.

The results of our study are consistent with Johnson et al. (1971), who find that only a small sample of stock returns could serve as an inflation hedge, and with Mansor (2011), who found hedging abilities of Malaysian stock only in the pre-crisis period.

Similarly, Zhao (2017) found that stock could serve as an inflation hedge in periods of crisis. Our study on the ZSE Crobex index in the period 2007-2011 reflects the conclusions of Gu et al. (2013), Zhao (2017) and Bhanja et al. (2019) study, and Geske et al. (1983) view that stock returns point to events preceding an increase in monetary expansion making the Fisher model applicable. In our sample,e this notion is consistent with a positive correlation between inflation rate and Crobex returns in 2007-2011, in which inflation served as the leading variable. Our research adds to this notion by including the debt index Crobis returns and conducting a wavelet coherence analysis on debt instruments. Our results suggest that debt instruments could serve as an inflation hedge in the crisis period.

On the other hand, Fama's (1981) proposition on the adverse relationship between stock prices and inflation due to prices, i.e., stock returns reacting to the inflation, is consistent with the Crobistr index suggesting that consumers price change as inflation determinant (similar as in Tiwari et al., 2015).

For most studies, there is no indication of stock returns serving as an inflation hedge, especially in the longer periods, i.e., those exceeding three (3) years. This notion in our study is consistent with Haniff et al. (2018) and Albulescu et al. (2017).

Implications for practice

This paper attempted to answer the underlying question: "Which is the first: the chicken or the egg?" In that manner, it examined the inflation hedging possibilities of four various stock returns. These stock returns are indexed on Zagreb Stock Exchange (ZSE) and consist of Crobex, Crobex 10, Crobis, and Crobistr.

Crobex and Crobex 10 are equity indices. Crobex index was launched in 1997 with a base value of 1,000.00 HRK. It consists of 15 to 25 trading shares with a free-float market capitalization. Currently, it is composed of 18 companies' indexes in which the highest weight is born by Podravka d.d. (11%), Ericsson Nikola Tesla d.d. (10.48%), and Atlantic Grupa d.d. (10.45%). Crobex 10 index was launched in 2009 with the same base value but consisting of the top 10 constituents of the Crobex index, i.e., all three mentioned companies. Herein however top three constituents include: HT d.d. (19.46%), Podravka (19.02%), and Adris grupa (14.20%).

Crobis and Crobistr are debt indices revised quarterly. Crobis was launched in 2002 with a base value of 100 HRK and included the Republic of Croatia's bullet bonds at fixed interest rates with a nominal value greater than 75 million EUR and at least 18 months to maturity. It currently contains 13 bonds whose maturity is from 2022 to 2040 and is denominated in Euros and Croatian kunas. The greatest weight is born by bond whose value is 12.46 billion HRK with an interest rate of 4,26% maturing in 2026 (13.18%), then by 1.4 billion EUR bond with an interest rate of 5,75% maturing in 2024 (10.70%) and 13.3 billion HRK with an interest rate of 1.75% maturing in 2023 (10.16%). Crobistr consists of 13 indices that were launched in 2011with a base value of 100 HRK. Its weights are similar to those of the Crobis index, i.e., the highest weight is born by 12.46 billion HRK bonds maturing in 2026 (13.25%).

Regarding equity indices, our wavelet coherence analysis confirms a statistically significant positive correlation between inflation rate and Crobex returns in the period 2007-2011 with inflation as the leading variable, implying Crobex returns could serve as an inflation hedge. Then, a positive correlation between inflation rates and Crobex10 returns proved to be more prominent at lower frequencies before 2012, with CROBEX10 returns as the leading variable implying Crobex10 returns could not serve as an inflation hedge. Although small differences exist between the two indices, the attributing companies' weights direct us towards the conclusion that Crobex returns could serve as an inflation hedge due to its slightly larger emphasis on food and trade

companies, while the Crobex10 index is slightly more leaned towards services (HT d.d.) and tobacco industry which in times of inflation tend to experience lower revenues.

The inflation rate was the leading variable in terms of debt indices when the correlation between inflation and Crobis returns between 2011 and 2013 was examined. In that period, Crobis return index could serve as an inflation hedge. It is observed that this is a period after the Crobex index (2007-2011) could prove to serve as a valuable inflation hedge. Crobistr returns' positive correlation with inflation in two different periods did not add to the usability of Crobistr as an inflation hedge as Crobistr was a leading variable.

Conclusion

This paper examined the inflation hedging possibilities in Croatia offered by the Zagreb Stock exchange indices. It used a wavelet coherence analysis to produce decomposition of inflation-stock indices nexus by time horizons and depict the differences between the leading and lagging variables. Four ZSE's indices examined: Crobex, Crobex10, Crobis, and Crobistr, have shown a positive and small correlation between Crobex returns and inflation rate and Crobistr returns and inflation rate when examined by standard correlation coefficient; and no significant comovements between Crobex10 returns and inflation rates neither between Crobis returns and inflation rate. The results suggest several important findings when using a wavelet coherence analysis across time and frequency domains to identify the leading and lagging variables. Firstly, statistically significant positive correlation between inflation rate and Crobex returns in the period 2007-2011, with inflation as the leading variable; hence Crobex returns could serve as an inflation hedge. Secondly, the positive correlation between inflation rates and Crobex10 returns is more prominent at lower frequencies before 2012, with CROBEX10 returns as the leading variable. Thirdly, positive correlation between inflation and Crobis returns between 2011 and 2013 with inflation rate as the leading variable, and between 2015 and 2017 with the Crobis returns as the leading variable. Eventually, positive correlation between Crobistr returns and inflation rates before 2013, and between 2015 and 201, with Crobistr being the leading variable.

The contribution of our study is threefold. Firstly, we use a method that has not been formerly used to examine the inflation hedging possibilities in Croatia, namely a wavelet coherence approach. Secondly, a wavelet coherence analysis allows us to study different time horizons that appropriate investor returns by identifying a leading variable in the time-frequency domain. In the context of inflation in Croatia and ZSE indices, only the Crobex index in 2007-2011 has leading variable inflation, which could serve as a hedging instrument, thereby answering the question that comes first: a chicken or the egg question based on specifically examined periods. In the shorter periods, i.e., those not exceeding 3 years, stock returns could serve as an inflation hedge. Our study confirmed this with the equity-based Crobex index for 2007-2011. The Fisher hypothesis states that prices reflect inflation is confirmed on the Crobistr index for 2011-2013. These results are consistent with the results of Gu et al. (2013), Zhao (2017), and Bhanja et al. (2019) study making the Fisher model applicable by stating that stock returns point to events preceding an increase in the monetary expansion (Geske et al., 1983). However, for the majority of examined periods, there exists no indication of stock returns being beneficial for inflation hedging, especially for periods exceeding three (3) years, whereby our study is in line with the studies of Haniff et al. (2018) and Albulescu et al. (2017), showing that an investment period exceeding 3 years is detrimental to investment returns.

Our study examined four indices and their relationship with inflation. Two indices Crobex and Crobex10 are equity indices, while the remaining two Crobis and Crobistr are debt indices. Our study showed that in times of crisis equity index Crobex, whose weights are attributed more towards food and trade services, and after crisis periods debt index Crobis, could serve as a hedge against inflation.

Limitations of our study include observation of merely two variables within the time-frequency domain, which is, however, a limitation of a wavelet coherence analysis. However, suppose our purpose is to examine a rationale behind the identified time-frequency domains. Future research should find and categorize causes of events preceding each period and analyze financial and business cycles jointly. Future research should incorporate different assets as an inflation hedge and make prescriptions for different time-horizons of investment in more detail. Inflation might be determined from abroad, while in the case of capital markets, the drivers might be more internal or show integration to the Eurozone markets (Fernandez-Macho, 2012).

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Appendix

Figure A1
Development of the Observed Series in Levels
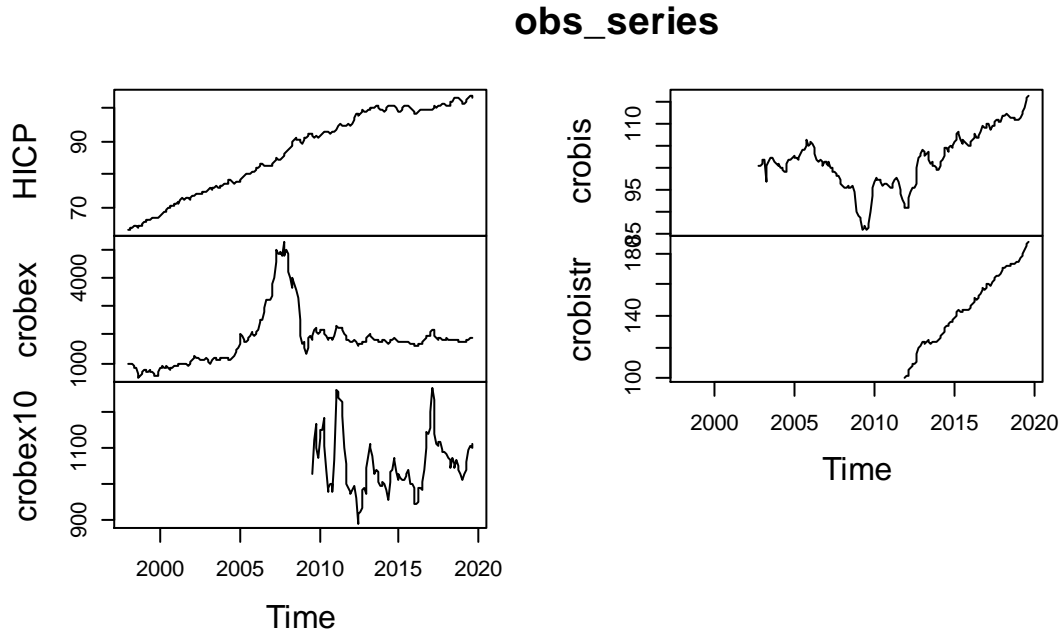
Source: Authors' estimates

Table A1
Descriptive Statistics of the Considered Time Series

	HICP	Crobex	Crobex10	Crobis	Crobistr
Min.	62.88	523.9	891.0	85.57	101.0
1st Qu.	75.89	1160.2	999.1	96.99	123.6
Median	90.61	1771.4	1037.9	101.70	144.0
Mean	86.99	1810.3	1054.7	101.78	145.3
3rd Qu.	99.55	1961.8	1097.2	106.01	165.6
Max.	104.12	5263.1	1264.8	116.79	187.5

Source: Authors' estimates

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Performance of Value and Growth Stocks in the Aftermath of the Global Financial Crisis

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Abstract

Background: Due to strong empirical evidence from different markets, existence of value premium became a financial theory standpoint. Although previous studies found that value stocks beat growth stocks in bearish and bullish markets, during the GFC, value stocks underperformed growth stocks. **Objectives:** This paper aims to examine the performance of value and growth stock portfolios after the GFC. Subjects of our analysis are constituent companies of the DJIA index, out of which portfolios of large-cap value and growth stocks have been constructed and evaluated. **Methods/Approach:** We measure the performance of stock portfolios, which are created based on the naïve diversification rule and random weighting approach. Statistical testing includes Levene's homogeneity test, the Mann-Whitney U test, T-test, and the One-Sample T-test. **Results:** Growth stock portfolios outperform value stock portfolios after the GFC. The dominance of growth stock portfolios compared to value stock portfolios is significant, and the value premium disappears. **Conclusions:** Financial theory and investment management implications show that growth stocks have overtaken the dominance over value stocks since 2009. Causes might be in (1) expansionary monetary policy characterized by very low long-term interest rates and (2) high performance of the tech industry to which most growth stocks belong.

Keywords: value premium; Dow Jones Industrial Average; investment strategies; naïve diversification
JEL classification: G11; G12; G14
Paper type: Research article

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Introduction

Value and growth investing are buying companies with low price-to-book ratios (value) versus high price-to-book ratios (growth), i.e., low versus high multiples. The value style was advocated by Benjamin Graham in the 1930s (Graham et al., 1938) and later by Warren Buffet. Value might indicate buying a stock at a low price, i.e., these stocks are seen as cheap compared with their potential compared to their intrinsic value estimated based on the balance sheet data. It has been found that value stocks outperforme not only growth stocks, but also the market itself (Folkinshteyn et al., 2017). Investing in growth stocks, i.e. stocks with relatively high price-earnings ratios, has been a popular portfolio strategy in the post-war periods, especially in times of strong economic growth (Bauman et al., 1997). Growth stocks come from innovative sectors, and the market positively values them, i.e., they have relatively high prices. For many decades, authors have pointed out that value stocks have excess return compared to the growth stocks. Many studies from the 1980s and the 1990s have found evidence about the outperformance of value stocks over growth stocks. The existence of value premium became a financial theory standpoint; it is a common belief that value stocks outperform growth stocks.

By buying stocks, future earnings are being bought. Price multiplies imbed expectations of earnings future growth. The widely used price-earnings ratio (P/E) demonstrate the expected future growth of earnings. Nevertheless, growth can be risky, so the stock market price does not discount future earnings only but also risks. On average, value stocks earn higher returns than growth stocks. Nevertheless sometimes there is a value trap and investors might be buying risky earnings growth (Penman et al., 2018).

Individual investment style is explained by several factors, such as the value or growth preference in stock markets. Investor's investment style can be explained by a biological basis, that are to some extend ingrained in an person from birth and by an individual's hedging demands (Cronqvist et al., 2015). In addition, they find that investors' style can be explained by life course theory in a way that former experiences are linked to investment styles. Living in unfavorable macroeconomic coditions, and a lower socioeconomic status amplify value preferences for many years later. Examples of such adverse experiences are growing up in times of crisis or looking for work in a recession.

Value stocks are generally seen as lower market prices than earnings per share or other multiples and could be less attractive due to low or negative earnings growth rates. Based on the previous records growth stocks are characterized by above-average performance, with same trend expectations. Compared to their earnings per share, dividends per share, cash flow per share and book value per share, growth stocks are being traded at relatively high prices. However, Bauman et al. (1997) find exact opposite characteristics of value stocks. In their work, they compared the performance of value stocks with the performance of growth stocks. They studied stocks behavior in the 14 years, 1980 to 1993. The hypothesis of adaptive expectations is analyzing differences in performance. The adaptive expectations hypothesis claims that forecasters rely too much on historical trends when predicting future and potential trends, leading to biased forecasts of future equity returns. They find evidence of favorable investment performance of value stocks. Namely, stocks with relatively low price multiples, like EPS, EPS growth rate and cash flow per share show favorable performance, supporting adaptive expectations hypothesis.

Crises seem to reset the rules. Large-cap value funds have outperformed their equivalent growth funds in 9 years during the last 22 years, from 1999 till 2020: 2000-

2002, 2004, 2006, 2008, 2011, 2014, and 2016, monitored by Morningstar. Interestingly, in the aftermath of the Global Financial Crisis (GFC), large-cap value stock funds have outperformed growth stock funds only in three years: 2011, 2014, and 2016, for 1.72%, 0.09%, and 11.4%, respectively. Since the outbreak of the Covid-19 crisis at the beginning of 2020, value stocks have experienced one of its worst years. From 2009 onwards, the value premium has disappeared. Large-cap growth stock funds with solid earnings growth profiles earning 34.8% have outperformed large-cap value funds. The margin is even wider that in 1999 dot-com bubble; 32% difference in 2020 versus 30.7% difference in 1999 (Lynch, 2021).

This study compares the performance of large-cap value stocks with large-cap growth stocks by implementing different diversification strategies. We address the research question about the existence of value premium on large-cap stocks after the GFC. The analysis is performed on the Dow Jones Industrial Average index (DJIA, Dow). DJIA constituents are observed over a ten-year period, from 2009 till the end of 2018/beginning of 2019. DJIA stocks are being analysed and marked as value or growth stock separately by the end of each year. Since multiples change over time, our analysis is based on portfolios of value and growth stock, which are created separately for each year, similar to Fama et al. (1998). We test the hypothesis if there is a statistically significant difference in returns on large-cap value and growth stock portfolios in a ten-year period after the GFC. Portfolios of value and growth stocks are created based on random weights and naïve diversification rules. Our methodological framework includes fundamental portfolio management techniques and statistical testing with Levene's test for equality of variances, T-test, Mann-Whitney U test, and One-Sample T-test.

Due to the relatively recent experience of the GFC that destroyed financial markets and economies worldwide and caused losses in trillions, it is interesting to analyze the behavior of US blue-chip large-cap value and growth stocks from DJIA in the ten-year period after the GFC. This research aims to further enrich the existing literature on stock performance because recent stock behavior deviates from financial theory and shows the disappearance of the positive value premium. The most interesting question is whether the negative value premium from the observed ten-year period will last in next years, especially after the Covid-19 crisis and after the expansionary monetary policies.

We find significant outperformance of growth stock portfolios compared to value stock portfolios in the aftermath of the GFC. The scientific contribution of our research is that in large-cap stocks portfolios, value premium disappeared. Growth stocks have overtaken dominance over value stocks, which calls for revision of the common standpoint of the financial theory. One reason for the outperformance of growth stocks might be expansionary monetary policy characterized by very low long-term interest rates. Another reason might be the incredible growth of tech stocks in the observed period, to which most growth stocks belong.

The paper starts with a literature review about growth and value stocks performance, followed by methodology. Analysis and main findings are presented in section data and results. Section discussion reveals the research's theoretical contribution and practical implications, followed by the conclusion.

Literature Review

Distinctive financial markets, from developed to emerging, and from domestic to global, are included in available studies about value and growth stocks performance. Most of those studies find that value stock portfolios tend to surpass

growth stock portfolios over long periods, usually meaning throughout at least ten years (Fama et al., 1998; Bauman et al., 1998; Bird et al., 2007).

Different authors chose different financial measures to examine and compare the performance and behavior of value and growth stocks and portfolios created out of those stocks. Bauman et al. (1997) used earnings per share (EPS) forecasts of security analysis as representative for investors' expectations about the future, while Bauman et al. (1998) used four valuation ratios, i.e., price-earnings (P/E), price-to-cash flow (P/CF), price-to-book (P/B) and dividend yield to define value and growth stocks. Stock performance based on value premium was analysed by Fama et al. (1998) and Chan et al. (2004).

Bird et al. (2007) analyze the excess returns of the European market when a portfolio is rotated between value and growth stocks. Their study shows that value increasing potential of their rotation strategy is ruined when market sentiment and financial health indicators are used for the portfolio performance enhancement purposes.

Since outperformance of value stocks compared to growth stocks throughout these articles is connected with a more extended period, it is questionable whether this is true for a shorter period. Fama et al. (1998) and Chan et al. (2004) find that value stock outperform growth stocks in terms of total returns. Value stocks are offering total return which is higher than the return on growth stocks and suggests the existence of positive value premium, which is a residue of difference between returns of growth and value stocks.

Different studies have different views regarding value premium. According to Fama et al. (1998), the global value premium exists throughout time. By study conducted by Yen et al. (2004) the existence of value premium is stated only for a short periods. Fama et al. (1993) state that the level of risk generates the value premium; hence, value premiums are generated by investor biases.

Another way to study and compare value and growth stocks is price multiples. Some articles discuss that creation of value and growth portfolios based on one price multiple results in higher returns than by using other price multiples. When Athanassakos (2009) studied the Canadian market, he found that using the P/E ratio as a criterion for value and growth stock portfolio creation will earn higher returns than portfolios created using the P/B ratio. Fama et al. (1998) claimed differently, meaning that the P/B ratio allows an investor to gain higher return than sorting by other multiple and Bauman et al. (1998) agreed with their study.

A study done by Yen et al. (2004) finds that growth stocks give a lower return per unit of systematic risk compared to value stocks, which is a consequence of different features between these two stock types. According to Fama et al. (1998), growth stocks beta do not have negative value, just a pretty low value. They failed to explain the excess returns using the CAPM model since the intersection was not indifferent to zero. Gonenc et al. (2003) also got different results on intersections meaning that intercepts were negative and statistically significant. Fama et al. (1998) discussed their failure with the CAPM model and said that failure is due to its intercept and market slope, so they used the multi-factor model and explained returns. They find that considering a multi-factor model was more appropriate. The model supposes that excess return cannot be earned when the market excess return does not exist and there is no statistical difference between growth and value stock returns.

Fama et al. (1998) assume that the decrease in intercept is affected by the value premium added as an additional factor. They analyzed the returns obtained from growth portfolios (high price multiples) and value portfolios (low price multiples).

Analysis based on average global market returns led them to conclude that value stock portfolios outperform growth stock portfolios. From 1975 through 1995, value stock portfolios were yielded superior returns in twelve out of thirteen significant markets. On the international level the value premium cannot be explained by CAPM. Still, if a risk factor for relative distress is being included in the two-factor model, the value premium is being captured on international level.

Cheh et al. (2008) studied the performance of stocks with high and low P/E ratios. The holding period was shorter than one year, and they wanted to examine how the holding period length impacts performance of value investment strategy related to the P/E ratio. Their analysis spotted that average annual returns are higher for the portfolio with high P/E than for the portfolio with low P/E irrespective of the frequency of P/E stocks balancing. The authors conclude an improvement in a low P/E infrequent rebalancing portfolio performance, but a high P/E portfolio performance is reduced.

Chahine (2008) analyzed sensitivity of value and growth strategies to earnings growth, in the Eurozone region from 1988 to 2003. Author used tests that were based on asset pricing and returns strategy. Supervising for previous risk factors indicated by Fama et al. (1993), Chahine (2008) found evidence that a value strategy which is based on high earnings growth rate, outperforms both, value and growth strategies in the observed period. Empirical results show that growth of earnings affects performance determination of value in opposition to growth-stocks portfolios. There is a positive effect of EPS momentum, but only in undervalued value stocks; that was not the case with overvalued growth stocks (Chahine, 2008).

An analysis of annual value premiums on the Italian stock market showed evidence favoring value premium only from 2001 to 2006 (Gagliolo et al., 2020). In the GFC and after, the returns on value and growth stocks were quite aligned. Authors find that value stocks do not yield excess return any more, as they were in the past in. Their findings are aligned with the US market appears. They find a significantly high-value premium only of small-cap stocks over some periods from 2001 to 2018. Evidence about high-value premium was limited and was found only at the beginning of 2000s.

Methodology

In the empirical part of our research, we analyze the behavior of blue-chip, large-cap US companies included in the DJIA index. This stock market index measures the stock performance of 30 American leading blue-chip industrial and financial companies. Based on the previous studies and actual data related to the performance of value and growth stock portfolios and funds, we investigate whether growth stocks from DJIA performed statistically significant higher returns than value stocks from the same index in 10 year period after the Global Financial Crisis.

Our analysis is conducted as follows: firstly, all stocks which were part of the DJIA index in the ten years, from 2009 to 2018, are taken into account, meaning that more than 30 stocks are observed since there were minor changes in DJIA index constituents from period to period. Secondly, historical data for all stocks is collected; the historical data refers to financial data from the balance sheet, income statement, cash flow statement, and data related to daily historical prices of stocks. Sources used to collect data are Yahoo Finance, Morningstar, and Macrotrends. Data from financial statements and daily historical prices are used to calculate the price-earnings ratio (P/E), price-to-book ratio (P/B) and price-earnings-to-growth ratio (PEG). All sample stocks were analyzed based on their P/E, P/B, and PEG ratios every year, based on what stocks were marked as either value

or growth. The P/E ratio of a stock is compared to the average sector P/E. The P/B ratio of a stock is also compared to the average sector P/B, and PEG is compared to 1. It is treated as a value if the stock's P/E is lower than the average sector P/E. The same rationale is used for the P/B ratio. Otherwise, it is treated as growth. According to Bodie et al. (2011) reference value of the PEG ratio is about 1. So stocks with a PEG ratio of 1 or lower are considered value stocks, whereas stocks with values greater than one are considered growth ones. After calculating all relevant ratios, the values are compared using the IF function in excel, and stocks are classified as either value or growth stocks. Hence value stock portfolios and growth stock portfolios are created. At least two multiples should indicate which stock we have, and in the ideal case, all three multiples show the same result.

When it comes to portfolio creation, we follow the same methodology as Fama et al. (1998) and create separate portfolios for each year, based on data available on fiscal year-end for a year under observation. The holding period for each portfolio is considered to be one year.

Although in the last 70 years, a large number of sophisticated theoretical models in portfolio management have been developed, many investors still use straightforward rules for their asset allocation. One of the simplest rules for risk diversification is naïve diversification, implying an equally weighted portfolio, i.e., the weight of individual asset i in a portfolio is $1/n$, where n is a total number of assets $(w_i = \frac{1}{n}; i = \overline{1,n})$. Optimal diversification will outperform naïve diversification only for high levels of unsystematic risk (DeMiguel et al., 2009).

Holding period return (HPR) for each composite stock of portfolio is calculated as the difference between the closing price of a stock on the last day of the year and its closing price on the first day of the year, relative to the closing price on the first day of the year. When weights and returns for each stock are known, realized return of a portfolio is calculated as the weighted average of holding period returns of each stock in a portfolio. Calculated return is compared with DJIA return for that year, and portfolios within the year are compared to see which one has greater return, i.e., 'beats the market'. Besides portfolios created by assigning each equal stock weight, an additional 50 portfolios are created, assigning each stock weight a random number. To get random numbers between 0 and 1 whose sum is equal to 1, code was created in MATLAB. Code is as follows (Figure 1)

Figure 1
Matlab Code

```
table=[];
for i=1:50
r = rand(1, 16);
r = r / sum(r);
Sum = sum(r) % check if sum equals
1
r=r';
table=[table r];
end
```

(1)

Lines of code (1) are created in MATLAB to get the desired number of numbers whose sum equals 1. To interpret the meaning of the code, the example of the portfolio with 16 stocks is taken and explained. We declared a variable called a table that we use to form the table of size $n*m$, where n is 16, representing rows, and m is 50, representing columns. The table is formed in a loop where we take n random

numbers in the interval [0,1] and add them into array *r*. To get those numbers equal to 1, we need to divide that array with *n* numbers. After that, we check if we get *n* numbers whose sum equals 1. By exporting the MATLAB table in Excel, we get new random weights for 16 stocks in 50 new portfolios. The returns for the new 50 portfolios are calculated.

We have performed a similar analysis with groups of 30, 100, and 150 portfolios. Results have shown that groups of 50 portfolios achieve the normality of arithmetic means (central limit theorem). An additional increase in the number of randomly generated portfolios and the selection of other 50 random portfolios did not cause a significant change of expected return and standard deviation since differences were found after the fourth decimal place.

The methodological framework for hypothesis testing of value and growth stock portfolio returns in all years include the following statistics conducted in SPSS: Shapiro-Wilk normality test used to choose appropriate test (parametric or nonparametric) for checking if there is a statistically significant difference between returns of value and growth stock portfolios; Mann-Whitney U test and Two-sample T-test used to compare parameters for two unrelated samples based on the results of the Shapiro-Wilk normality test; Levene's test for equality of variances used for check equality of variance assumption in Two-sample T-test; One-Sample T-test used to examine whether the mean value and growth stock portfolio returns is statistically different from returns on DJIA index. Besides comparing all value and all growth stock portfolios with random weights, the portfolios whose stocks are assigned equal weight are compared with the DIJA index in each year to see whether such portfolios would outperform the market. The outperformance or underperformance is expressed in percentages.

Data and Results

In total, 35 stocks were constituents of the DJIA index from 2009 to 2018/2019. Since two companies do not have publicly available information, we excluded them from our research. Our analysis comprises 33 stocks from eight sectors: financial services, technology, oils/energy, communication services, consumer cyclical and consumer defensive, health care, and industrials.

Price-multiples for each company are calculated at the end of the year. If the stock is identified as value at the end of the year, it is a value stock until the following year. Its status changes or stays the same, depending on the new financial ratios. If we overview each stock from our sample in all ten years, there are in total 15 stocks that are in most years growth stocks, 15 stocks that are in most years value stocks, and three stocks that are in five years value and five years growth stocks. The identification made year by year is used for creating portfolios.

Table 1 is derived after stocks classification in value or growth portfolio and calculation of return on value and growth portfolios for each year. Realized returns on each year's DJIA index, value, and growth stock portfolios are presented and calculated as weighted averages. The value and growth portfolios results shown in Table 1 are based on the equally weighted portfolios.

Table 1
Performance of DJIA and Equally Weighted Value and Growth Stock Portfolios

Year	DJIA returns	No. of value stocks	No. of growth stocks	Value portfolio returns	Growth portfolio returns	Outperformance or underperformance (%)	
						Value	Growth
2009	21.52%	23	10	23.91%	39.18%	2.39%	17.65%
2010	10.90%	25	8	5.74%	24.62%	-5.16%	13.72%
2011	3.32%	25	8	13.14%	17.95%	9.82%	14.63%
2012	6.78%	25	8	14.79%	105.26%	8.01%	98.48%
2013	17.45%	18	15	23.16%	33.59%	5.71%	16.14%
2014	8.09%	16	17	13.76%	11.78%	5.67%	3.69%
2015	-8.31%	12	21	15.29%	13.22%	23.60%	21.53%
2016	19.12%	11	22	22.34%	11.72%	3.22%	-7.40%
2017	26.99%	10	23	4.05%	27.17%	-22.93%	0.18%
2018	-7.81%	14	19	-15.94%	1.18%	-8.13%	8.99%

Source: Authors' work

DJIA index was dominated by value stocks in the first 5-year period after the Global Financial Crisis, 2009-2013, while growth stocks dominated it in the next five-year period from 2014 onwards. Growth stock portfolio returns are higher than value stock portfolio returns in 7 years out of 10; hence value stock portfolio outperformed growth one only in 2014, 2015, and 2016. Returns on portfolios for each year are compared with the DJIA index realized returns. We can see that an equally weighted portfolio of value and growth stocks from DJIA mostly outperform the index's return. For value stock portfolios, the underperformance of portfolios compared to the DJIA index is seen in 2010, 2017, and 2018. Growth stock portfolio underperformance was found only in 2016. In all other years' value and growth portfolios outperform the index itself.

Previously presented results indicate a difference in returns between value and growth stock portfolios, and between DJIA and those two portfolios. To statistically test our assumption of a difference between returns, we create 50 new portfolios of value stocks and growth stocks for each year. The goal of creating 50 new portfolios was to determine whether there is a statistically significant difference between value and growth portfolio returns and a statistically significant difference between returns on these portfolios and the DJIA index. The difference between value and growth portfolios from Table 1 and these 50 new portfolios for each stock type and year is in weights assigned to each stock. MATLAB code (1) was used to assign different and random weights to stocks. MATLAB provided us random number generator, whose function was to give us 50 different weights for each year out of 10 years for both value and growth portfolios. The sum of newly generated random weights is always 1, i.e., no negative holdings.

The mean return is negative only in 2018 for the value stock portfolio. In all other periods and for other portfolios, the mean return is positive. In contrast, the highest mean return accompanied by the highest standard deviation was observed in 2012 for the growth stock portfolio.

Table 2
Descriptive statistics of random value and growth stock portfolios

Descriptive Statistics		N	Mean	Std. Deviation	Std. Error Mean	Shapiro-Wilk Test Statistic	df	Sig.
2009	Value	50	0.2276	0.04504	0.00637	0.983	50	0.671
	Growth	50	0.3920	0.07296	0.01032	0.983	50	0.668
2010	Value	50	0.0577	0.01755	0.00248	0.988	50	0.883
	Growth	50	0.2370	0.06017	0.00851	0.985	50	0.792
2011	Value	50	0.1353	0.09944	0.01406	0.945	50	0.021**
	Growth	50	0.1762	0.02852	0.00403	0.981	50	0.613
2012	Value	50	0.1547	0.02597	0.00367	0.989	50	0.912
	Growth	50	1.1556	0.54794	0.07749	0.961	50	0.093
2013	Value	50	0.2318	0.02251	0.00318	0.970	50	0.241
	Growth	50	0.3262	0.03993	0.00565	0.989	50	0.910
2014	Value	50	0.1386	0.02536	0.00359	0.996	50	1.000
	Growth	50	0.1185	0.02036	0.00288	0.986	50	0.825
2015	Value	50	0.1460	0.04327	0.00612	0.991	50	0.973
	Growth	50	0.1390	0.03334	0.00472	0.983	50	0.702
2016	Value	50	0.2243	0.02150	0.00304	0.978	50	0.484
	Growth	50	0.1143	0.01621	0.00229	0.977	50	0.419
2017	Value	50	0.0446	0.04440	0.00628	0.989	50	0.909
	Growth	50	0.2730	0.03093	0.00437	0.982	50	0.633
2018	Value	50	-0.1567	0.02890	0.00409	0.986	50	0.804
	Growth	**50**	**0.0093**	**0.01765**	**0.00250**	**0.986**	**50**	**0.816**

Note: ** statistically significant at 5%
Source: Authors' work

It is necessary to check the assumption of the normality of returns distribution on a year-to-year basis and verify the assumption of variance equality (Table 2). Normality test helps us choose the correct test for checking if there is a statistically significant difference between returns of value and growth stock portfolios. Based on the Shapiro-Wilk test of normality, the null hypothesis of normally distributed portfolio returns cannot be rejected in all time-series and all years at 5%, except for the value stock portfolio in the year 2011. The results were the same by the Kolmogorov-Smirnov test of normality.

We test the significance of differences in returns of 50 growth and 50 value stock portfolios with randomly assigned weights each year using a T-test for independent samples and a Mann-Whitney U test for independent samples. Levene's test checked the homogeneity of variance, and the null hypothesis states that these groups have equal population variances. Test results are presented in Table 3.

The assumption of equal variances was satisfied only for 2014 and 2015, while it deteriorated for other years ($p<0.05$). These results are considered when interpreting the T-test.

Table 3
Results of Levene's Test for Equality of Variances

Dependent variable	F	df1	df2	Sig.	Dependent variable	F	df1	df2	Sig.
2009	8.075	1	98	0.005***	2014	2.124	1	98	0.148
2010	40.150	1	98	0.000***	2015	2.179	1	98	0.143
2011	79.854	1	98	0.000***	2016	5.275	1	98	0.024**
2012	156.164	1	98	0.000***	2017	7.098	1	98	0.009***
2013	15.554	1	98	0.000***	2018	7.574	1	98	0.007***
* Design: Intercept + Value or Growth									

Note: *** statistically significant at 1%; ** 5%
Source: Authors' work

The T-test is used to test differences in returns for growth and value stock portfolios per year except for 2011 since the normality assumption deteriorates for that year (Table 4).

Table 4
Results of T-test for Equality of Means

Year	t	df	p-value	Mean Diff.	Std. Error Diff.	95% Confidence Interval	
						Lower	Upper
2009	-13.557	81.613	0.000***	-0.16439	0.01213	-0.18851	-0.14026
2010	-20.231	57.281	0.000***	-0.17931	0.00886	-0.19706	-0.16156
2012	-12.903	49.220	0.000***	-1.00099	0.07758	- 1.15686	-0.84511
2013	-14.569	77.285	0.000***	-0.09444	0.00648	-0.10734	-0.08153
2014	4.375	98	0.000***	0.02012	0.00460	0.01099	0.02925
2015	.914	98	0.363	0.00706	0.00773	-0.00827	0.02240
2016	28.868	91.113	0.000***	0.10994	0.00381	0.10238	0.11751
2017	-29.841	87.494	0.000***	-0.22834	0.00765	-0.24355	-0.21313
2018	-34.661	81.095	0.000***	-0.16599	0.00479	-0.17551	-0.15646

Note: *** statistically significant at 1%; Equal variances not assumed for all variables
Source: Authors' work

Whether the assumption of variance equality is met, we see that p-values are less than the test value of 0.05 for all years except for 2015. Therefore, we consider a statically significant difference in the returns of value and growth portfolios except for 2015. For the year 2011, in which the normality of portfolio returns distribution is violated, the Mann-Whitney U test presented in Table 5 indicates no statistically significant difference between median returns of value and growth portfolios.

Table 5
Results of Mann-Whitney U Test

	Test Statistics*
Mann-Whitney U	1033.000
Wilcoxon W	2308.000
Z	-1.496
Asymp. Sig. (2-tailed)	0.135
*Grouping Variable: Value or Growth	

Source: Authors' work

For 50 randomly generated value and growth stock portfolios, we made a One-Sample T-test to check the statistical significance of the difference in returns

between value and growth stock portfolios and DJIA. Table 6 compares realized index returns (DJIA) and value and growth portfolio returns.

Table 6
Results of One-Sample T-Test

Year	Index Value	Value or Growth	t	df	p-value	Mean Difference	95% Confidence Interval of the Difference	
							Lower	Upper
2009	Index Value = 0.2152	Value	1.941	49	0.058	0.01237	-0.0004	0.0252
		Growth	17.131	49	0.000***	0.17675	0.1560	0.1975
2010	Index Value = 0.1090	Value	-20.651	49	0.000***	-0.05126	-0.0562	-0.0463
		Growth	15.049	49	0.000***	0.12805	0.1110	0.1451
2011	Index Value = 0.0332	Value	7.263	49	0.000***	0.10214	0.0739	0.1304
		Growth	35.448	49	0.000***	0.14298	0.1349	0.1511
2012	Index Value = 0.0678	Value	23.650	49	0.000***	0.08685	0.0795	0.0942
		Growth	14.038	49	0.000***	1.08784	0.9321	1.2436
2013	Index Value = 0.1745	Value	18.002	49	0.000***	0.05730	0.0509	0.0637
		Growth	26.872	49	0.000***	0.15174	0.1404	0.1631
2014	Index Value = 0.0809	Value	16.082	49	0.000***	0.05768	0.0505	0.0649
		Growth	13.048	49	0.000***	0.03756	0.0318	0.0433
2015	Index Value = -0.0831	Value	37.440	49	0.000***	0.22913	0.2168	0.2414
		Growth	47.093	49	0.000***	0.22207	0.2126	0.2315
2016	Index Value = 0.1912	Value	10.874	49	0.000***	0.03307	0.0270	0.0392
		Growth	-33.526	49	0.000***	-0.07688	-0.0815	-0.0723
2017	Index Value = 0.2699	Value	-35.878	49	0.000***	-0.22527	-0.2379	-0.2126
		Growth	0.703	49	0.485	0.00307	-0.0057	0.0119
2018	Index Value = -0.0781	Value	-19.226	49	0.000***	-0.07857	-0.0868	-0.0704
		Growth	35.017	49	0.000***	0.08741	0.0824	0.0924

Note: *** statistically significant at 1%
Source: Authors' work

Our analysis shows a statistically significant difference at 1% between returns on value and growth stock portfolios versus DJIA returns in all periods, except for two cases. In 2009 returns on value stock portfolios were statistically significantly different than DJIA returns at 10%, while in 2017, returns on growth stock portfolios were not statistically significantly different than DJIA. In 15 out of 20 cases, DJIA value and growth stock portfolios formed based on the randomly generated weights have significantly outperformed DJIA itself.

Discussion
Theoretical contribution
Most of the studies conducted in the last two decades of the 20th century that were related to the performance of value and growth stock portfolios found that the value stocks have superior performance compared to the growth stocks in most developed and emerging markets, which became a standpoint of the financial theory. Actual data from the US stock market on investment fund performance indicates that growth stock portfolios outperform value stock portfolios in 9 out of 12 years, from 2009 until 2020 (Lynch, 2021). Our study performed on DJIA component stocks shows the dominance of large-cap growth stock portfolios over large-cap value stock portfolios in the ten years after the GFC, indicating our main scientific contribution's disappearance of the value premium.

Returns on equally weighted portfolios of value and growth stocks from DJIA mostly outperform the index's return. When analyzing returns of 50 randomly weighted value and growth stock portfolios, we find a statistically significant difference in returns for all years, except 2011 and 2015. Growth stock portfolios outperform value stock portfolios in seven out of ten years, while value stocks performed statistically higher returns only in 2016. The outperformance of value stocks in 2016 could be due to the energy and utility sector, which have been among the best-performing sectors in 2016 and created value premium. In addition, the healthcare sector was usually a component of growth portfolios and was among the worst-performing in that year. Further, we find a statistically significant difference between returns on value and growth stock portfolios versus DJIA returns in all periods, except 2017 for growth stock portfolios.

One possible issue is that large-cap value stocks are b classified as growth stocks (Chan et al., 2009). Fays et al. (2021) analysed mutual funds and found that there is a higher probability that value portfolios are being characterized as value portfolios if stocks are being firstly sorted on the basis of the size characteristic and then using book-to-equity ratio. The same holds for growth stocks and growth portfolios. Since our study is performed only on large-cap stocks, the risk of misclassifying stocks into value and growth stocks due to their size is minimized.

We contribute to the literature in many different ways. In contrast to previous research, which found that value stocks outperform growth stocks (Graham et al., 1938; Basu, 1977; Lakonishok et al., 1994; Bauman et al., 1998; Fama et al., 1998; Bird et al., 2007), growth stocks and market itself found by Folkinshteyn et al. (2017), we find that in ten-year period after the GFC large-cap growth stocks outperform value stocks. Growth stocks yielded higher returns than value stocks in brief periods, but value stocks reestablished their dominance very quickly. The continuity of excess returns of growth stocks in the aftermath of the GFC might be due to the historically low interest rates imposed by the expansionary monetary policies. These market conditions enable an increase in prices of growth stocks, since stock market pricing is strongly influenced by the expected cash flows (Gagliolo et al., 2020). An additional explanation might be that growth stocks are often from the technological sector (e.g., e-commerce, digital payments, digital advertising, hardware, and software), while value stocks are from the industrial and financial sectors. Tech companies persistently perform better than financial sector companies.

Finally, the important implications of our analysis for financial theory and investment strategies are that in (1) the post-crisis period and (2) expansionary monetary policy time value premium on large-cap stocks seems to disappear. Our results favor growth investing after a crisis and in expansionary monetary time, thereby impacting the portfolio management of private and institutional investors.

Implication for practice

Besides expanding the previous knowledge about the performance of value and growth investments, our results offer valuable insight into the effectiveness of these two investment styles in the post-crisis periods. Research results offer important implications for the investment management process. They could be insightful for private investors, institutional investors like mutual funds, pension funds, banks, insurance companies, other investment companies, portfolio managers, and investment advisors.

In this study, we found a general outperformance of value and growth stock portfolios created from the DJIA index compared to the index itself, which could be

explained by the weighting issues of the DJIA index. Namely, it is often argued that Dow might be an inadequate representation of the overall US stock market compared to S&P 500, NASDAQ Composite, or Russel 3000 Index because it includes only 30 large-capitalization companies from the US, and it does not use weighted arithmetic mean nor is being weighted by market capitalization. Our results show that DJIA weighting issues question its benchmarking suitability with important implications in investment management, such as when choosing a proxy for the market, implementing index-tracking strategies, and benchmarking investment fund performance.

In 75% of cases (15 out of 20), blue-chip large-cap value and growth portfolios created based on the randomly generated weights have significantly outperformed DJIA in the aftermath of the GFC. DJIA will outperform the same stocks from the index regardless of the value or growth investment strategy being implemented. Due to higher returns, our results favor creating and implementing value and/or growth strategy rather than investing based on the DJIA index replication. In that way, higher returns will be generated. Again, it is shown that DJIA is inadequate for benchmarking and index-tracking strategies.

Most stocks from the DJIA index had price multiplies higher than sector averages at the end of 2013 and onwards. In the first five years after the GFC, 2009-2013, DJIA was predominantly constituted from value stocks, while in the next five years, 2014-2018, it was dominated by growth stocks. In the aftermath of the GFC, the expansionary monetary policy helped large-cap stocks increase their price-multiplies so that most DJIA constituents could be characterized as growth stocks from 2014 onwards. US stock market fully recovered to the level before the GFC in 2013 (measured by DJIA and S&P 500 index values) and continued its growth in the following years. We find that capital market recovery to the pre-crisis level coincides with the shift in stocks characteristics and dominance of growth stocks over value stocks among large-cap stocks from DJIA, with practical implications for investment managers.

Finally, according to the life course theory, after the experience of the massive crisis (like the GFC was), there should be a more robust value orientation for decades later (Cronqvist et al., 2015). Our research shows the dominance of growth stocks in the first decade after the GFC. An important implication to all investors is that after the GFC value premium has faded out.

Conclusion

Our analysis of DJIA component stocks shows that growth stock portfolios outperform value stock portfolios in the aftermath of the GFC. Returns on the growth stock portfolios are statistically significantly higher than on the value stock portfolios in seven out of ten years, namely in 2009, 2010, 2012, 2013, 2014, 2017, and 2018. Value stock portfolios performed significantly better only in 2016, while in 2011 and 2015, there is no statistically significant difference in the performance of value and growth portfolios. Although this research is conducted on DJIA component stocks, our results align with the actual data on the performance of Morningstar's large-cap value and growth funds. Morningstar reports a value-growth large-cap investment fund performance difference of 1.72% and 0.09% in 2011 and 2015, respectively (Lynch, 2021). Our study explains that the performance difference in those two years was not significantly different. After the GFC value premium in large-cap stocks disappears.

Previous studies focused on time before the GFC have shown that value stocks outperform growth stocks (Graham et al., 1938; Basu, 1977; Lakonishok et al., 1994;

Bauman et al., 1998; Fama et al., 1998; Bird et al., 2007). Analysis of the behavior of value and growth stocks during short-term market declines shows that value stocks outperform not only growth stocks, but the market itself (Folkinshteyn et al., 2017). Our study is focused on the stocks after the GFC, and our conclusions are opposite to those of previous studies. However, our findings align with Gagliolo et al.'s (2020) research, finding that the value premium on the large-cap stock has disappeared after the GFC.

Our results have crucial financial theory and investment management implications: in the post-crisis period and expansionary monetary policy time, the value premium on large-cap stocks seems to disappear. We find that DJIA weighting issues question its benchmarking suitability. Implementing either value or growth strategy in 10 year period after the GFC would yield higher returns than the DJIA index-tracking strategy. Large-cap stocks increased their price multiplies by the end of 2013, so most DJIA constituents have been characterized as growth stocks from 2014 onwards, resulting from expansionary monetary policy. US capital market recovered to the pre-crisis levels in 2013, coinciding with the dominance of growth stocks over value stocks among large-cap stocks from DJIA.

Our research results of DIJA growth portfolios outperformance over DJIA value portfolios should be seen in the light of the overall stock market recovery after the GFC, which erased trillions of dollars worldwide. Our study has some limitations. We did not investigate the performance of mid or small-cap stocks after the GFC or other large-cap stocks that differ from DJIA constituents or stocks from other capital markets. Other methodological approaches, including investment strategies and regression analysis, could also be used to research this topic. We analyzed stock performance measured by mean return.

Further research could include various stock performance measures, e.g., the Sharpe ratio. Although the adverse macroeconomic and financial experience during the GFC, when confidence in value stocks could have increased (Cronqvist et al., 2015), growth stocks have soared in height. Further research is warranted to examine whether the negative value premium from the observed ten-year period will continue in the next years, especially once the Covid-19 crisis ends and the expansionary monetary policies fade away, and whether the standpoint of the financial theory should change to the existence of positive growth instead of the value premium.

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Innovativeness of Family Businesses in Slovenia: Do Heirs follow the Founders?

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Abstract

Background: The innovativeness of founders and their heirs and family businesses (FBs) is a relatively unexplored field of research, and its understanding is incomplete and inconsistent. **Objectives:** The goal is to compare the founders' innovativeness and investigate the relationship of life-long learning with the innovativeness of heirs in FBs. **Methods/Approach:** The paper is based on research, including a survey on FBs in Slovenia. The differences in the innovativeness of the two groups – founders and heirs are compared, and the strength of the dependence of the life-long learning and innovativeness through the external training of heirs determined. **Results:** The innovativeness of founders and heirs in FBs, measured by the number of new product and service lines and by the number of new processes that founders and heirs in FBs have developed or started marketing in the last five years, shows higher results for the founders. Life-long learning through external training correlates positively with the innovativeness of heirs. **Conclusions:** An appropriate culture for innovation needs to be created in FBs to foster innovativeness among heirs, which can be supported by life-long learning.

Keywords: family business, entrepreneurship, innovativeness, life-long learning
JEL classification: L26, O31
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Introduction

Most national economies are dominated by family businesses (FBs) (Mandl, 2008) which play an important role in national economies around the world and make an important contribution to stability and economic growth (Laforet, 2012). FBs are of particular importance for the growth and economic progress of EU economies. The EU Small Business Act (SBA) (European Commission, 2008) emphasizes the importance of family-owned businesses and the problem of their succession (the first SBA principle).

In recent years, family entrepreneurship and succession have often been the subject of research, and the interest has been steadily increasing since the 1990s (De Massis, Frattini, & Lichtenthaler, 2013). The interest in researching innovation in FBs is growing (Cefis & Marsili, 2006; Roessl et al., 2010; Laforet, 2013). Past research suggests that the creativity of previous generations influences the creativity of a new generation - this is attributed to the mentoring role of family/ non-family members and exposure to multiple adults in early life (Smyrnios et al., 2003). Research also suggests a link between control generation and innovation (Zahra, 2005) and that young FBs are more innovative than old FBs in adapting to radical innovation and winning awards for innovation (Laforet, 2013).

Previous research indicates that the founders are seen as enterprising in their leadership style. At the same time, usually, the next generation does not have the same motivation as the founders when entering the FB (Ganzaroli, Fiscato, & Pilotti, 2006). Although family entrepreneurs tend to keep the company in the hands of the family in the long run (Astrachan et al., 2002), various reasons are given for the collapse of FBs, including the withdrawal of the founder/parent, incompetence of the next generation, rivalry of heirs, industry development (Mahto et al., 2019). Possible reasons are incompetence for the innovativeness, technical-technological, and non-technological innovativeness, especially innovativeness of management style and values, culture, ethics, and norms are often overlooked.

This paper focuses on the transfer of those characteristics essential for the innovation capacity of the generation of heirs in the FB in a transition economy and its importance for innovation. We analyze the transfer of management, governance, and ownership in the FBs to the next generation in the context of innovativeness in the FBs in a transition economy. Slovenia has been chosen as the case study country since, in Slovenia, there was a break-even of previously very modest entrepreneurial tradition after the Second World War, which began to awaken again in the late '80s.

The research goal is to compare the innovativeness of the founders and their heirs. The goal builds on the premise that heirs are more managerially oriented than entrepreneurially and thus are less innovative than their parents. The following research questions were developed: (i) RQ1: Are heirs in FBs more innovative than founders?; (ii) RQ2: Does life-long learning through external training correlate positively with the innovativeness of heirs in FBs?. To answer these research questions, empirical research has been conducted on a sample of Slovanian SMEs.

Literature review

Family business

According to some estimates, the share of FBs in the EU is more than 60% of all companies worldwide, between 70-95% (European Family Businesses, 2017). As many as 20% of the Fortune 500 companies are controlled by families (Mohanakrishnan, 2020). However, some studies in different countries have confirmed the importance of FBs in the economies of these countries. Mandl (2008) estimates that FBs in the EU account for 70-80% and employ 40-50% of all employees. According to The Cornell

University Family Business Research Institute (Laforet, 2012), 75% of all family businesses globally employ 50% of the workforce. In Mexico, 80% of businesses are family-owned. Additionally, in Europe, around 80% (around two million companies) in Germany are family-owned and the German economy's backbone. These companies employ 75% of the workforce and contribute 66% of the German GDP. In Spain, as many as 71% of companies that generate over two million US dollars in annual turnover are family-owned. As many as 17% of the 100 largest Spanish companies are family-owned. The same source states that families run 99% of companies in Italy. 76% of the top 8,000 businesses are family-owned or controlled by families in the UK. Also, according to the Institute for Family Business (Laforet, 2012), more than 65% of UK businesses are family-owned. A similar conclusion is made by Astrachan & Schenker (2003), who estimate that FBs contribute up to 64% of GDP and employ 62% of the national workforce in the United States.

The importance of FBs in Slovenia can be justified through research in different periods, the last of which is from 2015 (Antončič, Auer Antončič & Juričič, 2015), which says that in Slovenia, as many as 83% of all FBs companies (including micro, small and medium-sized, even large) generate 69% of total sales, 67% of value-added and employ 70% of employees. Estimation for the ratio of FBs in Slovenia ranges between 40 and 50%, 60 to 80%, and 72.6%, respectively (Glas et al., 2006; Vadnjal, 2005).

However, the transition of FBs from one generation to another is critical in their development (Combs, 2020). On the other hand, numerous authors (Eddleston et al., 2008; Kellermanns & Eddleston, 2002) argue that conflict is one of the most important problems of FBs, while another group of authors (Mandl, 2008; Miller et al., 2003) argue that the key problem is succession. The transfer of a FB to the next generation is often a critical event in the life of the FB, since it is supposed for heirs to generate the increase in the ability to innovate, not just to replace the founding generation (Ganzaroli, Fiscato, & Pilotti, 2006).

Family business and innovativeness

According to Wang and Ahmed (2004), innovativeness is the ability of the company to innovate; it introduces new processes, products, or ideas into an organization (Marcati et al., 2008); it is often used alternately with the term "Innovation" and "Innovation Orientation" (Siguaw, Simpson & Enz, 2006).

The continuity and longevity of modern family firms depend largely on their ability to generate and implement innovation (Erdogan et al., 2019) and to renew through innovation (Hauck and Prügl, 2015). The innovation ability of the firm is a prerequisite of innovativeness and is reflected in innovation. It is the ability to mobilize employees' knowledge in the firm (Kogut and Zander, 1992) and combine it with new knowledge that results in product and process innovation (Cakar and Ertuerk, 2010). Innovation abilities as a source of competitive advantage are deeply rooted in the context of an organization, and it isn't easy to define and imitate them (Nonaka, 1994) accurately. A firm with a high level of innovation ability usually uses a knowledge transfer method, "learning by doing," which prevents competitors from accessing this knowledge in the market, and imitation of knowledge is more difficult (Cavusgil et al., 2003).

Hurt and Teigen (1977) defined individuals' innovativeness as a level to which an individual adopts relatively early something new compared to others in the social system. Aulawi et al. (2009) emphasize the importance of sharing knowledge to develop an individual's innovation ability.

Life-long learning in entrepreneurship

In September 2020, the European Commission presented the Strategic Framework for European Cooperation in Education and Training ("Education and Training until 2020"), which consists of six dimensions: quality of education and training, inclusion, environmental and digital transition, teachers and training leaders, higher education and the geopolitical dimension (European Commission, 2020).

The strategic framework has a list of goals to be achieved by 2020, and a similar list will be for 2030 with some minor modifications: (i) increase the number of children in preschool education; (ii) reduce the number of 15-year-olds who do not have sufficient skills in reading, mathematics, and science; (iii) reduce the number of people leaving education and training; (iv) increase the number of highly educated people aged 30-34; (v) increase the number of adults participating in life-long learning and training programs; (vi) increase the number of highly educated and people with initial vocational qualifications who will spend some time studying or training abroad, and (vii) increase the number of graduates aged 20 to 34 who should be employed.

However, life-long learning and training is not an unambiguously defined activity but can be observed through two basic groups of educational processes. The first group is life-long education, which views education as a life-long process that begins with compulsory schooling and that formally lasts throughout life and in which only organized learning is included. The second group is life-long learning, which refers to the overall life-long learning activity to improve knowledge, skills, and competencies, include learning in all periods of life and all forms (formal, non-formal, and informal) and has four basic goals: personal satisfaction and development of the individual, active citizenship, social inclusion, and employability (Vekić, 2015).

Life-long learning activities are an important part of training people for innovation. This relies not only on a broad and relevant education but also on developing extensive knowledge and skills that complement formal education. In teaching, emphasis should be placed on critical thinking, creativity, communication, user orientation, and teamwork, alongside domain-specific and language skills. Companies invite external experts into their environment and provide internal training for all employees, not only for heirs in the FBs, but they can send them for training outside the FB. Academic courses and practical workshops are a form of learning through which FBs gain the experience of others and have the opportunity to create new knowledge by combining their existing tacit knowledge with the knowledge of others (Nonaka & Takeuchi, 1995). The importance of academic courses and practical training outside the FB in different schools, universities, other educational institutions, companies is emphasized by various authors (Chirico, 2008; Duh, 2014). This allows heirs to add new knowledge that is important when FBs operate in markets that are changing rapidly (Chirico, 2008) and opens up new perspectives for the long-term survival of FBs. Also, these types of training and education (production, marketing, management, etc.) make it possible to acquire "pure knowledge" and develop skills that, once transferred to the FB, must be shared with and transferred to other members of the FB. Conversely, practical training within FB enables people to acquire, share, and pass on knowledge through generations (Le Breton-Miller et al., 2004). Training people for innovation relies on broad and relevant education and developing extensive knowledge and skills that complement formal education (Chirico, 2008; Nonaka et al., 2009).

The emphasis in the survey is on the innovativeness of individuals in FBs, the result of which is the innovativeness of FBs. It is assumed that by measuring the innovativeness of the FB, the individual's innovativeness can be indirectly measured. In this assumption, the definition of Tajeddini and Trueman (2008) and Verhees and

Meulenberg (2004), who claim that innovativeness is a feature of a firm or the owner (and therefore also of the heir, note by the author) is followed.

Methodology

Research instrument

Empirical research on the innovativeness of the generation of heirs in the FBs in the transition economy was conducted using the online survey tool (1KA.si). After 2000, we witnessed a real expansion of online surveys, becoming the leading way of modern data collection. The transfer of surveys to the Internet is a logical consequence of the rapid development of computer-aided data collection methods, increasingly marked by modern survey research.

Two separate survey questionnaires - one for the founders of the FB the other for the heir/s in the FB were prepared and used. Closed-ended questions were designed, where all possible answers are already foreseen and determined and are more suitable for the verification of the research, as they enable generalization. In the questionnaires, the Likert scale was used. Possible answers on a five-point Likert scale. The Likert scale is one of the most reliable ways to measure the level of satisfaction, agreement, liking, opinions, perceptions, etc. In univariate or descriptive statistics, the Likert scale is represented by mean measures, most often by the arithmetic mean. The data is checked for its distribution when using the Likert scale in further statistical analyses. If data distribution is normal, parametric tests appropriate to the interval measurement scale can be used. In the research, the Student's t-test was used to test the statistically significant differences between the mean values of the variables of the two samples, the founders and successors. By calculating Cronbach's alpha coefficient, a measure of reliability, the reliability of the variables included in the individual constructs was checked. Cronbach's alpha was developed to measure the internal consistency of a set of statements with the same measurement scale, usually the Likert scale, used in the research. Correlation analysis was used to determine the interdependence between two or more groups of variables. Pearson's correlation coefficient was used to determine the strength of the dependence (but not causality) between the variables.

The ability for people to respond as they find expected, socially accepted, likable, and not as actually corresponding to the facts is a disadvantage of the use of the Likert scale. But by precisely defining the concepts and carefully formulating the questions.

The limitation of the research is that the research question on a global scale from the point of view of the next generation has not been researched for FBs. The authors developed the survey questionnaires as no suitable tested, standardized scale has been found, and they were tested before the research was conducted. Thus, only individual tested scales for measuring the propensity of companies to innovate, individual innovation, company innovation, checking variables such as entrepreneurial skills of entrepreneurs, and social capital of entrepreneurs were included in the questionnaires. For other variables for which the measurement scale was not developed, the questions had to be compiled by the authors, or the existing questions for the needs of the research were adjusted.

The items of the research instrument are presented in Table 1. The questionnaires consist of five sets: the first set includes general, self-explanatory questions and statements about the FB's demographics and the entrepreneur (founder) or heir (data on the company and the general attitude of the company to the innovativeness and innovation; data on the founder/heir, education and previous work experience); the

second set covers specific questions and statements about the innovativeness of the individual (founder/heir) and the contribution of the founders and heirs to innovation; the fourth set contains specific questions and statements about the connection between individual factors and the heir's innovativeness, and the fifth set covers questions and statements about the innovativeness of FB.

Table 1
Research instrument

Code	Statement	Measurement
Innovativeness in FBs		
INNO1	Innovation is a priority of our company.	Likert scale (1-5); 1- not
INNO2	We nurture a culture of innovation in our company.	agree at all; 5-fully
INNO3	We have reserved funds for innovation and R&D activities.	agree
INNO4	Innovation is the key to our success.	
INNO5	Our company regularly tests new ideas.	
INNO6	Our company is looking for new ways to do things.	
INNO7	Our company is creative in business methods.	
INNO8	Our company is often the first on the market with new products and services.	
INNO9	Our company addresses innovations as too risky, and there is resistance to them.	
INN10	The introduction of new products on the market has increased in our company in the last 5 years.	
Formal measures of innovativeness		
FORM-INNO1	Please estimate how many patents you have registered in the last 5 years	Likert scale - 1 (no new patents, licenses,
FORM-INNO2	Please estimate how many license agreements you have bought in the last 5 years	trademarks), 2 (one), 3 (two), 4 (three to five)
FORM-INNO3	Please estimate how many license agreements you have sold in the last 5 years	to 5 (more than five patents, licenses,
FORM-INNO4	Please rate how many trademarks you have registered in the last 5 years	trademarks).
Personal innovativeness		
PER-INNO1	I often surprise people with my new ideas.	Likert scale (1-5); 1-not
PER-INNO2	People often ask me for help with creative activities.	agree at all; 5-fully
PER-INNO3	I am more satisfied if I develop a new idea than if I master a skill.	agree
PER-INNO4	I prefer a job that requires original thinking.	
PER-INNO5	I don't usually go on with new work the way I've been taught.	
PER-INNO6	I prefer a job that requires inventiveness than skills and practice.	
PER-INNO7	I am a very creative person.	Source: (Jackson, 1976;
PER-INNO8	I like to experiment with different ways of doing the same things.	1994)
Organizational innovativeness		
ORG-INNO1	In the last 5 years, I have developed/started marketing 0, 1, 2, 3-5, more than 5 new product lines and services.	Likert scale (1-5); 1-not agree at all; 5-fully
ORG-INNO2	In the last 5 years, I have developed/started marketing 0, 1, 2, 3-5, more than 5 new processes.	agree
ORG-INNO	In the last 5 years, there have been changes in production/service/process lines.	
Life-long learning		
EDU1	External training enables the acquisition of new knowledge that is important for working in rapidly changing markets and is positively related to the heir's innovativeness.	Likert scale (1-5); 1-not agree at all; 5-fully agree
EDU2	External training in programs in specialized areas, such as marketing, production, management, is positively related to the heir's innovativeness.	
EDU3	External training enables the transfer of knowledge that others have to the heir in the FB, which combines the tacit knowledge into new knowledge, increasing the innovativeness of the heir.	

Source: Authors' work; Jackson (1976; 1994)

Data

The population addressed in the research are FBs. According to SiStat (2020) data, there are 205,139 companies in Slovenia, and 99.8% are micro, small, and medium-sized companies. When we talk about the number of FBs in Slovenia, we start from the research of Antončič, Auer Antončič, and Juričič (2015) that the share of FBs in all companies in Slovenia is 83% (170,265 companies, author's estimate).

Publicly available databases on companies enable and facilitate the implementation of various surveys, but in addition to advantages, they also have many limitations (Žmuk, 2017). One of them, which is important for the conducted research, is that it is difficult to obtain a list of companies with FB status from public databases because this characteristic of the company is not recorded.

The author collected the company database for several years and contained more than four hundred FBs, which correspond to at least one criterion for FB. The majority of FBs in Slovenia are micro, small and medium-sized companies (Antončič, Auer Antončič & Juričič, 2015), so large companies, according to the number of employees, were not included. 408 FBs were included in the survey. Purposive sampling was used. In such sampling, representativeness is the lowest, and more relevant units should be included in future research.

The limitation for inclusion in the sample was that the owner/founder is actively present in the company (either active and employed or retired, still active or procurator), and also that the next generation is at least partially present in the FB (either active and employed successor or successor who already participates in FB but is not yet employed).

A 25% response rate was achieved. 103 FBs, with 103 founders and 103 heirs from Slovenia, were included in the sample. Thus, 206 survey questionnaires were obtained and considered in the survey. The founders and successors were also provided with the response option "I can't rate" (the computer assigns a value of "-99"), so there were relatively few empty fields. The basic demographic characteristics of both samples are shown in Table 2.

The average age of the FB in the survey is 23.5 years (the oldest was founded in 1961 and the youngest in 2013). First-generation FBs (79.6%) predominate among FBs compared to second-generation FBs (20.4%). In the FBs of the first generation, the founders of the FB are strongly involved in the management and operation of the FB are active and employed. The heirs already participate, but not actively, are students or pupils and are not employed in the FB. In the FB of the second generation, the heirs are already formally included in the FB and are employed, and the founders have already partially or fully transferred the ownership and management of the FB to their heirs; the founders are retired but still active and possibly procurators.

52.4% micro, 29.1% small, and 18.5% medium-sized FBs are included in the sample. Although micro FBs dominate the sample, the average number of employees is 30, a small company with an average of 3 family members (2.77). By activity, FBs were classified into manufacturing, service, and trading companies; The sample of 103 FBs is predominated by service companies with 46.6%, followed by manufacturing companies with 27.2% and trade companies with 26.2%.

The founders are dominated by men (82.5%). There are 18 women (17.5%). The founders are mostly active and employed in the FB (57.3%). Among heirs, men also predominate by gender (61.2%); 40 women (38.8%). Heirs are mostly already active - formally involved, employed, and in one of the leading positions (63.1%).

Table 2
Demographic characteristics of the sample (founders/heirs)

Variable	Characteristics (#)	%
The predominant type of activity of FB	Manufacturing (28)	27.2%
	Services (48)	46.6%
	Trade (27)	26.2%
Gender of the founder	Male (85)	82.5%
	Female (18)	17.5%
Gender of the heir	Male (63)	61.2%
	Female (40)	38.8%
Involvement of the founder in FB	Active, employed (59)	57.3%
	Active, retired, procurator (44)	42.7%
Involvement of the heir in FB	I participate as a student; I am not employed (38)	36.9%
	Formally involved, employed, and leading position (65)	63.1%
Is an heir chosen?	Yes, one (50)	48.5%
	Yes, more of them (39)	37.9%
	No (14)	13.6%
Already performed transfer of FB	Management (27)	26.2%
	Ownership - fully (2)	1.9%
	Ownership – in part (5)	4.9%
	Management and ownership (20)	19.4%
Generation of FB	First generation (82)	79.6%
	Second generation (21)	20.4%
The founder's level of education	Primary school (1)	1.0%
	Vocational school (19)	18.4%
	Secondary school – technical (27)	26.2%
	Secondary school – general (14)	13.6%
	College (9)	8.7%
	HEI – business (12)	11.7%
	HEI – technical (14)	13.6%
	HEI – other (4)	3.9%
	Master's degree (3)	2.9%
The heir's level of education	Primary school (1)	1.0%
	Vocational school (2)	1.9%
	Secondary school – technical (16)	15.5%
	Secondary school – general (23)	22.4%
	College (6)	5.8%
	HEI – business (35)	34.0%
	HEI – technical (5)	4.9%
	HEI - other (3)	2.9%
	Master's degree (10)	9.7%
	Ph.D. (2)	1.9%
The work experience of the founder at the establishment of the FB	No previous work experience (14)	13.6%
	Co-owner in another company (4)	3.9%
	Employed in FB (8)	7.8%
	Employed in another company (77)	74.7%
The work experience of the heir before involvement in FB	No previous work experience (45)	43.7%
	Work in other company – internship (13)	12.6%
	Work 1yr in other company - same industry (3)	2.9%
	Work 1 yr in other company - different industry (11)	10.7%
	Work in other company +2yr – same industry (8)	7.8%
	Work in other company +2yr – different industry (23)	22.3%

Source: Authors' work

According to the level of education, the sample is dominated by founders with secondary school - technical orientations (26.2%). Before establishing their FB, most founders were employed in another company (74.7%). The founders have already determined one potential heir of the FB in 50 companies (48.5%), more than one potential heir in 37.9% of companies, and have not yet determined an heir in 13.6%. In 26.2% of FBs, the founders have already transferred management to the next generation; in 19.4% management and ownership, in 4.9% of FBs, they have carried out a partial transfer of ownership and a complete transfer of ownership in only 2 FBs (1.9 %). According to the level of education, the sample is dominated by heirs with a higher educational degree - business orientation (35; 34.0%). The majority of heirs (45; 43.7%) had no previous work experience before joining the FB, while 22.3% had worked in another company from various industries for more than one year.

While 77 founders (74.8%) had previous work experience in another company before establishing their own business, the heirs mostly (43.7%) joined the FB without previous work experience. The finding is not surprising, as 26,938 young people aged 15 to 29 were registered as unemployed in Slovenia in December 2015, this is 23.8% of all registered unemployed, and most children from FB take the opportunity to work in the domestic FB, while it is harder to find it in other companies.

Regarding the level of education, there is a difference between the founders and the heirs. The founders mostly have a secondary technical education and a vocational education. In contrast, the heirs have higher education in the business field and general secondary education, with fewer technical graduates. Several heirs with a master's degree in social sciences (economics) and business-organizational sciences (entrepreneurship, management) indicate that they are focused on upgrading their knowledge in business management.

Research results

Innovativeness of FBs

Table 3 presents the descriptive statistics of construct variables in FB innovativeness. The variable "Innovations are considered too risky in our company, and there is resistance to them" (INNO9) was set as the flipped statement. The Cronbach's alpha is 0.761, which means that the reliability of the construct in terms of FB innovativeness is good (coefficient value between 0.70 and 0.90).

Table 3
Descriptive statistics of construct variables in the field of FB innovativeness

Code	N	Mean	St. Dev.
INNO1	203	3.33	1.176
INNO2	201	3.42	1.147
INNO3	201	2.92	1.252
INNO4	202	3.30	1.327
INNO5	204	3.65	1.137
INNO6	204	3.94	.916
INNO7	205	3.75	.899
INNO8	200	3.27	1.202
INNO9	201	2.54	1.077
INN10	199	3.60	1.180

Source: Authors' work
Note: Likert scale (1-5); 1-not agree at all; 5-fully agree

The company's attitude towards innovativeness was measured with the first four variables, marked INNO1 - INNO4. The mean values of these variables range between 2.92 and 3.42. The lowest mean value is for the variable "We have reserved funds for innovation and R&D activities" (INNO3; mean value 2.92). The standard deviations for the variables used to measure a company's attitude towards innovation are different; they all exceed 1,147, with the largest being "We have funds reserved for innovation and R&D activities" (INNO3; standard deviation 1,252) and "Innovation is the key to our success" (INNO4; standard deviation 1,327). The following six variables labeled INNO5 - INNO9, measure the innovativeness of the FB. The mean values of these variables are between 2.54 and 3.94; the lowest mean value is reached by the variable "Innovations in our company are considered too risky, and there is resistance to them" (INNO9; mean value 2.54); in doing so, the founders and heirs express that they neither agree nor reject this statement; the highest mean reached by the variable "Our company is looking for new ways of doing things" (INNO6; mean 3.94). The largest standard deviation is for the variable "Our company is often first in the market with new products and services" (INNO8; standard deviation 1,202). The standard deviation for the variable with the highest mean is below 1.0; for others, it is between 1.0 and 1.2.

Table 4 measures the formal indicators of innovativeness in FBs, including new patents, licenses, and trademarks in the last five years. The FORM-INNO1 variable measures the number of patents registered with the FB in the last 5 years; the variables marked FORM-INNO2 and FORM-INNO3 measure the number of licenses bought and sold in the last 5 years, and the variable marked FORM-INNO4 measures the number of registered trademarks in the company in the last 5 years. The highest mean values are for the variables "number of registered trademarks" (FORM-INNO4; mean value 1.62, which means on average one registered patent) and "the number of purchased license agreements" (FORM-INNO2; average value 1.60, which means on average one purchased license agreement) and for these two variables, the dispersion of responses is also greater; the standard deviation exceeds the value of 1.0.

Table 4
Formal indicators of innovativeness in FBs

Code	N	Mean	St. Dev.
FORM-INNO1	204	1.15	0.542
FORM-INNO2	205	1.60	1.207
FORM-INNO3	205	1.09	0.471
FORM-INNO4	206	1.62	1.105

Source: Authors' work
Note: Measured on Likert scale from 1 (no new patents, licenses, trademarks), 2 (one patent, license, trademark), 3 (two patents, licenses, trademarks), 4 (three to five patents, licenses, trademarks) to 5 (more than 5 patents, licenses, trademarks).

Personal and organizational innovativeness of heirs and founders
Personal and organizational innovativeness of heirs and finders was measured by the several items and compared.

Table 5 presents the descriptive statistics of construct variables in the field of innovativeness of heirs. The reliability coefficient (Cronbach alpha) is 0.764, which means that the reliability of the construct in the field of heir's innovativeness is good (the value of the coefficient is between 0.70 and 0.90).

Table 5
Descriptive statistics of variables measuring the personal and organizational innovativeness of heirs

Code	N	Mean	St. Dev.
Personal innovativeness			
PER-INNO1	102	3.87	0.699
PER-INNO2	100	3.93	0.742
PER-INNO3	102	3.72	0.958
PER-INNO4	101	4.17	0.722
PER-INNO5	101	3.36	0.878
PER-INNO6	103	3.46	0.916
PER-INNO7	102	3.94	0.672
PER-INNO8	102	3.96	0.770
Organizational innovativeness			
ORG-INNO1	91	2.85	1.584
ORG-INNO2	86	2.64	1.463
ORG-INNO3	88	3.09	1.345

Source: Authors' work
Note: Likert scale (1-5); 1-not agree at all; 5-fully agree

The first 8 variables marked PER-INNO1 - PER-INNO8 measure the heir's innovativeness with the JPI scale; most mean values are between 3.72 and 4.17. The dispersion of responses around the mean is very consistent. The highest mean is reached by the variable "I prefer work that requires original thinking" (PER-INNO4), whose standard deviation is among the lowest. The two mean values are lower - for the variable "I don't usually continue with a new work in a way I was taught" (PER-INNO5; mean 3.36) and "I prefer work that requires inventiveness rather than skills and practice" (PER-INNO6; mean 3.46), where standard deviations are also higher - except for "I am more satisfied if I develop a new idea than if I master a skill"(PER-INNO3), which has the highest value of standard deviation (0.958) in this set of variables.

Respondents answered the number of new products, services, processes, production, service, and process lines changes. Mean values of variables "How many new product or service lines have you developed in the last 5 years" (ORG-INNO1), "How many new processes have you developed in the last 5 years" (ORG-INNO2), and "What was the nature of the changes you made as an heir in production/service/process lines in the last 5 years "(ORG-INNO3) is between 2.64 and 3.09; standard deviations reflect a greater dispersion of data around these values; the lowest standard deviation (1,345) is achieved by the variable with which the heirs assessed the nature of changes in production/service/process lines in the last 5 years, which has the highest mean value (3.09). The mean value of 2.85 means that they have developed and started marketing 2 new products or services in the last 5 years.

Table 6 presents the descriptive statistics of construct variables in founders' innovativeness. The same 11 variables were used to measure the construct in the founders' innovativeness as for the heirs. The reliability coefficient (Cronbach alpha) is 0.852, which means that the reliability of the construct in the field of innovativeness of the founders is good (the value of the coefficient is between 0.70 and 0.90).

Table 6
Descriptive statistics of construct variables in the field of founders' personal and organizational innovativeness

Code	N	Mean	St. Dev.
Personal innovativeness			
PER-INNO1	103	3,89	0,815
PER-INNO2	103	3,88	0,844
PER-INNO3	103	3,73	0,972
PER-INNO4	102	4,16	0,754
PER-INNO5	97	3,41	0,921
PER-INNO6	103	3,64	1,083
PER-INNO7	103	4	0,78
PER-INNO8	103	3,75	0,86
Organizational innovativeness			
ORG-INNO1	90	3,46	1,5
ORG-INNO2	85	3,2	1,478
ORG-INNO3	95	3,45	1,319

Source: Authors' work
Note: Likert scale (1-5); 1-not agree at all; 5-fully agree

Within the first eight variables marked PER-INNO1 - PER-INNO8, which measure the innovativeness of founders with a JPI scale, most of the mean values are between 3.73 and 4.16. The dispersion of responses around the mean is very consistent. The highest mean is achieved by the variable "I prefer work that requires original thinking" (PER-INNO4; mean 4.16), whose standard deviation is the lowest (0.754). Two mean values are lower - for the variables "I do not usually continue with new work in the way I have been taught" (PER-INNO5; mean 3.41) and "I prefer work that requires inventiveness rather than skills and practice" (PER-INNO6; mean value 3.64), where standard deviations are also higher - except for "I am more satisfied if I develop a new idea than if I master a skill" (PER-INNO3), which has the second-highest value of standard deviation (0.972) in this set of variables.

Respondents answered the number of new products, services, processes, production, service, and process lines changes. The mean values of the variables used to measure the innovativeness of heirs, and (ORG-INNO1), "How many new processes have you developed in the last 5 years" (ORG-INNO2) and "What were the changes you made as a founder in manufacturing/service/process lines in the last 5 years" (ORG-INNO2) is between 3.20 and 3.46; standard deviations express a greater dispersion of data around these values (0.754 - 1.083) but are consistent. The mean value of 3.46 means that they have developed and started marketing, e.g., 3 new products or services or processes in the last 5 years.

Founders' and heirs' personal and organizational innovativeness
The JPI scale measured personal innovativeness with 8 variables/statements (Jackson, 1976; 1994). The founder or heir who achieves a higher number of points on the scale (from 1-5) (sum of mean values of variables) is more creative, inventive, capable of original thinking, motivated to develop new solutions to problems, appreciates new ideas, likes to improvise. Lower values are characteristic of founders and heirs who have less motivation for creativity, rarely seek originality, are conservative thinkers, prefer routine. The highest value of the sum of the values of the means for 8 variables on the scale can be 40, and the lowest is 8. A comparison of the JPI values for the founders (30.46) and heirs (30.41) showed 0.002%. The T-test confirmed no statistically significant differences between the JPI values for founders and heirs.

Figure 1 presents the mean values of heirs' and founders' personal and organizational innovativeness.

Figure 1
Mean values of heirs' and founders' personal and organizational innovativeness
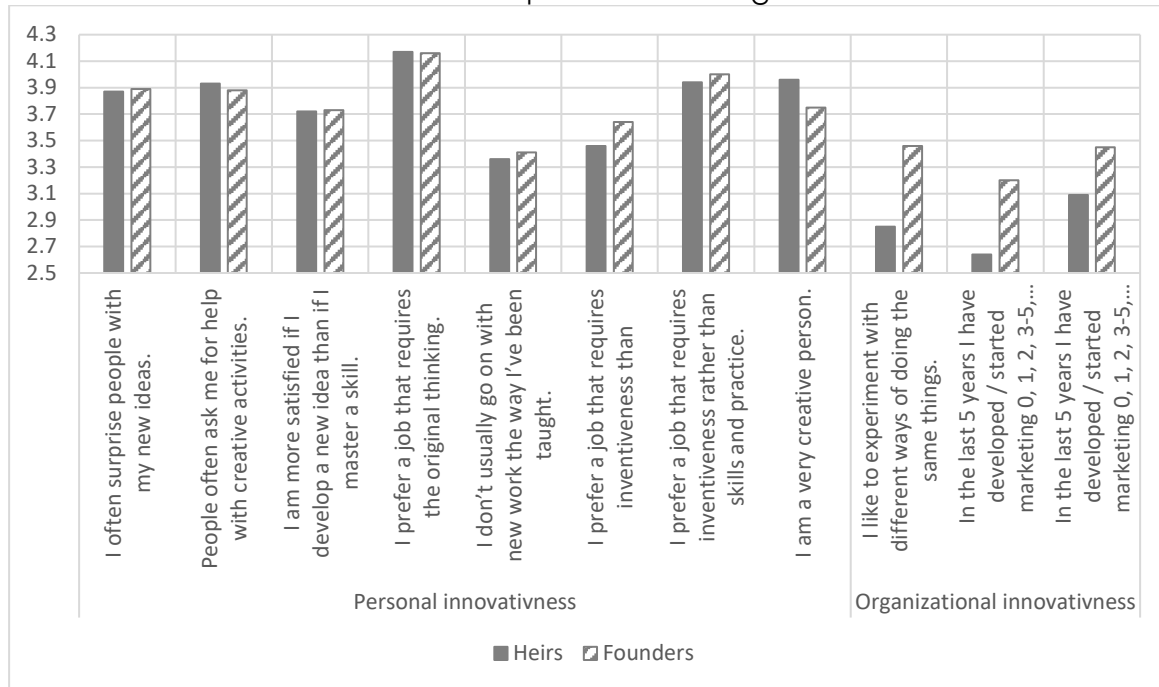
Source: Authors' work

A comparison of the mean values of the variable with the code ORG-INNO1, which measured the number of new product and service lines developed or launched by the heirs or founders in the last 5 years, showed that the mean value of the variable for founders exceeds the mean value of variables for heirs by 21.4%. Also, a comparison of the mean values of the variable ORG-INNO2, which measured the number of new processes developed or launched by heirs or founders in the last 5 years, showed that the mean value of the variable for founders exceeds the mean value of the variable for heirs by 21.1%. In the case of the variable ORG-INNO3, we measured the nature of changes in production/service/process lines in the last 5 years. The average values of the variables for the founders also exceed by 11.6% average values of the variables for heirs. The t-test for all three variables ORG-INNO1 to ORG-INNO3 was calculated. The T-test (Table 7) confirmed statistically significant differences between the mean values of the variables for founders and heirs for the variables ORG-INNO1 and ORG-INNO2. In contrast, the t-test did not confirm statistically significant differences for the variable ORG-INNO3.

Based on the mean values of the personal innovativeness PER-INNO1 to PER-INNO8, a t-test was calculated to check whether there are statistically significant differences between the mean values of these variables, which were used to measure the construct in the field of innovativeness of heirs and founders (Table 7). It was found that the values of the variables measuring personal innovativeness show that both founders and heirs are more creative, inventive, capable of original thinking, motivated to develop new solutions, appreciate new ideas, they like to improvise, but people who have less motivation for creativity according to the JPI index, rarely look for originality, are conservative thinkers, prefer routine. On the contrary, the t-test for the variables measuring organizational innovativeness confirmed that the founders

are more innovative than the heirs in the FBs in the transition economy, as they have developed/started marketing more new products/services and processes than heirs in the last 5 years.

Table 7
T-test of mean value differences between the founders' and heirs' innovativeness

	Mean difference	Lower Boundary	Upper Boundary	df	T-test	P-value
Personal innovativeness						
PER-INNO1	-0.02	-0.22919	0.18919	203	0.1885	0.8507
PER-INNO2	0.05	-0.17018	0.27018	201	0.4478	0.6548
PER-INNO3	-0.01	-0.2758	0.25580	203	0.0742	0.9409
PER-INNO4	0.01	-0.19434	0.21434	201	0.0965	0.9232
PER-INNO5	-0.05	-0.2972	0.19720	196	0.3988	0.6905
PER-INNO6	-0.18	-0.45556	0.09556	204	12.879	0.1992
PER-INNO7	-0.06	-0.26058	0.14058	203	0.5898	0.5560
PER-INNO8	0.21	-0.01487	0.43487	203	18.413	0.0670*
Organizational innovativeness						
ORG-INNO1	-0.61	-133.259	-0.42741	179	38.368	0.0002***
ORG-INNO2	-0.56	-100.398	-0.11602	169	24.900	0.0137**
ORG-INNO3	-0.36	-0.74873	0.02873	181	18.273	0.0693**

Note: *** statistically significant at 1%; ** 5%; *10%; Likert scale (1-5); 1-not agree at all; 5-fully agree
Source: Authors' work

Life-long learning and heirs' innovativeness
Table 8 presents descriptive statistics of variables related to life-long learning through external training and innovativeness.

The mean values of the variables for the construct in the field of the life-long learning through external training range between 4.21 ("External training enables the transfer of knowledge held by others to the heir in the FB, combining it with tacit knowledge in the FB into new knowledge thus increasing heirs innovativeness"; EDU3) and 4.24 ("External training enables the acquisition of new skills relevant to working in fast-changing markets"; EDU1), standard deviations are ranging between 0.698 and 0.766; the dispersion of responses around the mean is small.

Table 8
Descriptive statistics of construct variables in the field of factors of heirs' innovativeness

Code	N	Mean	St.Dev
EDU1	100	4.24	0.698
EDU2	101	4.21	0.766
EDU3	100	4.21	0.729

Note: Likert scale (1-5); 1-not agree at all; 5-fully agree
Source: Authors' work

Table 9 presents the results of the correlation calculated between the construct variables in the field of heir's innovativeness (PER-INNO1 to PER-INNO8) and the variables of the construct in the field of the heir's life-long learning through external training (EDU1, EDU2, and EDU3).

The correlation showed that heir's innovativeness, measured by ORG-INNO2, is positive, weakly related to EDU1. There is a positive, weak correlation between heir's innovativeness, measured by ORG-INNO3 and EDU2. Positive, weak correlations also exist between innovativeness, measured by PER-INNO1, ORG-INNO1, ORG -INNO2,

and EDU2. There are positive, weak correlations among the innovativeness measured by PER-INNO1, PER-INNO2, PER-INNO7, PER-INNO8, and (EDU3).

Table 9
Pearson correlation coefficient between the variables of innovativeness and life-long learning through external training

Life-long learning through external training			
	EDU1	EDU2	EDU3
Personal innovativeness			
PER-INNO1	0.102	0.223*	0.274**
PER-INNO1	0.093	0.153	0.200*
PER-INNO3	0.023	0.159	0.095
PER-INNO4	-0.100	0.175	0.106
PER-INNO5	-0.041	0.079	0.002
PER-INNO6	-0.037	0.015	0.002
PER-INNO7	0.155	0.237*	0.291**
PER-INNO8	0.075	0.186	0.237*
Organizational innovativeness			
ORG-INNO1	0.159	0.226*	0.153
ORG-INNO2	0.250*	0.243*	0.204
ORG-INNO2	0.217*	0.167	0.200

Note: *** statistically significant at 1%; ** 5%; *10%
Source: Authors' work

Discussion

The generation of heirs in FBs in the transition economy, including Slovenia, is just as innovative as founders. This is reflected in the increased innovativeness of the next generation of FBs in the last five years, which exceeds the first-generation FBs in terms of the average number of technical-technological innovations, and lags behind it concerning non-technological (program, organizational, management, and methodological) innovations. Although FBs that a generation of heirs has already taken over are in a more mature period of the FB's life cycle, when managerial skills are more needed, heirs are also becoming more entrepreneurs, which is forced into them by modern competitive conditions. The next generations in FBs are cautious, but they already have a different attitude towards risk-taking, confirmed by the research. The finding is inconsistent with Molly et al. (2012). They note that next-generation FBs grow slower because they tend to forego part of their growth (and innovations are growth determinants, the author's note) rather than risk the loss of family control due to the increased use of debt.

In today's global economic environment, FBs must no longer reduce the interest and effort for innovation as they once did when the first generation, when the time of the FB transfer to the next generation approached, became more cautious and readier to take the only moderate risk, and also invested less not to jeopardize the long-term existence of the FB. In the research, similarly to Eddleston et al. (2008) and McCann et al. (2001), when they say that innovativeness has greater potential for greater success when guided by comprehensive strategic business decision-making and a long-term orientation, it was found that the second generation evaluates, that their early involvement in business decision-making and strategic planning processes, as well as cooperation in creating a common vision of the company with the first

generation of entrepreneurs, is important for the innovativeness and long-term existence of the FB.

The research found that the innovativeness of founders and heirs in FBs in a transition economy does not differ significantly. The results of measuring the innovativeness of founders and heirs in the FB with the JPI scale did not differ statistically. This finding does not confirm the results of previous research by the authors of Langlois (2007); Miller, Le Breton Miller, and Lester (2010; 2011), who showed that heirs are less innovative than founders.

It is estimated that the difference in the assessment of innovativeness, which results from the measurement with the JPI scale, where the interest lays on creativity, inventiveness, ability to think the original, motivation to develop new solutions and search for new ideas, and tendency to improvise, in this research compared to past research, due to changes in business conditions in the economic environment of FBs (since 2008, author's note) and the awareness of the next generation that innovation is essential for the long-term survival of FB. The innovativeness of founders and heirs in FBs was measured by the number of new product and service lines and the number of new processes that founders and heirs in FBs have developed or started marketing in the last five years. The survey result was different, and greater innovativeness of the founders was shown. With this finding of the research, however, the findings of previous research by Langlois (2007), Miller, Le Breton Miller, and Lester (2010; 2011) were confirmed. The findings of research by Prajogo and Ahmed (2006), who argue the opposite - that heirs are more innovative than founders, were also not confirmed.

Heirs show a slightly higher propensity for risk than founders, consistent with Arregle et al. (2021) finding that founders, before the transition, become more cautious about taking a moderate risk. Heirs also exhibit a high degree of innovativeness, consistent with Kraus et al.'s (2012) statement that entrepreneurship attracts people who prefer a more innovative way of solving problems. Heirs in FBs in a transition economy are more open to interaction and cooperation across geographical and technological boundaries.

Based on the above-discussed results, we can argue that the position of Slovenian FB's founders is more of a Re-enactor, while the Heirs could be considered more as Adventurers (Rondi et al., 2019). Figure 2 presents the position of heirs and founders on the innovation model of Slovenian FBs

The research findings coincide with the previously mentioned research concerning life-long learning. The research results confirmed that life-long learning through external training is positively related to the innovativeness of heirs. Positive correlations between heir's innovativeness and external training are most often manifested through the transfer of knowledge to heirs, who combine this knowledge with tacit knowledge in FBs and create new knowledge, or through the creativity of heirs, their willingness to experiment and develop new ideas. The heirs rated the importance of new skills, which are important for operating in rapidly changing markets, for their innovativeness. External training programs are considered in the family entrepreneurship literature to be very important for the development of heirs, as they enable them to acquire new knowledge that is essential when FBs are operating in markets subject to very rapid change (Cabrera-Suárez et al., 2001; Chirico, 2008, Calabrò et al., 2019) and play a key role in innovation processes (Litz & Kleysen, 2001; Filser et al., 2018).

Figure 2
Position of heirs and founders on the innovation model of Slovenian FBs
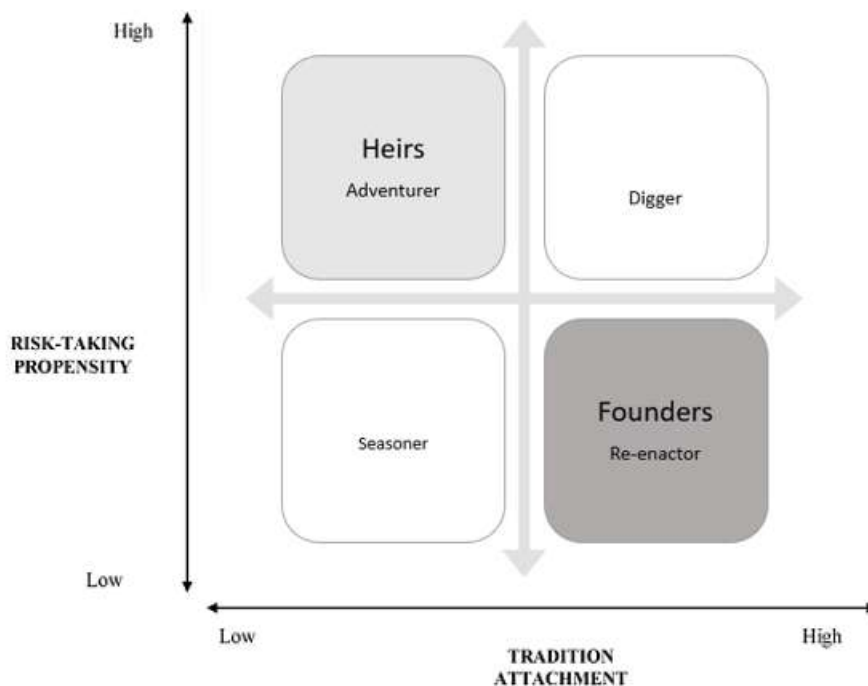
Source: Adapted from Rondi et al. (2019)

The non-technological innovation approach is supposed to turn routine companies into innovative ones, while in Slovenia, there are almost no educational institutions that would offer knowledge about innovation management (Ženko & Mulej, 2014). It is, therefore, necessary to modernize existing programs and offer more courses focused on innovation and innovation management, in particular innovation sources with concepts of commercially sustainable innovation, innovation strategies, innovation marketing, innovation financing, and control, thus filling the gap in this area (Duh, Letonja, & Vadnjal, 2015). Education and innovation should be encouraged to lead to technical-technological and non-technological innovation (Ženko & Šardi, 2014).

Conclusion

The research contributes to a better knowledge of the family entrepreneurship segment from the aspect of the problem of succession and innovation management in FBs in Slovenia. The research results are important for the future planning of entrepreneurship support, the key share of which is represented by FBs, especially smaller FBs. In-depth knowledge of FBs and the problems of succession and innovativeness in this important economy segment is added to the multitude of knowledge about entrepreneurship, entrepreneurial start-ups, and forms of entrepreneurship, such as dynamic entrepreneurship, women's entrepreneurship, franchising, biotech entrepreneurship, etc.

An important limitation of the research was that few theoretical sources with combinations of the fields studied were viewed globally. Many researchers study individual aspects of the transfer of succession in FBs to the next generation, but none of them innovativeness of founders and heirs and factors related to the innovativeness of FBs. The research was limited to family businesses of the first and the second generation, so the results can not be generalized to any companies. In the future, based on researchers' interdisciplinary work, the various dilemmas of FBs and the impact of individual factors on the innovativeness of heirs in FBs should be explored.

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