ZESZYTY NAUKOWE
MAŁOPOLSKIEJ WYŻSZEJ SZKOŁY EKONOMICZNEJ W TARNOWIE

numer 4

Tarnów 2020

Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie, t. 48
Kwartalnik, nr 4, grudzień 2020

Rada Programowa	prof. dr Alina Bădulescu (Rumunia), dr Elsa Barbosa (Portugalia), dr inż. Radka Johnová (Czechy), prof. dr Memet Karakuş (Turcja), prof. dr Androniki Kavoura (Grecja), prof. dr Stathis Kefallonitis (USA), prof. dr hab. Leszek Kozioł (Polska), prof. dr Ivars Muzis (Łotwa), mgr Eisa Patricia Orozco Quijano (Kanada), prof. dr Saša Petar (Chorwacja), prof. dr Jarmila Radová (Czechy), prof. dr Elisabete Rodrigues (Portugalia), prof. dr hab. Wasilij Rudnicki – przewodniczący (Ukraina), prof. dr hab. Jan Siekierski (Polska), prof. dr Paloma Taltavull de la Paz (Hiszpania), dr Sotirios Varelas (Cypr), doc. dr Dagmar Weberová (Czechy), mgr Lidia Matuszewska – sekretarz (Polska)
Redaktor naczelny	prof. dr hab. Leszek Kozioł
Redaktorzy tematyczni	dr Kazimierz Barwacz dr Michał Kozioł dr Renata Śliwa dr Janusz Ząbek mgr Karolina Chrabąszcz-Sarad mgr Anna Mikos
Redaktor statystyczny	dr hab. Michał Woźniak, prof. MWSE
Opracowanie redakcyjne	Anastazja Oleśkiewicz
Adres redakcji	Małopolska Wyższa Szkoła Ekonomiczna Redakcja Zeszytów Naukowych ul. Waryńskiego 14, 33-100 Tarnów, Polska tel.: +48 14 65 65 553 faks: +48 14 65 65 561 http://zn.mwse.edu.pl e-mail: redakcja@mwse.edu.pl

Redakcja informuje, że wersją pierwotną (referencyjną) czasopisma jest wydanie elektroniczne.

Wszystkie artykuły zamieszczone w czasopiśmie są recenzowane.

Pełne teksty artykułów są zamieszczane
na stronie internetowej czasopisma: http://zn.mwse.edu.pl.

Zgodnie z wykazem Ministerstwa Nauki i Szkolnictwa Wyższego
publikacjom naukowym zamieszczonym w czasopiśmie przyznawane jest 20 punktów.

Indeksowane w: BazEkon, CEJSH, Index Copernicus (ICV 2019: 96,19), POL-Index

© Copyright by Małopolska Wyższa Szkoła Ekonomiczna w Tarnowie, 2020
Udostępniane na podstawie Creative Commons Uznanie autorstwa – Użycie niekomercyjne – Bez utworów zależnych 4.0 Międzynarodowa Licencja Publiczna (CC BY-NC-ND 4.0)

Druk i oprawa: Poligrafia Wydawnictwa BIBLOS

Wydawnictwo Diecezji Tarnowskiej
Biblos
plac Katedralny 6, 33-100 Tarnów
tel.: +48 14 621 27 77
faks: +48 14 622 40 40
e-mail: biblos@biblos.pl
http://www.biblos.pl

THE MAŁOPOLSKA SCHOOL OF ECONOMICS IN TARNÓW

RESEARCH PAPERS COLLECTION

issue 4

Tarnów 2020

The Małopolska School of Economics in Tarnów Research Papers Collection, vol. 48
Quarterly, issue 4, December 2020

Programme Council	Prof. dr Alina Bădulescu, PhD (Romania), Elsa Barbosa, PhD (Portugal), Ing. Radka Johnová, PhD (Czech Republic), Prof. Memet Karakuş, PhD (Turkey), Prof. Androniki Kavoura, PhD (Greece), Prof. Stathis Kefallonitis, PhD (USA), Prof. Leszek Kozioł, PhD (Poland), Prof. Ivars Muzis, PhD (Latvia), Eisa Patricia Orozco Quijano, MA (Canada), Prof. Saša Petar, PhD (Croatia), Prof. Jarmila Radová, PhD (Czech Republic), Prof. Elisabete Rodrigues, PhD (Portugal), Prof. Vasiliy Rudnitskiy, PhD—President (Ukraine), Prof. Jan Siekierski, PhD (Poland), Prof. Paloma Taltavull de la Paz, PhD (Spain), Sotirios Varelas, PhD (Cyprus), Doc. Dagmar Weberová, PhD (Czech Republic), Lidia Matuszewska, MA—Secretary (Poland)
Chief Editor	Prof. Leszek Kozioł, PhD
Subject Editors	Kazimierz Barwacz, PhD Michał Kozioł, PhD Renata Śliwa, PhD Janusz Ząbek, PhD Karolina Chrabąszcz-Sarad, MSc Anna Mikos, MSc
Statistical Editor	Prof. Michał Woźniak, PhD
Editor	Anastazja Oleśkiewicz
Editorial Office	Małopolska School of Economics Editorial Office ul. Waryńskiego 14, 33-100 Tarnów, Poland Tel.: +48 14 65 65 553 Fax: +48 14 65 65 561 http://zn.mwse.edu.pl E-mail: redakcja@mwse.edu.pl

The Editorial Board informs that the reference version of this magazine is its electronic edition.

All articles published in the journal are subject to reviews.

Full-text articles are posted on the website of the journal: http://zn.mwse.edu.pl.

According to the regulations of the Ministry of Science and Higher Education
scientific publication in the journal is awarded 20 points.

Indexed in: BazEkon, CEJSH, Index Copernicus (ICV 2019: 96.19), POL-Index

© Copyright by Małopolska School of Economics in Tarnów, 2020
Available under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (CC BY-NC-ND 4.0)

Printed and bound at the Poligrafia Wydawnictwa BIBLOS

Wydawnictwo Diecezji Tarnowskiej
Biblos
plac Katedralny 6, 33-100 Tarnów
Tel.: +48 14 621 27 77
Fax: +48 14 622 40 40
E-mail: biblos@biblos.pl
http://www.biblos.pl

Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie
The Małopolska School of Economics in Tarnów Research Papers Collection
ISSN 1506-2635, e-ISSN 2658-1817
2020, 48(4)
© 2020 MWSE

Table of contents

Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie
The Małopolska School of Economics in Tarnów Research Papers Collection
ISSN 1506-2635, e-ISSN 2658-1817
2020, 48(4)
© 2020 MWSE

Spis treści

Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie
The Małopolska School of Economics in Tarnów Research Papers Collection
ISSN 1506-2635, e-ISSN 2658-1817
2020, 48(4)
© 2020 MWSE

Foreword

The Małopolska School of Economics in Tarnów Research Papers Collection, published since 1999, is a continuous publication issued as a quarterly, four times a year. The topics of the articles presented in it are related to five research areas: economics and finance, management and quality, ergonomics, and tourism and recreation. To a large extent, the journal is used to disseminate the scientific and research achievements of the academic staff of the Małopolska School of Economics in Tarnów. It should be emphasized, however, that it is an open journal, in which external authors from various universities in the country and abroad, as well as practitioners and even students, can also be published. A similar structure of the works and their authors is clear in this edition of the journal, which consists of ten works: seven of them are the work of external authors—employees of the University of Lodz, the Cracow University of Economics, the University of West Attica in Athens (Greece), Poznan University of Technology, the State School of Higher Professional Education in Konin. Among the distinguished group of authors there were four professors and ten doctors.

Although the issues are quite diverse, most of them assume that it is modern technology, good organization of management and organization of the work of a company or institution in the operational dimension that determine the increase in productivity and innovation of an organization, and ultimately the achievement of the outlined economic and social goals. The presented works were dominated by the diagnostic and decision-making approach, limited to selected areas of the company's or institution's activity. In the content of the publication, several research trends and threads can be distinguished, namely: the impact of digitization and Industry 4.0 on robotization and improvement of production processes and the use of Wearable Technologies in the company and society; analysis and evaluation of: innovative projects, brand competitiveness in the automotive industry, the effectiveness of taxation forms in the SME sector, prediction of discriminant analysis models, promoting physical activity among older people, as well as safety culture in the company.

The articles are the result of scientific work carried out as part of basic and implementation research, they contain a large amount of interesting cognitive and application-related information. In the articles, the reader can find several original theoretical approaches and observations of practical nature. For these reasons, *The Małopolska School of Economics in Tarnów Research Papers Collection* may be an interesting and useful item for both theoreticians of economics and finance, ergonomics, organization and management, as well as students and practitioners. It is worth adding that the journal is included in the top 100 most frequently cited journals on the list provided by the Ministry of Science.

I would like to thank everyone who contributed to this issue of the journal, especially the Editors who took the trouble to give their opinions on the submitted articles, the Reviewers for their substantive and valuable comments, and also the entire Editorial Team and collaborators.

Leszek Kozioł
Editor-in-Chief

ECONOMICS AND FINANCE

Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie
The Małopolska School of Economics in Tarnów Research Papers Collection
ISSN 1506-2635, e-ISSN 2658-1817
2020, 48(4), 13–25
DOI: 10.25944/znmwse.2020.04.1325
© 2020 MWSE, distributed under the Creative Commons Attribution 4.0 International License (CC BY-NC-ND 4.0)

Wearable Devices in digital society: Recognition, use of and readiness for use by young consumers

Jakub Brzeziński

University of Lodz, Poland

E-mail:
jakub.brzezinski@uni.lodz.pl
ORCID: 0000-0001-5353-8777

Emilian Gwiaździński

University of Lodz, Poland

E-mail:
emilian.gwiazdzinski@uni.lodz.pl
ORCID: 0000-0002-7125-9955

Abstract: This article presents the issue of using and recognizing Wearable Technology by young consumers. The review of literature and reports has shown that this type of devices is increasingly common, available and allows to support digital society in leading healthy lifestyle, by monitoring health parameters. In the perspective of these factors, the authors formulated the aim of the article, which is to identify the recognition, use of and readiness for use of Wearable Devices. The study was conducted on a sample of 173 representatives of young consumers. The technique of an Internet survey based on an electronic questionnaire was used for this purpose. This research aimed to find answers to questions focusing on finding factors on which recognition, use of and readiness for use of Wearable Devices depends. The results of the survey showed that most often dependencies occur in the case of variables such as gender of respondents, age and professional status. In terms of the most important functions, the respondents indicated measurement of steps, pulse and time in motion (on your feet). Respondents also showed the greatest willingness to use Wearable Devices such as smartwatch, smartglasses and smartband. The findings of this study provide several practical implications for developers and marketers of sports wearables that can be used to better design and promote their products as well as better satisfy users' needs.

Keywords: Wearable Technology, wearables market, data monitoring

1. Introduction

The evolution of information and communication technology (ICT) in recent years has dramatically reshaped people's behaviour. Compact mobile devices with robust computing power and battery life have become a common and universal good. One of the most popular representatives—Wearable Technology (WT), has gained traction in recent years to track data about everyday life and physical well-being for personal use (Khakurel et al., 2018). Moreover, the introduction and development of Wearable Devices (WD) have granted the any-

Financed by:
Małopolska School of Economics in Tarnów with support of the Ministry of Science and Higher Education ("Support for scientific journals")

Correspondence to:
Jakub Brzeziński
Uniwersytet Łódzki
Wydział Zarządzania
Katedra Logistyki
ul. Matejki 22/26
90-237 Łódź, Poland
Tel.: +48 42 63 55 215

where-anytime access to information (Kim and Shin, 2015), and thus they are emerging as the next-generation tools for ubiquitous communication (Park et al., 2016). These undoubted benefits affect the growing importance of wearables in the economy. According to the market research reports, the global Wearable Technology market is estimated to reach 56.8 billion USD by 2025, at a compound annual growth rate (CAGR) of 11.28% between 2016 and 2025 (Markets and Markets, 2017). A similar trend direction concerns the popularity of a healthy lifestyle, which has also been noticed by mobile device manufactures. Bearing in mind the research of the same market agency, the global wearable healthcare devices market size is projected to reach 46.6 billion USD by 2025 from 18.4 billion USD in 2020, at a CAGR of 20.5% from 2020 to 2025 (Markets and Markets, 2020). The interface between technology and a healthy lifestyle is a source of opportunities for the development of Wearable Devices, which is clearly visible in the behaviour of young people. Most transparently, Wearable Devices are defined as electronic devices that provide the functions of a computer or system and can be attached to or worn on the body (Buenaflor and Kim, 2012).

Currently, there are two main kinds of wearables available on the market—medical and fitness devices. Medical Wearable Devices are more likely to be adopted by the elder and unhealthy users. They are generally designed for certain disease such as diabetes and cancer (Gao et al., 2015). There are various methods used to monitor human health parameters, and the existing systems are costlier and are not easily affordable by various sections of people (Evangeline and Lenin, 2019). Moreover, the specific medical parameters are also limited in each device available on the market (Bloss, 2015; Chandana and Latha, 2014; Sivasankari et al., 2016), so there is a necessity to buy different types to measure and monitor specialist indicators by professionals. These limitations prompted the authors to focus in this research on the second type of wearables—fitness devices. It is worth mentioning here that regular physical activity is key to both the prevention and the treatment of lifestyle diseases such as cardiovascular diseases (Chomistek et al., 2015) and type 2 diabetes (Sigal, 2006), especially by modern, digital society.

Primarily fitness/ sports wearables were used by professional athletes to improve their performance. Currently, these devices have been widely adopted by health-conscious consumers, who want to track their daily activities (Kim et al., 2019). The wide penetration of smartphones and Wearable Devices has enabled society to track, store and transmit information related to their physical activities (heart rate, temperature, burned calories and elapsed time since the last physical activity) (Talukder et al., 2019). Understanding the phenomenon of the success of this technology requires emphasizing their basic features and systematics.

According to Liu and Guo (2017), Wearable Devices are wearable computers with a mobile Internet connection that are worn like dresses and personal adornments to display information for users intelligently and efficiently, such as wearable glasses and wearable watches (Liu and Guo, 2017). More broadly, Wearable Devices are smart electronic devices available in various forms, that are used near or on the human body to sense and analyze physiological and psychological data, such as feelings, sleep, movements, heart rate and blood, via applications either installed on the device or on external devices, such as smartphones connected to the cloud (Khakurel et al., 2018). Regardless of the adopted definition, these devices bring users several benefits. They allow continuous monitoring of individual's health and well-being sta-

tus, offer a scaling of measurement capability in the community, enable measurement of key parameters in new and direct ways, or also allow remote monitoring of lifestyle and medication adherence.

According to Kim and Shin (2015), wearables are typically classified into four categories: accessory (e.g., smartwatch, smartglasses), clothing (e.g., smartwear, sensors mounted in textile gods), body-mounted (skin-patch formed sensor or devices) and bio-implants (implantable sensors or devices). Wearable Devices can be also divided into three categories according to their functionality: *notifiers* that provide information about the world around the user (e.g., smartwatches), *eyeglasses* that create augmented reality seen by the wearer, and *trackers* that use sensors to record data (Lunney et al., 2016). Most of the sports wearables fall into the third category, which is responsible for about 50% share of the Wearable Technology market (Kim and Chiu, 2019). It may be attributed to several drivers of interest in Wearable Technology, which have been aggregated by Doughty and Appleby (2016) into the following:

- an increased consumer interest in medical technology, especially concerning prevention agendas and the need for greater fitness, and levels of activity for improved lifestyle;
- new interests in personalized and digital healthcare programmes, many prompted through apps for smartphones and tablet devices;
- the availability of nearly universal wireless connectivity through Wi-Fi and mobile networks;
- recent improvements in electronics and sensing technologies that have resulted in smaller, more lightweight and power-efficient devices and dispersed sensors;
- efficient and powerful wearable plus portable computing power and software.

As a fundamental component of a young customers lifestyle, being physically active is socially praised (Feng and Agosto, 2019). There are growing interests in consumer-facing mobile and Wearable Technologies that promise to help people become or stay physically active. Prevention is seen as perhaps the only sustainable way of managing the health and support needs and expectations in the future (Dought and Appleby, 2016). Considering the above, this paper focuses on fitness wearables concerning their recognition, use and readiness for use by the young people.

2. Materials and methods

The research was conducted using the Internet survey technique, with a measuring instrument in the form of a survey questionnaire. The research tool was designed using forms available on Google. It consisted of two parts—substantive and metric, in which questions based on both nominal and interval scales were placed. The first part made it possible to examine such aspects as knowledge and use of Wearable Devices together with the recognition of features important for the respondent. The question on general knowledge/ recognition of the term *Wearable Technology*, knowledge of its specific examples and general use of Wearable Devices contained a response cafeteria consisting of two possible dichotomous answers: Yes or No. The question about the use and readiness to use the Wearable Device was based on a scale with four possible answers: “I do not use, and I do not declare readiness to use”, “I don’t use, but I declare readiness to use”, “I use and I’m not satisfied” and “I use and I am satisfied”. The question

of significance assessment of health features of Wearable Devices was based on a seven-stage scale, where 1 meant completely unimportant, 4—hard to say, and 7—extremely important. The second part was focused on metric data such as: gender, age, education and professional status of the respondents. These questions contained a cafeteria consisting of two possible answers. The statistical analysis was performed using IBM SPSS statistics version 25. The data was presented using frequency, arithmetic mean and stretch marks analysis. Also, cross tables in the form of two-partite tables were used from which the value of statistics *p* of the Pearson's chi-square variable independence test was calculated. When any area of the table was lower than 9, the value of statistics including Yates correction was read, when the number was lower than 5, the value of Fisher's Exact Test statistics was read.

In the research process the following research questions were prepared:

- RQ1—What does declared recognition of Wearable Technology in the research group depend on?
- RQ2—What does declared use of Wearable Technology in the research group depend on?
- RQ3—What does declared recognition of specific Wearable Devices like smartglasses, smartband, smartwatch, smartjewellery, smartclothes, smarttattoo and smartchip, in the research group depend on?
- RQ4—Which Wearable Devices do the representatives of the examined group declare use and readiness to use?
- RQ5—What are the most important features of Wearable Devices in the study group?

The details of the sample are presented in Table 1.

Table 1. Sample characteristics (n = 173)

Variables	Number of respondents	Percent of respondents
Gender		
Male	74	42.8
Female	99	57.2
Age		
19–24 y.o.	130	75.1
25–30 y.o.	43	24.9
Education		
Secondary	98	56.6
Higher	75	43.4
Professional situation		
Student	141	81.5
Employee	32	18.5

S o u r c e: Authors' own elaboration

The research was conducted from February to April 2020 on a sample of 173 young customers. Almost 43% of the research group were men—the rest were women. The sample includes young people: Generation Z (19–24) and Y (25–30) representatives. In the literature, there is also a division of Y-generation into two subgenerations: online, also called generation C, and offline (Van den Bergh and Behrer, 2011). Generation boundaries are not clearly defined. The Y generation is sometimes defined as persons born between 1977 and 1995 (Bartlett, 2004; Dalton, 2003), and the lower limit for 1980 (Bolton et al., 2013; Huh and Chang, 2017; Kim et al., 2016) and 1982 (Paul, 2001) is also given. More than 75% of the study group are representatives of generation Z. These are people who spend their time in the social media world using mobile devices like smartphone, tablets, phablets and laplets (Hoxha and Zeqiraj, 2020), and have high technological competences (Tapscott, 1998). They are characterized by a much faster pace of life, they have to have everything on the line, for now, when something in the real world catches their attention—they check it on the Internet. They are well-informed and educated, have a low tolerance for errors. They are more and more aware of their position on the market, can actively communicate about their needs and participate in creating products or services of the brands they use (Kotler et al., 2016). This type of behaviour shows that the representatives of this generation are prosumers—a hybrid form of producer and consumer. They consume the goods offered by brands and, based on their opinions, become part of the chain of co-creating this market value (Seran and Izvercian, 2014; Fine et al., 2017). The representatives of generation Y (millennials), unlike Zs, do not live only in the virtual sphere. They can connect these spheres and move dynamically between them. Examples of such smooth transitions are ROPO consumer (research online, purchase offline), reverse ROPO effects (research offline, purchase online) (Szymanski and Stanislawski, 2018; Kowalczuk, 2018). They have unique attitudes towards brands, are consumption-oriented and take care of their health and physical condition (Lazarevic, 2012). More than 56% of respondents had secondary education, the rest—higher education. The majority of the respondents (81.5%) were students, the rest of them working daily.

3. Results

The data collected during the research process are presented in the tables below. Table 2 presents two factors: declared recognition and use of Wearable Technology in relation to gender, age, education status and professional situation in the research group.

Table 2. Declared recognition and use of Wearable Technology in the research group (n = 173)

Variables	Declared recognition of WT		Declared use of WT	
	Yes	No	Yes	No
Gender (Total)	77	96	38	135
Male	41	33	22	52
Female	36	63	16	83
p[1]	0.013[2]		0.033[2]	

Age (Total)	77	96	38	135
19–24 y.o.	64	66	30	100
25–30 y.o.	13	30	8	35
p[1]	0.030[2]		0.688[3]	
Education (Total)	77	96	38	135
Secondary	47	51	20	78
Higher	30	45	18	57
p[1]	0.297		0.572	
Professional situation (Total)	77	96	38	135
Student	67	74	34	107
Employee	10	22	4	28
p[1]	0.095		0.236[4]	

[1] Value of *p* statistics of chi-square test; [2] $p < 0,05$; [3] Yates correction; [4] Fisher's Exact Test

S o u r c e: Authors' own elaboration.

According to the above, results factor "declared recognition of Wearable Technology" depends on two variables: gender (*p*-value = 0.013) and age (*p*-value = 0.030). Relatively more men (55.4%) declare knowledge of Wearable Technology than women (36.4%) and relatively more people aged 19–24 (49.2%) declare knowledge than people aged 25–30 (30.2%). The second factor "declared use of Wearable Technology" depends on one variable: gender (*p*-value = 0,033). In the research group, relatively more men (29.7%) than women (16.2%) declare the use of Wearable Technology.

The next aspect researched was "declared recognition of specific Wearable Devices". The results are presented in Table 3.

Table 3. Declared recognition of specific Wearable Devices (*n* = 173)

Declared recognition of	**Gender**		**Age**		**Education**		**Professional situation**	
	Male	**Female**	**19–24 y.o.**	**25–30 y.o.**	**Secondary**	**Higher**	**Student**	**Employee**
Smartglasses (Total)	74	99	130	43	98	75	141	32
Yes	58	59	91	26	72	45	99	18
No	16	40	39	17	26	30	42	14
p[1]	0.009[3]		0.247		0.061		0.128	

Smartband (Total)	74	99	130	43	98	75	141	32
Yes	67	81	112	36	84	64	123	25
No	7	18	18	7	14	11	18	7
p[1]	0.163[5]		0.886[5]		0.944		0.296[5]	
Smartwatch (Total)	74	99	130	43	98	75	141	32
Yes	73	95	128	40	96	72	139	29
No	1	4	2	3	2	3	2	3
p[1]	0.394[6]		0.099[6]		0.654[6]		0.045[2, 6]	
Smartjewellery (Total)	74	99	130	43	98	75	141	32
Yes	28	32	47	13	31	29	44	16
No	46	67	83	30	67	46	97	16
p[1]	0.451		0.479		0.335		0.044[2]	
Smartclothes (Total)	74	99	130	43	98	75	141	32
Yes	31	19	38	12	27	23	39	11
No	43	80	92	31	71	52	102	21
p[1]	0.001[4]		0.868		0.654		0.449	
Smarttattoo (Total)	74	99	130	43	98	75	141	32
Yes	13	4	11	6	8	9	12	5
No	61	95	119	37	90	66	129	27
p[1]	0.004[3, 6]		0.451[5]		0.560[5]		0.373[5]	
Smartchip (Total)	74	99	130	43	98	75	141	32
Yes	53	54	89	18	61	46	90	17
No	21	45	41	25	37	29	51	15
p[1]	0.022[2]		0.002[3]		0.903		0.260	

[1] Value of p statistics of chi-square test; [2] $p < 0,05$; [3] $p < 0,01$; [4] $p = 0,001$; [5] Yates correction; [6] Fisher's Exact Test

S o u r c e: Authors' own elaboration

Accordingly, as indicated in this table, factor "declared recognition of smartglasses" depends on gender (p-value = 0.009). In the research group, more men (78.4%) than women

(59.6%) declare the recognition of smartglasses. Factor "declared recognition of smartwatch" depends on professional status (p-value = 0.045). Relatively more students (98.6%) declare knowledge than working people (90.6%). Factor "declared recognition of smartjewellery" depends on professional status (p-value = 0.044). Relatively more employees (50%) declare knowledge than students (27.7%). Factor "declared knowledge of smartclothes" depends on gender (p-value = 0.001). Relatively more men (41.9%) declare knowledge than women (19.2%). The next factor—"declared knowledge of smarttattoo"—depends on gender (p-value = 0,004). Relatively more men (17.6%) declare knowledge than women (4%). Factor "declared knowledge of smartchip" depends on gender (p-value = 0.022) and age (p-value = 0.002). In the research group, relatively more men (71.6%) declare knowledge than women (54.5%) and relatively more people aged 19–24 (68.5%) declare knowledge than people aged 25–30 (41.9%). No dependencies have been identified for variables in the case of a smartband.

Next, the aspect of declared use and readiness to use Wearable Devices was examined. The results are presented in Table 4.

Table 4. Declared use and readiness to use Wearable Devices (n = 173)

Wearable Technology	I do not use, and I do not declare readiness to use	I don't use, but I declare readiness to use	I use and I'm not satisfied	I use and I am satisfied
Smartglasses	73	89	3	8
Smartband	51	84	9	29
Smartwatch	49	93	1	30
Smartjewellery	122	46	3	2
Smartclothes	110	63	0	0
Smarttattoo	153	20	0	0
Smartchip	131	41	1	0

S o u r c e: Authors' own elaboration

According to the results:
- more consumers declare readiness to use devices related to the measurement of sports functions (smartband and smartwatch);
- fewer consumers declare their readiness to useless known devices such as smartjewellery, clothes, tattooing;
- the vast majority of consumers do not declare readiness to use chips.

In Table 5 significance assessment of health features of Wearable Devices in the research group was presented.

Table 5. Significance assessment of health features of Wearable Devices (n = 173)

Health Features	Calories burnt	Time in motion (on your feet)	Time at rest (sitting)	Sleep	Steps	Pulse	ECG
			Significance assessment				
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	30	21	31	23	19	19	33
6	16	23	28	31	16	25	39
7	127	129	114	119	138	129	101
Mean	6.56	6.62	6.48	6.55	6.69	6.64	6.39
Range	2	2	2	2	2	2	2

S o u r c e: Authors' own elaboration

According to these results, all the mentioned functions were marked for the respondents as very important. Their arithmetic mean was between 6.39 and 6.69. The highest mean was for steps (mean = 6.69), pulse (mean = 6.64) and time in motion (on your feet) (mean = 6.62), which means that these three features were the most important for the respondents. The dominant answers for each of the individual functions were 7, which is the most significant value for respondents of the research group.

4. Discussion

Concerning the first research question RQ1—declared recognition of Wearable Technology in the research group depends on gender and age. In contrast, when comparing research results with RQ2—declared use of Wearable Technology in the research group depends on gender. For RQ3—declared recognition of specific Wearable Devices in the research group depends on gender (for smartglasses, smartclothes, smarttattoo and smartchip), age (for smartchip), professional situation (for smartwatch and smartjewellery). Our study explored the differences between gender groups and the results of the research show that male consumers have higher mean values for awareness and using Wearable Technology. This coincides with the results of Kim and Chiu (2019) research, who identified those values for positive: technology readiness, perceived ease of use and perceived usefulness, are significantly higher in the male group. This shows a broader context in which females tend to be more concerned and anxious about using new technologies. Several studies proved possession of higher learnability and adaptability when using new technology services or products by

males (Li and Kirkup, 2007; Jackson et al., 2001; Venkatesh and Morris, 2000; Orji, 2010; Nysveen et al., 2005). Male consumers are more technologically adept, although positive and negative beliefs of using technology are critical influencers of acceptable behaviour towards new technology by them (Kim and Chiu, 2019). It may be due to the earlier adoption of sports wearables by males (Canhoto and Arp, 2017). Also, higher males sensitivity to the functionalities of sports wearables may be due to the higher level of their technological affinity and prior technological experience (Kim and Chiu, 2019).

Another important finding of the study is the significance of age as a control variable in the context of sports wearables. Since individuals from different age groups can behave differently when accepting a technology or its recognition, improving the results by controlling for even more focused age groups would be beneficial.

Due to technology's expanding role in people's daily lives, it is necessary to explore consumers' readiness to use technology-based products and services (Parasuraman, 2000), as people's dispositions towards using technology-based products and services differ (Kim et al., 2019). Comparing the results from Table 4 of RQ4, it can be concluded that in the study group the highest number of people declare readiness to use smartwatch (93 indications), smartglasses (89 indications) and smartband (84 indications). A review of the literature indicates that researchers are paying increasing attention to understanding users adoption of Wearable Devices. Most extant literature of Wearable Devices emphasizes the segment of smartwatches (Kim and Shin, 2015; Chuah et al., 2016). However, the sports wearables segment, which possesses the most growth potential, was overlooked in the extant literature (Lunney et al., 2016; Canhoto and Arp, 2017). The findings of Aksoy, Alan, Kabadayi and Aksoy (2019) study support the positive effects of performance expectancy, effort expectancy, facilitating conditions, social influence on attitude towards sports wearables. In this regard, their study provides evidence both for the studies where Wearable Technologies are specifically examined and studies that are conducted in other sports products-related contexts.

In response to RQ5, the most important features in Wearable Technology are steps, pulse, time in motion (on your feet). These three functions are related to fitness activities like jogging, running, etc. Our results correlate with other studies and show a significant role in improving sports performance by devices like smartwatch or smartband. Feng and Agosto (2018) examined amateur runners' needs and find that two main goals they want to achieve through their planned physical exercises are: "live a healthy lifestyle" and "improve physical health". The most prominent theme in their qualitative data was a special type of health/fitness-related needs aiming at improving running performance (Feng and Agosto, 2019). Their respondents expressed needs to improve running performance by accurately tracking advanced types of data like heart rate (pulse), cadence, pace, etc. Extant literature proved that users usually exhibit a positive attitude towards the product of healthcare Wearable Devices (Gao et al., 2015). Also, perceived ease of use is very important in determining consumers adoption of healthcare Wearable Devices (Hensel et al., 2006).

The findings of this study provide several practical implications for developers and marketers of sports wearables that can be used to better design and promote their products as well as better satisfy users' needs. Marketers should aim mainly at young male consumers (generation Z) with their products, but also persuade females that their products are easy to learn

and use at the same time. Sport and health functions should be developed as it is appreciated by users. As a relatively new market segment, Wearable Technology has huge development potential, considering their positive impact devices on a digital society. While wearable practices motivate users to stay fit, it is still not clear what privacy consequences they can bring for its users (Pingo and Naryan, 2020). In the past researchers have found that wearable trackers transmit data including consumers identifiers, address, diet and workout information to third parties (Lupton, 2016). Despite the invaluable benefits of Wearable Devices, we should not forget about the risks of privacy and the risk of depriving us of self-control. In our opinion, these threats should become the subject of future research, along with new Wearable Devices functions and the improvement of their ergonomics.

References

Aksoy, N. C., Alan, A. K., Kabadayi, E. T., Aksoy, A. (2020). Individuals' intention to use sports wearables: The moderating role of technophobia. *International Journal of Sports Marketing and Sponsorship*, *21*(2), 225–245. DOI: 10.1108/IJSMS-08-2019-0083.

Bartlett, M. (2004). Analyst: Understanding what shapes generation can help the CU market to that generation. *Credit Union Journal*, *8*(21), 14–17.

Bloss, R. (2015). Wearable sensors bring new benefits to continuous medical monitoring, real time physical activity assessment, baby monitoring and industrial applications. *Sensor Review*, *35*(2), 141–145. DOI: 10.1108/SR-10-2014-722.

Bolton, R. N., Parasuraman, A., Hoefnagels, A., Migchels, N., Kabadayi, S., Gruber, T., Komarova, Y., Solnet, D. (2013). Understanding generation Y and their use of social media: A review and research agenda, *Journal of Service Management*, *24*(3), 245–267. DOI: 10.1108/09564231311326987.

Buenaflor, C., Kim, H. (2012). Wearable computers in human perspective: The decision process of innovation acceptance with user issues and concerns. *International Journal of Emerging Technology and Advanced Engineering*, *2*(11), 573–580.

Canhoto, A. I., Arp, S. (2017). Exploring the factors that support adoption and sustained use of health and fitness wearables. *Journal of Marketing Management*, *33*(1–2), 32–60. DOI: 10.1080/0267257X.2016.1234505.

Chandana, D., Latha, B. (2014). A tele-medicine system for measuring heart rate, blood pressure, and drug level detection. *International Journal of Engineering Development and Research*, *2*(1), 23–29.

Chomistek, A. K., Chiuve, S. E., Eliassen, A. H., Mukamal, K. J., Willett W. C., Rimm, E. B. (2015). Healthy lifestyle in the primordial prevention of cardiovascular disease among young women. *Journal of the American College of Cardiology*, *65*(1), 43–51. DOI: 10.1016/j.jacc.2014.10.024.

Chuah, S. H., Rauschnabel, P. A., Krey, N., Nguyen, B., Ramayah, T., Lade, S. (2016). Wearable Technologies: The role of usefulness and visibility in smartwatch adoption. *Computers in Human Behavior*, *65*, 276–284. DOI: 10.1016/j.chb.2016.07.047.

Dalton, P. (2003). Managing the generation. *ABA Washington News*, *11*(19), 1–3.

Dought, K., Appleby, A. (2016). Wearable Devices to support rehabilitation and social care. *Journal of Assistive Technologies*, *10*(1), 51–63. DOI: 10.1108/JAT-01-2016-0004.

Evangeline, C. S., Lenin, A. (2019). Human health monitoring using wearable sensor. *Sensor Review*, *39*(3), 364–376. DOI: 10.1108/SR-05-2018-0111.

Feng, Y., Agosto, D. E. (2019). From health to performance: Amateur runners' personal health information management with activity tracking technology. *Aslib Journal of Information Management*, *71*(2), 217–240. DOI: 10.1108/AJIM-07-2018-0170.

Fine, M. B., Gironda, J., Petrescu, M. (2017). Prosumer motivations for electronic word-of-mouth communication behaviors. *Journal of Hospitality and Tourism Technology*, *8*(2), 280–295. DOI: 10.1108/JHTT--09-2016-0048.

Gao, Y., Li, H., Luo, Y. (2015). An empirical study of Wearable Technology acceptance in healthcare. *Industrial Management & Data Systems*, *115*(9), 1704–1723. DOI: 10.1108/IMDS-03-2015-0087.

Hensel, B. K., Demiris, G., Karlen, L., Courtney, K. L. (2006). Defining obtrusiveness in home telehealth technologies: A conceptual framework. *Journal of the American Medical Informatics Association*, *13*(4), 428–431. DOI: 10.1197/jamia.M2026.

Hoxha, V., Zeqiraj, E. (2020). The impact of Generation Z in the intention to purchase real estate in Kosovo, *Property Management*, *38*(1), 1–24. DOI: 10.1108/PM-12-2018-0060.

Huh, C., Chang, H. S. (2017). An investigation of generation Y travellers' beliefs and attitudes towards green hotel practices: A view from active and passive green generation Y travelers. *International Journal of Tourism Sciences*, *17*(2), 126–139. DOI: 10.1080/15980634.2017.1318590.

Jackson, L. A., Ervin, K. S., Gardner, P. D., Schmitt, N. (2001). Gender and the Internet: women communicating and men searching. *Sex Roles*, *44*, 363–379. DOI: 10.1023/A:1010937901821.

Khakurel, J., Melkas, H., Porras, J. (2018). Tapping into the Wearable Device revolution in the work environment: A systematic review. *Information Technology & People*, *31*(3), 791–818. DOI: 10.1108/ITP--03-2017-0076.

Kim, K. J., Shin, D. (2015). An acceptance model for smartwatches: Implications for the adoption of future Wearable Technology. *Internet Research*, *25*(4), 527–541. DOI: 10.1108/IntR-05-2014-0126.

Kim, M., Knutson, B. J., Choi, L. (2016). The effects of employee voice and delight on job satisfaction and behaviors: Comparison between employee generations. *Journal of Hospitality Marketing & Management*, *25*(5), 563–588. DOI: 10.1108/EJTD-10-2018-0097.

Kim, T., Chiu, W. (2019). Consumer acceptance of sports Wearable Technology: The role of technology readiness. *International Journal of Sports, Marketing and Sponsorship*, *20*(1), 109–126. DOI: 10.1108/IJSMS-06-2017-0050.

Kim, T., Chiu, W., Chow, M. K. F. (2019). Sport technology consumers: Segmenting users of sports Wearable Devices based on technology readiness. *Sport, Business and Management: An International Journal*, *9*(2), 134–145. DOI: 10.1108/SBM-02-2018-0011.

Kotler, Ph., Kartajaya, H., Setiawan, I. (2016). *Marketing 4.0: Moving from traditional to digital*. Hoboken, NJ: John Wiley and Sons. ISBN 9781119341208.

Kowalczuk, J. (2018). The evolvement of online consumer behavior: The ROPO and reverse ROPO effect in Poland and Germany. *Journal of Management and Business Administration. Central Europe*, *26*(3), 14–29. DOI: 10.7206/jmba.ce.2450-7814.233.

Lazarevic, V. (2012). Encouraging brand loyalty in fickle generation Y consumers. *Young Consumers*, *13*(1), 45–61. DOI: 10.1108/17473611211203939.

Li, N., Kirkup, G. (2007). Gender and cultural differences in Internet use: A study of China and the UK. *Computers & Education*, *48*(2), 301–317. DOI: 10.1016/j.compedu.2005.01.007.

Liu, D., Guo, X. (2017). Can trust and social benefit really help? Empirical examination of purchase intentions for Wearable Devices. *Information Development*, *33*(1), 43–56. DOI: 10.1177/0266666916635724.

Lunney, A., Cunningham, N. R., Eastin, M. S. (2016). Wearable fitness technology: A structural investigation into acceptance and perceived fitness outcomes. *Computers in Human Behavior*, *65*, 114–120. DOI: 10.1016/j.chb.2016.08.007.

Lupton, D. (2016). The diverse domains of quantified selves: Self-tracking modes and dataveillance. *Economy and Society*, *45*(1), 101–122. DOI: 10.1080/03085147.2016.1143726.

Markets and Markets. (2017). *Wearable Technology market* [online, accessed: 2020-06-15]. Retrieved from: https://www.marketsandmarkets.com/PressReleases/wearable-electronics.asp.

Markets and Markets. (2020). *Wearable healthcare devices market* [online, accessed: 2020-06-15]. Retrieved from: https://www.marketsandmarkets.com/PressReleases/wearable-medical-device.asp.

Nysveen, H., Pedersen, P. E., Thorbjornsen, H. (2005). Explaining intention to use mobile chat services: Moderating effects of gender. *Journal of Consumer Marketing*, *22*(5), 247–256. DOI: 10.1108/07363760510611671.

Orji, R. O. (2010). Impact of gender and nationality on acceptance of a digital library: An empirical validation of nationality-based UTAUT using SEM. *Journal of Emerging Trends in Computing and Information Sciences*, *12*, 68–79.

Parasuraman, A. (2000). Technology Readiness Index (TRI): A multiple-item scale to measure readiness to embrace new technologies. *Journal of Service Research*, *2*(4), 307–320. DOI: 10.1177/109467050024001.

Park, E., Kim, K. J., Kwon, S. J. (2016). Understanding the emergence of Wearable Devices as next-generation tools for health communication. *Information Technology & People*, *29*(4), 717–732. DOI: 10.1108/ITP-04--2015-0096.

Paul, P. (2001). Getting inside Gen Y. *American Demographics*, *23*(9), 42–90.
Pingo, Z., Naryan, B. (2020). "My smartwatch told me to see a sleep doctor": A study of activity tracker use. *Online Information Review*, *44*(2), 503–519. DOI: 10.1108/OIR-04-2018-0115.
Seran, S., Izvercian, M. (2014). Prosumer engagement in innovation strategies: The prosumer creativity and focus model. *Management Decision*, *52*(10), 1968–1980. DOI: 10.1108/MD-06-2013-0347.
Sigal, R. J., Kenny, G. P., Wasserman, D. H., Castaneda-Sceppa, C., White, R. D. (2006). Physical activity/exercise and type 2 diabetes: A consensus statement from the American diabetes association. *Diabetes Care*, *29*(6), 1433–1438. DOI: 10.2337/dc06-9910.
Sivasankari, P., Anbarasan, M., Moses, M. (2016). Arduino based human health care monitoring and control system. *IOSR Journal of Electrical and Electronics Engineering*, *11*(3), 9–18. DOI: 10.9790/1676--1103010918.
Szymanski, G., Stanislawski, R. (2018). Research online – purchase offline – a phenomenon among the young generation in the e-commerce sector. *Journal of International Scientific Publications*, *12*(1), 185–192.
Talukder, M. S., Choing, R., Bao, Y., Malik, B. H. (2019). Acceptance and use predictors of fitness Wearable Technology and intention to recommend: An empirical study. *Industrial Management & Data Systems*, *119*(1), 170–188. DOI: 10.1108/IMDS-01-2018-0009.
Tapscott, D. (1998). *Growing up digital: The rise of the net generation*. New York: McGraw-Hill. ISBN 0070633614.
Van den Bergh, J., Behrer, M. (2011). *How cool brands stay hot: Branding to generation Y*. London: Kogan Page. ISBN 9780749462505.
Venkatesh, V., Morris, M.G. (2000). Why don't men ever stop to ask for directions? Gender social influence and their role in technology acceptance and usage behavior. *MIS Quarterly*, *24*(1), 115–139. DOI: 10.2307/3250981.

Wearable Devices w społeczeństwie cyfrowym – znajomość, użytkowanie i gotowość do użycia przez młodych konsumentów

Abstrakt: Niniejszy artykuł porusza kwestie rozpoznawania, użytkowania oraz gotowości do użycia technologii noszonej (Wearable Technology) przez współczesnych konsumentów. Przegląd literatury przedmiotu oraz raportów branżowych wykazał, że ten typ technologii oraz urządzeń jest coraz bardziej rozpowszechniony, dostępny i odgrywa coraz większą rolę w życiu codziennym współczesnego społeczeństwa cyfrowego. W związku z tym autorzy sformułowali cel badawczy, jakim była identyfikacja poziomu rozpoznawalności, użytkowania oraz gotowości do użycia urządzeń noszonych (Wearable Devices). Badanie zostało przeprowadzone na próbie 173 respondentów, będących młodymi konsumentami (pokolenie Z i Y), przy zastosowaniu elektronicznego kwestionariusza ankiety. Pytania badawcze były nakierowane na rozpoznanie czynników, które determinują wykorzystywanie oraz gotowość do stosowania technologii noszonej. W świetle wyników badania istotne zależności odnotować można w przypadku zmiennych takich jak płeć, wiek i status zawodowy respondentów. Najważniejsze funkcje opisywanej technologii zdaniem młodych konsumentów koncentrują się wokół pomiaru pulsu, liczby wykonywanych kroków oraz obliczania czasu spędzanego w ruchu. Respondenci wykazali również, że najbardziej interesującymi ich produktami w tym zakresie są smartwatch, smartglasses oraz smartband. Szczegółowe wyniki opisywanego badania niosą szereg implikacji dla twórców i sprzedawców tego typu technologii oraz urządzeń, w szczególności przedstawiając profil potencjalnych konsumentów oraz oczekiwania użytkowników.

Słowa kluczowe: technologia noszona, społeczeństwo informacyjne, monitorowanie danych

Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie
The Małopolska School of Economics in Tarnów Research Papers Collection
ISSN 1506-2635, e-ISSN 2658-1817
2020, 48(4), 27–36
DOI: 10.25944/znmwse.2020.04.2736
© 2020 MWSE, distributed under the Creative Commons Attribution 4.0 International License (CC BY-NC-ND 4.0)

The comparative analysis of the prediction effectiveness of selected discriminant analysis models

Wojciech Lichota

University of Rzeszów, Poland
E-mail: wlichota@tlen.pl
ORCID: 0000-0001-5059-3439

Abstract: The main aim of the article was to verify the effectiveness of prediction of selected models of discriminant analysis on the example of a sample of 40 enterprises. The data of enterprises was obtained from the EMIS database and in the case of enterprises continuing their operations it concerned the year 2017, while in the case of bankrupt enterprises it was the data from the year before bankruptcy. The article presents models of discriminant analysis, which are classified as early warning systems about the risk of enterprise bankruptcy. The results allow to assess the financial situation of the company. Based on the results of a sample of forty companies, including ten for which an application for bankruptcy was filed, it was found that most of the discriminant models used in the article properly reflected the good or threatened financial condition of the company. The authors conclude that discriminatory models facilitate decision making but the models do not have 100% effectiveness.

Keywords: discriminant analysis, financial standing of companies, financial analysis

1. Introduction

Verification of the financial condition of enterprises is performed by many entities operating on the market. The results of the verification with the interpretation are used primarily by the business owners and managers to make decisions regarding further development directions and entities that intend to invest in the business, entities undertaking cooperation, institutions granting credits, loans and subsidies for the enterprise.

At the same time, too strong mutual relations between entities may lead to the so-called domino effect—the bankruptcy of one company may lead to another bankruptcy. Therefore, the problem of bankruptcy of the company, its definition and forecasting becomes an important issue from an economic point of view (Balina, 2012).

Financed by:
Małopolska School of Economics in Tarnów with support of the Ministry of Science and Higher Education ("Support for scientific journals")

Correspondence to:
Wojciech Lichota
Uniwersytet Rzeszowski
Instytut Ekonomii i Finansów
Katedra Finansów i Rachunkowości
ul. Ćwiklińskiej 2
35-601 Rzeszów, Poland
Tel.: +48 17 87 21 612

The main aim of this article is to verify the diagnostic effectiveness of selected models of discriminant analysis on the example of a sample of 40 enterprises operating in Poland, of which 10 filed for bankruptcy. 26 discriminant models were analyzed. The calculations for enterprises conducting operations were made on the basis of the reports for 2016. These companies continued operations in 2017. The data of the company's continuing business activities were generated from the EMIS database and were generated according to the following criteria. Companies in the IT, automotive industries and WIG 20 were selected based on the size of assets, while in the case of WIG 20 companies, the research does not include banks and insurers. The data of the bankrupt enterprises were generated from the National Court Register and EMIS and cover the years 2003–2018.

A research hypothesis was also put forward that "with the passage of time, discriminant models are characterized by a lower prediction ability".

2. Discriminatory models as a predictor of the company's financial situation

There are many methods of assessing the financial condition of a company, in the literature, e.g. traditional indicator analysis, discriminant analysis models, logistic regression models, point risk assessment methods. This article will present the results of the research on effectiveness of prediction selected models of discriminant analysis.

There have been many studies on the effectiveness of these models so far, which is confirmed by publications: Hamrol and Chodakowski, 2008; Balina, 2012; Kisielińska and Waszkowski, 2010; Pitera, 2018. The conducted research shows that discriminant models are characterized by a high degree of effectiveness in predicting the financial condition of enterprises. However, it should be remembered that the first model developed for the Polish economy was created in 1994 (Mączyńska), next in 1996 (Gajdka and Stos), 1998 (Hadasik), and 2004 (Appenzeller and Szarzec), so it was created in other economic realities, which means that these models could lose their diagnostic credibility.

In addition, there were statements in the domestic literature that "there is no single, only valid and best model of assessing the enterprise's risk of bankruptcy" (Mączyńska and Zawadzki, 2006) and it is not always possible to make an unambiguous assessment of the overall financial situation of the company, which takes into account parallel, various aspects of the business activity of enterprise (Korol, 2005). A. Hołda wrote that it is practically impossible to formulate one function that would preserve its prognostic values for decades in the conditions of the Polish economy (Hołda, 2001; Zarzecki, 2000). G. Gołębiowski and A. Tłaczała formulated the thesis that models constructed "no later than in the last decade" should be used (Gołębiowski and Tłaczała, 2005; Kitowski, 2011).

Therefore, the author carried out research aimed at determining whether discriminant models did not lose diagnostic credibility. Because early warning systems developed for a particular country should not be mechanically transferred to other countries, this article uses only models that take into account the specificity of the Polish economy (Spychała, 2013). According to D. Wędzki, the Altman models (1968) should not be used, because the American economy is so structurally different from the Polish one that it seems unlikely to obtain

the expected results of the model (Wędzki, 2005). Discriminatory models do not have disadvantage that has indicator analysis, namely difficulties in interpretation (Bombiak, 2010). Therefore, in countries with a developed market economy, in addition to traditional indicator analysis, the most popular analytical tools that allow to identify threats of the company's financial condition should be multi-criteria discriminant analysis (Rolbiecki, 2011), which allows the firm to qualify to one of two or to one of more research groups (Wajda, 2009).

The discriminatory function is the value that is the sum of the multiply of the indicators that characterize the economic and financial condition of the enterprise and the weights (discriminant factors) corresponding to these indicators. This value is the basis for deducting about the economic and financial situation of the enterprise through its confrontation with the threshold values adopted in the model (Żelazowska-Przewłoka, 2012). At the same time, these methods are attributed the value of universality and unchanging diagnostic credibility, regardless of the passage of time from their publication, which is unauthorized from a methodological point of view (Kitowski, 2013).

The linear discriminant function has the following form:

$$f(X) = a_0 + a_1X_1 + a_2X_2\ldots + a_nX_n, \tag{1}$$

where:

a—weight of the financial analysis ratio
x—financial analysis indicators
a_0—constant.

Each object is described by the values of n variables (X) (Gajdka and Stos, 2003). Interpretation of the result is made on the basis of a comparison of the calculated value of the discriminant function $f(X)$ with the limit value, the level of which is determined by the author of the model (Zielińska-Sitkiewicz, 2012).

26 models of discriminant analysis available in the national literature, based on financial statements of 40 enterprises, were subject to verification.

The discriminant models used in the article differ not only in the number of financial analysis indicators used, but also in the period in which they were created, the number of entities that constituted the test group when estimating the parameters, a specific range of the value of assets and a specific sector or legal form of a commercial company.

Table 1. Discrimination functions applied

No.	Author and date of model construction	The limit value of the function that determines the safe financial condition	Formula of the discriminant function	Model effectiveness determined by the author
1.	E. Mączyńska. 1994	> 0	$Z_M = 1.5 \cdot W_1 + 0.08 \cdot W_2 + 10.0 \cdot W_3 + 5.0 \cdot W_4 + 0.3 \cdot W_5 + 0.1 \cdot W_6$	NDA
2.	R. Jagiełło. 2013	> 0	$Z_{JU} = -2.24461 + 2.122 \cdot W_1 + 5.738 \cdot W_2 + 0.07 \cdot W_3 + 0.323 \cdot W_4$ (services)	91.25%
3.	R. Jagiełło. 2013	> 0	$Z_{JP} = -1.8603 + 12.296 \cdot W_1 + 0.1675 \cdot W_2 + 1.399 \cdot W_3$ (industry)	92.50%
4.	E. Mączyńska and M. Zawadzki. INE PAN F. 2006	> 0	$Z_{PAN\ F} = 9.478 \cdot W_1 + 3.613 \cdot W_2 + 3.246 \cdot W_3 + 0.455 \cdot W_4 + 0.802 \cdot W_5 - 2.478$	85.20%
5.	E. Mączyńska and M. Zawadzki. INE PAN G. 2006	> 0	$Z_{PAN\ G} = 9.498 \cdot W_1 + 3.566 \cdot W_2 + 2.903 \cdot W_3 + 0.452 \cdot W_4 - 1.498$	88.40%
6.	M. Hamrol, B. Czajka and M. Piechocki. 2004	> 0	$Z_{HCzP} = 3.562 \cdot W_7 + 1.588 \cdot W_{16} + 4.288 \cdot W_5 + 6.719 \cdot W_{13} - 2.368$	96.00%
7.	D. Hadasik. 1998	> 0	$Z_{H1} = -2.50761 \cdot W_5 + 0.00141147 \cdot W_9 - 0.00925162 \cdot W_{12} + 0.0233545 \cdot W_{17} + 2.60839$	93.18%
8.	D. Hadasik. 1998	> 0	$Z_{H2} = 0.703585 \cdot W_1 - 1.2966 \cdot W_2 - 2.21854 \cdot W_5 + 1.52891 \cdot W_7 + 0.00254294 \cdot W_9 - 0.01140733 \cdot W_{12} + 0.0186057 \cdot W_{17} + 2.76843$	95.45%
9.	D. Hadasik. 1998	> –0.3842325	$Z_{H3} = -1.3301 \cdot W_5 + 0.04094 \cdot W_8 - 0.0038 \cdot W_{12} + 2.16525 \cdot W_{14} + 0.0235 \cdot W_{17} + 1.6238$	88.52%
10.	D. Hadasik. 1998	> –0,374345	$Z_{H4} = 0.365425 \cdot W_1 - 0.765526 \cdot W_2 - 2.40435 \cdot W_5 + 1.59079 \cdot W_7 + 0.00230258 \cdot W_9 - 0.0127826 \cdot W_{12} + 2.36261$	95.08%
11.	D. Hadasik. 1998	> –0,354915	$Z_{H5} = -2.62766 \cdot W_5 + 0.0013463 \cdot W_9 - 0.00922513 \cdot W_{12} + 0.0272307 \cdot W_{17} + 2.41753$	93.44%
12.	D. Hadasik. 1998	> –0,42895	$Z_{H6} = 0.335969 \cdot W_1 - 0.71245 \cdot W_2 - 2.4716 \cdot W_5 + 1.46434 \cdot W_7 + 0.00246069 \cdot W_9 - 0.0138937 \cdot W_{12} + 0.0243387 \cdot W_{17} + 2.59323$	96.72%
13.	D. Hadasik. 1998	> 0	$Z_{H7} = -2.3001 \cdot W_5 + 0.00153002 \cdot W_9 - 0.0104159 \cdot W_{12} + 0.0286736 \cdot W_{17} + 2.6571$	91.07%
14.	D. Hadasik. 1998	> –0,227935	$Z_{H8} = -1.98281 \cdot W_5 + 0.00118429 \cdot W_9 + 0.180604 \cdot W_{11} - 0.00847833 \cdot W_{12} + 1.53416 \cdot W_{14} + 0.0235729 \cdot W_{17} + 1.97095$	92.54%

15.	D. Appenzeller and K. Szarzec. 2004	> 0	$Z_{ASz1} = 1.286 \cdot W_1 - 1.305 \cdot W_2 - 0.226 \cdot W_3 + 3.015 \cdot W_4 - 0.005 \cdot W_5 - 0.009 \cdot W_6 - 0.661$	85.29%
16.	D. Appenzeller and K. Szarzec. 2004	> 0	$Z_{ASz2} = 0.819138 \cdot W_1 + 2.56661 \cdot W_2 - 0.00500208 \cdot W_3 + 0.000628865 \cdot W_4 - 0.00951358 \cdot W_5 - 0.556326$	88.23%
17.	T. Maślanka. 2008	> 0	$Z_{M4} = -1.44979 + 3.55401 \cdot W_4 + 2.14847 \cdot W_6 - 0.33302 \cdot W_7 + 4.81862 \cdot W_{17} + 0.05236 \cdot W_{26} + 2.52164 \cdot W_4$	91.25%
18.	T. Maślanka. 2008	> 0	$Z_{M24} = 2.26566 + 6.00203 \cdot W_6 - 0.57209 \cdot W_7 + 11.85751 \cdot W_{13} - 0.01632 \cdot W_2$	92.50%
19.	J. Gajdka and D. Stos. 1996	< 0,32268	$Z_{GS2} = 0.017803 \cdot W_1 + 0.588694 \cdot W_2 + 0.138657 \cdot W_3 - 4.31026 \cdot W_4 - 0.01038 \cdot W_5 + 0.43744$	85.00%
20.	J. Gajdka and D. Stos. 1996	> 0,44	$Z_{GS3} = 0.20098985 \cdot W_1 + 0.0013027 \cdot W_2 + 0.7609754 \cdot W_3 + 0.9659628 \cdot W_4 - 0.341096 \cdot W_5$	82.50%
21.	J. Gajdka and D. Stos. 1996	> 0,45	$Z_{GS4} = 0.7732059 - 0.0856425 \cdot W_1 + 0.0007747 \cdot W_2 + 0.9220985 \cdot W_3 + 0.6535995 \cdot W_4 - 0.594687 \cdot W_5$	92.50%
22.	J. Gajdka and D. Stos. 1996	> 0	$Z_{GS5} = - 0.0005 \cdot W_1 + 2.0552 \cdot W_2 + 1.7260 \cdot W_3 + 0.1155 \cdot W_4 - 0.3342$	100.00%
23.	B. Prusak. 2004	> –0,1	$Z_{P1} = -1.568492770195 + 6.5244812965393 \cdot W_1 + 0.147970467805862 \cdot W_2 + 0.406149059534073 \cdot W_3 + 2.17539358139038 \cdot W_4$	100.00%
24.	B. Prusak. 2004	> 0	$Z_{P3} = 6.9973 \cdot W_1 + 0.1191 \cdot W_2 + 0.1932 \cdot W_3 - 1.176$	97.86%
25.	M. Tymoszuk. 2013	> 0	$Z_T = 14.71330 \cdot W_1 - 0.00157 \cdot W_2 - 0.03304 \cdot W_3 + 6.80845 \cdot W_4 - 7.35595$	85.29%
26.	T. Korol. 2010	$Z_{ban} < Z_{non}$	$Z_{ban} = -1.97 + 2.35 \cdot W_1 - 2.90 \cdot W_5 - 2.68 \cdot W_8 + 0.79 \cdot W_9$ $Znon = -3.49 + 9.93 \cdot W_1 - 0.05 \cdot W_5 - 0.62 \cdot W_8 + 1.19 \cdot W_9$	86.79%

S o u r c e: Author's own elaboration.

3. Research results

The results of correct indications of the financial condition of companies made using the models presented in point 2 are presented in Table 2. The research sample consisted of 10 enterprises from the IT sector (AB, Action, Asseco, Magdalena Mucha Przedsiębiorstwo Wielobranżowe Batna, Dell Products [Poland], Zakłady Urządzeń Komputerowych Elzab, Flextronics International Poland, Introl, Nokia Solutions and Networks, NTT System),

10 enterprises from the automotive sector (Volkswagen Poznań, Trw Polska, Solaris Bus Coach, Sitech, Saint-Gobain Innovative Materials Polska, Nexteer Automotive Poland, MAN Trucks, Hutchinson Poland, Faurecia Wałbrzych, Firma Oponiarska Dębica), and 10 enterprises from the WIG 20 portfolio (CCC, CD Projekt, Energa, JSW, KGHM, Lotos, LPP, Orlen, PGE, Tauron), which in 2017 continued their activities, and 10 enterprises for which an application for bankruptcy has been filed (Euro Cargo, Instal, Kastor, Persena, Polkap, Resbud, Transsystem, Watex, ZM Dębica, Zielona Energia). The data of the operating companies were generated from the EMIS database and the National Court Register and were included in the sample based on the highest asset value criterion.

According to the research, the financial condition of enterprises representing the research sample from the IT industry, automotive industry and the WIG 20 portfolio is not endangered. It is true that some models indicated individual cases of bankruptcy, but taking into account the indications of other models, it should be stated that these were incorrect indications.

Table 2. Results of correct indications based on the results of discriminative models for the selected sample of 40 companies

No.	Model author (model number)	Correct indication of the condition of 40 enterprises[1]—arranged in descending order
1.	E. Mączyńska (Z_{M})	93%
2.	M. Hamrol, B. Czajka and M. Piechocki—the Poznań model (Z_{HCzP})	93%
3.	D. Hadasik (Z_{H5})	93%
4.	D. Hadasik (Z_{H8})	93%
5.	D. Appenzeller and K. Szarzec (Z_{ASz2})	92%
6.	T. Maślanka (Z_{M4})	92%
7.	E. Mączyńska and M. Zawadzki—INE PAN G ($Z_{PAN\ G}$)	91%
8.	D. Hadasik (Z_{H2})	90%
9.	D. Hadasik (Z_{H6})	90%
10.	D. Hadasik (Z_{H7})	90%
11.	E. Mączyńska and M. Zawadzki—INE PAN F ($Z_{PAN\ F}$)	89%
12.	D. Hadasik (Z_{H1})	88%
13.	D. Hadasik (Z_{H3})	88%
14.	D. Hadasik (Z_{H4})	85%
15.	R. Jagiełło (Z_{JU}) (Z_{JP})	85%

[1] In the case of companies that published a profit and loss account in the comparative variant, it was not possible to apply all discriminatory models.

16.	T. Maślanka (Z_{M24})	85%
17.	T. Korol	82%
18.	D. Appenzeller and K. Szarzec (Z_{ASz1})	79%
19.	J. Gajdka and D. Stos (Z_{GS4})	76%
20.	M. Tymoszuk (Z_{T})	71%
21.	B. Prusak (Z_{P3})	66%
22.	J. Gajdka and D. Stos (Z_{GS5})	63%
23.	J. Gajdka and D. Stos (Z_{GS3})	52%
24.	B. Prusak (Z_{P3})	46%
25.	J. Gajdka and D. Stos (Z_{GS2})	38%

S o u r c e: Author's own elaboration.

According to the research, the highest efficiency was achieved by the models of E. Mączyńska, M. Hamrol, B. Czajka and M. Piechocki (the Poznań model) and D. Hadasik (5) and (8), which amounted to 93%. Taking into account the sample of 40 companies, the model of E. Mączyńska incorrectly classified one company which continued operations and two enterprises for which a bankruptcy application was filed. However, the Poznań model incorrectly classified two enterprises which continued operations and one bankrupt enterprise whereas the models 5 and 8 by D. Hadasik correctly classified all enterprises operating, while wrongly classified 3 bankrupt enterprises. It should be noted that these models were constructed by the authors in 1994, 1998 and 2004, respectively, 26, 22 and 16 years ago, which means that with the passage of time the models did not lose the ability to predict.

Thus, the research hypothesis was rejected.

A slightly lower efficiency, i.e. 92%, was demonstrated by D. Appenzeller and K. Szarzec model (2) and the T. Maślanka model (4). These models incorrectly classified 2 "operating" and 1 "bankrupt" enterprises.

In the top of ten models that most accurately represented the financial condition were also the INE PAN model G—91% and D. Hadasik models (2), (6) and (7)—90%. It should be noted that D. Hadasik's models correctly qualified enterprises which continued operations in 100%, while the incorrect indications concerned only bankrupt enterprises.

The correct classification from 76%–89% was presented by models of INE PAN F, D. Hadasik (1), (3) and (4), R. Jagiełło, T. Maślanka (24), T. Korol, D. Appenzeller and K. Szarzec (1), J. Gajdka and D. Stos (4). In this group, the model by D. Hadasik (3) correctly classified all operating enterprises, whereas the T. Korol model and J. Gajdka and D. Stos model (4) correctly classified all enterprises threatened with bankruptcy.

The remaining models were characterized by efficiency at the level of 38%–71%. The weakest predictive ability was demonstrated by the model of J. Gajdka and D. Stos (2). However, it should be noted, that most of the models included in this range correctly classified the

companies which applied for bankruptcy because the percentage of correct indications was in the case of B. Prusak model (1) and J. Gajdka and D. Stos models (2), (3) and (5)—100%, while for the models of M. Tymoszuk and B. Prusak (3)—80%.

It should also be noted that the models were estimated on the basis of a certain group of companies from various industries and with a specific asset value. Therefore, there may be a mismatch between the enterprise and the model. That is why it is so important to use several models to exclude a possible mismatch.

4. Conclusions

Taking into account the results, it can be concluded that not all discriminant models are a reliable source of information about the company's financial condition and do not allow predicting the risk of bankruptcy of the company. Of the 25 discriminant models covered by the study:

- 10 correctly reflected the financial condition of enterprises, as their prediction ability amounted to at least 90%. These were the models of E. Mączyńska, M. Hamrol, B. Czajka, M. Piechocki—the Poznań model, D. Hadasik (5) and (8), D. Appenzeller, K. Szarzec (2), T. Maślanka (4), E. Mączyńska, M. Zawadzki—INE PAN G, D. Hadasik (2), (6) and (7). Taking into account the date of the model's creation, it should be noted that among those listed there is the first model designed for enterprises operating in Poland, i.e. the model of E. Mączyńska from 1994, while the youngest one is the model by T. Maślanka (4) from 2008. Note that the companies included in each analytical sample on the basis of which the above forecasting models were built covered various sectors, hence it can be concluded that these models are universal and therefore their prognostic value is so high;
- 9 models presented efficiency ranging from 76% to 89%;
- 6 models were characterized by the prediction ability at a level below 75%, so at least one in four companies was misclassified.

In the opinion of the author who conducts the research, decisions made, for example, by managers, owners or financial institutions on the basis of models whose forecasting ability is below 75%, constitute too high a risk that it will be incorrect.

As indicated in the introduction, so far many attempts have been made to analyze the prediction ability of discriminant models. Changing economic realities means that individual models should be successively verified to be sure that they accurately reflect the financial condition of enterprises.

It should be emphasized that the models that showed the highest prediction ability were constructed by the authors in 1994, 1998 and 2004, respectively, which means that with the passage of time they did not lose their prediction ability. Thus, the research hypothesis was rejected.

Due to the fact that the models are not 100% effective, in order to accurately analyze the company's financial condition and avoid the risk of misdiagnosis, other available methods of financial analysis should be used.

References

Altman, E. I. (1968). Financial ratios: Discriminant analysis and the prediction of corporate bankruptcy. *The Journal of Finance*, *23*(4), 589–609. DOI: 10.2307/2978933.

Appenzeller, D., Szarzec, K. (2004). Prognozowanie zagrożenia upadłością polskich spółek publicznych. *Rynek Terminowy*, *1*, 120–128.

Balina, R. (2012). Skuteczność wybranych modeli dyskryminacyjnych na przykładzie branży robót budowlanych. *Zeszyty Naukowe Uniwersytetu Szczecińskiego. Finanse, Rynki Finansowe, Ubezpieczenia*, *689*, 231–238.

Bombiak, E. (2010). Modele dyskryminacyjne jako metoda oceny sytuacji finansowej przedsiębiorstwa. *Zeszyty Naukowe Akademii Podlaskiej w Siedlcach. Seria: Administracja i Zarządzanie*, *13*(86), 141–152.

Gajdka, J., Stos, D. (1996). Wykorzystanie analizy dyskryminacyjnej w ocenie kondycji finansowej przedsiębiorstw. In: R. Borowiecki (ed.). *Restrukturyzacja w procesie przekształceń i rozwoju przedsiębiorstw* (pp. 56–65). Kraków: Wydawnictwo Akademii Ekonomicznej. ISBN 8390155028.

Gajdka, J., Stos, D. (2003). Ocena kondycji finansowej polskich spółek publicznych w okresie 1998–2001. *Zarządzanie finansami: mierzenie wyników i wycena przedsiębiorstw*. Vol. 1 (pp. 149–162). Szczecin: Uniwersytet Szczeciński. ISBN 8389142112.

Gołębiowski, G., Tłaczała, A. (2005). *Analiza ekonomiczno-finansowa w ujęciu praktycznym*. Warszawa: Difin. ISBN 8372515646.

Hadasik, D. (1998). *Upadłość przedsiębiorstw w Polsce i metody jej prognozowania*. Poznań: Wydawnictwo Akademii Ekonomicznej.

Hamrol, M., Chodakowski, J. (2008). Prognozowanie zagrożenia finansowego przedsiębiorstwa. Wartość predykcyjna polskich modeli analizy dyskryminacyjnej. *Badania Operacyjne i Decyzje*, *3*, 17–32.

Hamrol, M., Czajka, B., Piechocki, M. (2004). Upadłość przedsiębiorstwa – model analizy dyskryminacyjnej. *Przegląd Organizacji*, *6*, 35–39.

Hołda, A. (2001). Prognozowanie bankructwa jednostki w warunkach gospodarki polskiej z wykorzystaniem funkcji dyskryminacyjnej $Z_{H.}$ *Rachunkowość*, *5*, 17–32.

Jagiełło, R. (2013). *Analiza dyskryminacyjna i regresja logistyczna w procesie oceny zdolności kredytowej przedsiębiorstw*. Warszawa: Narodowy Bank Polski. Departament Edukacji i Wydawnictw.

Kisielińska, J., Waszkowski, A. (2010). Polskie modele do prognozowania bankructwa przedsiębiorstw i ich weryfikacja. *Zeszyty Naukowe Szkoły Głównej Gospodarstwa Wiejskiego w Warszawie. Ekonomika i Organizacja Gospodarki Żywnościowej*, *82*, 17–31.

Kitowski, J. (2011). Bariery wiarygodnego stosowania metod dyskryminacyjnych do oceny kondycji finansowej przedsiębiorstw. *Zeszyty Naukowe Uniwersytetu Szczecińskiego. Finanse, Rynki Finansowe, Ubezpieczenia*, *639*, 71–80.

Kitowski, J. (2013). Sposoby ujmowania kryterium uwarunkowań działalności w metodach oceny kondycji finansowej przedsiębiorstwa. *Zeszyty Naukowe Uniwersytetu Szczecińskiego. Finanse, Rynki Finansowe, Ubezpieczenia*, *59*, 155–166.

Korol, T. (2005). Modele prognozowania upadłości przedsiębiorstw – analiza porównawcza wyników sztucznych sieci neuronowych z tradycyjną analizą dyskryminacyjną. *Bank i Kredyt*, *6*, 10–17.

Korol, T. (2010). *Systemy ostrzegania przedsiębiorstw przed ryzykiem upadłości*. Warszawa: Oficyna a Wolters Kluwer business. ISBN 9788375267358.

Korol, T., Prusak, B. (2005). *Upadłość przedsiębiorstw a wykorzystanie sztucznej inteligencji.* Warszawa: CeDeWu. ISBN 8360089000.

Mączyńska, E. (1994). Ocena kondycji przedsiębiorstwa. *Życie Gospodarcze*, *38*, 42–45.

Mączyńska, E., Zawadzki, M. (2006). Dyskryminacyjne modele predykcji bankructwa przedsiębiorstw. *Ekonomista*, *2*, 205–235.

Maślanka, T. (2008). *Przepływy pieniężne w zarządzaniu finansami przedsiębiorstw.* Warszawa: Wydawnictwo C. H. Beck. ISBN 9788325502393.

Pitera, R. (2018). Ocena wiarygodności wybranych modeli wczesnego ostrzegania w badaniu kondycji finansowej przedsiębiorstwa. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, *514*, 342–354.

Prusak, B. (2004). Ocena zagrożenia upadłością produkcyjnych spółek kapitałowych w Polsce w latach 1998–2002. In: D. Appenzeller (ed.). *Upadłość przedsiębiorstw w Polsce w latach 1990–2003: teoria i praktyka* (pp. 165–179). Poznań: Wydawnictwo Akademii Ekonomicznej. ISBN 8374170387.

Prusak, B. (2005). *Nowoczesne metody prognozowania zagrożenia finansowego przedsiębiorstw*. Warszawa: Difin. ISBN 8372515247.

Rolbiecki, R. (2011). *Jak oceniać kondycję finansową firm transportowych* [online, accessed: 2020-09-15]. Retrieved from: https://mojafirma.infor.pl/moto/logistyka/transport/499066,6,Jak-oceniac-kondycje--finansowa-firm-transportowych.html.

Spychała, M. (2013). Zastosowanie analizy wskaźnikowej oraz modeli wczesnego ostrzegania w prognozowaniu upadłości przedsiębiorstw na przykładzie spółek Irena S.A. i Krosno S.A. *Zarządzanie i Finanse*, *1*(4), 467–483.

Tymoszuk, M. (2013). Skuteczność modeli prognozowania upadłości przedsiębiorstw a upływ czasu – porównanie popularnych polskich modeli wielowymiarowej analizy dyskryminacyjnej z modelem zbudowanym przez autorkę. In: A. Adamska, E. Mączyńska (eds.). *Upadłości, bankructwa i naprawa przedsiębiorstw: wybrane zagadnienia* (pp. 193–210). Warszawa: Szkoła Główna Handlowa w Warszawie. ISBN 9788373787988.

Wajda, P. (2009). Wykorzystanie analizy dyskryminacyjnej w ocenie ryzyka upadłości przedsiębiorstw. *Przegląd Corporate Governance*, *1*, 29–35.

Wędzki, D. (2005). Wielowymiarowa analiza bankructwa na przykładzie budownictwa. *Badania Operacyjne i Decyzje*, *2*, 59–81.

Zarzecki, D. (2000). O metodach oceny zagrożenia bankructwem i możliwościach ich wykorzystania. In: W. Tarczyński (ed.). *Rynek kapitałowy: skuteczne inwestowanie* (pp. 361–376). Szczecin: Wydawnictwo Naukowe Uniwersytetu Szczecińskiego.

Żelazowska-Przewłoka, A. (2012). Prognozowanie zagrożenia sytuacji ekonomicznej wybranych przedsiębiorstw agrobiznesu w województwie świętokrzyskim w latach 2004–2010. *Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu*, *14*(4), 221–230.

Zielińska-Sitkiewicz, M. (2012). Zastosowanie metod wielowymiarowej analizy dyskryminacyjnej do oceny kondycji firm deweloperskich. *Metody Ilościowe w Badaniach Ekonomicznych*, *13*(3), 288–301.

Skuteczność predykcji wybranych modeli analizy dyskryminacyjnej

Abstrakt: Celem artykułu była weryfikacja skuteczności predykcji wybranych modeli analizy dyskryminacyjnej na przykładzie próby 40 przedsiębiorstw. Dane przedsiębiorstw pochodziły z bazy danych EMIS i w przypadku przedsiębiorstw kontynuujących działalność dotyczyły 2017 roku, natomiast w przypadku przedsiębiorstw upadłych były to dane na rok przed upadłością. W artykule zaprezentowano modele analizy dyskryminacyjnej, które są zaliczane do systemów wczesnego ostrzegania o zagrożeniu upadłością przedsiębiorstwa. Otrzymane wyniki pozwalają na ocenę sytuacji finansowej przedsiębiorstwa, a więc mogą wpływać na racjonalizację zarządzania przedsiębiorstwami i ich kontroli np. przez rady nadzorcze, biegłych rewidentów czy też sądy gospodarcze. Na podstawie wyników z próby czterdziestu przedsiębiorstw, w tym dziesięciu, dla których został złożony wniosek o upadłość, stwierdzono, że większość zastosowanych w artykule modeli dyskryminacyjnych właściwie odwzorowała dobrą lub zagrożoną kondycję finansową przedsiębiorstwa. Przeprowadzone badania wskazały, że modele dyskryminacyjne ułatwiają podejmowanie decyzji, niemniej należy mieć na uwadze, że nie odznaczają się one stuprocentową skutecznością.

Słowa kluczowe: analiza dyskryminacyjna, sytuacja finansowa przedsiębiorstwa, kondycja finansowa przedsiębiorstwa

Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie
The Małopolska School of Economics in Tarnów Research Papers Collection
ISSN 1506-2635, e-ISSN 2658-1817
2020, 48(4), 37–48
DOI: 10.25944/znmwse.2020.04.3748
© 2020 MWSE, distributed under the Creative Commons Attribution 4.0 International License (CC BY-NC-ND 4.0)

Choice of the form of taxation in small and medium-sized enterprises and their importance for the economic growth and the country's economy

Izabela Emerling

Cracow University
of Economics, Poland

E-mail:
izabela.emerling@uek.krakow.pl
ORCID: 0000-0002-9371-9430

Abstract: When making a decision to start a business, an entrepreneur is forced to choose the form of taxation of income from business activity. The aim of the article is to present the importance of the sector of small and medium-sized enterprises for economic growth and the economy, as well as to present the forms of their taxation and their choice. The applied research methods are based on the study of literature in the studied area and survey research. In order to learn more about the main reasons that guide entrepreneurs when choosing the form of tax and accounting records, a questionnaire survey was conducted in Lower and Upper Silesia (Poland). 500 respondents were included in the survey. When analyzing the data from the Central Statistical Office, it should be stated that the importance of enterprises of the SME group for the country's economy and economic growth is an undeniable fact. The dominant form of settlements of SME enterprises is the Tax Book of Income and Expenditure. After analyzing the survey it should be stated that the main reason for choosing a specific form of tax and accounting records are financial benefits, and then the simplified method of keeping documentation. Thus, it should be stated that simplification system of tax settlements will have an impact on the development of these enterprises, which will contribute to increasing the economic growth of the country.

Keywords: tax system, economic growth, GDP, taxes, small and medium-sized enterprises, choice of taxation forms

Financed by:
Cracow University of Economics,
Małopolska School
of Economics in Tarnów
with support of the Ministry
of Science and Higher Education
("Support for scientific journals")

Correspondence to:
Izabela Emerling
Uniwersytet Ekonomiczny w Krakowie
Kolegium Ekonomii, Prawa i Finansów
Instytut Finansów
Katedra Rachunkowości Finansowej
ul. Rakowicka 27
31-510 Kraków
Tel.: +48 12 29 35 646

1. Introduction

The main task of most tax systems is to cover public expenditure in the country. Thus, tax is one of the oldest financial categories, and is also the oldest source of state budget revenues (Wolański, 2016). "In antiquity, taxes became the central device of public and state life […] from the very beginning, taxes were used to pursue both fiscal, economic, social and political goals (Kosek-Wojnar, 2012, p. 109). The importance of many tax solutions of that time is so great that they are being used today" (Felis, Jamroży and Ślęzak, 2010,

pp. 15–16). Due to their importance, "the struggle for and with state power becomes a tax fight", and "the memory of famous rulers is associated not so much with the battles or wars they won, but with ensuring the prosperity of the state and society through economic and tax reforms" (Kosikowski, 1992, p. 17).

From the point of view of state budget, a very important element is personal income tax, which ranks second in the structure of tax revenues of the Polish state budget. It constitutes a part of income taxes, i.e. taxes collected on the total revenues obtained by various entities as a result of their business activity. The subject of taxation is all revenues without deducting the costs—the so-called gross income. Income taxes include: sales and industrial taxes paid on services, production and trade activities, as well as agricultural land tax. This form can also be used by natural persons engaged in business activity who do resign from paying personal income tax in accordance with general principles and choose the lump-sum tax.

The second important group of taxes are taxes on expenses. Their characteristic feature is that their material burden is borne by final recipients (Gomułowicz and Małecki, 2000, pp. 75–78), while the taxpayer is an entity engaged in business activity involving the sale of goods or provision of taxable services. In the Polish tax system, they include: value added tax, excise duty and tax on games.

The last category are income taxes, which are the most common. Their major assumption is the universality of taxation. The basis for calculating income tax is the known net income of the taxpayer, decreased by tax deductible costs.

There are two types of income tax in Poland:

– personal income tax—regulated by the Act on personal income tax of 26 July 1991 (consolidated text: Journal of Laws of 2020, item 1426, as amended; hereinafter referred to as: PDOFizU);
– corporate tax—regulated by the Act on corporate income tax of 15 February 1992 (consolidated text: Journal of Laws of 2020, item 1406, as amended; hereinafter referred to as: PDOPrU).

A very important role in shaping of budget revenues is played by enterprises, including medium-sized companies.

When deciding to start a business, every entrepreneur is obliged to take many important decisions. One of them is the choice of the form of taxation of income from business activity, which largely affects the amount of taxes paid to the budget.

The aim of the article is to present the importance of small and medium-sized enterprises for the economy, and thus for economic growth, and the factors influencing the choice of forms of taxation by small and medium-sized enterprises.

The applied research methods are based on the study of literature in the research area and the presentation of the analysis of the forms of selection and evaluation of methods of taxation of income from the conducted activity on the basis of the conducted survey research. In order to learn more about the main reasons that guide entrepreneurs when choosing the form of tax and accounting records, a questionnaire survey was conducted among the owners of SME enterprises, their employees from accounting departments and employees of accounting offices in Lower and Upper Silesia. 500 respondents were included in the survey.

2. Importance of small and medium-sized enterprises for the economy

The topic of economic growth is very important to fully understand the functioning of the market economy. Moreover, it is one of the main macroeconomic and public finance problems. Economic growth is a basic factor contributing to a higher standard of living of citizens, to an increase in investments, and, in consequence, to a better development of the budgetary sphere. When talking about economic growth, one should understand a situation in which the economic effect of the society improves every year by constantly increasing the ability of a given country to produce goods and services needed by people. Alternatively, it can be stated that economic growth is a quantitative increase of basic economic values from one period to another, and above all, of national income per capita. It can therefore be concluded that the level of economic growth is influenced by the production capacity of a given economy, i.e. the quantity and quality of its material natural resources, the type of fixed assets, the level of production technology and personal factors of production (e.g. the level of job qualifications, unemployment, etc.) (Gomółka, 1998). Long-term economic growth takes place in an economy where all factors of production are used. In addition to engaging the full production capacity, economic growth can be achieved by increasing the supply of labour and capital as well as increasing the efficiency of use of production factors (Begg et al., 2014).

The SME sector has a huge impact on economic growth and plays a significant role in economy. However, small and medium-sized enterprises frequently face barriers that hinder the growth of this sector.

One of the main barriers are non-wage labour costs, the amount of which negatively affects the profitability of small and medium-sized enterprises. Taxes are also a significant barrier as their amount does not help entrepreneurs to develop their business, and the ambiguity and volatility of legal regulations poses numerous difficulties (Borowiecki and Siuta-Tokarska, 2008, p. 56).

Small and medium-sized enterprises (SMEs) are the backbone of Europe's economy. They represent 99% of all businesses in the EU. They employ around 100 million people, account for more than half of Europe's GDP and play a key role in adding value in every sector of the economy. SMEs bring innovative solutions to challenges like climate change, resource efficiency and social cohesion and help spread this innovation throughout Europe's regions. They are therefore central to the EU's twin transitions to a sustainable and digital economy. They are essential to Europe's competitiveness and prosperity, industrial ecosystems, economic and technological sovereignty, and resilience to external shocks.

According to the European Commission in 2019, SMEs account for 98% of the total share of all enterprises in the European Union and offer a significant number of jobs in the private sector (EC, 2019). Currently, the structure of enterprises in Poland by company size is as follows (Statistics Poland, 2020):

- microenterprises—98%;
- small enterprises—1.4%;
- medium-sized enterprises—0.5%;
- large enterprises—0.1%.

Due to their significant number, SMEs influence and shape the national economy and have an impact on its development, contributing to a significant increase in the national income. They generate every second PLN of GDP (49.9%), of which the largest share is generated by micro-enterprises (30.5%) (Skowrońska and Tarnawa, 2018, p. 17). The participation in generating GDP of large enterprises and the SME sector by the basic area of activity is presented in Figure 1.

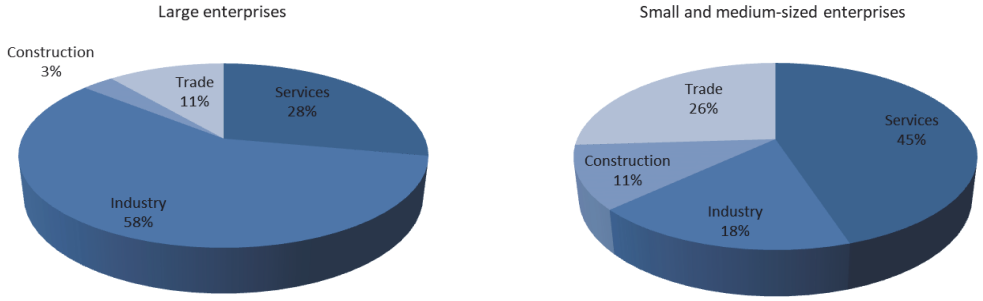

Figure 1. Share of large enterprises and the SME sector in GDP by basic area of activity in 2018 (in %)

S o u r c e: Author's own elaboration based on Statistics Poland, 2019.

Also the importance of small and medium-sized enterprises as entities creating new jobs should not be underestimated. The average number of people employed in this sector in 2019 was about 7 million, which accounted for about 69% of all people working in the enterprise sector. Data for particular years are presented in Table 1.

Table 1. The average number of employees in enterprises in particular size classes in 2013–2019

Year	Total SMEs	0–9	10–49	50–249	> 249
2013	69.5%	37.9%	13.7%	17.9%	30.5%
2015	69.2%	38.2%	13.4%	17.6%	30.8%
2017	69.1%	39.0s%	12.7%	17.4%	30.9%
2019	68.7%	39.8%	12.2%	16.7%	31.3%

S o u r c e: Author's own elaboration based on Statistics Poland, 2019.

There is a greater guarantee of maintaining new jobs in the SME sector than in the case of large enterprises. Even in the period of recession, owing to their ability to quickly adapt to the conditions of environmental changes, SMEs can increase employment (Safin, 2012, p. 73). Small entrepreneurs also contribute to enhanced professional qualifications of employees, as opposed to large enterprises that rely on the staff of SMEs or take them over.

Small and medium-sized enterprises enable the growth of healthy competition, and thus, encourage entrepreneurs to create high-quality goods and services according to consumers' requirements (Tokarski, Tokarski and Voss, 2015, p. 11). They are able to flexibly adapt to changes in market

needs, especially to the demand, and fill the resulting market gaps which are unattractive for large enterprises by adjusting their production structure (Hajduk, 1998, pp. 156–157).

Foreign investments are also a positive phenomenon for SMEs. This sector is very attractive for foreign investors, while from the point of view of smaller entrepreneurs, it offers many new opportunities in terms of technological solutions, methods of operation, products and technologies (Strużycki, 2002, pp. 44–45).

SMEs play an important role in creating the conditions for economic life. By using local human resources and raw materials, as well as by feeding municipal budgets with taxes, they revive the local economy. Small entrepreneurs have greater opportunities to quickly establish contact with the environment, acquire regular customers, gain their trust and read their market preferences.

Despite favourable conditions for technological progress, the SME sector encounters many barriers in this regard. Table 2 presents weaknesses and strengths of SMEs.

Table 2. Weaknesses and strengths of SMEs in the field of innovation

Strengths	Weaknesses
Research effectiveness	Difficulty in getting capital
Quick response to internal needs	Level of inflation
No bureaucracy	Difficulties in applying for patent protection
Ability to quickly adapt to market requirements	Complicated laws and related transaction costs
Personally committed managers are open to new opportunities and are more prone to risk	Innovations are often characterized by disproportionately high financial risk

S o u r c e: Safin (ed.), 2012, p. 71.

The advantages of SMEs certainly include a lower impact on the natural environment compared to large enterprises. They follow a less aggressive and decentralized company policy. The research indicates that as the size of the enterprise increases, its negative impact on the environment also increases (Safin, 2012, p. 75–76). Günter Verheugen, Member of the European Commission, Commissioner for Enterprise and Industry, said that "micro, small and medium-sized enterprises are the engine of the European economy. They are the main source of employment, they inspire the spirit of entrepreneurship and innovation in the EU, and therefore are crucial for increasing competitiveness and employment."

The role played by the SME sector in the economy makes it a basis for the proper functioning of market economy. Currently, microenterprises are developing the most dynamically, demonstrating the highest profitability in relation to other enterprises. Despite many capital barriers, the SME sector has huge development opportunities. Since the growth of potential and competitiveness improvement depends to a large extent on access to capital, many financial programmes and institutions supporting the SME sector have been established in Poland. This resulted mainly from the Polish government's awareness of the importance of this sector for

innovation, economic growth, local development and employment improvement (Skowrońska and Tarnawa, 2018, p. 8).

3. Forms of taxation of small and medium-sized enterprises

One of the main obligations of every entrepreneur running a business is to settle the income tax regardless of the amount of income earned in a given year. The Accounting Act defines the types of enterprises from the SME sector (see: article 3), dividing them into micro, medium and small, and imposes obligations in the field of accounting and forms of settlements. Types of records for particular forms of taxation are presented in Table 3. In accordance with the tax law in force in Poland, entrepreneurs have the option of choosing the form they will use when settling the income obtained. These forms include (Tokarski, Tokarski and Voss, 2015, p. 8):

– tax card;
– lump-sum tax on registered revenues;
– general rules according to progressive rates or a flat rate.

The decision on the form of settlement is influenced by many factors, such as the size of the business, the amount of expected revenues and costs, and the type of business.

The lump-sum is associated with simplified accounting and flat tax rates. In case taxation in line with general terms has been chosen, one should choose the option of keeping accounting in full (accounting books) or in a simplified form (revenue and expense ledger) (Tokarski, Tokarski and Voss, 2015, p. 24). The forms of taxation of SMEs are presented in Figure 2 and Table 3.

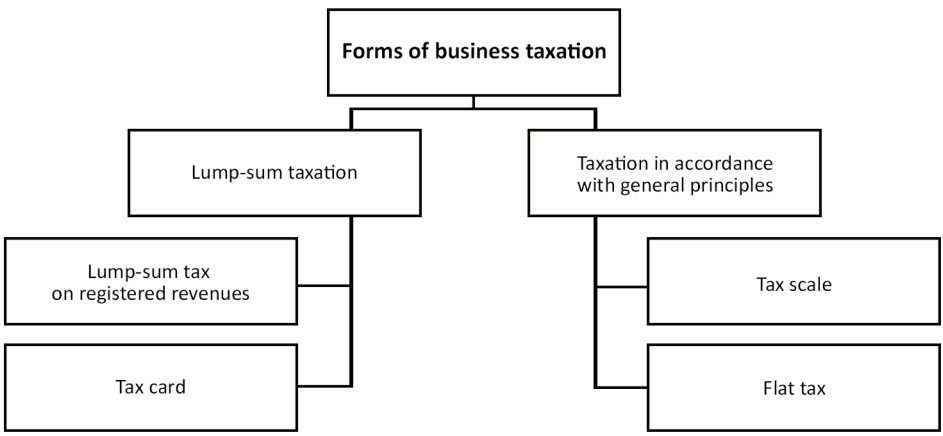

Figure 2. Forms of business taxation

S o u r c e: Author's own elaboration.

Table 3. Types of records for particular forms of taxation

<table>
<tr><td colspan="4">Form of taxation</td></tr>
<tr><td rowspan="2">Tax card</td><td rowspan="2">Lump-sum tax on registered revenues</td><td colspan="2">General rules (progressive or flat rate tax)</td></tr>
<tr><td>Revenue and expense ledger</td><td>Accounting books</td></tr>
<tr><td>Employment records</td><td>Income records</td><td>Revenue records</td><td>Revenue records</td></tr>
<tr><td>Employee payroll</td><td>Employee payroll</td><td>Purchase records</td><td>Purchase records</td></tr>
<tr><td>Sales value record</td><td>List of fixed assets and intangible assets</td><td>Expense records</td><td>Expense records</td></tr>
<tr><td rowspan="5">Storage of issued sales bills</td><td>Equipment inventory</td><td>Employee payroll</td><td>Cash records</td></tr>
<tr><td>Records for VAT purposes</td><td>Records of quantitative and qualitative record and consumption of fixed assets and intangible assets</td><td>Records of settlements with recipients and suppliers</td></tr>
<tr><td rowspan="4">Collecting proofs of purchase of goods, materials and finished products</td><td>Additional records of:
a) equipment
b) vehicle mileage
c) sales
d) loans and pawned property
e) records of purchase and sale of foreign exchange values</td><td>Records of quantitative and qualitative record and consumption of fixed assets and intangible assets</td></tr>
<tr><td rowspan="3">Records for VAT purposes</td><td>Employee payroll</td></tr>
<tr><td>Additional records of
a) vehicle mileage</td></tr>
<tr><td>Records for VAT purposes</td></tr>
</table>

S o u r c e: Martyniuk, 2006, p. 23.

4. Analysis of selected forms of taxation of small enterprises and their choices

Given the fact that SMEs play a very important role in the economy and provide a substantial part of budget revenues, an analysis of the forms of their tax settlement has been conducted.

The analysis of the data provided by the Central Statistical Office indicates that for small and medium-sized enterprises the dominant form of settlement is the tax revenue and expense ledger and accounting books (Figure 3).

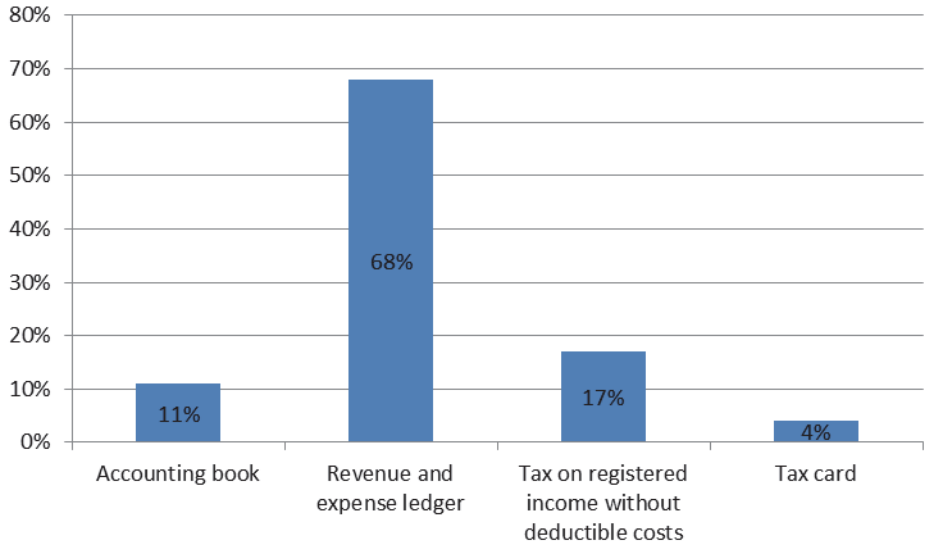

Figure 3. Forms of tax and accounting records in microenterprises 2018

S o u r c e: Author's own elaboration based on Statistics Poland, 2019.

The tax card has become the least popular form (4%), which has been losing its supporters in recent years.

In order to further explore the main reasons that guide entrepreneurs when choosing the form of tax and accounting records, a survey was carried out among the owners of SME enterprises, their employees from accounting departments and employees of accounting offices in Upper and Lower Silesia (Poland). 500 respondents were included in the survey. Among the respondents, 73% of the research population were micro-enterprises, 18% small enterprises and 9% medium-sized enterprises. Most of the enterprises operated in the service sector.

In the opinion of the respondents, the dominant reason for choosing a specific form of tax and accounting records was financial benefits, followed by a simplified method of keeping records. The results are shown in Figure 4.

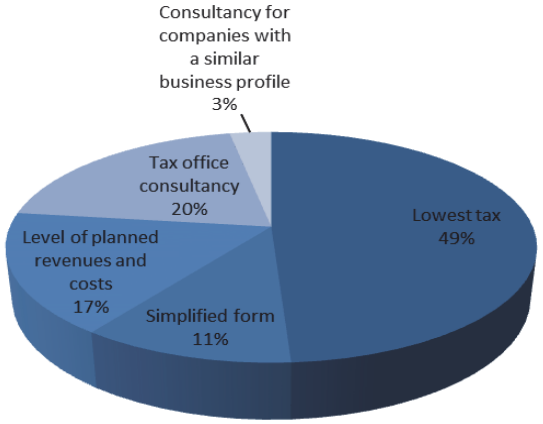

Figure 4. Criteria for selecting the form of tax and accounting records

S o u r c e: Author's own elaboration based on a questionnaire survey.

Next, in the research process, the respondents were asked to evaluate the advantages of the selected form of tax and accounting records. They could choose more than one answer. The obtained results indicate that the largest number of respondents—as many as 98%, consider the lowest tax liability and the simplified form of settlement (93%) as the greatest benefit. The opinions of the respondents are presented in Figure 5.

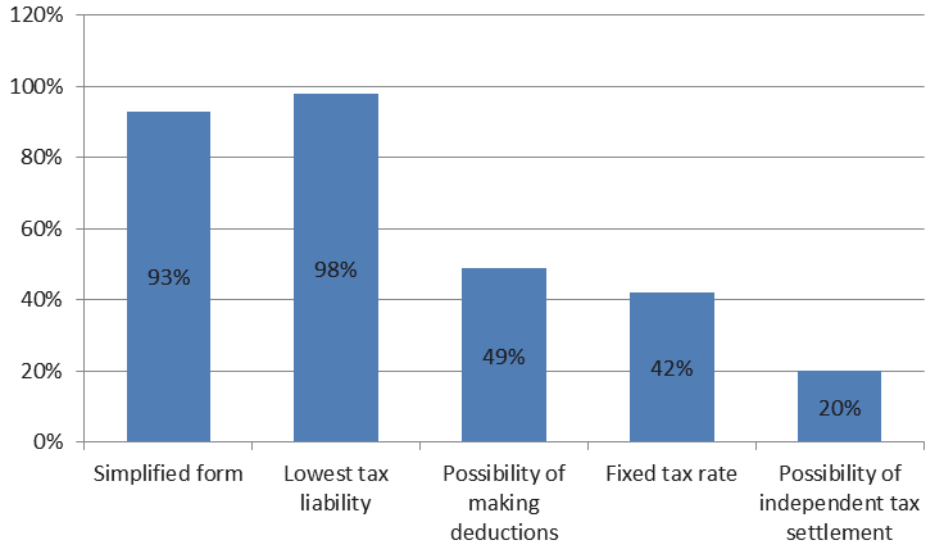

Figure 5. Advantages of the selected form of tax and accounting records

S o u r c e: Author's own elaboration based on a questionnaire survey.

In the last part of the research, the respondents identified the greatest difficulties and barriers which in their opinion were related to keeping of particular forms of tax records. They pointed to a limited scope of activity and high tax rates in comparison with the generated income. This is shown in Figure 6.

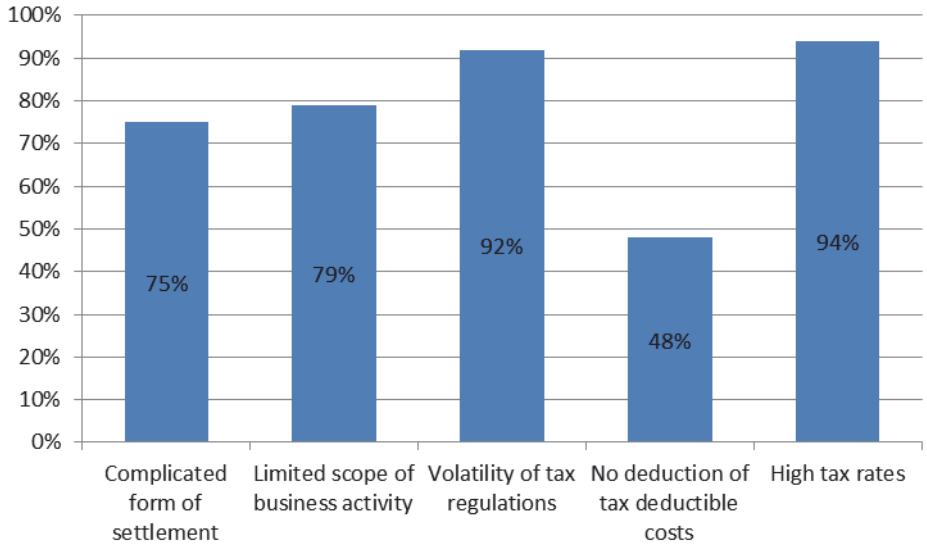

Figure 6. Barriers to keeping the selected form of tax and accounting records

S o u r c e: Author's own elaboration based on a questionnaire survey.

5. Conclusion

Considerations presented in the article do not solve the analyzed problem. It should be noted, however, that they are very important from the point of view of the interests of the economy and enterprises.

The aim of this study was to present the significance of the SMEs sector and the impact of factors determining whether the choice of a given type of income taxation (permitted by the legislator) is beneficial or even optimal for the enterprise, but also to show how important the SMEs sector is from the point of view of income inflow to the state budget. The considered analyses clearly illustrate the legitimacy of the choice of tax structures used by entrepreneurs.

When analyzing the data from the Central Statistical Office, it should be stated that the importance of enterprises of the SMEs group for the country's economy and economic growth is an undeniable fact. The dominant form of settlements of SMEs enterprises is the Tax Book of Income and Expenditure, while the least popular is the tax card. This is because most businesses cannot take advantage of it. The CSO research also shows that over 45% of GDP is made up of the SME service sector. After analyzing the surveys conducted as part of the project in Silesia, it should be stated that the main reason for choosing a specific form of tax and accounting records are financial benefits, and then the simplified method of keeping documentation. On the other hand, the main advantage of choosing a specific form of taxation, the respondents considered financial benefits, i.e. the smallest financial obligation and

a simplified form of settlements, and the biggest barrier was the volatility of regulations and complicated forms of settlements.

Thus, it should be stated that facilitating the operation and system of tax settlements will have an impact on the development of these enterprises, which will also contribute to increasing the economic growth of the country.

The choice of the form of business activity taxation is undoubtedly one of the most difficult decisions that every entrepreneur must take. Once a decision has been made, it is not necessarily the final choice, as the changing internal and external conditions of running a business may force the entrepreneur to change the way of settling tax liabilities. Then again, it is important information for the state, which is what entrepreneurs pay attention to. This subject seems to be very important in the changing economic conditions, especially in the era of globalization and free flow of capital.

References

Act of 26 July 1991 on personal income tax. Consolidated text: Journal of Laws of 2020, item 1426 [= Ustawa z dnia 26 lipca 1991 r. o podatku dochodowym od osób fizycznych. Dz.U. 2020, 1426].

Act of 15 February 1992 on corporate income tax. Consolidated text: Journal of Laws of 2020, item 1406, as amended [= Ustawa z 15 lutego 1992 r. o podatku dochodowym od osób prawnych. Dz.U. 2020, 1406].

Act of 29 September 1994 on accountancy. Consolidated text: Journal of Laws of 2019, item 351 [= Ustawa z dnia 29 września 1994 r. o rachunkowości. Dz.U. 2019, 351].

Begg, D., Vernasca, G., Fischer, S., Dornbusch, R. (2014). *Economics*. Maidenhead: McGraw-Hill Education. ISBN 9780077154516.

Borowiecki, R., Siuta-Tokarska, B. (2008). *Problemy funkcjonowania i rozwoju małych i średnich przedsiębiorstw w Polsce: synteza badań i kierunki działania*. Warszawa: Difin. ISBN 9788372519757.

EC. (2019). *Entrepreneurship and small and medium-sized enterprises (SMEs)* [online, accessed: 2020-09--01]. European Commission. Retrieved from: https://ec.europa.eu/growth/smes_pl.

Felis, P. (2010). Podstawowe elementy opodatkowania. In: P. Felis, M. Jamroży, J. Szlęzak-Matusewicz. *Podatki i składki w działalności przedsiębiorców* (pp. 15–33). Warszawa: Difin. ISBN 9788376411873.

Gomułka, S. (1998). *Teoria innowacji i wzrostu gospodarczego*. Warszawa: Centrum Analiz Społeczno-Ekonomicznych. ISBN 8371781121.

Gomułowicz, A., Małecki, J. (2000). *Podatki i prawo podatkowe dla studentów i praktyków*. Poznań: Ars Boni et Aequi. ISBN 8387148156.

Hajduk, I. (1998). Mała przedsiębiorczość: dylematy rozwoju małych i średnich przedsiębiorstw. In: B. Wawrzyniak (ed.). *Raport o zarządzaniu: polskie przedsiębiorstwa i menedżerowie wobec wyzwań XXI wieku* (pp. 154–169). Warszawa: Wyższa Szkoła Przedsiębiorczości i Zarządzania im. Leona Koźmińskiego. ISBN 8386846208.

KE. (2020). *Entrepreneurship and small and medium-sized enterprises (SMEs)* [online, accessed: 2020-09--01]. Komisja Europejska. Retrieved from: https://ec.europa.eu/growth/smes_pl.

Kosek-Wojnar, M. (2012). *Zasady podatkowe w teorii i praktyce*. Warszawa: Polskie Wydawnictwo Ekonomiczne. ISBN 9788320820362.

Kosikowski, C. (1992). Podatek jako instytucja ustrojowo-prawna. In: C. Kosikowski, T. Dębowska-Romanowska (eds.). *System podatkowy: zagadnienia teoretycznoprawne*. Łódź: Wydawnictwo Uniwersytetu Łódzkiego,

Marciniak, S. (ed.). (2001). *Makro- i mikroekonomia: podstawowe problemy*. Warszawa: Wydawnictwo Naukowe PWN. ISBN 8301133066.

Safin, K. (ed.). (2012). *Zarządzanie małym i średnim przedsiębiorstwem*. Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego. ISBN 9788376952086.

Skowrońska, A., Tarnawa, A. (ed.). (2018). *Raport o stanie sektora małych i średnich przedsiębiorstw w Polsce*. Warszawa: Polska Agencja Rozwoju Przedsiębiorczości, Warszawa.

Statistics Poland. (2019). *Statistical Yearbook of the Republic of Poland 2019*. Warsaw: Statistics Poland. ISSN 1506-0632.

Statistics Poland. (2020). *The activities of non-financial enterprises in Poland in 2019* [online, accessed: 2020-11-20]. Warsaw: Statistics Poland. Retrieved from: https://stat.gov.pl/en/topics/economic-activities-finances/activity-of-enterprises-activity-of-companies/financial-results-of-non-financial-enterprises--in-the-first-quarter-of-2020,5,36.html.
Strużycki, M. (ed.). (2002). *Zarządzanie małym i średnim przedsiębiorstwem: uwarunkowania europejskie*. Warszawa: Difin. ISBN 8372512590.
Tokarski, A., Tokarski, M., Voss, G. (2015). *Księgowość w małej i średniej firmie. Uproszczone formy ewidencji*. Warszawa: CeDeWu. ISBN 9788375567335.
WE. (2006). *Nowa definicja MŚP: poradnik dla użytkowników i wzór oświadczenia* [online, accessed: 2020--10-15]. Luksemburg: Urząd Oficjalnych Publikacji Wspólnot Europejskich. ISBN 9789289479233. Retrieved from: https://www.parp.gov.pl/files/74/87/1155.pdf.
Wolański, R. (2016). *System podatkowy w Polsce*. Warszawa: Wolters Kluwer. ISBN 9788326495816.

Wybór formy opodatkowania w małych i średnich przedsiębiorstwach i ich znaczenie dla wzrostu gospodarczego kraju

Abstrakt: Podejmując decyzję o rozpoczęciu działalności, każdy przedsiębiorca zmuszony jest do wyboru formy opodatkowania dochodów z działalności gospodarczej, co w dużej mierze wpływa na wysokość podatków wpłacanych do budżetu, a tym samym na wzrost gospodarczy. Celem artykułu jest przedstawienie znaczenia sektora małych i średnich przedsiębiorstw dla gospodarki, pokazanie form ich opodatkowania oraz dokonanego przez nie wyboru i jego wpływu na wysokość obciążeń podatkowych. Zastosowane metody badawcze opierają się na studiach literatury z badanego zakresu oraz na przeprowadzonych badaniach ankietowych. W celu poznania przyczyn, którymi kierują się przedsiębiorcy przy wyborze formy ewidencji podatkowo-księgowej, przeprowadzono badanie ankietowe wśród właścicieli przedsiębiorstw MSP, ich pracowników z działów księgowych oraz pracowników biur rachunkowych na Dolnym i Górnym Śląsku. Ankietą objęto 500 respondentów. Analizując dane GUS, należy stwierdzić, że dominującą formą rozliczeń przedsiębiorstw MSP jest PKPiR, natomiast najmniej popularna jest karta podatkowa. Wynika to z faktu, że większość przedsiębiorstw nie może z niej skorzystać. Analiza wyników ankiety wskazuje, że głównym powodem wyboru określonej formy ewidencji podatkowo-księgowej są korzyści finansowe, a następnie uproszczony sposób prowadzenia dokumentacji. Za największą barierę respondenci uznali zmienność przepisów oraz skomplikowane formy rozliczeń. Można zatem przyjąć, że uproszczenie systemu rozliczeń podatkowych wpłynie na rozwój przedsiębiorstw i w rezultacie przyczyni się do wzrostu gospodarczego.

Słowa kluczowe: system podatkowy, wzrost gospodarczy, PKB, podatki, małe i średnie przedsiębiorstwa, wybór form opodatkowania

Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie
The Małopolska School of Economics in Tarnów Research Papers Collection
ISSN 1506-2635, e-ISSN 2658-1817
2020, 48(4), 49–58
DOI: 10.25944/znmwse.2020.04.4958
© 2020 MWSE, distributed under the Creative Commons Attribution 4.0 International License (CC BY-NC-ND 4.0)

Shaping entrepreneurial intentions: The impact of entrepreneurship education on university students

Alexandros G. Sahinidis

University of West Attica, Greece
E-mail: asachinidis@uniwa.gr

Panagiotis A. Tsaknis

University of West Attica, Greece
E-mail: panagiotis_tsaknis@windowslive.com

Abstract: The purpose of this paper is to investigate the impact of entrepreneurship education on university students' entrepreneurial intentions. The study attempts to empirically determine the extent to which entrepreneurship education can shape students' entrepreneurial intentions. A questionnaire-based survey is used to test the hypotheses examined. A pre-test-post-test group design was adopted to measure the change in students' attitude, subjective norms, Perceived Behavioural Control (PBC) and entrepreneurial intention using the Theory of Planned Behavior (TPB). A questionnaire was completed by 210 business students (out of 400), studying at a public university based in Athens, Greece, at the beginning of their 13-week compulsory course in Entrepreneurship. A second questionnaire was re-sent to the same students at the end of the course and they were asked to complete it. The second questionnaire was completed by 158 students from the original respondent group. The student participation was voluntary at both times. The sample was a convenience one given that the resources available were limited. The findings lent support to the theory and the hypotheses proposed. The authors report that attitude, PBC and entrepreneurial intention can be positively influenced by entrepreneurial education.

Keywords: entrepreneurial education, entrepreneurial intention, entrepreneurship programmes, Theory of Planned Behavior, attitude, Perceived Behavioral Control, subjective norms

1. Introduction

Entrepreneurship education is a concept that has been steadily evolving in recent decades, highlighting business culture, and creating policies and practices that promote the development of entrepreneurial thinking and behaviours. Entrepreneurial education is linked to the creation of business ecosystems and contributes to the sustainable socio-economic development (NCEE, 2010). Entrepreneurship courses are incorporated in the curriculum of universities and schools of secondary or primary education. In universities, entrepre-

Financed by:
Małopolska School of Economics in Tarnów with support of the Ministry of Science and Higher Education ("Support for scientific journals")

Correspondence to:
Alexandros G. Sahinidis
University of West Attica
Agiou Spyridonos 2
Aigaleo 12210, Greece
Tel.: +30 210 538 11 86

neurship programmes are rapidly proliferating at both undergraduate and post-graduate levels. Beyond the educational system, there are also courses and programmes targeting specific audiences and social groups. Promoting entrepreneurship is considered a key feature of theories related to economic growth and structural changes in economies. Based on this proposal, entrepreneurial education could be identified as an effective strategy to promote starting new businesses (Liñán, 2004).

2. Entrepreneurial education

University programmes on entrepreneurship are designed to promote entrepreneurship by enhancing students' entrepreneurial intention (Galloway and Brown, 2002; Fayolle and Gailly, 2009; Secundo and Elia, 2014; Secundo et al., 2017; Souitaris, Zerbinati and Al-Laham 2007; Rodrigues et al., 2010; Bae et al., 2014), so that new graduates can effectively pursue their careers as entrepreneurs if they chose to do so (Sahinidis et al., 2020a). Entrepreneurial education influences entrepreneurial intention and creates the capacity for flexibility, willingness to conceptualize thinking, imagination, creativity and the perception of change as an opportunity (Timmons and Spinelli, 2004). Beyond the goals of research and teaching (the production and dissemination of knowledge at the individual level), universities are increasingly involved in supporting the nurturing of new entrepreneurs by enhancing their role in the development of entrepreneurship (Sánchez and Elena, 2006; Laredo, 2007). They support entrepreneurship through initiatives aimed at creating new businesses and spreading the scientific and entrepreneurial culture (Laredo, 2007; Fini et al., 2011). Entrepreneurship education aims to provide the knowledge (through training courses, workshops, and business plan competitions) and skills that trainees need to successfully handle managerial and financial problems (Kolvereid and Moen, 1997; Fayolle and Gailly, 2015). Entrepreneurship education encourages individuals by empowering their entrepreneurial intention prior to the creation of new businesses, while providing the guideposts for the realization of their endeavour (Liñán and Chen, 2009; Liñán, Urbano and Guerrero, 2011). While this issue has been widely studied in several countries, in Greece it has not received analogous attention. This study contributes to the literature regarding the factors influencing entrepreneurial intention, providing empirical evidence that concerns teachers, students, universities and policymakers. This paper provides insights and corroborates previous findings in which entrepreneurship programmes have a positive effect on students' intention to start their own business.

3. Theory of Planned Behavior

Theory of Planned Behavior (TPB) is probably one of the most widely used models of entrepreneurial intention to this day. TPB describes and predicts human behaviour of their intentions to perform an action. Numerous research work has used it to improve our understanding of the entrepreneurial intention of students (Souitaris et al., 2007; Fayolle and Gailly, 2015; Sahinidis et al., 2019; Sahinidis, Polychronopoulos and Kallivokas, 2019; Shook and Bratianu, 2008; Gird and Bagraim, 2008; Veciana, Aponte and Urbano, 2005; Segal, Borgia and Schoenfeld, 2005) and of other categories of individuals (Tsaknis and Sahinidis, 2020;

Sahinidis et al., 2020b). According to TPB, a person's intention to participate in the business process is primarily shaped by three factors: personal attitude, subjective norms and PBC.

Attitude is determined by the individuals' beliefs about outcomes or attributes of performing the behaviour (behavioural beliefs), weighted by evaluations of those outcomes or attributes. Thus, a person who has strong beliefs that positive outcomes will result from performing such behaviour will have a positive attitude towards it. Conversely, a person who has strong beliefs that the results will be negative—will have a negative attitude towards the behaviour (Tsaknis and Sahinidis, 2020).

Subjective norms refer to perceived social pressure from society as well as family and friends. A person's subjective norms are determined by his or her normative beliefs (important referent individuals approve or disapprove of performing the behaviour) weighted by the person's motivation to comply with those referents. A person who believes that certain referents think that he or she should perform a behaviour and who is motivated to meet their expectations will hold a positive subjective norm. Conversely, a person who believes that these referents think he or she should not perform the behaviour—will have a negative subjective norm, and a person who is less motivated to comply with those referents will have a relatively neutral subjective norm (Glanz, Rimer and Viswanath, 2015).

Perceived Behavioural Control (PBC) is defined by control beliefs in connection with the presence or absence of barriers in the behavioural performance (this refers to the extent to which a person feels capable to perform a behaviour), weighted by the perceived power (the impact of each control factor to facilitate or prevent behaviour). The integration of the perceived control by Ajzen was based on the idea that the behavioural performance is defined by the motivations (intention) and the abilities (behavioural control). Fishbein and Ajzen (2010) proposed that Perceived Behavioral Control and self-efficacy, as defined by Bandura, constitute the same theoretical construct. Self-efficacy refers to judgments on how well one can perform actions required to handle future situations (Bandura, 1982). Self-efficacy has been linked to opportunity identification, risk-taking, and it has been found to be positively related to global feasibility perceptions (Krueger, Reilly and Carsrud, 2000). An individual's perception concerning control of the performance of the behaviour, together with the intention, are expected to have direct impact on the behaviour, especially when Perceived Behavioral Control constitutes an accurate estimation of real behavioural control and when the volitional control is not high. In situations where volitional control is high, the impact of the perceived control is reduced and the intention is a sufficient behaviour predicting factor (Tsaknis and Sahinidis, 2020).

Several meta-analyses and the majority of the studies using mostly the TPB support the hypothesis that entrepreneurship education has a positive impact on entrepreneurial intention and it does so to its antecedents (Galloway and Brown, 2002; Sahinidis et al., 2019; Lorz, Mueller and Volery, 2011; Autio et al., 2001). Most studies did point to some extent a positive relationship between entrepreneurship education and entrepreneurial intention and its antecedents, skills and other outcomes (Lorz et al., 2011; Nabi et al., 2017; Nabi et al., 2018; Liu et al., 2019; Nowiński et al., 2019; Vodă and Florea, 2019). The approach taken in this study is that of Ajzen's Theory of Planned Behavior, leading us to the examination of the relationships between entrepreneurial intention and attitude, entrepreneurial intention and Perceived Behavioral Control.

The hypotheses derived from the literature review are the following:
H1: There is a significant relationship between entrepreneurship education and students intentions.
H2: Entrepreneurship education will have a positive effect on attitude.
H3: Entrepreneurship education will have a positive effect on subjective norms.
H4: Entrepreneurship education will have a positive effect on Perceived Behavioral Control.

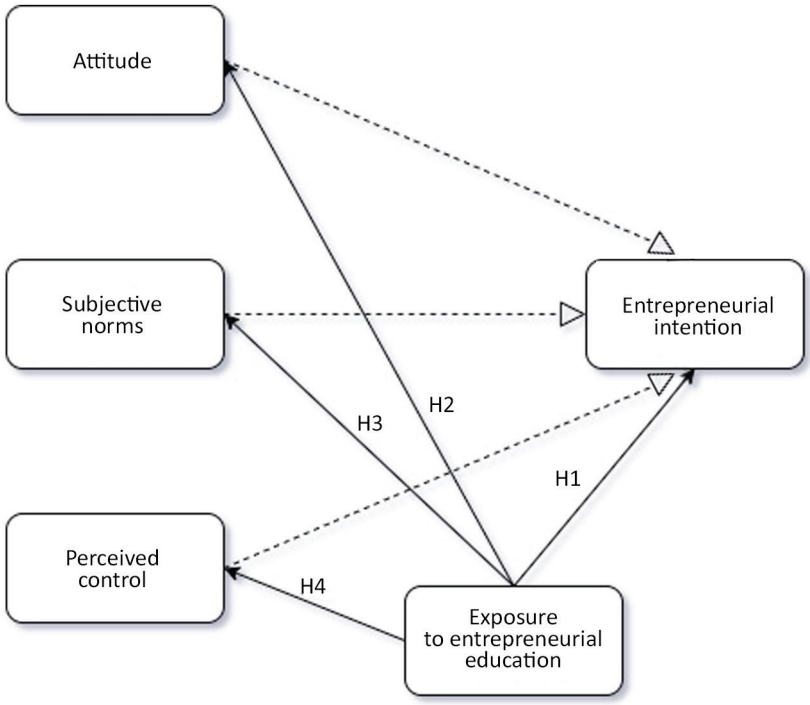

Figure 1. Research model

S o u r c e: Authors' own elaboration.

The diagram above shows the hypotheses that have been formed. Dotted lines show the relationship of the TPB variables towards entrepreneurial intention, with the intervening variable of entrepreneurial education. In other words, a pre-test-post-test group design was adopted to measure the change in students' attitude, subjective norms, PBC and entrepreneurial intention.

4. Methods

In order to analyze the most recent literature, a thorough search was conducted in all relevant studies that are available so far. The areas of the study consist of online databases, magazines and any other areas that fully cover the scope of this study. Furthermore, there was an extensive search, based on the existing literature, on the impact of entrepreneurial education on entrepreneurial intention and its antecedents.

The 158 students participating in the study (81 females and 77 males) were attending their third semester at the Department of Business Administration of a large university and enrolled in a compulsory Entrepreneurship course. The course was designed to familiarize students with concepts pertinent to entrepreneurship, provide them with some basic understanding of the skills and knowledge required for making of a successful entrepreneur and exposing them to real-life examples, local and international, so as to appreciate the theory and practice of the subject. The course included lectures based on a textbook, writing of a business plan and a visit of two guest speakers representing their start-up companies, aiming to present the students the entrepreneurship career option.

After determining the initial aim and orientation of the proposed study and given its complexity, the questionnaire method is deemed as appropriate to get answers to the questions raised. In order to determine the relationship between the variables stated in the hypotheses above and entrepreneurial education, 19 questions were used (7-point Likert scale). A pre-test-post-test group design was adopted to measure the change in students' attitude, subjective norms, Perceived Behavioral Control and entrepreneurial intention. The group participating in this study was voluntarily tested at both times. The first questionnaire was completed by 210 business students (out of 400 taking the course), who are studying at a public Greek university based in Athens, at the beginning of their 13-week compulsory course in Entrepreneurship. At the end of the course the questionnaire was re-sent to the students who responded to the first one (158 students responded to the second questionnaire). The sample was a convenience one given that the resources available were limited. The size of the sample allows us to proceed with reliable statistical analyses and produce valid conclusions. Subsequently, a paired sample T-test analysis was used to measure and test our hypotheses twice resulting in pairs. The data was empirically tested using the SPSS software version 24. Through a literature review, the results of our research were compared with those of similar studies from other countries.

5. Results and findings

Table 1 presents paired samples statistics and Table 2 presents the differences in the measurements of attitude, subjective norms, Perceived Behavioral Control and entrepreneurial intention, before and after the end of the Entrepreneurship one semester course. As expected, the first hypothesis was not rejected, leading us to the conclusion that entrepreneurial education does have a significant effect on entrepreneurial intention (Sahinidis et al., 2019, pp. 35–36). The second hypothesis is also accepted, with entrepreneurship education relating positively to attitude, lending support to earlier findings (Bae et al., 2014; Sahinidis et al., 2019; Pittaway and Cope, 2007; Brandstätter, 2011). The third hypothesis is not supported in our analysis (p value > 0.05), showing no significant relationship between entrepreneurship education and subjective norms (Sahinidis et al., 2019). The fourth hypothesis proposing a positive relationship of entrepreneurial education and Perceived Behavioral Control is accepted, corroborating the findings of earlier studies (Sahinidis et al., 2019; Pittaway and Cope, 2007; Brandstätter, 2011).

Table 1. Paired samples statistics

		Mean	N	Std. deviation	Std. error mean
Pair 1	Attitude post-test	5.4367	158	1.14768	0.09130
	Attitude pre-test	5.104	158	1.1434	0.910
Pair 2	Subjective norms post-test	4.959915612	158	1.214944449	0.0966557906
	Subjective norms pre-test	5.109704641	158	1.450501067	0.1153956689
Pair 3	Perceived behavioural control post-test	4.358	158	1.1887	0.0946
	Perceived behavioural control pre-test	4.000	158	1.2108	0.0963
Pair 4	Intention post-test	4.813080169	158	1.565922647	0.1245781168
	Intention pre-test	4.449367089	158	1.531540175	0.1218427942

S o u r c e: Authors' own elaboration.

Table 2. Paired samples test

		Mean	Std. deviation	Std. error mean	95% confidence interval of the difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Attitude post-test– Attitude pre-test	0.33291	0.72340	0.5755	0.21924	0.44658	5.785	157	0.000
Pair 2	Subjective norms post-test– Subjective norms pre-test	−0.149789030	1.405956124	0.1118518636	−0.370717618	0.711395593	−1.339	157	0.182
Pair 3	Perceived behavioural control post-test– Perceived behavioural control pre-test	0.3582	1.0549	0.839	0.1925	0.5240	4.268	157	0.000
Pair 4	Intention post-test– Intention pre-test	0.3637130802	1.033140724	0.0821922629	0.2013678133	0.5260583471	4.425	157	0.000

S o u r c e: Authors' own elaboration.

Based on the findings of this study, entrepreneurship education can shape students' entrepreneurial intentions through affecting positively attitude and Perceived Behavioral Control. It can be concluded that entrepreneurial education affects students' entrepreneurial intentions in isolation from other factors but interacts with the factors that shape entrepreneurial intentions. This study corroborated the efficacy of TPB in explaining the relationship between entrepreneurship education and the factors that shape students entrepreneurial intentions. Also, this study could be used by researchers to evaluate the effectiveness of entrepreneurship programmes in fostering students' entrepreneurial intentions.

6. Conclusions

The improvement in entrepreneurship education programmes provided by universities is linked to greater levels of entrepreneurial intention as predicted by the Theory of Planned Behavior. Entrepreneurship education enables one to become familiar with entrepreneurial logic, the challenges and processes involved in entrepreneurship. In addition to transferring knowledge on entrepreneurship and successful business management practices, university entrepreneurship education entails the configuration of a favourable micro-environment for developing a business model, providing a network of relationships with other research centres, businesses and counselors (Laredo, 2007; Kavoura and Kozioł 2017). The positive relationship of the effects of university entrepreneurship education on entrepreneurial intention is clear and all stakeholders involved are called to act upon the proven relationship of entrepreneurship education and the outcomes it delivers (Fayolle and Gailly, 2015; Liñán et al., 2011). Higher levels of entrepreneurial intention can be achieved through the knowledge provided by higher and secondary education (Sánchez and Elena, 2006). The availability of business knowledge is seen as a key component that encourages self-employment. It is argued that knowledge related to starting a business has a positive impact on entrepreneurial intention and further the probability of success of the new venture (Secundo et al., 2017). Therefore, the higher the entrepreneurial education level, the higher the direct or indirect impact on the entrepreneurial intention (Galloway and Brown, 2002; Souitaris et al., 2007; Bae et al., 2014).

References

Autio, E., Keeley, R., Klofsten, M., Parker, G., Hay, M. (2001). Entrepreneurial intent among students in Scandinavia and in the USA. *Enterprise and Innovation Management Studies*, *2*(2), 145–160. DOI: 10.1080/14632440110094632.

Bae, T. J., Qian, S., Miao, C., Fiet, J. O. (2014). The relationship between entrepreneurship education and entrepreneurial intentions: A meta-analytic review. *Entrepreneurship Theory and Practice*, *38*(2), 217–254. DOI: 10.1111/etap.12095.

Bandura, A. (1982). The assessment and predictive generality of self-percepts of efficacy. *Journal of Behavior Therapy and Experimental Psychiatry*, *13*(3), 195–199. DOI: 10.1016/0005-7916(82)90004-0.

Brandstätter, H. (2011). Personality aspects of entrepreneurship: A look at five meta-analyses. *Personality and Individual Differences*, *51*(3), 222–230. DOI: 10.1016/j.paid.2010.07.007.

Fayolle, A., Gailly, B. (2009). Assessing the impact of entrepreneurship education: A methodology and three experiments from French engineering schools. In: de G. Page West III, E. J. Gatewood, K. G. Shaver (eds.). *Handbook of university-wide entrepreneurship education* (pp. 203–214). Cheltenham: Edward Elgar Publishing. ISBN 9781847204554.

Fayolle, A., Gailly, B. (2015). The impact of entrepreneurship education on entrepreneurial attitudes and intention: Hysteresis and persistence. *Journal of Small Business Management*, *53*(1), 75–93. DOI: 10.1111/jsbm.12065.

Fini, R., Grimaldi, R., Santoni, S., Sobrero, M. (2011). Complements or substitutes? The role of universities and local context in supporting the creation of academic spin-offs. *Research Policy*, *40*(8), 1113–1127. DOI: 10.1016/j.respol.2011.05.013.

Fishbein, M., Ajzen, I. (2010). Predicting and Changing Behavior. New York: Psychology Press. DOI: 10.4324/9780203838020.

Galloway, L., Brown, W. (2002). Entrepreneurship education at university: A driver in the creation of high growth firms? *Education Training*, *44*(8/9), 398–405. DOI: 10.1108/00400910210449231.

Gird, A., Bagraim, J. J. (2008). The Theory of Planned Behaviour as predictor of entrepreneurial intent amongst final-year university students. *South African Journal of Psychology*, *38*(4), 711–724. DOI: 10.1177/008124630803800410.

Glanz, K., Rimer, B. K., Viswanath, K. (2015). Health behavior: Theory, research, and practice. San Francisco, CA: Jossey-Bass. ISBN 9781118628980.

Kavoura, A., Kozioł, L. (2017). Polish firms' innovation capability for competitiveness via information technologies and social media implementation. In: A. Vlachvei, O. Notta, K. Karantininis, N. Tsountas (eds.). *Factors affecting firm competitiveness and performance in the modern business world* (pp. 185–214). Hershey: IGI Global. DOI: 10.4018/978-1-5225-0843-4.ch007.

Kolvereid, L., Moen, Ø. (1997). Entrepreneurship among business graduates: Does a major in entrepreneurship make a difference? *Journal of European Industrial Training*, *21*(4), 154–160. DOI: 10.1108/03090599710171404.

Krueger, N. F., Reilly, M. D., Carsrud, A. L. (2000). Competing models of entrepreneurial intentions. *Journal of Business Venturing*, *15*(5–6), 411–432. DOI: 10.1016/s0883-9026(98)00033-0.

Laredo, P. (2007). Revisiting the third mission of universities: Toward a renewed categorization of university activities? *Higher Education Policy*, *20*(4), 441–456. DOI: 10.1057/palgrave.hep.8300169.

Liñán, F. (2004). Intention-based models of entrepreneurship education. *Piccolo Impresa/Small Business*, *2*, 1–35.

Liñán, F., Chen, Y.-W. (2009). Development and cross-cultural application of a specific instrument to measure entrepreneurial intentions. *Entrepreneurship Theory and Practice*, *33*(3), 593–617. DOI: 10.1111/j.1540--6520.2009.00318.x.

Liñán, F., Urbano, D., Guerrero, M. (2011). Regional variations in entrepreneurial cognitions: Start-up intentions of university students in Spain. *Entrepreneurship and Regional Development*, *23*(3–4), 187–215. DOI: 10.1080/08985620903233929.

Liu, X., Lin, C., Zhao, G., Zhao, D. (2019). Research on the effects of entrepreneurial education and entrepreneurial self-efficacy on college students' entrepreneurial intention. *Frontiers in Psychology*, *10*, 869. DOI: 10.3389/fpsyg.2019.00869.

Lorz, M., Mueller, S., Volery, T. (2011). Entrepreneurship education: A meta-analysis of impact studies and applied methodologies. In: Conference paper, FGF G-forum 2011. Förderkreis Gründungs-Forschung E. V. Bonn. DOI: 10.1504/IJEV.2015.073648.

Nabi, A., Liñán, F., Fayolle, A., Krueger, N., Walmsley, W. (2017). The impact of entrepreneurship education in higher education: A systematic review and research agenda. *Academy of Management Learning and Education*, *16*(2), 277–299. DOI: 10.5465/amle.2015.0026.

Nabi, G., Walmsley, A., Liñán, F., Akhtar, I., Neame, C. (2018). Does entrepreneurship education in the first year of higher education develop entrepreneurial intentions? The role of learning and inspiration. *Studies in Higher Education*, *43*, 452–467. DOI: 10.14419/ijet.v7i4.9.20631.

NCEE (2010). *Entrepreneurial University of the Year 2010/2011* [online, accessed: 2014-04-15]. Retrieved from http://ncee.org.uk/publications.

Nowiński, W., Haddoud, M. Y., Lančarič, D., Egerová, D., Czeglédi, C. (2019). The impact of entrepreneurship education, entrepreneurial self-efficacy and gender on entrepreneurial intentions of university students in the Visegrad countries. *Studies in Higher Education*, *44*(2), 361–379. DOI: 10.1080/03075079.2017.1365359.

Pittaway, L., Cope, J. (2007). Entrepreneurship education: A systematic review of the evidence. *International Small Business Journal*, *25*(5), 479–510. DOI: 10.1177/0266242607080656.

Rodrigues, R. G., Raposo, M., Ferreira, J., Paco, A. D. (2010). Entrepreneurship education and the propensity for business creation: Testing a structural model. *International Journal of Entrepreneurship and Small Business*, *9*(1), 58. DOI: 10.1504/ijesb.2010.029506.

Sahinidis, A. G., Tsaknis, P. A., Gkika, E., Stavroulakis, D. (2020b). The influence of the big five personality traits and risk aversion on entrepreneurial intention. In: A. Kavoura, E. Kefallonitis, P. Theodoridis (eds.). *Strategic innovative marketing and tourism* (pp. 215–224). Cham: Springer International Publishing. DOI: 10.1007/978-3-030-36126-6_24.

Sahinidis, A., Gkika, E., Tsaknis, P. A., Stavroulakis, D. (2020a). Personality type and career preferences among young adults in post-recession Greece. In: A. Kavoura, E. Kefallonitis, P. Theodoridis (eds.). *Strategic innovative marketing and tourism* (pp. 1089–1095). Cham: Springer International Publishing. DOI: 10.1007/978-3-030-36126-6_121.

Sahinidis, A., Polychronopoulos, G., Kallivokas, D. (2019). Entrepreneurship education impact on entrepreneurial intention among tourism students: A longitudinal study. In: A. Kavoura, E. Kefallonitis, A. Giovanis (eds.). *Strategic innovative marketing and tourism* (pp. 1245–1250). Cham: Springer International Publishing. DOI: 10.1007/978-3-030-12453-3_142.

Sahinidis, A., Stavroulakis, D., Kossieri, E., Varelas, S. (2019). Entrepreneurial intention determinants among female students: The influence of role models, parents' occupation and Perceived Behavioral Control on forming the desire to become a business owner. In: A. Kavoura, E. Kefallonitis, A. Giovanis (eds.). *Strategic Innovative Marketing and Tourism* (pp. 173–178). Cham: Springer International Publishing. DOI: 10.1007/978-3030-12453-3_20.

Sánchez, M. P., Elena, S. (2006). Intellectual capital in universities. *Journal of Intellectual Capital*, *7*(4), 529–548. DOI: 10.1108/14691930610709158.

Secundo, G., Beer, C. D., Schutte, C. S., Passiante, G. (2017). Mobilising intellectual capital to improve European universities' competitiveness. *Journal of Intellectual Capital*, *18*(3), 607–624. DOI: 10.1108/jic-12-2016-0139.

Secundo, G., Elia, G. (2014). A performance measurement system for academic entrepreneurship: A case study. *Measuring Business Excellence*, *18*(3), 23–37. DOI: 10.1108/mbe-11-2013-0061.

Secundo, G., Vecchio, P. D., Schiuma, G., Passiante, G. (2017). Activating entrepreneurial learning processes for transforming university students' idea into entrepreneurial practices. *International Journal of Entrepreneurial Behavior & Research*, *23*(3), 465–485. DOI: 10.1108/ijebr-12-2015-0315.

Segal, G., Borgia, D., Schoenfeld, J. (2005). The motivation to become an entrepreneur. *International Journal of Entrepreneurial Behavior & Research*, *11*(1), 42–57. DOI: 10.1108/13552550510580834.

Shook, C. L., Bratianu, C. (2008). Entrepreneurial intent in a transitional economy: An application of the Theory of Planned Behavior to Romanian students. *International Entrepreneurship and Management Journal*, *6*(3), 231–247. DOI: 10.1007/s11365-008-0091-2.

Souitaris, V., Zerbinati, S., Al-Laham, A. (2007). Do entrepreneurship programmes raise entrepreneurial intention of science and engineering students? The effect of learning, inspiration and resources. *Journal of Business Venturing*, *22*(4), 566–591. DOI: 10.1016/j.jbusvent.2006.05.002.

Timmons, J., Spinelli, S. (2004). *New venture creation*. 6th ed. Chicago: Irwin.

Tsaknis, P. A., Sahinidis, A. G. (2020). An investigation of entrepreneurial intention among university students using the Theory of Planned Behavior and parents' occupation. In: A. Masouras, G. Maris, A. Kavoura (eds.). *Entrepreneurial development and innovation in family businesses and SMEs* (pp. 149–166). Hershey, PA: IGI Global. DOI: 10.4018/978-1-7998-3648-3.ch009.

Veciana, J. M., Aponte, M., Urbano, D. (2005). University students' attitudes towards entrepreneurship: A two countries comparison. *The International Entrepreneurship and Management Journal*, *1*(2), 165–182. DOI: 10.1007/s11365-005-1127-5.

Vodă, A. I., Florea, N. (2019). Impact of personality traits and entrepreneurship education on entrepreneurial intentions of business and engineering students. *Sustainability*, *11*(4), 1192. DOI: 10.3390/su11041192.

Kształtowanie planów zawodowych. Wpływ edukacji z zakresu przedsiębiorczości na intencje przedsiębiorcze studentów uczelni wyższych

Abstrakt: Celem artykułu jest zbadanie wpływu edukacji z zakresu przedsiębiorczości na intencje przedsiębiorcze i plany zawodowe studentów. W pracy podjęto próbę empirycznego określenia stopnia, w jakim edukacja z zakresu przedsiębiorczości może kształtować intencje przedsiębiorcze studentów. Do weryfikacji postawionych hipotez wykorzystano badanie ankietowe. W celu pomiaru zmiany w postawach studentów, subiektywnych normach, postrzeganej kontroli behawioralnej i zamiarach związanych z przedsiębiorczością przyjęto pracę na modelu grupy przed-testowej i post-testowej, wykorzystując Teorię Planowanego Zachowania (TPZ). Kwestionariusz wypełniło 210 studentów kierunków związanych z przedsiębiorczością (z 400), studiujących na publicznym uniwersytecie w Atenach (Grecja), rozpoczynających trzynastotygodniowy obowiązkowy kurs przedsiębiorczości. Drugi kwestionariusz został ponownie wysłany do tych samych studentów pod koniec tego kursu z prośbą o jego wypełnienie. Został on wypełniony przez 158 studentów z pierwotnej grupy respondentów. W obu przypadkach udział studentów był dobrowolny. Dobór próby miał charakter wygodny, ze względu na ograniczoną ilość dostępnych zasobów. Ustalenia badawcze potwierdziły teorię i wysunięte hipotezy. Autorzy wskazują, że edukacja w zakresie przedsiębiorczości może mieć pozytywny wpływ na postawę studentów, postrzeganą kontrolę behawioralną i ich intencje przedsiębiorcze dotyczące przyszłości.

Słowa kluczowe: edukacja z zakresu przedsiębiorczości, intencje przedsiębiorcze, kursy przedsiębiorczości, teoria planowanego zachowania, postawy, normy subiektywne, kontrola behawioralna

Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie
The Małopolska School of Economics in Tarnów Research Papers Collection
ISSN 1506-2635, e-ISSN 2658-1817
2020, 48(4), 59–73
DOI: 10.25944/znmwse.2020.04.5973
© 2020 MWSE, distributed under the Creative Commons Attribution 4.0 International License (CC BY-NC-ND 4.0)

Counteracting the negative aspects of ageing through promotion of physical activities on the example of the Nysa Daily Care Centre

Marzena Dobruk

University of Applied Sciences in Nysa, Poland

E-mail: em.d@interia.pl
ORCID: 0000-0002-2270-5605

Abstract: The article deals with the growing problem of an ageing society as well as the role of the state in prophylaxis and prevention of negative effects of this process primarily by promoting physical activity among the elderly. The aim of the study is to show how public institutions carry out preventive activities in this area. The starting point is to present this issue on a global, European and Polish scale. Then on a selected example, methods and means that are used by local institutions were shown. The important thing here is a multi-faceted approach, which includes a range of measures to improve the condition and well-being of older people in all spheres of life, with particular emphasis on physical activity. The object of the analysis was the Nysa Daily Care Centre and its activities in the years 2016–2019. As a result of data analysis, it was observed that the implementation of tasks by the examined institution is an appropriate example of organization, functioning and use of financial resources to activate older people. At the same time, it undertakes activities aimed at increasing the value of the income obtained by conducting additional activities to meet the needs of the elderly and lonely people. This can be considered as model of good practice in this area, which is worth promoting and implementing on a larger scale.

Keywords: ageing process, physical activity of the elderly, preventive activities

1. Introduction

The aging society is still a problem for many countries. It is particularly visible in highly developed countries. On the one hand, the increase in life expectancy is a positive phenomenon and can be a sign of good health and high awareness, but on the other hand, older people are exposed to many dangers, both in the spheres of health and psychological.

Ageing as a physiological process in human development is an extremely difficult period. As a result of natural phenomena, the body undergoes evolutionary processes, which seem inevitable, however, leading an appropriate, hygienic lifestyle is conducive to slowing down and mitigating the effects of aging. In this respect it is important to emphasize the importance of

Financed by:
Małopolska School of Economics in Tarnów with support of the Ministry of Science and Higher Education ("Support for scientific journals")

Correspondence to:
Marzena Dobruk
E-mail: em.d@interia.pl

physical activity. According to international research, a high level of physical activity has a positive impact on health in many areas of existence (Guthold et al., 2018) and refers to the prevention of various diseases and improving the functioning of many systems, such as: the cardiovascular, nervous, respiratory, skeletal and muscular system. Physical activity also supports the entire mental sphere, helps prevent overweight and obesity (WHO, 2018), and is an important part of a healthy lifestyle for seniors, preventing and treating many diseases that may be fatal not only as a result of these diseases but of new, unknown risks. Through physical activity, older people can contribute to improving the quality of life (Rowiński and Dąbrowski, 2012).

As the aging of the population in recent years is an increasingly pressing problem both in Poland and in the European Union, the aim of the article is to show how public institutions support elderly people in terms of physical activity. The starting point for this is an analysis of methods and means used in different countries to carry out activating and preventive efforts for the elderly. The analysis will also include activities undertaken by Polish institutions. In this respect basic methods of statistical description will be used.

In the following, the research method used is a case study. The research object was the activity of the Jerzy Kozarzewski Nysa Daily Care Centre in the years 2016–2019, which implements the concept of active and positive aging. The aim of these activities is to increase the level of life activity and social engagement of older people living in the region. The analysis of the selected entity's activity is focused on the sphere of implementation of the statutory task, which is, among others, care for seniors, both in financial and organizational aspects. The analysis includes and elaborates data obtained from the Nysa DCC, which were subjected to descriptive analysis.

2. Demographic circumstances of the ageing process

In Europe, a significant proportion of the population are elderly people. It is about 25% of the total population. According to the data provided (Figure 1), this is an increasing trend. Over the years, we can observe its deepening both in Poland and in the European Union.

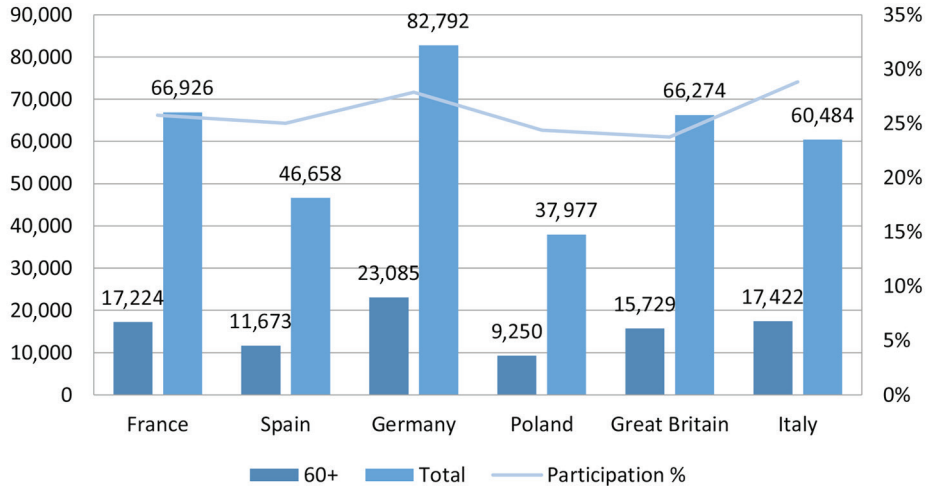

Figure 1. Population by age in thousands—selected European Countries—as of 1 January 2018

Source: GUS, 2019b, p. 471.

The highest percentage of the population over 60 years of age in selected EU countries is recorded in Italy and Germany respectively 28.8% and 27.9%. This high percentage certainly indicates good health, both physically and mentally, favourable genetic factors, a hygienic lifestyle, and the appropriate living conditions created by the state.

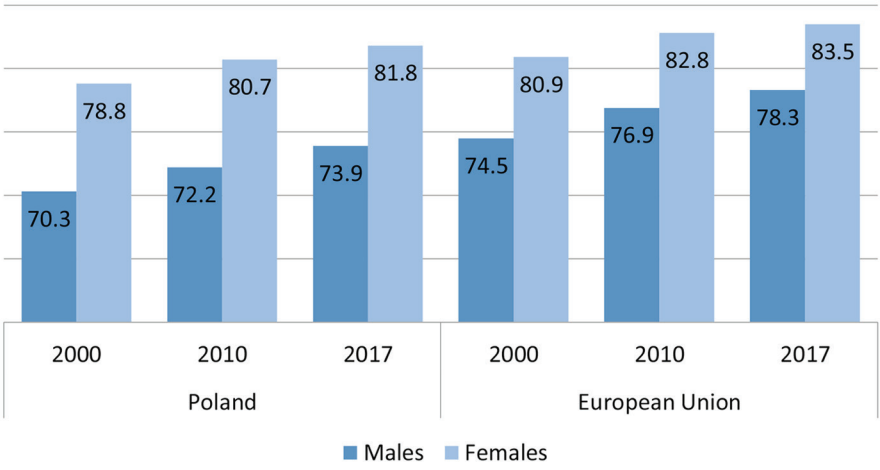

Figure 2. Life expectancy in Poland and European Union in years 2000, 2010, 2017

S o u r c e: GUS, 2019b, p. 472.

Population growth in the 60+ age group is a result of extended life expectancy. The phenomenon of population aging occurs as a consequence of a decrease in the number of births and longer life expectancy. In this regard, there is a certain gender differentiation, as can be seen in Figure 2. These relationships are unchanged over the years and indicate a high mortality rate for men in the 60+ age group, and consequently a feminization of the population. The analysis of the data shows that in the European Union the difference is about 5 years, while in Poland the difference is much bigger as it oscillates around 8 years. The average life expectancy of Poles is shorter than the population of the European Union, and so in the case of women by about 2 years, and in the case of men by 4.5 years.

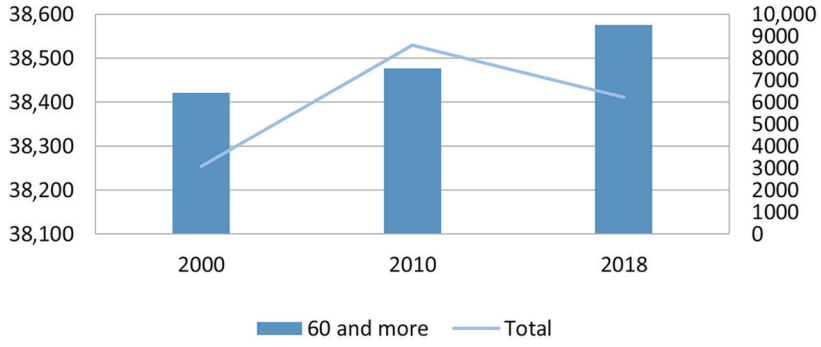

Figure 3. Population by age in thousands as of 31 December

S o u r c e: GUS, 2019b, pp. 138, 139.

Comparing the number of people in the 60+ age group, a growth of more than 1 million, that is 1.120 thousand in 2010 to 2000 is visible, while comparing the data of 2018 to the data 2010, an increase of almost 2 million, that is 1.966 thousand was noted. This means a percentage increase from 16.8% in 2000 to 24.8% in 2018. This demonstrates a very high growth dynamics of this age group, especially if the total population in these periods has not fundamentally changed (Figure 3).

Table 1. Poland—Population by gender and age in thousands as of 31 December

Age groups	2000			2010			2018		
	Total	Of which		Total	Of which		Total	Of which	
		Males	Females		Males	Females		Males	Females
60–64	1696.7	762.4	934.3	2352.2	1086.9	1265.2	2776.0	1302.5	1473.5
65–69	1608.1	690.6	917.5	1359.8	592.5	767.4	2412.9	1078.0	1335.0
70–74	1379.6	541.5	838.1	1356.3	546.9	809.5	1596.0	672.1	923.8
75–79	964.0	329.0	634.9	1146.3	423.5	722.7	1057.7	402.3	655.4
80 and more	774.0	225.9	548.1	1328.0	396.3	931.7	1665.7	516.7	1149.1
60 and more	**6422.4**	**2549.4**	**3872.9**	**7542.6**	**3046.1**	**4496.5**	**9508.3**	**3971.6**	**5536.8**
Total	38,254.0	18,537.4	19,716.6	38,529.9	18,653.1	19,876.7	38,411.1	18,581.9	19,829.3

S o u r c e: GUS, 2019b, pp. 138, 139.

In Poland over the last twenty years there has been an upward trend in the number of people in the 60+ age group. Although analyzing the whole group we can notice an increase in the number of people, looking at individual age ranges we can see a certain anomaly (Table 1). The greatest disproportion can be observed in the 65–69 age range, which decreased by 248 thousand in 2010 compared to 2000, while in the 75–79 age range in 2018 there was a decrease by 89 thousand compared to 2010. It arises that this reduction concerned the years 1941–1945 and 1939–1943, respectively, which is the period of World War II. While performing a vertical analysis, it should be noted that both in 2010 and 2018 there was an increase in the range 80+ compared to the range 75–79 by 182 thousand and 608 thousand respectively, which is a reversal of the downward trend with age. This growth concerned only women in 2010 by 209 thousand, and in 2018 both women (by 494 thousand) and men (by 114 thousand). It results from the fact that the increase included in 2010 women born in 1930 and below, and in 2018 both women and men born before 1939. In the remaining ranges and years from younger to older there has always been a decline in numbers.

Life expectancy depends on many factors. Some of them do not turn on human will, such as genetic conditions or some environmental factors. However, some of them are directly related to a person's activity. Improper diet, smoking, alcohol abuse, lack of physical activity, imprudent behaviour on the roads, failure to follow medical recommendations and disregard

for prophylactic tests—these are the factors which are determined by the inappropriate approach and which can cause cardiovascular diseases, infarctions and strokes leading to premature death (Wojtyniak, 2020).

There are still more women than men in the 60+ age group, but between 2000 and 2018 a gradual increase in the proportion of men of 2.1% can be observed, while the proportion of women decreases. This tendency may, in the near future, be somewhat unevenly balanced due to the prevailing coronavirus pandemic, as mortality due to coronavirus infection affects slightly more men. It can also be assumed that this virus will reduce the overall number of people in this age range.

As a result of his research, Char Leung states that with the development of the pandemic, the number of deaths is expected to increase, especially in the elderly. Chinese patients over 80 years of age have an approximate mortality rate of 22%, much higher than the overall national rate of 3.8%. Unlike other respiratory disorders, mortality due to COVID-19 rises with age. A total of 154 individual cases were studied in 26 provinces. Gender did not seem to be a mortality risk factor. Based on these studies, it was found that age was a crucial mortality risk factor in geriatric coronavirus-infected patients (2020).

Taking into account particular health conditions of elderly people, physical inactivity is predestined for the severe course of many diseases, including COVID-19. Therefore, it seems to be an indispensable element, even necessary for the health and life of these people.

3. Physical activity among older people as a determinant of quality of life

According to Xu Hong Chao, Jang Wan-Sok, Pan Young-Hwan's study, the spatial characteristics of daily activity of the elderly aged 60–75 years were analyzed on a group of 198 women and 189 men. The activity of seniors significantly determines their living conditions and health and improves their quality of life. The objective factors that influence the activity of this group are gender, age and climate. Women were much more active than men, and their much greater participation was particularly evident in such activities as dancing, walking with a dog, food shopping and childcare. The only form in which men had a greater share was sitting (2020).

The programmes aimed at the elderly in their assumptions are to improve their physical and mental health in addition to their social value, which also has a positive financial effect. Thanks to prevention, it is possible to reduce the expenditure on treatment. According to the National Health Survey in Australia in 2006–2007, the estimated direct health care costs due to lack of physical activity were almost 1.5 billion USD. Approximately 62% of adult Australians have failed to meet the recommended guidelines for physical activity, and most of them are older people over 75 years old. In 2009–2010, about a quarter of Australians were involved in organized sports and physical activity. This proportion decreased with age. The level of physical inactivity in 2011 was also examined, and at that time the most frequent reported was the "sitting" mode (40%). Inactivity increased with age, as 83% of people aged 75 years and more reported lack of activity (BetterHealth, 2019).

Lack of physical activity enhances the risk of many adverse health conditions, including the most common non-communicable diseases such as coronary arterial disease, type 2 diabetes, breast and colon cancer and shortens life expectancy. Lack of physical activity has a significant impact on the health of people around the world (Lee et al., 2012).

The main risk factor for chronic disease and premature death is lack of physical activity, which can cause a greater economic burden on society. At a global level, this inactivity is responsible for 6% to 10% of major non-communicable diseases, including coronary arterial disease, some cancers and type 2 diabetes. Changing from physical inactivity to activity can contribute to prevention (reduction in the number of deaths) and an increase in life expectancy. The economic burden of physical inactivity in Korea in terms of health care costs is significant. Inactive people have higher treatment costs than active people. Effective strategies to encourage physical activity can bring considerable health and economic benefits (Min and Min, 2016).

More than 70% of all deaths in the BRICS countries (Brazil, Russia, India, China and South Africa), which represent the major emerging economies of the world and almost half of the world's population, are caused by non-communicable diseases. As many as 14% of all deaths in BRICS countries are due to lack of physical activity (Mielke and Brown, 2019).

Gerontology is an interdisciplinary science, combining medicine, physiology, biology, psychology, pedagogy, economics and law. Much of the research is focused on the prevention of premature functional failure, improving quality of life and longevity, concentrating on the impact of physical activity on the reduction of heart disease, obesity, hypertension, cancer, diabetes, osteoporosis, depression, falls and other injuries. With every decade of life, all motor characteristics, including muscle strength and movement coordination, are significantly weakened. These effects clearly indicate that older people are becoming less and less physically capable and hence more prone to various diseases. An active, healthy lifestyle connected with physical exercise and proper nutrition are prerequisites for good physical and mental health. The most commonly used forms of physical recreation for the elderly include walks and marches, rehabilitation gymnastics, movement games and plays, Nordic walking, music activities, swimming and gymnastics in water (Parnicka, 2018).

From the presented studies, a conclusion emerges that physical activity is a very important factor influencing health, quality and life expectancy. It has both a health and financial dimension, as it prevents many serious diseases that require specialist and long-term treatment, for which considerable financial resources are allocated. It is important to realize the role and relevance of physical activity, as well as to intensify activities to promote and disseminate it, with particular emphasis on the needs of older people.

People want to live not only longer, but above all in relatively complete physical, emotional and intellectual ability. Aspirations of elderly people are growing (Osiński, 2015). Older people need not only appropriate organizational, infrastructural or technological conditions, but also contact with another person, gaining further desire to live, motivation, opportunities to exchange views, new goals in life, social acceptance and feeling that they are needed.

4. Functioning of social assistance institutions for the elderly in Poland

At the end of 2018, there were 1831 stationary social assistance institutions in Poland (108 more institutions than in 2017), including 876 social welfare homes and 364 institutions providing 24-hour care for the elderly. In 2018, more than 7 people of seniority per 1000 people of that age benefited from stationary social welfare institutions (Kamińska-Gawryluk, 2020, p. 14).

The audit conducted by NIK in 2016 showed that there were 295 Daily Care Centres in Poland. Communes throughout the country had only 15 thousand places in these centres. The operation of such facilities is advantageous for both sides—seniors and municipalities, being less of a financial burden than the cost of maintaining all-day care centres. Despite this, only 10% of municipalities decide to start them (NIK, 2017b).

The controlled Daily Care Centres functioned properly and focused on activating and counteracting exclusion with various forms. The large centres offered a comprehensive range of services, while the less prosperous ones tried to offer basic assistance to alleviate the feeling of loneliness, provide food and support. Pensioners expressed their satisfaction with the activities offered (NIK, 2017a). Since the creation and running of DCC is not obligatory, few municipalities decide on their functioning. Both the development and establishment of such facilities are strongly influenced by financial conditions and may result in their limited availability, especially for small municipalities with little resources.

Table 2. Participation in sporting activities or physical recreation in 2016

Specification	Total		Of the total number			
			Males		Females	
	Total	including regular/ frequent	Total	including regular/ frequent	Total	including regular/ frequent
Country average—total	46.4	21.7	48.4	22.8	44.6	20.6
60 years and more (60+)	25.1	10.6	27.7	10.1	23.2	10.9

S o u r c e: MRPiPS, 2019, pp. 56, 57.

In 2016, people aged 60 and over relatively rarely participated in sports or physical recreation. Only every fourth person in this age group took such participation. The declaration of regular attendance involved 10.6% of older people. Men in this age group were slightly more active than women by 4.5% (GUS, 2018b).

Daily Care Centres in Poland offer various types of activities aimed at the elderly. Profiled exercises are adapted to their preferences. Due to the different needs and health condition of seniors, sports and recreational activities take place with various intensity and frequency. The condition, state of health and willingness to take up physical activity are the elements determining both the type and intensity of training. All entities try to mobilize seniors to take up to activate them by introducing appropriate types and forms of exercises designed for older people.

5. Promotion of physical activity as a demonstration of social policy—case study of the Nysa Daily Care Centre

The Jerzy Kozarzewski Nysa Daily Care Centre was chosen for analysis because it has been operating in the region for many years and this activity is an important element of social policy of the Nysa Commune. The entity is an organizational unit of Nysa Municipality—a budget unit established on the basis of the Resolution No. LVIII/726/2002 of the Nysa City Council of 29 May 2002 on the transformation of the budget establishment into an independent budget unit. It operates on the basis of the Act of 8 March 1990 on Municipal Self-Government, the Act of 12 March 2004 on Social Welfare, the Act of 27 August 2009 on Public Finance and the abovementioned Resolution of the Municipal Council, as well as the statute of the Nysa Daily Care Centre. The headquarters is the city of Nysa, and its territorial scope is the area of the Municipality of Nysa. This entity conducts financial management according to the principles set out in the Public Finance Act, which is based on an annual financial plan approved by the Nysa City Council (Nysa City Council, 2018).

The basic function of the Daily Care Centre is to support elderly people in order to improve the effectiveness of the aid impact, in particular to counteract the isolation and marginalization of this social group. The organized activities are adapted to the needs of seniors. Using the facility restores the motivation to stay among other people and encourages to be active.

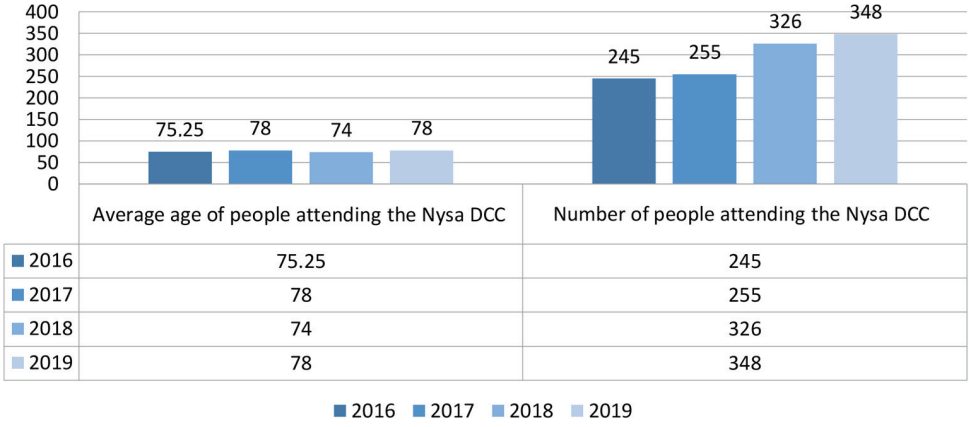

Figure 4. Number and average age of people attending the Nysa Daily Care Centre in the years 2016–2019

S o u r c e: Author's own elaboration based on the data obtained from the Nysa Daily Care Centre.

The number of people attending the Nysa DCC services is steadily growing, while the average age does not fluctuate too much and is relatively constant, which means that these services are usually used by people between 66 and 79, e.g. in 2019 it was 262 out of 348 people, slightly over 75%.

Table 3. The scale of using the Nysa DCC in relation to people aged 60+ of the Nysa County in the years 2016–2019

Year	Number of people attending the Nysa Daily Care Centre	Number of people aged 60+ Nysa County	Percentage of the number of users from the Nysa DCC in the number of people aged 60+ Nysa County
2016	245	15,518	1.6%
2017	255	15,914	1.6%
2018	326	16,281	2.0%
2019	348	16,596	2.1%

S o u r c e: Author's own elaboration based on the data obtained from the Nysa Daily Care Centre and GUS, 2016, 2017, 2018a, 2019a.

The number of people using the services of the Nysa Daily Care Centre increased more than the total number of people aged 60+, from 1.6% in 2016 and 2017 to 2.1% in 2019. The presented data prove not only the rising number of people in this age group, but also the growing social demand for this type of services in the Nysa district.

The main purpose of the Nysa DCC is to care for the elderly, and in its tasks it ensures the basic needs of the elderly and lonely. In its scope, it offers the possibility of using massages, pressure and weight measurement and gymnastics. There are Nordic walking marches and dance classes, eurhythmics, music therapy, bibliotherapy, memory exercises and cultural and entertainment events, sightseeing tours, anniversary meetings with respect to traditions and customs, and trips to the cinema and museum. Picnics are organized in the garden during spring and summer.

In 2016, lectures were held on physiotherapy, healthy nutrition, providing first assistance, beauty and the harmfulness of drug abuse. In January 2017, free of charge visual acuity and BMI (Body Mass Index)—with dietician consultations, tests were conducted. In September 2018 a meeting "Senior on the road. I am aware—I will be safe" was organized. Seniors could take advantage of free bicycle check-ups, received bands and reflective vests. In 2018, the residents took part in the Fifth Provincial Amateur Senior Review in the category of dance and cabaret.

The Nysa Daily Care Centre is the organizer of many events of different nature, among which there were those that encouraged physical activity, such as Carnival Party, Valentine's Day, Women's Day, "Welcome to Summer" Picnic, Fairy Tale Summer Picnic, Picnic on the occasion of the International Day of the Elderly, Picnic "Canoe for Joy", Canoe on the pond, Fun and Andrew's Fairy Tales. These undertakings included social integration between the participants enriched with various forms of physical activity, often in the open air and using the tourist values of the region. The location of the analyzed centre creates favourable opportunities for recreation and movement in diverse outdoor conditions, such as lake, river, ponds, parks, educational paths and outdoor gyms.

Table 4. Physical activity of the Nysa Daily Care Centre and expenses in the years 2016–2019

Year	2016	2017	2018	2019
Types of activities	3 times a week: gymnastics for active people, daily: sitting gymnastics, Nordic walking, dance parties, picnics in the garden			
	—	clappers	once a week dance workshops, clappers, once per quarter dancings	once a week dance workshops, clappers, yoga laughter, once per quarter dancings
Total costs of salaries and contracts of orders including burdens of Social Insurance Institution	52,217 PLN	106,500 PLN	116,100 PLN	117,560 PLN
Other activities not financed by the Nysa DCC	—	—	once a week tai chi class	belly dance— 2 classes in December

S o u r c e: Author's own elaboration based on data obtained from the Nysa Daily Care Centre.

The Daily Care Centre has been constantly supplementing its offer concerning physical activity of elderly people and adapting it to the reported needs. Expenditure on physical activity of seniors is characterized by a significant increase over the period of 4 years. Their value in 2016 amounted to 52,217 PLN, which constitutes 5.6% of the total expenditure, and in 2019 as much as 117,560 PLN. Since 2017, the value of funds allocated for physical activity of seniors has increased dynamically, keeping at the level of about 11% of the total expenditure.

The main purpose of the Nysa Daily Care Centre is to take care of the elderly, and the business is to raise funds for these people.

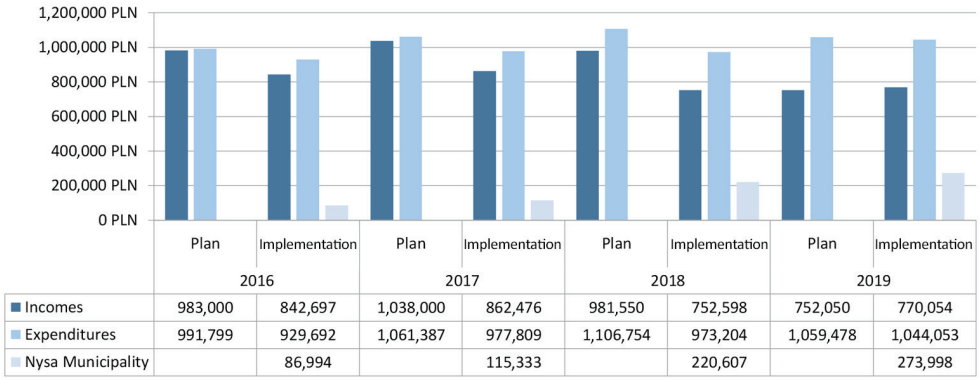

Figure 5. Realization of incomes and expenditures of the Nysa Daily Care Centre in the years 2016–2019

S o u r c e: Author's own elaboration based on data obtained from the Nysa Daily Care Centre.

The Nysa Daily Care Centre generated incomes with 86%, 83%, 77% and 102% of the annual plan in the years 2016–2019. The decrease in the realization of income in relation to the plan in individual years was influenced by the resignation from some kindergartens or schools, a reduction in the number of Social Welfare Centre in Nysa residents attending lunches, a decrease in the number of participants and a delay in cooperation with the Social Integration Centre in Nysa. Legislative modifications in the functioning of the Nysa Dormitory resulted in resignation from meals from 1 May 2017. The appearance of private enterprises providing catering services to educational institutions on the Nysa market also contributes to the reduction of income.

In order to reduce the amount of non-performance of the income plan, new entrants and additional income from catering for children participating in winter and summer day-camps, children from kindergarten wards, Nysa Dormitory charges, CIS participants in Nysa and income from renting the canteen were obtained.

The implementation of the budget expenditure plan has proceeded properly. The financial means were mainly used for the salaries of employees and their derivatives, food, energy, and for co-organizing "Senior Citizens' Days" and activating seniors during the year. In 2016 the main entrance with a terrace was renovated for 12,403 PLN, in 2019 the leaking roof was repaired for 5,230 PLN. Between 2016 and 2018 the Nysa Daily Care Centre did not realize any investments. In connection with the 2019—the 35th anniversary of the Nysa DCC—additional funds were received from the Municipality of Nysa in the amount of 15,000 PLN for the purchase and installation of a garden arbour, which was erected in the garden.

Table 5. Development of incomes and expenditures in the Nysa Daily Care Centre in the years 2016–2019

	Realization 2016 (in PLN)	Percentage	Realization 2017 (in PLN)	Percentage	Realization 2018 (in PLN)	Percentage	Realization 2019 (in PLN)	Percentage
Incomes	**842,697.32**		**862,476.20**		**752,597.61**		**770,054.44**	
Proceeds from services § 0830	840,908.85	99.8	862,135.07	100.0	749,161.80	99.5	769,744.34	100.0
Expenditures	**929,691.80**	–	**977,809.39**	–	**973,204.37**	–	**1,044,052.51**	–
4010 employee salaries	348,699.95	37.5	386,000.00	39.5	432,880.98	44.5	469,558.19	45.0
4040 additional annual salaries	29,263.32	3.1	29,481.48	3.0	31,770.85	3.3	31,583.93	3.0
4110 social security contributions	64,825.56	7.0	69,130.87	7.1	75,587.21	7.8	78,679.02	7.5
4210 material and equipment	28,420.29	3.1	31,070.07	3.2	35,142.43	3.6	30,275.26	2.9
4220 purchase of food products	345,887.38	37.2	353,088.97	36.1	281,782.49	29.0	297,084.18	28.5

4260 purchase of energy	42,340.04	4.6	45,847.37	4.7	44,334.78	4.6	44,828.09	4.3
6050 investment purchases	–	–	–	–	–	–	15,000.00	1.4
Nysa Municipality	**86,994.48**	9.4	**115,333.19**	11.8	**220,606.76**	22.7	**273,998.07**	26.2

S o u r c e: Author's own elaboration based on data obtained from the Nysa Daily Care Centre.

Analyzing over the years 2016–2019, incomes from services (food) account for almost 100% of all incomes (99.5%–99.96%), while the most important cost items are salaries (37.5%–45%) and purchases of food (28.5%–37.2%). The financial resources from the Nysa Municipality are also significant, covering 9.4%–26.2% of the expenses of each year and, as it turns out, they show an upward trend. Despite the increasing participation of funds from the commune's budget, the Nysa Daily Care Centre shows great involvement and activity in maintaining current and acquiring new sources of incomes. For this purpose, it diversifies its offer and reaches out to new groups of recipients.

All these activities are aimed at providing resources to support older people. Considerable emphasis is placed on creating appropriate conditions for these people in the aspect of physical activity. Expenditures for this purpose show a steadily increasing share and range at the level of about 110 thousand PLN per year, which is the result of a higher number of seniors and suitable organization of exercises to meet the needs in the sphere of physical activity of older people.

6. Conclusion

An ageing society is a global and progressive problem. Both in Europe and Poland, older people represent about one quarter of the population. In highly developed countries this share is the highest. In Poland, over the last twenty years, the scale of this phenomenon has shown high growth dynamics, from about 6.5 million people in the age range of 60 and more in 2000 to 9.5 million in 2018 in the age range of 60 and more. Taking into account the peculiar demographic situation, which is undoubtedly the rising process of population ageing, the implemented state policy solutions, as well as the programmes carried out by a number of institutions are fundamental to counteract the negative effects of this phenomenon. It is important here to have a multi-faceted approach, which includes a number of efforts, to improve the condition and well-being of the elderly in all spheres. These efforts should have a wide spectrum and be characterized by effectiveness. In the present, difficult times—in the era of pandemic—the elderly are at a particular disadvantage. Physical activity is crucial not only to improve quality of life and health, but also to prevent high mortality due to many diseases.

Therefore, the assistance and involvement of the state, institutions and many people is fundamental. As a result of the research, it has been observed that the realization of these tasks by the Nysa Daily Care Centre is a proper instance of organization and functioning, care and concern for the elderly, as well as inventiveness and understanding of their needs to meet their expectations. The research was conducted on the basis of available documents and own

summaries and analyses, which showed that an entity undertakes various activities for "active aging", using methods and means by which it intensifies and rationalizes its activities, in order to maintain and gain incomes for this purpose and at the same time optimize costs. To this end, it conducts a policy that is characterized by great creativity and operability in order to sustain existing customers, as well as recognize the needs of the market in which it operates, reaching new customers and diversifying the type of services provided. It conducts various types of physical activities, through which it stimulates seniors. The implementation of social policy in this area focuses on promoting physical activity. The health condition of the elderly determines the selection of appropriate methods and forms of physical activity. The most commonly used methods include gymnastics, dance classes, Nordic walking, yoga as well as outdoor physical games and plays. This type of classes results from satisfying individual needs of physical activity of elderly people, which influences their fitness and physical performance resulting in improvement of their health. On the organization of this sphere, due to the constantly growing social demand for this type of services, the entity allocates more and more financial means. Therefore, it can be concluded that the activity of the Nysa Daily Care Centre is an example that is worth spreading.

The aim of the study was to show how public institutions support for elderly people in their physical activity. The selected example shows what actions can be taken, on what scale and what their effects can be. Since an interesting aspect is the way of financing this activity, the analysis was made of the share of public funds and the funds raised on their own for this purpose. Taking into account the evolution of this issue, its scale and prevalence, it is worth making further attempts to study and analyze this phenomenon in the context of increasing social demand for this type of centres and services, including the ways of their implementation.

References

Better Health Channel. (2019). *Sports and physical activity and our health* [online, accessed: 2020-06-04]. Retrieved from: https://www.betterhealth.vic.gov.au/health/HealthyLiving/sports-and-physical-activity.

Dzienny Dom Pobytu w Nysie. (2016, 2017, 2018, 2019). *Informacje o działalności Dziennego Domu Pobytu.* Nysa: Dzienny Dom Pobytu w Nysie.

GUS. (2016, 2017, 2018a, 2019a). Data for Nysa County in the category: population: state group, subgroup: population by age and gender [online, accessed: 2020-10-04]. Bank Danych Lokalnych Głównego Urzędu Statystycznego [= Central Statistical Office Local Data Bank]. Retrieved from: https://bdl.stat.gov.pl/BDL/dane/teryt/tablica.

GUS. (2018b). *Informacja o sytuacji osób starszych na podstawie badań Głównego Urzędu Statystycznego.* Warszawa: Główny Urząd Statystyczny.

GUS. (2019b). *Rocznik demograficzny.* Warszawa: Główny Urząd Statystyczny.

Guthold, R., Stevens, G., Riley, L., Bull F. (2018). Worldwide trends in insufficient physical activity from 2001 to 2016: A pooled analysis of 358 population-based surveys with 1.9 million participants. *The Lancet Global Health*, *6*(10), E1077–E1086. DOI: 10.1016/S2214-109X(18)30357-7.

Kamińska-Gawryluk, E. (2020). *Sytuacja osób starszych w Polsce w 2018 r.* Warszawa and Białystok: Główny Urząd Statystyczny, Urząd Statystyczny w Białymstoku.

Lee, I., Shiroma, E., Lobelo, F., Puska, P., Blair, S., Katzmarzyk P. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. *The Lancet*, *380*(9838), 219–229. DOI: 10.1016/S0140-6736(12)61031-9.

Leung, C. (2020). Risk factors for predicting mortality in elderly patients with COVID-19: A review of clinical data in China. *Mechanisms of Ageing and Development*, *188*, 111255. DOI: 10.1016/j.mad.2020.111255.

Marciniak, A. (2020). Sposób na dłuższe życie. Rozmowa z dr. Bodanem Wojtyniakiem, prof. NIZP-PZH i zastępcą dyrektora ds. analiz i strategii w drowiu publicznym. *Angora*, *24*, 61.

Mielke, G., Brown, W. (2019). Physical activity and the prevention of chronic illness in the BRICS nations: Issues relating to gender equality. *Journal of Sport and Health Science*, *8*(6), 507–508. DOI: 0.1016/j.jshs.2019.08.001.

Min, J.-Y., Min, K.-B. (2016). Excess medical care costs associated with physical inactivity among Korean adults: Retrospective cohort study. *International Journal of Environmental Research and Public Health*, *13*(1), 136. DOI: 10.3390/ijerph13010136.

MRPiPS. (2019). *Informacja o sytuacji osób starszych w Polsce za 2018 r.* Warszawa: Ministerstwo Rodziny, Pracy i Polityki Społecznej.

NIK. (2017a). Kontrolerzy NIK sprawdzili, jak wygląda opieka nad seniorami w dziennych domach pomocy. „Poważne wyzwanie" [online, accessed: 2020-06-26]. *Wprost*, 30 June. Retrieved from: https://www.wprost.pl/kraj/10061012/kontrolerzy-nik-sprawdzili-jak-wyglada-opieka-nad-seniorami-w-dziennych-domach-pomocy-powazne-wyzwanie.html.

NIK. (2017b). *NIK o opiece nad osobami starszymi w dziennych domach pomocy* [online, accessed: 2020-06-26]. Warszawa: Najwyższa Izba Kontroli. Retrieved from: https://www.nik.gov.pl/aktualnosci/zdrowie/nik-o-opiece-nad-osobami-starszymi-w-dziennych-domach-pomocy.html.

Osiński, W. (2015). *Gerokinezjologia: Nauka i praktyka aktywności fizycznej w wieku starszym.* Warszawa: Wydawnictwo Lekarskie PZWL. ISBN 9788320046236.

Parnicka, U. (2018). Physical activity in promoting health of the elderly. *Health Problems and Civilization*, *12*(4), 265–271. DOI: 10.5114/hpc.2018.77840.

Rada Miejska w Nysie [= Nysa City Council]. (2018). Statut jednostki. *Statut Dziennego Domu Pobytu w Nysie im. Jerzego Kozarzewskiego, Załącznik do Uchwały Nr L/746/18 Rady Miejskiej w Nysie z dnia 24 kwietnia 2018 r.* Nysa, opolskie: Rada Miejska w Nysie.

Rowiński, R., Dąbrowski, A. (2012). Aktywność fizyczna Polaków w wieku podeszłym. In: M. Mossakowska, A. Więcek, P. Błędowski (eds.). *Aspekty medyczne, psychologiczne, socjologiczne i ekonomiczne starzenia się ludzi w Polsce* (pp. 531–548). Poznań: Termedia Wydawnictwa Medyczne. ISBN 9788362138814.

WHO. (2018). *Global action plan on physical activity 2018–2030: More active people for a healthier world.* Geneva: World Health Organization.

Xu, H.-Ch., Jang, W.-S., Pan, Y.-H. (2020). Study on the improvement of elderly activity demand in outdoor public space in urban communities – a case study of Wuhan in China. *Journal of the Korea Convergence Society*, *11*(1), 141–150. DOI: 10.15207/JKCS.2020.11.1.141.

Przeciwdziałanie negatywnym aspektom starzenia się przez promowanie aktywności fizycznej wśród osób starszych na przykładzie Dziennego Domu Pobytu w Nysie

Abstrakt: Niniejszy artykuł porusza tematykę narastającego problemu starzejącego się społeczeństwa, jak również rolę państwa w profilaktyce i zapobieganiu negatywnym skutkom tego procesu – przede wszystkim poprzez promocję aktywności fizycznej wśród osób starszych. Celem opracowania jest zatem ukazanie, w jaki sposób instytucje publiczne wspomagają osoby starsze w zakresie aktywności fizycznej. Punktem wyjścia jest przedstawienie tego zagadnienia w skali ogólnoświatowej, europejskiej oraz ukazanie sytuacji w Polsce. Na wybranym przykładzie pokazano, z jakich metod i środków korzystają lokalne instytucje. Obiektem badań był Dzienny Dom Pobytu w Nysie i jego działalność w latach 2016–2019. W wyniku analizy danych zaobserwowano, że realizacja zadań przez badaną instytucję stanowi właściwy przykład organizacji, funkcjonowania oraz wyko-

rzystania środków finansowych w celu aktywizacji osób starszych. Jednocześnie podejmuje ona działania w zakresie zwiększenia uzyskiwanych dochodów, prowadząc dodatkową działalność w celu zaspakajania potrzeb osób starszych i samotnych. Ponieważ niezwykle ważne jest tu postępowanie wieloaspektowe, obejmujące szereg działań służących poprawie kondycji i samopoczucia we wszystkich sferach życia osób starszych, ze szczególnym uwzględnieniem aktywności fizycznej, działalność analizowanego podmiotu można uznać za pewien wzór dobrych praktyk w tym zakresie, który warto promować i wdrażać na większą skalę.

Słowa kluczowe: starzenie się, aktywność fizyczna osób starszych, działalność prewencyjna

MANAGEMENT AND QUALITY, ERGONOMICS

Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie
The Małopolska School of Economics in Tarnów Research Papers Collection
ISSN 1506-2635, e-ISSN 2658-1817
2020, 48(4), 77–93
DOI: 10.25944/znmwse.2020.04.7793
© 2020 MWSE, distributed under the Creative Commons Attribution 4.0 International License (CC BY-NC-ND 4.0)

Competitive advantage of the car brand in the light of qualitative price quantification: Analysis based on the example of the selected impact area

Janusz Ząbek

Małopolska School
of Economics in Tarnów, Poland

E-mail: janusz.zabek@mwse.edu.pl
ORCID: 0000-0003-4150-9850

Abstract: Changing operating conditions cause an important challenge for car manufacturers to influence the market through price. The main research goal of the work is to identify the role of price in building the competitive advantage of the car brand manufacturer in a given area of its impact. Auditorium research was carried out among the clients of a leading car brand from the area of the former Tarnów province. The research shows the rule of creating a competitive advantage. The rule shows that the number of customers satisfied with the final quality of the purchased product is greater if there is a larger number of customers deciding on the choice of the brand and the repair plant representing the brand based on the price. This rule also indicates that the number of customers satisfied with the final quality of the purchased product is greater if the number of customers considering the price of specific repair services as meeting their requirements is greater. The study confirmed that effective price management using quality parameters means that the brand will gain a competitive advantage. Price evaluation using quality can be used to market brands in global conditions.

Keywords: competitive advantage, quality, satisfaction, brand, dealership network

1. Introduction

After the political breakthrough in the 1990s, various forms of economic activity began to develop in Eastern Europe. Various forms of activity are constantly shaping the new economic and social order (Kopycińska and Sergi, 2008). Business brokerage is one of the new activities. An example of business brokerage is the network of authorized car dealerships created. Authorized car dealers, pursuing commercial goals, represent manufacturers and owners of car brands on the business market (Aboltins and Rivza, 2014). This is a very important market because it strongly affects various areas of economic life. In Poland, according to the author's estimation, only the basic forms of automotive activity implemented in dealer networks generate 5% of GDP. These basic

Financed by:
Małopolska School of Economics in Tarnów with support of the Ministry of Science and Higher Education ("Support for scientific journals")

Correspondence to:
Janusz Ząbek
Małopolska Wyższa Szkoła Ekonomiczna
Katedra Zarządzania
ul. Waryńskiego 14
33-100 Tarnów, Poland
Tel.: +48 14 65 65 535

forms are: sale of new cars, sale of spare parts and car repairs. It should be noted that in addition to these basic forms, there are areas of activity supporting the functioning of the automotive industry.

In the European Union, the legal basis for the functioning of the dealer market is Commission Regulation (EU) no. 461/2010 of 27 May 2010 on the application of Article 101(3) of the Treaty on the Functioning of the European Union to categories of vertical agreements and concerted practices in the motor vehicle. This act is valid together with act no. 330/2010 of 20 April 2010 on the application of Article 101(3) of the Treaty on the Functioning of the European Union to categories of vertical agreements and concerted practices. The application of this right aims to improve economic efficiency and simplify many administrative procedures. In addition, the essence of these regulations is to help car brand owners (manufacturers) to optimize sale levels in relation to the size of investment. An important goal of the abovementioned regulations is also to bring about uniformity of the market in the automotive sector and to harmonize consumers' rights to buy a car anywhere in the European Union. One of the practical aspects of these regulations, which are binding at the level of cooperation between producers and their representatives in the region, is the great freedom of concluded contracts. In other words, under the European Union rules, important elements of the dealership market are excluded from the principles of free competition. They are these regulations that show how dealers are selected under the selective system. The presence of these regulations means that the distribution of new cars, services and spare parts is usually carried out by authorized brand dealers under the control of manufacturers or their domestic importers (Riel et al., 2011). However, exemption from the rules of free competition is not unconditional. One of the conditions for exclusion is to limit the manufacturer in terms of uncompetitive impact on the market through price. The provision states that the producer may not introduce price pressure as to minimum or rigid prices. On the other hand, the regulations mentioned above show the manufacturer's ability to suggest price levels and set maximum prices. For this reason, the current and important research problem is the search for the sources optimizing the functioning of producers. For the reasons described above, every possibility of the manufacturer's influence on the market via the price perceived by the customer must be examined.

It should be clarified that the concept of price in this paper is much broader (more strategic) than it results from the standard understanding of marketing concepts. The price reflects not only the prestige and the relationship between inputs and benefits resulting from these inputs. The price is related to the degree of fulfillment of clients' requirements in the context of the relation of their expenses to benefits, in addition to other offers on the market. In this work, the price refers to the idea of three new marketing instruments. These are value, relationships and brand (Johnson, Hermann and Huber, 2006). In the consumer market, the value of products and services helps the brand gain a competitive advantage (Sheth and Sinha, 2015; Gomes et al., 2016). The work is important because it deals with aspects that have not yet been explored enough. The most important of them related to the brand (branding) are: evolving forms of business brokerage in global conditions, unexplored position of the customer in the internal relations and responsibility of the producer and his representative, and identification of sources of competitive advantage in unusual competitive conditions. This is even more important as branding is not rooted in theory but shaped on practical paradigms (Kay, 2006).

The uniqueness and originality (of activities, methods, tools) are necessary in the pursuit of competitive advantage. Finding nuanced sources in existing management instruments has the ability to achieve the effect of distinction by the organization and thus ensure its competitive advantage. In connection with the abovementioned interpretations of management by prices, which are the unexplored aspects of the organization's operation, create such a possibility.

2. Theoretical background and literature review

2.1. Variable buyer awareness versus price

Contemporary management means constant adaptation to changing operating conditions. These changing operating conditions result from the technological achievements and applied innovative solutions that characterize the twenty-first century (Bartes, 2009; Hamel and Green, 2007). A growing consumer awareness is also their sign. In such a situation, obtaining a competitive advantage is getting more and more difficult. The challenge for management is the need to seek new sources of competitive advantage (Markley and Davis, 2007). According to Rijamampianina (Rijamampianina et al., 2003), an organization will gain a competitive advantage when available management factors (elements of influence) are used in a unique way. In marketing, the basic tools for influencing customers are place, promotion, price and product. The price is one of the external guidelines when making purchasing decisions. According to Ząbek (2019), the factors of selection and current assessment of products including prices are becoming more and more important in the automotive industry. Many studies have been carried out to confirm the relationship between price and quality of a product in the context of its selection and selection of the organization supplying the product (Zeithaml, 1988, Khudhair et al., 2019). In many cases, the research results confirm the relationship between price and perceived quality (Rao and Monroe, 1989). In other cases, the essence of price as a guide to product quality decreases (Parasurman et al., 1985).

2.2. Quality measured by customer satisfaction as a tool of business competition (source of competitive advantage)

The basis for consideration is the recognition of quality as a factor of competitive advantage (Bugdol, 2011, Cholewicka-Goździk, 2008; Lakhal, 2009). This relationship is described by the formula (1).

$$CA = f(Q) \tag{1}$$

where:
CA—competitive advantage
Q—quality of products/ services.

Quality is an important parameter for assessing complex systems or structures that shape the final quality of products offered by the company (Hamrol and Mantura, 2012). Quality as a source of system management is also seen as a stimulus to competitive advantage

(Elshaer and Augustyn, 2016; Kafetzopoulos et al., 2015; Sukwadi, 2015). The use of quality as a competitive tool means, in essence, comparing the degree of fulfillment of the requirements addressed to various projects and activities. These activities enable the production of a high value product (Bryson et al., 2007). In the aforementioned situations, the measures of quality perceived by customers are also used as measures of the management's behaviour at every stage of the organization's functioning and at every stage of the production of products (Hamel and Prahald, 1996; Taghizadeh and Shokri, 2015). It should be emphasized that in the adopted work concept, the level of customer satisfaction was used as a measure of the quality of the products purchased. In addition, satisfaction affects the formation of long-term customer relationships (Shiau and Luo, 2012). The estimated level (degree) of satisfaction reflects the degree of product compliance with customer requirements. In addition, it is also a measure of the effectiveness and efficiency of organization management (Bilan, 2013; Lim et al., 2006; Yeo et al., 2015). It should be emphasized that customer reviews are used as a measure of competitiveness assessment in various industries (Ogorodnikova et al., 2019). The above relationships are characterized by the general equation (2).

$$Q = RD / RE = CS / CAL \tag{2}$$

where:
Q—quality of products/ services
RD—product requirements met
RE—all product requirements
CS—the number of customers with the highest degree of satisfaction
CAL—the number of all customers.

2.3. Contemporary challenges of the brand's marketing policy

It is currently certain that existing marketing assumptions must change (Sawhney and Kotler, 2001). In many authors' opinion, brand management requires marketing channels to be improved through integration (Kapferer and Thonig, 2001; Aaker and Joachimsthaler, 2000; Aaker, Fournier and Brasel, 2004; Keller and Lehmann, 2006; Ohlins, 2008; Kapferer, 2008). Leading to the conscious creation of an integrated and unique marketing mix will result in the transmission of benefits to the brand (Duncan, 2002; Naik and Raman, 2003; Keller and Lehmann, 2006). Only such an action allows the brand to reach the level of leader. Importantly, many authors believe that it is about achieving the position of a brand builder in a specific community (Muniz and O'Guinn, 2001; Cova and Cova, 2002; Bagozzi and Dholakia, 2002; 2006; McAlexander et al., 2002, Muniz and Schau, 2005; Cherubini and Pattuglia, 2007). This community can be treated as the one created from a given area of influence of the brand mentioned earlier.

3. Research objective, methodology and data

The main research goal of the paper is to identify the role of price in building the competitive advantage of the manufacturer of a given car brand in the identified area of its impact. In the case of such intangible products as business intermediation services in the automotive

industry, it plays an important role (Kuczamer-Kłopotowska, 2009). In the concept of this work, price is treated as more comprehensive than a usual tool of influence.

The research was carried out among the clients of the leading car brand. The tool used to obtain information was an auditorium survey. The survey was conducted among those clients who once again used the brand's services in the southern region of Poland. The area of influence is the region of southern Poland defined by the borders of the former Tarnów province. 514 reviews were obtained. As part of the survey, customers were asked to respond to shopping relationships related to a given car brand. Possible relationships are:

– buying a brand car and satisfaction;
– buying a brand car and dissatisfaction;
– no brand car purchased (aftermarket car);
– no response from the respondent.

In addition, as part of the survey, respondents were asked to identify the criteria they followed when deciding to buy a product from a given brand. Among the proposed themes, the survey included the following options:

– attractive price;
– media's opinion;
– friend's recommendations;
– experience with the brand's representative;
– accidental purchase;
– not specified;
– no response.

As part of the survey, customers were asked to indicate the criteria they followed when choosing a specific organization representing the brand in a given area. Among the proposed themes, the survey included the following options:

– loyalty and satisfaction;
– good friends' opinion;
– competitive prices of services;
– good location;
– business conditions (dependencies and relationships);
– other;
– no response from the respondent.

As part of the survey, customers were also asked to provide their opinion on the price of repairs carried out. The formula of this request is the result of a long-term observation of the dealer market and authorized repairs. In essence, the request meant a comment on the statement. The repair price is adequate to the activities performed in the context of customer requirements in relation to the repair. Possible customer responses are: I completely agree, I agree, neither agree nor disagree, I disagree, I completely disagree. Leaving the field blank at this point in the study, the client may not have commented on it at all.

At the same time, as part of the survey, each of the respondents was asked to assess their level of satisfaction with the overall quality of services provided. When answering, the client quantified his satisfaction by assessing his level of satisfaction on a five-point scale: 1—completely unsatisfied customer, 2—unsatisfied customer, 3—customer neutral about his satisfaction, 4—customer

satisfied, 5—customer completely satisfied. According to the rules set by the producer only score 5 means that the requirements are fulfilled. Owing to this in testing hypotheses the variable 5 is contradictory to score 2, 3 and 4. It should be noted that a balanced ordinal scale was used to assess the level of satisfaction. Figure 1 presents the idea of completed research work.

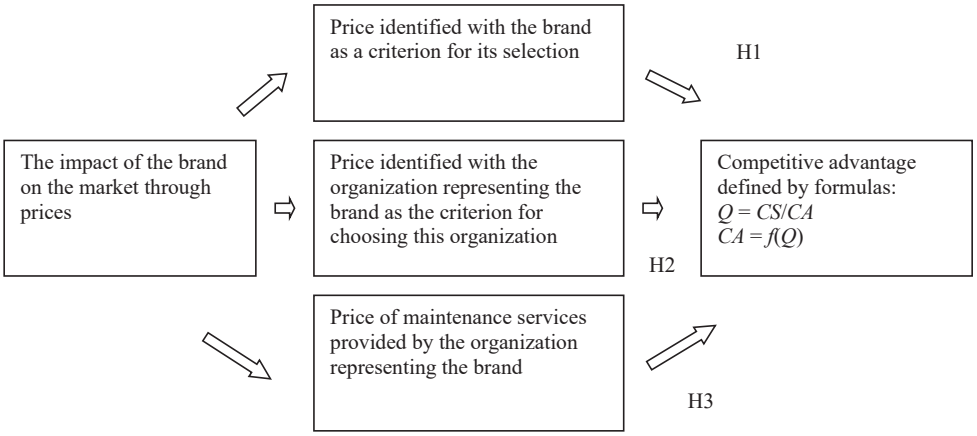

Figure 1. Conceptual framework

S o u r c e: Author's own elaboration.

As part of the work, the following hypotheses were verified:

H1: There is a positive relationship between the price communicated by the brand and a competitive advantage

H2: There is a positive relationship between the attractiveness of the price used in the organization representing the given car brand and the competitive advantage of the brand.

H3: There is a positive relationship between the level of compliance with the requirements in the assessment of repair service prices and a competitive advantage.

The research assumptions take into account that the brand itself is a bit of a source of competitive advantage in itself. The brand affects the perceived quality of products (Cretu and Brodie, 2007; Lee et al., 2017).

In the adopted concept of work, independent variables are assessments quantified by the degree of compliance with the requirements:

– prices attributed to and associated with a given brand;
– prices identified with the organization that represents the brand;
– level of compliance with service price requirements.

The dependent variable is the level of customer satisfaction denoting product quality. This variable in the adopted work concept is a measure of competitive advantage.

The aim of the work was achieved using:

– analysis of legal acts;
– testing organizational diagrams;
– drawing graphs of the number of occurrences of variables;
– chi-square test.

4. Results and discussion

4.1. Information on respondents

Table 1 shows the structure of respondents. Respondents are customers who used the brand's car repair service. Not everyone in the study group bought a new car of a given brand.

Table. 1. Customer structure by purchase activity and satisfaction

Customers purchase activity and satisfaction	Number of occurrence	
	N	%
Buying a brand car with satisfaction	362	70.42
Buying a brand car without satisfaction	2	0.39
No brand car purchased (aftermarket car)	84	16.34
No response	66	12.84
Total	514	100.00

S o u r c e: Author's own elaboration.

The group of respondents included customers, in the number of 84, who purchased the vehicle in the aftermarket. This value confirms the trend occurring in Poland. Over 50% of vehicles operated in Poland come from private imports and secondary trade. Only a small group of these cars is serviced by authorized dealers. The study confirmed that in the total group of respondents, 16% were owners of vehicles purchased outside the dealership. In the group of respondents 66 were those who did not answer the source of purchase of a used vehicle. The research shows that out of a group of 514 customers, 364 are those who have purchased a vehicle of a given brand. There were 362 customers who bought a vehicle from a given brand and confirmed their satisfaction, in this group 2 were not satisfied. In accordance with the adopted work concept, the opinions of a group of 362 clients located in the selected area of the brand's impact were further analyzed. It should be noted that these clients implemented the brand's cognitive process and positively accepted the brand's conditions. In the further part of the work it was checked how they treated price messages in force in the producer brand, how they assessed the prices of the dealer organization representing the brand in a given area of influence and their relation to the prices of specific repair services.

4.2. Price as a source of decision about choosing a car brand

The choice of a car brand is related to the opinion of buyers about the prices in force in the brand. Figure 2 presents the distribution of factors that guide customers while making brand selection decisions. The results of the research presented in Figure 2 show that 60 customers out of 362 indicated the price as the factor determining the use of the services of the car service under examination. This means that for 16.57% of customers price is a decisive factor in choosing a brand. At the same time, these customers belong to the group of customers satis-

fied with their purchase (see Table 1.). Identifying the final satisfaction with the quality level of services obtained in this group, 31 customers, giving a rating of 5, rated their satisfaction the highest possible. This means that in the group of customers who decided to use the offer of a given brand based on the price, 52% confirmed that they received a product that fully complies with their requirements.

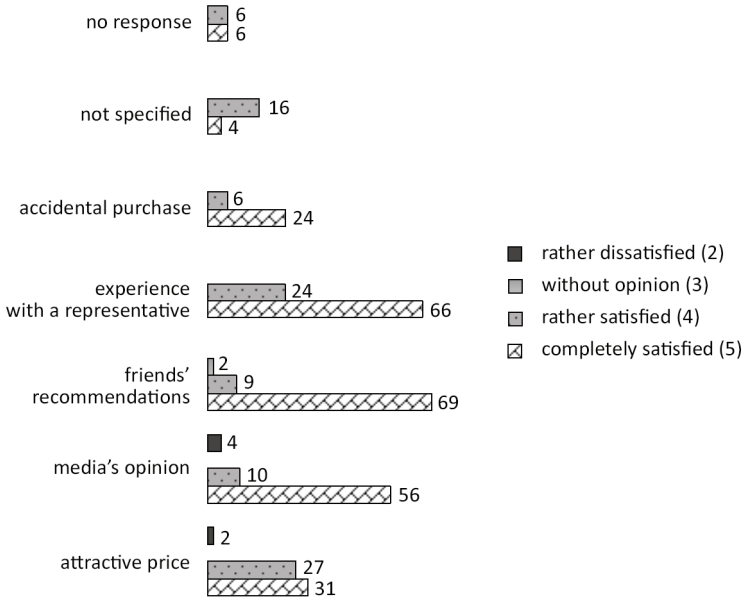

Figure. 2. Criteria for choosing a car brand and customer satisfaction

S o u r c e: Author's own elaboration.

It should be emphasized that in the group of selection factors in terms of number, price is the fourth selection criterion. It is worth emphasizing, however, that this is a very carrying factor and it contains an important message. It is a factor related to the 4P marketing component. The research shows that the number of customers choosing a brand based on price stimulates the number of customers completely satisfied with the quality of the services purchased.

The results of the above tests were the subject to additional verification. For this purpose, the chi-square test was used. Two research subgroups have been identified to enable the test to be used. One research subgroup was created from customers who chose the brand recognizing that the prices in the manufacturer's brand are appropriate. The second research group consisted of customers choosing the brand on the basis of factors other than brand prices.

Hypothesis to test:

H1: The level of satisfaction with the quality of the products received is related to the choice of brand based on price.

The chi-square test was used to verify the hypothesis.

The individual statistical values resulting from the use of the chi-square test are shown in Table 2. The chi-square is greater than the critical value of chi-square. This means that you can

say with a probability of 99% that the number of customers declaring full satisfaction with the quality of the purchased products is related to the number of customers declaring the choice of brand based on the price criterion. This way the hypothesis was confirmed that there is a statistically high relationship between opinions on prices in force in the brand and the level of product quality as a tool for creating competitive advantage.

Table 2. Awareness of product quality and criteria for car brand selection—statistical values (SV) for chi-square test

The number of customers in the light of their assesment of product/ service quality	The number of customers who have chosen the car brand based on its price and on the basis of other factors		
	The number of customers who choose the car brand based on prices	The number of customers who made the choice of the brand based on other factors	Total of row
The number of customers completely satisfied (satisfaction scored 5)	$O = 31$ $E = 42.4309$ $SV = 3.0795$	$O = 225$ $E = 213.5691$ $SV = 0.6118$	256
The number of customers with a different level of satisfaction than completely satisfied (satisfaction scored 2, 3, 4)	$O = 29$ $E = 17.5691$ $SV = 7.4372$	$O = 77$ $E = 88.4309$ $SV = 1.4776$	106
Grand total	60	302	362
O = observed value			
E = [(row total) × (column total)] / sample total			
SV = [($O - E$) squared] / E			
Chi-square = $\sum SV$			12.6061
Critical value of chi-square at 0.01 and 1 degrees of freedom			6.6349

S o u r c e: Author's own elaboration.

4.3. The impact of price on the choice of organization representing the car brand manufacturer

The policy of shaping brand prices is related to prices offered by organizations representing the brand. Figure 3 shows the distribution of factors that guide customers when making decisions about choosing an organization representing a brand in a given area. The results of the research presented in Figure 3 show that 72 clients out of 362 indicated the price as a factor determining the use of services of a given organization representing the brand. This means that 20% of the customers who purchased the brand vehicle and were satisfied with this fact, based on the price, value the most. Identifying the final satisfaction with the level of quality of services obtained in this group, 34 customers, giving a rating of 5, rated their satisfaction the highest possible. This means that in the group of customers who decided to use the ser-

vices of a given service based on the price 47% confirmed that they received the product in full compliance with their requirements. It should be emphasized that in the group of selection factors of a particular organization in terms of number, price is the second selection criterion. It is worth emphasizing, however, that this is a factor that can determine the fact that a given organization obtains a competitive advantage.

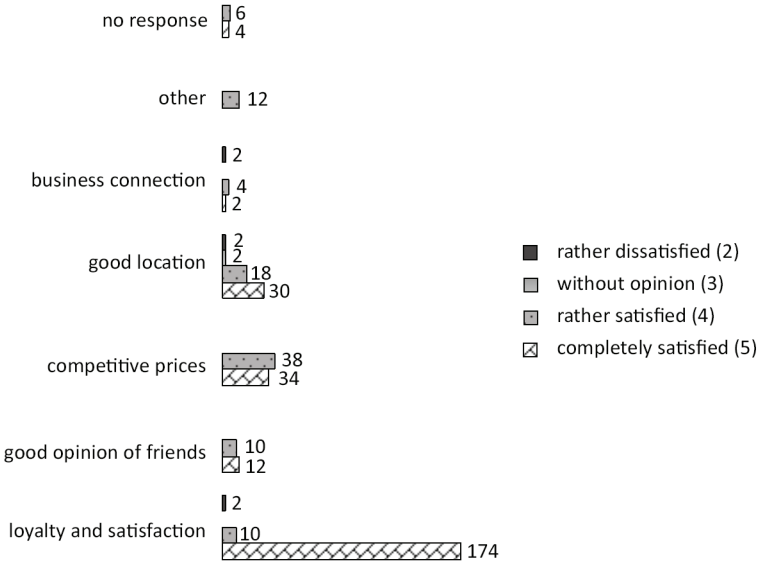

Figure 3. Criteria for choosing an organization representing a brand owner (car service) and customer satisfaction

S o u r c e: Author's own elaboration.

In order to substantiate the obtained results, they were subjected to additional verification using the chi-square test. The individual statistical quantities enabling the test to be carried out are presented in Table 3. The test was carried out into two research subgroups. One research subgroup was created from clients who chose the organization representing a given brand, recognizing that it applies competitive prices. The second research group consisted of customers choosing a given organization on the basis of factors other than prices in the organization.

In this case, the hypothesis to test is:

H2: There is a relationship between the number of customers choosing an organization based on its competitive prices and the number of customers confirming full satisfaction with the quality of the products purchased.

The data presented in Table 3 show that the calculated value of chi-square is greater than the critical value of chi-square. This means that you can say with a probability of 99% that there is a relationship between the number of customers choosing an organization based on its competitive prices and the number of customers confirming full satisfaction with the quality of the products purchased. In other words, it means that the level of customer satisfaction of an authorized car service measured by the number of ratings awarded on a scale of 1 to 5 is connected

with their specific relation to prices applied in the organization representing the manufacturer's brand. This way the hypothesis was confirmed that there is a statistically high relationship between the system of using prices in a given organization and the level of product quality as a tool for achieving competitive advantage.

Table 3. Awareness of product quality and criteria for the selection of an organization representing a brand owner (car service)—statistical values (SV) for chi-square test

The number of customers in the light of their assesment of product/ service quality	The number of customers who have chosen the car service based on price and on the basis of other factors		
	The number of customers who choose the car service based on its price	The number of customers who made the choice of the car service based on other factors	Total of row
The number of customers completely satisfied (satisfaction scored 5)	$O = 34$ $E = 50.9171$ $SV = 5.6207$	$O = 222$ $E = 205.0829$ $SV = 1.3955$	256
The number of customers with a different level of satisfaction than completely satisfied (satisfaction scored 2, 3, 4)	$O = 38$ $E = 21.0829$ $SV = 13.5744$	$O = 68$ $E = 84.9171$ $SV = 3.3702$	106
Grand total	72	290	362
O = observed value			
E = [(row total) × (column total)] / sample total			
SV = [($O - E$) squared] / E			
Chi-square = $\sum SV$			23.9608
Critical value of chi-square at 0.01 and 1 degrees of freedom			6.349

S o u r c e: Author's own elaboration.

4.4. The price of car repair services as a determinant of satisfaction

The brand price policy also applies to prices that are the result of specific car repair operations. Figure 4 presents the distribution of customer opinions on the prices of purchased maintenance services. The research results presented in Figure 4 show that 161 clients out of 362 experienced a service priced in a fully acceptable way. This means that 44.48% of the clients surveyed confirmed full acceptance for the valuation of maintenance services. The research also shows that 128 customers out of 362 have experienced a service priced in a fully acceptable manner and at the same time confirmed the highest rated level of satisfaction with the quality of the purchased product. This means that 35.36% of the clients whose relations to the brand have been analyzed confirmed full acceptance for the valuation of maintenance services and at the same time declared full satisfaction with the quality of purchased maintenance services.

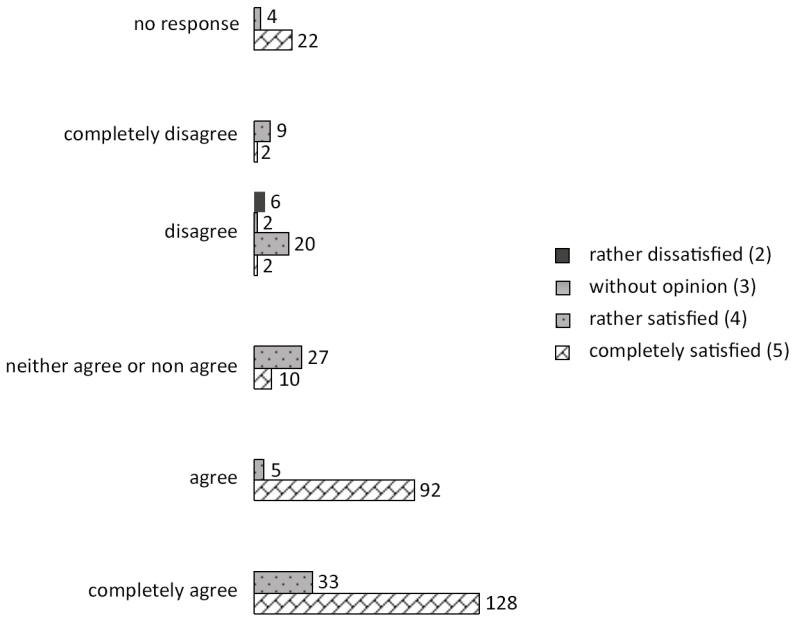

Figure 4. Level of compliance with the requirements (acceptance) of service prices in a repair company and customer satisfaction

S o u r c e: Author's own elaboration.

In order to substantiate the obtained results, they were subjected to additional verification using the chi-square test. The individual statistical quantities enabling the test to be carried out are presented in Table 4. The test was carried out in two research subgroups. One research subgroup was created from clients who fully accepted the price level for services offered in the organization. The second research group consisted of clients with the remaining level of acceptance of prices applied for services rendered in the organization.

In this case, the hypothesis to test is:

H3: There is a relationship between the number of customers accepting prices for repair services provided in the organization and the number of customers confirming full satisfaction with the quality of purchased products.

The individual statistical values resulting from the use of the chi-square test are shown in Table 4. The chi-square is greater than the critical chi-square value. This means that you can say with a probability of 99% that the number of customers declaring full satisfaction with the quality of the purchased products is related to the number of customers expressing full acceptance of the price level for repair services. This confirmed the hypothesis that there is a statistically high relationship between opinions on prices used in specific repairs and the level of product quality as a tool for creating competitive advantage.

Table 4. Awareness of product quality and level of compliance with the requirements (acceptance) of service prices in a repair company—statistical values (SV) for chi-square test

The number of customers in the light of their assesment of product/ service quality	The number of customers who fully accept the prices of services and also have a different level of acceptance		
	The number of customers who fully accept the prices of services	The number of customers who have a different level of acceptance of the prices of services	Total of row
The number of customers completely satisfied (satisfaction scored 5)	$O = 128$ $E = 113.8564$ $SV = 1.757$	$O = 128$ $E = 142.1436$ $SV = 1.4073$	256
The number of customers with a different level of satisfaction than completely satisfied (satisfaction scored 2, 3, 4)	$O = 33$ $E = 47.1436$ $SV = 4.2432$	$O = 73$ $E = 58.8564$ $SV = 3.3988$	106
Grand total	161	201	362
O = observed value			
E = [(row total) × (column total)] / sample total			
SV = [($O - E$) squared] / E			
Chi-square = $\sum SV$			10.8063
Critical value of chi-square at 0.01 and 1 degrees of freedom			6.6349

S o u r c e: Author's own elaboration.

4.5. Discussion

The automotive dealership market is a rapidly growing form of business operations. It is a form in many respects not researched and functioning on the basis of internal principles. In the context of completed research, it was established that:

- car brand owners (manufacturers) operate in the EU on the basis of uniform rules;
- representatives of producers are dealers who, as a single organization, operate on the basis of business brokerage;
- the idea of the dealer's operation is the impact area established under the agreement covering individual parts of the country;
- dealers form a network that covers the entire country;
- in a given country, competition between car manufacturers depends on the result of competition implemented in individual areas of influence.

The importance of price in the automotive dealership market supervised by car manufacturers is changing. During the study, several important relationships were identified. Effective price management means that the brand will gain a competitive advantage. The research

shows that customers who have confirmed the purchase of a car of a given brand and are happy about it indicate that there is a rule of creating a competitive advantage. As part of H1 testing, it was shown that customers who choose a brand based on communicated prices confirm the translation of this element into the final quality assessment of the purchased product. This is related to the positive reaction of consumers to the brand (Keller, 1993).

In turn, as a result of H2 verification, the relationship between the number of selections of the organization representing the brand based on prices and the quality of the purchased product was identified. On the other hand, verifying the accuracy of H3 allowed determining the impact of service prices on product quality. It should be recalled that quality was used at work as a tool to compete.

5. Conclusion

Car brand owners perform their tasks through dealer networks using business brokerage mechanisms. In the face of changing operating conditions, the need to identify new sources of competitive advantage in the automotive industry network activity has been demonstrated. Given the various possibilities of a crisis occurring in one element of activity, e.g. in the sale of new models, it is important to understand the aspects of the existence of another element, e.g. car repair. The appreciated car repair sector may further contribute to maintaining proper brand prestige (and its choice) after the crisis (Bundschuh and Dezvane, 2003).

It should be noted that the work confirmed the existence of an effect of price on customer satisfaction (Yulisetiarini and Prahasta, 2019). Thus, the possibility of influence via prices on the competitive advantage was confirmed. In the system of implementation of producers' tasks through dealers, three plane mechanisms of shaping competitive advantage by means of prices were identified. It has been effectively confirmed in the area of brand selection, choice of organization representing a given car brand and in the area of service provision. Customers' understanding of the pricing policy used in the dealership network means customers' favour and component from their subsequent satisfaction with the quality of the products purchased as a result of repair activities. This way, a source of distinction from other brands was discovered in the work (Louro and Cunha, 2001). This is very important in a situation when buyers' awareness of brands is limited (Park et al., 2010).

This work is just a beginning of the research in the area of development of the car brand owner on the network market. This is despite the fact that the dealer network market in emerging economies has been operating for over a quarter of a century. The reasons for this are the hermeticity of operating rules and the changing general legal rules on this market. The search for other sources of competitive advantage is a good subject for further scientific work. This is very important for the development of organizations operating in the business brokerage system. In addition, understanding the role of price in the way proposed by the author can be helpful in placing branded products on the market in global conditions and every industry.

References

Aaker, D., Fournier, S. M., Brasel, S. A. (2004). When good brands do bad. *Journal of Consumer Research*, *31*(1), 1–6. DOI: 10.1086/383419.

Aaker, D., Joachimstahler, E. (2000). *Brand leadership.* New York: Free Press. ISBN 0684839245.

Aboltins, K., Rivza, B. (2014). The car aftersales market development trends in the new economy. *Procedia: Social and Behavioral Science*, *110*, 341–352. DOI: 10.1016/j.sbspro.2013.12.878.

Bagozzi, R., Dholakia, U. M. (2002). Intentional social action in virtual communities. *Journal of Interactive Marketing*, *16*(2), 2–21. DOI: 10.1002/dir.10006.

Bagozzi, R., Dholakia, U. M. (2006). Antecedents and purchase consequences of customer participation in small group brand communities. *International Journal of Research in Marketing*, *23*(1), 45–61. DOI: 10.1016/j.ijresmar.2006.01.005.

Bartes, F. (2009). *Paradigma inovací a hodnotové inženýrství.* Brno: VÚT.

Bilan, Y. (2013). Sustainable development of a company: Building of new level relationship with the consumers of XXI century. *Amfiteatru Economic Journal*, *15*(7), 687–701.

Bryson, J. M., Ackermann, F., Eden, C. (2007). Putting the resource-based view of strategy and distinctive competencies to work in public organizations. *Public Administration Review*, *67*(4), 702–717. DOI: 10.1111/j.1540-6210.2007.00754.x.

Bugdol, M. (2011). *Zarządzanie jakością w urzędach administracji publicznej. Teoria i Praktyka.* Warszawa: Difin. ISBN 9788376413532.

Bundschuh, R. G., Dezvane, T. M. 2003. How to make after-sales services pay off. *McKinsey Quarterly 4*(4), 116–128.

Cherubini, S., Pattuglia, S. (2007). *Comunicare con gli eventi*. Milano: Franco Angeli. ISBN 9788846490995.

Cholewicka-Goździk, K. (2008). Istota zarządzania jakością. *Problemy Jakości*, *6*, 6–12.

Cova, B., Cova, V. (2002). Tribal marketing: The tribalization of society and its impact on the conduct of marketing. *European Journal of Marketing*, *36*(5–6), 595–620. DOI: 10.1108/03090560210423023.

Cretu, A. E., Brodie, R. J. (2007). The influence of brand image and company reputation where manufacturers market to small firms: A customer value perspective. *Industrial Marketing Management*, *36*(2), 230–240. DOI: 10.1016/j.indmarman.2005.08.013.

Duncan, T. (2002). *IMC: Using advertising & promotion to build brands*. New York: McGrawHill. ISBN 0071123318.

Elshaer, I. A., Augustyn, M. M. (2016). Direct effects of quality management on competitive advantage. *International Journal of Quality & Reliability Management*, *33*(9), 1286–1310. DOI: 10.1108/IJQRM-07--2014-0086.

Gomes, M., Fernandes, T., Brandão, A. (2016). Determinants of brand relevance in a B2B service purchasing context. *Journal of Business & Industrial Marketing*, *31*(2), 193–204. DOI: 10.1108/JBIM-08-2014-0151.

Hamel, G., Green, B. (2007). *The future of management*. Boston: Harvard Business School Press. ISBN 9781422102503.

Hamel, G., Prahald, C. K. (1996). *Competing for the future*. Boston: Harvard Business School Press. ISBN 9780875847160.

Hamrol, A., Mantura, W. (2012). *Zarządzanie jakością. Teoria i praktyka*. Warszawa: Wydawnictwo Naukowe PWN. ISBN 9788301167752.

Johnson, M. D., Herrmann, A., Huber, F. (2006). The evolution of loyalty intentions. *Journal of Marketing*, *70*(2), 122–132. DOI: 10.1509/jmkg.70.2.122.

Kafetzopoulos, D., Gotzamani, K., Gkana, V. (2015). Relationship between quality management, innovation and competitiveness: Evidence from Greek companies. *Journal of Manufacturing Technology Management*, *26*(8), 1177–1200. DOI: 10.1108/JMTM-02-2015-0007.

Kapferer, J.-N. (2008). *The New Strategic Brand Management: Creating and sustaining brand equity long term*. London: Kogan Page. ISBN 9780749450854.

Kay, M. J. 2006. Strong brands and corporate brands. *European Journal of Marketing*, *40*(7–8), 742–760. DOI: 10.1108/03090560610669973.

Keller, K. L. (1993). Conceptualizing, measuring, and managing customer-based brand equity. *Journal of Marketing*, *57*(1), 1–22. DOI: 10.1177/002224299305700101.

Keller, K. L., Lehmann, D. R. (2006). Brands and branding: Research findings and future priorities. *Marketing Science*, *25*(6), 551–765. 10.1287/mksc.1050.0153.

Khudhair, H. Y., Jusoh, A., Mardani, A., Nor, K. M. (2019). A conceptual model of customer satisfaction: Moderating effects of price sensitivity and quality seekers in the airline industry. *Contemporary Economics*, *13*(3), 283–292.

Kopycińska, D., Sergi, B. S. (2008). Economic development and prospects in Poland: An introduction. *International Journal of Economic Policy in Emerging Economies*, *1*(2–3), 127–136.

Kuczamer-Kłopotowska, S. (2009). *Polityka dystrybucji*. In: W. Żurawik (ed.). *Marketing. Podstawy i kontrowersje* (pp. 177–197). Gdańsk: Wydawnictwo Uniwersytetu Gdańskiego. ISBN 8373263187.

Lakhal, L. (2009). Impact of quality on competitive advantage and organizational performance. *The Journal of the Operational Research Society*, *60*(5), 637–645. DOI: 10.1057/palgrave.jors.2602601.

Lee, W. J., O'Cass, A., Sok, P. (2017). Unpacking brand management superiority: Examining the interplay of brand management capability, brand orientation and formalisation. *European Journal of Marketing*, *51*(1), 177–199. DOI: 10.1108/EJM-09-2015-0698.

Lim, H., Widdows, R., Park, J. (2006). M-loyalty: Winning strategies for mobile carriers. *Journal of Consumer Marketing*, *23*(4), 208–218. DOI: 10.1108/07363760610674338.

Louro, M., Cunha, P. (2001). Brand management paradigm. *Journal of Marketing Management*, *17*(7–8), 849–875. DOI: 10.1362/026725701323366845.

Markley, M. J., Davis, L. (2007). Exploring future competitive advantage through sustainable supply chains. *International Journal of Physical Distribution & Logistics Management*, *37*(9), 763–774. DOI: 10.1108/09600030710840859.

Mcalexander, J. H., Schouten, J. W., Koening, H. F. (2002). Building brand community. *Journal of Marketing*, *66*(1). DOI: 10.1509/jmkg.66.1.38.18451.

Muniz, A. M. Jr., O'Guinn, T. C. (2001). Brand community. *Journal of Consumer Research*, *27*(4), 412–432. DOI: 10.1086/319618.

Muniz, A. M. Jr., Schau, H. J. (2005). Religiosity in the Abandoned Apple Newton Brand Community. *Journal of Consumer Research*, *31*(4), 737–747. DOI: 10.1086/426607.

Naik, P. A., Raman, K. (2003). Understanding the impact of synergy in multimedia communications. *Journal of Marketing Research*, *40*(4), DOI: 10.1509/jmkr.40.4.375.19385.

Ogorodnikova, E., Sidorenko, A., Plakhin, A. (2019). Competitive analysis of public urban transport. *International Journal of Economic Policy in Emerging Economies*, *12*(2), 140–148. DOI: 10.1504/IJEPEE.2019.099731.

Parasurman, A., Zeithmal, V. A., Berty, L. (1985). A Conceptual model of service quality and its implication for future research. *Journal of Marketing*, *49*(4), 41–50. DOI: 10.1177/002224298504900403.

Park, C.W., MacInnis, D. J., Priester, J., Eisingerich, A. B., Iacobucci, D. (2010). Brand attachment and brand attitude strength: Conceptual and empirical differentiation of two critical brand equity drivers. *Journal of Marketing*, *74*(6), 1–17. DOI: 10.1509/jmkg.74.6.1.

Rao, A. R., Monroe, K. B. (1989). The effect of price, brand name, and store name on buyers' perception of product quality: An integrative review. *Journal of Marketing Research*, *26*(3), 351–357. DOI: 10.2307/3172907.

Rijamampianina, R., Abratt, R., February, Y. (2003). A framework for concentric diversification through sustainable competitive advantage. *Management Decision*, *41*(4), 362–371. DOI: 10.1108/00251740310468031.

Sawhney, M., Kotler P. (2001). Marketing in the age of information democracy. In: D. Iacobucci (ed.). *Kellogg on Marketing* (pp. 386–408). New York: John Wiley & Sons. ISBN 047135399X.

Semiz, S. (2011). The effects of quality management applications on automotive authorized sales and service firms. *African Journal of Business Management*, *5*(2), 306–315. DOI: 10.5897/AJBM10.034.

Sheth, J. N., Sinha, M. (2015). B2B branding in emerging markets: A sustainability perspective. *Industrial Marketing Management*, *51*, 79–88. DOI: 10.1016/j.indmarman.2015.06.002.

Shiau, W., Luo, M. M. (2012). Factors affecting online group buying intention and satisfaction: A social exchange theory perspective. *Computers in Human Behavior*, *28*(6), 2431–2444. DOI: 10.1016/j.chb.2012.07.030.

Sukwadi, R, (2015). The implementation of quality management practices in Indonesian SMEs. *International Journal of Trade and Global Markets*, *8*(3), 207–222. DOI: 10.1504/IJTGM.2015.071604.

Taghizadeh, H., Shokri, A. (2015). The relationships among agility empowerers from the viewpoint of gaining competitive advantage. *International Journal of Trade and Global Markets*, *8*(3), 223–265.

van Riel, A. C. R., Liljander, V., Semeijn, J., Polsa, P. (2011). EU deregulation and dealer-supplier relations in automotive distribution. *Journal of Business & Industrial Marketing*, *26*(2), 115–131. DOI: 10.1108/08858621111112294.

Yeo, G. T., Thai, V. V., Roh, S. Y. (2015). An analysis of port service quality and customer satisfaction: The case of Korean container ports. *The Asian Journal of Shipping and Logistics*, *31*(4), 437–447. DOI: 10.1016/j.ajsl.2016.01.002.

Yulisetiarini, D., Prahasta, Y. A. (2019). The effect of price, service quality, customer value, and brand image on customers satisfaction of Telkomsel cellular operators in East Java Indonesia. *International Journal of Scientific & Technology Research*, *8*(3), 5–9.

Ząbek, J. (2019). The impact of customer service on product quality and the loyalty with the brand. *13th International Days of Statistics and Economics. The Conference Proceedings* (pp. 1688–1697). Praha, Slaný: Melandrium. DOI: 10.18267/pr.2019.los.186.169.

Zeithaml, V. A., (1988). Consumer perception of price, quality, and value: A means-end model and synthesis of evidence. *Journal of Marketing*, *52*(3), 2–22. DOI: 10.2307/1251446.

Przewaga konkurencyjna marki samochodowej w świetle jakościowej kwantyfikacji cen. Analiza na przykładzie wybranego obszaru oddziaływania

Abstrakt: W obliczu zachodzących zmian ważnym wyzwaniem dla producentów samochodów jest oddziaływanie na rynek za pośrednictwem cen. Głównym celem badawczym pracy jest identyfikacja roli ceny w budowie przewagi konkurencyjnej producenta marki samochodu w danym obszarze jego oddziaływania. Badanie audytoryjne zrealizowano wśród klientów wiodącej marki samochodowej z obszaru byłego województwa tarnowskiego. Z przeprowadzonych badań wynika reguła tworzenia przewagi konkurencyjnej. Z reguły tej wynika, że liczba klientów zadowolonych z końcowej jakości nabytego wyrobu jest większa, jeżeli większa jest liczba klientów decydujących o wyborze marki oraz zakładu naprawczego reprezentującego markę na podstawie ceny. Z reguły tej wynika także, że liczba klientów zadowolonych z końcowej jakości nabytego wyrobu jest większa, jeżeli większa jest liczba klientów uznających cenę za konkretne usługi naprawcze jako spełniającą ich wymagania. W badaniu potwierdzono, że skuteczne zarządzanie przez cenę z wykorzystaniem parametrów jakościowych oznacza zdobycie przez markę przewagi konkurencyjnej. Ocena ceny z uwzględnieniem jakości może być wykorzystana do wprowadzania marek na rynek w warunkach globalnych.

Słowa kluczowe: przewaga konkurencyjna, jakość, satysfakcja, marka, sieć dealerska

Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie
The Małopolska School of Economics in Tarnów Research Papers Collection
ISSN 1506-2635, e-ISSN 2658-1817
2020, 48(4), 95–110
DOI: 10.25944/znmwse.2020.04.95110
© 2020 MWSE, distributed under the Creative Commons Attribution 4.0 International License (CC BY-NC-ND 4.0)

The concept of project evaluation in the implementation of innovation

Ryszard Ćwiertniak

Małopolska School
of Economics in Tarnów, Poland

E-mail: rcwiertniak@mwse.edu.pl
ORCID: 0000-0001-9295-5549

Abstract: Innovation is a collection of unique projects, portfolios or project programmes. Current changes are influenced by phenomena in the organization and its environment. We continue to ask ourselves, especially during the pandemic crisis, how to build the trust and safety of project teams if the assumptions made, which had previously been undisputed, become a challenge. The aim of the article is to identify the limitations and barriers that accompany project teams during the implementation of innovations and to present methods for overcoming them. To achieve this goal, a proposition was prepared for our own diagnostic tools, paying particular attention to the phenomenon of priming in the design and dissemination of innovations. The factors determining the effectiveness of project handover between teams were also selected. According to the author, priming is the removal of obstacles to making a transition in innovative projects. The author's presented method of assessing internal stimuli determines the functioning of project teams. The article adopts the thesis that the effectiveness of the handing over of innovative projects depends on the preparation of project teams to fulfill this mission in the company. Based on the conclusions of the discussion, the handing over of an innovative project is the fulfillment of stakeholder expectations in accordance with the criteria of the feasibility, desirability and viability of the project. To achieve this, the (transferor/ user) teams should have a common understanding of the final product design requirements and expected quality.

Keywords: innovation management, innovation projects, handing off innovation projects, implementation of innovation projects, diffusion of innovations

Financed by:
Małopolska School of Economics
in Tarnów with support
of the Ministry of Science
and Higher Education
("Support for scientific journals")

Correspondence to:
Ryszard Ćwiertniak
Małopolska Wyższa Szkoła
Ekonomiczna w Tarnowie
Katedra Zarządzania
ul. Waryńskiego 14
33-100 Tarnów, Poland
Tel.: +48 14 65 65 528

1. Introduction

Project management is an interesting way to manage change and achieve results in an organization. For this purpose, integrated platforms are created that include complex systems, processes and tools. For a significant number of companies, it is still a challenge to change the business profile from tra-

ditional task orientation to project and to effectively disseminate new products in the market space, in business reality and in contact with clients.

Innovation is rarely the result of the work of lone designers. Nowadays, numerous innovations begin to use old ideas in new contexts (Hargadon and Sutton, 2006, p. 63). The best companies in the world apply this principle in the course of a cyclical innovation process that focuses like a lens during the transfer of an Innovation Project (IP) to the market space. The main goal of the discussion described in the article is to identify the factors determining the transfer of projects and to indicate methods that can improve this process in the organization. The goal defined in this way required the analysis of selected literature items, the development of a study on the phenomenon of priming in projects and the preparation of a concept for the method of handing over innovation.

The methodology of the research described in the article is based on three pillars:

– rich domestic and foreign literature in the field of innovation and a small amount in the area of transfer of innovation projects were analyzed;
– a study of the phenomenon of priming in projects during the pandemic was carried out;
– experience in agile project management and knowledge of design thinking methodology were used.

The article adopts a thesis according to which the effectiveness of the transfer of innovation projects depends on the appropriate preparation of project teams to fulfill this mission in the company. Projects that achieve market success are results-oriented, rather than action-oriented, undertakings. The goal of any new product or service is to fulfill the expectations and needs of clients. To achieve this, an agreement should be built between the parties (stakeholders) in the project.

Project management is a multidisciplinary and eclectic area. Also, project handover can be defined in different ways. According to the traditional PRINCE2 methodology, the transfer of a project is closely linked to its closure, which consists in "indicating the agreed point at which the acceptance of the final product of the project shall be confirmed and the state in which the goals specified in the original Project Initiation Documentation have been achieved (or approved changes in these goals have been achieved), or that the project (that is, the temporary organization) has nothing else to contribute" (Axelos, 2014, p. 217). The presented definition of the completion stage of an ordinary project results from the belief that it is a predictable undertaking, which has a finite duration and provides previously planned outputs/ deliverables. During the diffusion of an ordinary project, the deficiencies are remedied and warranty service or financial settlement of the investment takes place. The basis of these activities is an agreement (contract), which results from the definition of the final state of the investment.

Meanwhile, nothing is obvious in innovation projects. The lack of a clear definition of project implementation activities further aggravates the difficulties in understanding the nature of innovation transfer. Teams (transferor/ user) have general and specialist knowledge, but they relate to narrow areas of project implementation. Moreover, not all stakeholders of this event have common goals, therefore the handing over of innovation should be treated as an iterative process in which the parties to the transfer should agree on deliverables. Preparation of the implementation of project and support for it, as well as support for implementation teams (responsible for disseminating new products), constitute a key part of this undertaking.

The main goal of project verification is then to draw conclusions, and its final effect should be the preparation of proposals for the future.

The results of observations by the *Association for Project Management* indicate several important factors that have been confirmed during research into effective project teams (2017, p. 7), i.e.:

- the planned benefits have been established and communicated to stakeholders at the outset (85% positive feedback);
- the design approach was dominant throughout the life cycle of the new product or service (85%);
- the end users are represented on the project team throughout the project life cycle (75%);
- lessons learned from previous projects are reviewed at the start of this project (71%);
- post-handover, on-site support from the project team remained for longer than 2 weeks (65%);
- training happens in a concentrated period leading up to handover (61%);
- documents concerning the dissemination of the project were prepared by an external company (58%);
- knowledge transfer was planned from the start of the project (58%).

To sum up, it should be stated that in the traditional sense, projects serve in the process of producing material effects. On the other hand, innovation projects create intangible artifacts that benefit the entire organization. One of the reasons why issues of the coherence of project activities are the subject of research is the urgent need to effectively disseminate innovation through the process of diffusion (Hansen and Birkinshaw, 2007, p. 3). The handover of innovative projects means meeting the expectations of stakeholders in accordance with the adopted criteria of the feasibility, desirability and viability of innovation. To achieve this, the (transferor/ user) teams should have a common understanding of product requirements and expected quality. Taking the above definition as a starting point, it should be stated unequivocally that defining information and knowledge transfer activities is crucial, in relation to both the project and the management of its implementation.

2. Contemporary determinants of the transfer of innovative projects

Project is a broad term that covers both the creation of new products and the improvement of existing ones.[1] Modern project management methodologies (e.g. PRINCE2, Project Management Institute—PMI, International Organization for Standardization—ISO, International Project Management Association—IPMA) emphasize the importance of time, goal, resources, models and result orientation of the project (e.g. development of a new product, service or other specific result). Unique execution activities, a business case and a dedicated project team are also important attributes. A traditional project is: "a temporary organization designed to deliver one or more business products in accordance with a business case" or "a unique process consisting of a set of coordinated and managed activities with specific start and end dates, with the intention of achieving a goal consistent with specific requirements based on time, cost and resource constraints".

[1] The most important features of the project are: purposefulness, temporality, complexity, limitation, uniqueness, planning and predictability.

A project is also a "cost and time limited operation producing a set of defined products in accordance with quality standards and requirements" (OGC, 2005; IPMA, 2006).

In recent years, there has been an increase in the importance of project approaches for solving complex problems and creating innovation. The efficiency of designing new products and services distinguishes organizations in the market. The core content of projects, such as "time-limited effects", "managed collection of resources", "unique process", "cost and time--limited operation", determine the competitive advantage in the market.

It is hard to clearly distinguish an innovation project from a traditional one, due to the blurred line that appears in the context of these two separate activities (Sońta-Drączkowska, 2018, p. 61). The question is what the differences between these undertakings are. First, an innovation can vary in form and scope. It is an idea, a sketch of something, an intended action plan, a programme, a pre-design concept. It is also a prototype, i.e. the first trial experimental copy of a new type of machine, a model that can be modified and developed in the future. Secondly, an innovation project should not be treated as one more traditional task in an organization, therefore it cannot be managed by ordinary methods, it requires new control models.

It is not difficult to notice that each project represents the most important value of an innovative company. The uniqueness of this activity means that the experience gained during its implementation cannot be repeated in the form of the same actions in the next project, but it supports the decision-making process. This results in a creative approach to a new problem, where uniqueness concerns not only the method of implementation, but also the benefits, i.e. the product or service that arises as a result of it. Innovation today is not a one-way process, nor is it based on a simple cause-and-effect relationship between creativity and business operations. It is an interactive, collegial process with a strong social tone.

Recent years have proved that the handover of innovation projects is not automatic. The *Association for Project Management* (2017) defines transfer projects from one team to another as "the point in its life cycle where deliverables are handed over to the sponsor and users". Evidence for the importance of comprehensive dissemination of innovative projects is provided by cases described in the literature (Cadle and Yeates, 2008; McIntosh, 2017), which include the following factors:

– knowledge and experience of the project team;
– project maturity of the organization;
– contact with project stakeholders;
– evaluation of project progress;
– implementation competences;
– preparation of the organization for the operation of a new project.

Innovation diffusion is a process of change, and the process of change is a sphere of communication (Highsmith, 2010, pp. 268–269). At this stage, the client receives the finished product and carries out a series of examinations and tests to confirm whether the system meets his expectations and needs. Project implementation control enables, as a result, efficient organization of production, distribution, operating, maintenance and servicing of the product throughout its life cycle.

Notwithstanding the described material features of projects, there are also significant discrepancies in their evaluation and handover procedure. As a rule, control efforts are focused

on the initiation and implementation phase of the project. This measurement concerns the determination of expenditure on research and development, acquisition of new technologies, licenses and employment of personnel. On the other hand, the assessment of the effects comes down to monitoring changes in financial statements. At the end of each project, the deliverables are measured to check whether the users are satisfied and whether the cost and implementation time of the undertakings have been met (in accordance with the specification). On the basis of the evaluation of projects, it is then possible to decide on preventive actions or measures, or emergency actions, during the dissemination of innovations.

3. Proposition of diagnostic tools in the area of innovation implementation

3.1. Research methodology

The implementation of a new product or service for production or use closes up the innovative project. It is also the beginning of the gradual absorption of innovations in the market.[2] At this stage, the elements of the innovation system are examined and the project's possibilities are identified and tested in real conditions (van Heerden, Steyn and van der Walt, 2015). There are also new concepts of product management in the diffusion phase and a detailed plan for the use of resources in the new organizational and market environment. A pilot batch is launched that defines the production process. In turn, the marketing and sales departments are responsible for introducing the offer to the market. The commercialization of the project is the final test of the new product, i.e. whether the innovation works; how can we be successful in the market and what will be the multifaceted benefits?

Diffusion of innovation is an activity that covers the whole organization (Langley et al., 2009, pp. 5–24). It is also a complicated task of handing over a project for implementation, in which two teams participate, a design team (creative team) and an implementation team (e.g. production, sales, legal, etc.). Project evaluation under such circumstances has a temporal and spatial dimension. Indeed, it presupposes a control that is not obvious. It is a phenomenon that causes conflicts and dissatisfaction among staff. The crisis consists in an innovation coming closer to the rules of conduct in the organization, and thus to the pragmatic way of managing a product or service.

The discussion around the implementation of innovative projects touches upon many aspects. Theorists acknowledge the complexity of this process, which may depend on the context and scope of the project, and the overlap between development and delivery activities (Khan and Kajko-Mattsson, 2010). In the presented research, a qualitative approach was chosen which treats the subject of research—the evaluation of projects in the implementation of innovations—naturalistically. It is intended to answer the questions of how, in what way and why. This procedure is therefore explanatory and highly descriptive, which works well for conceptual and design work. In these studies, there is already the possibility of focusing on

[2] Diffusion refers to the way innovation spreads through market and non-market channels, from initial deployment to customer engagement, to presence in different countries, regions, sectors, markets and companies. Without diffusion, innovation would not be economically significant.

the means by which designers identify their experience related to the specificity of innovative projects, and less on numerical data or the frequency of occurrence of certain phenomena.

3.2. Implementation of the project and the phenomenon of priming in project management

As a result of a comprehensive diagnosis of the course of innovation transfer, the author's own concept of the handover of innovative projects was prepared. The proposed tools result primarily from the analysis of the phenomenon of priming in the design and application of innovations.

The success of innovation increasingly depends on the competence of project teams. Priming is the removal of obstacles to making a transition in innovative projects. Many authors write about the importance of priming in psychology, a phenomenon that initiates an automatic mental process which "latent at first, then reveals itself in the presence of liberating external information. Automatic subconscious processes are therefore activated before the appearance of an external stimulus. On the other hand, the occurrence of goal-related automatisms requires the fulfillment of one prerequisite—the intention to perform a mental activity. If this condition is met, it is immediately followed by an autonomous process that does not require any additional, conscious and reflective control of its course (for example, as occurs in a well-trained cognitive procedure or perceptual-motor skill)" (Bargh, 1999). Additionally, according to Wikipedia: priming "is a phenomenon whereby exposure to one stimulus influences a response to a subsequent stimulus, without conscious guidance or intention" (Priming, 2020). This is the manipulation of effects (experiences) that arise under the influence of multiple factors.

Presented effect can be used in various areas of life, as well as in project management, especially during their application. It is influenced by earlier contact with a given factor. In this way, a team can be developed to implement a project effectively. Priming is, in a sense, the effective preparation of team members for unexpected events that may occur at any time. The basis is a stimulus directed to our prime subconscious, which can be verbal, visual, tactile or auditory. This factor influences our subsequent behaviour, activating itself in the project environment. How can we use this knowledge?

3.3. The phenomenon of priming in project teams—a qualitative study

Confirmation of the occurrence of the phenomenon of priming in design was carried out among experts and designers from the IT industry. This study was interesting because it was not, like most experiments of this type, conducted on students, but on 50 computer scientists. As in the study by Karyłowski et al., the described test used the phenomenon of priming. However, instead of urging the subjects to try not to pay attention to the initial stimuli (in our case—the design process), the opposite strategy was used. Namely, the respondents were asked to try to keep the introductory stimulus (design experience) in mind for a few seconds so that after seeing and reacting to a specific factor (in our case a specific question) they could answer a question concerning the initial stimulus (1999).

During the experiment, specialists were divided into two groups—one was given a note to read about high-risk projects, which ended in success. The second group received informa-

tion on the need to avoid an error as a result of interrupting a risky activity. Next, both groups received a questionnaire—an introduction to the new project involved answering a few questions: what are you really good at; what is your professional success; what have you achieved for your company; what proves that you are suitable for the project you are doing; why are you, out of all the candidates, the best suited to lead the next project; why should you lead people on a project team? The group that read the information about the risky project was inclined to make difficult design decisions, there were more positive relationships, the individual characteristics also included challenges and descriptions of ways to deal with them. Additionally, during the evaluation and analysis of the research results, the specialists' statements were divided into three roles in the project team that relate to the course of the innovation process: research, scaling and optimization (Brown, 2018). The study concerned the work of a designer in a research and development team, in contact with clients and developers. Scaling involved an iterative experimentation process that, using agile management methods, brings a new product to the market space. Optimization is the successful business implementation of a project (Table 1).

Table 1. The phenomenon of priming in project teams—a qualitative study

Role in the project team	Characteristics (selected statements of the study participants)
What are you really good at?	
Research	"Analytical thinking; configuration of network devices; participation in research; Angular programming/ Net/ Azure cloud; marketing; resistance to stress; setting up computer networks; logical thinking; sense of aesthetics; planning, writing texts and learning languages"
Scaling	"Programming, creating and designing IT architectures; computer technology; interpersonal contact; perceiving connections between various phenomena in the environment"
Optimizing	"Implementation of networks, listening to employees; organizing cooperation; operating systems and sales"
What is your professional success?	
Research	"The current project, in which I fulfill the role of analyst, and not just a domain expert; building the project from scratch; implementing several large projects in state-owned companies worth several million zlotys"
Scaling	"Preparation of several interns for work in positions; in three years I became the technical leader of the team, starting from a junior position; being the best in the team and becoming promoted; that the team did not fall apart; creating new infrastructure and improving the old network"
Optimizing	"Winning clients, taking care of employees; building an effective team; with 40% higher application performance (RAM); finding a large error in the production of software on the first day of work; solution of a large network problem in a short time; logical thinking"
What have you achieved for your company?	
Research	"Building the front-end and back-end as well as automation of implementations; support for projects; proposal for a change that had an impact on the effectiveness of work"

Role in the project team	Characteristics (selected statements of the study participants)
Scaling	"Maintaining development in the company; contracts; organization of a project from the front-end; high profitability; client satisfaction; improving functioning in communication and technical aspects; creating a back office, selecting a team, obtaining resources for international projects"
Optimizing	"Improvements in the working group on the basis of office tools; management of the entire architecture of the product, thanks to which functionality is 'delivered' despite very limited time; significant reduction of infrastructure maintenance costs"
What proves that you are suitable for the project you are doing?	
Research	"Speed of learning, knowledge related to IT systems in the organization, being hard-working, knowledge, experience; independence; commitment; deep knowledge of protocols, compilers and virtual machines (JVM, NET, CLang); ability to manage time when working with clients"
Scaling	"I can carry out any task in the organization; I can supervise the team in terms of the technical/ project/ client contact sides"
Optimizing	"Familiarity with multiple planes and understanding of their integration; ability, method of management; I can adapt to different conditions"
Why are you, out of all the candidates, the best suited to lead the next project?	
Research	"I can set goals clearly and I can listen; in my previous company I dealt with designing architecture in Azure, so I will be the most competent during migration from one supplier to another person"
Scaling	"Over 10 years of experience in the company, where I often acted not only as an initiator/ leader in terms of changes regarding my unit, but also as a mediator and tester; I possess leadership skills, I can divide tasks; I have already led technology projects of high complexity (core banking system, zero downtime requirement)"
Optimizing	"I have many years of experience in the field of team management and software development; I have experience and always try to find the best route to the destination"
Why should you lead people on the project team?	
Research	"I always try to be well prepared so my decisions can be relied upon; I am well-suited to the role of mentor who supports team members in solving their tasks"
Scaling	"Due to my experience; I consider myself a perfectionist and I can see the elements even in the smallest things; I have managerial experience, I have already managed a team of several people"
Optimizing	"I have both knowledge and skills in IT and business, I also have some experience in project work and people management; before I started working as a programmer, I ran two associations and youth sections in political parties, in which I managed projects and managed the people involved in them; I can plan tasks and look at a project from many perspectives"

S o u r c e: Author's own elaboration.

Based on the presented qualitative research in the IT industry, it can be seen that even such a complex process as design can be influenced by incentives related to the knowledge and experience of designers, especially in the area of results that have been successful in the past. It turns out that computer scientists often use priming. But the impact of priming is also worth remembering when making tough design choices in other industries.

3.4. Analysis of the functionality of the company in terms of handover of innovation projects

Integrated knowledge, created from the collision and overlapping of different directions of changes, can stimulate conceptual work and enrich the methods of its implementation. Measurement factors, understood as the ability of the (transferor/ user) teams to accept the innovation project, are included in the components related to the strategy, organization and implementation process and include: defining new managerial roles, creating action plans, designing processes, mastering IT tools, emergency response, etc., which can be measured in the areas listed below (Table 2).

The presented assessment categories result from various decision-making problems in the entire organization (McIntosh, 2017). The assumption is that the innovative project is a complex undertaking concerning the implementation of the strategy, capturing benefits, protection of intellectual property, use of resources and modeling of business processes. These are also features that determine the value of the project in the long term (what level does it represent; what is its intellectual value; will it create space for the organization's development; is it a competitive advantage?) and contribute to the problem of innovation transfer.

Table 2. Internal determinants of the implementation team

Assessment team determinants	Components
Innovation strategy	
Adaptation of the innovation strategy	Knowledge of strategic documents, innovation indicators
Project maturity	The ability to properly select projects, the ability of the organization to identify success factors
Organization and innovation culture	
Leadership	Decision-making, education, ability to react in crisis situations and communication skills
Cooperation	Openness, the ability to work in a group, the ability to perform tasks in a team and solve problems together
Culture	Understanding, tolerance, permission to make mistakes
Organization of work	Planning, coordination, staff participation
Diffusion process	
Budget	Knowledge of the financial and investment plan

Assessment team determinants	Components
Implementation methods	Ability to use existing organization methods and management
Assessment criteria	Clearly defined, useful, broadly understood determinants of evaluation
Factors enabling the evaluation of innovation	
Protection	Knowledge of the legal forms of protection of innovation
Competencies	Ease of efficient and effective assessment—meeting quality expectations
Motivation	Willingness to take actions that are relevant to the assessment
IT tools	Mastering IT tools, using databases and experience

S o u r c e: Author's own elaboration.

Analysis of the company's functionality in terms of handing over innovative projects can be carried out in accordance with the author's matrix below (Table 3). The first area of measurement includes the company's ability to hand over the features of the functionality of an innovative project, i.e. product quality, marketing methods, innovativeness of the solutions adopted and the place of the project in the innovation system. The second part covers the company's predispositions to transfer information about the desirability of the project, i.e. production technology, organizational and legal solutions adopted, personnel preparation, management style, organizational culture and external contacts of the company. The third area covers the competence of the personnel to hand over the economic and technical effectiveness of the project.

Table 3. Analysis of the functionality of the company in terms of handover of innovation projects

Category of the company's ability to evaluate and hand over the project and characteristics		System Assessment	
		Pts.	Characteristics of the indicator
1		2	3
Diagnostic function—evaluation of the feasibility of the project			
The ability to evaluate project quality—AQ	Knowledge of planning and quality control methods	1	There is a lack of staff and quality assessment activities
		2	The organization carries out its own quality tests to a limited extent
		3	There is a quality department that deals with the adaptation of solutions from outside the company

Category of the company's ability to evaluate and hand over the project and characteristics		System Assessment	
		Pts.	Characteristics of the indicator
1		2	3
The ability to evaluate the marketing of the project—AM	Mastering marketing tools	1	The company lacks separate marketing units and no market research is conducted
		2	The company has marketing personnel who generally research client needs
		3	The organization has a marketing department and a management system, thanks to which systematic research of client requirements and satisfaction is carried out
The ability to evaluate project innovation—AI	Ease of efficient, effective evaluation (handover) meeting the quality expectations	1	Lack of research and development services and activities
		2	The organization conducts its own research to a limited extent in order to constantly modernize and create new products
		3	The organization conducts its own research and cooperates with specialized units of the R&D sector in order to create new products
The ability to evaluate the information system—AIS	Mastering IT tools, using databases and experience	1	Information is collected and stored only on paper carriers
		2	There is an internal IT network in the company that covers 30–50% of employees
		3	There are various databases in the internal network and modern IT systems are used
Structural function—project desirability assessment			
The ability to evaluate innovation and production technology—AT	Willingness to take actions that are relevant to the evaluation	1	Own costs of manufacturing the product are at the level of the average prices obtainable on the market (profit margin 0–7%)
		2	Profit margin obtained on the products sold is 8–15%
		3	Profit margin obtained on the products sold is over 15%
The ability to evaluate organizational and legal aspects of the project—AL	Knowledge of legal forms of protection of innovation, organizational structure adjusted to PI	1	Lack of staff and activities related to organizational and legal assessment
		2	The company carries out limited organizational and legal activities, including a patent audit of an innovative project
		3	There is a legal department dealing with organizational and legal issues, including a patent audit of new products

Category of the company's ability to evaluate and hand over the project and characteristics		System Assessment	
		Pts.	Characteristics of the indicator
1		2	3
The ability of personnel to evaluate—AH	Decision-making, education, reacting in crisis situations, communicativeness	1	The average number of improvement applications per 1 employee in the company is 0–9
		2	The average number of improvement applications per 1 employee in the company is 10–14
		3	The average number of improvement applications per 1 employee in the company exceeds 15
The ability of the style and system of management to evaluate—AM	Ability to use existing standards and methods of organization and management	1	No innovative products on sale
		2	The share in sales of innovative products is 5–49%
		3	The share in sales of innovative products is more than 50%
The ability to evaluate the organizational culture—AC	Forbearance, tolerance, the possibility of making mistakes	1	No visible traces of organizational culture and the effects of innovative activities
		2	Visible external artifacts and the ability to organize and implement team work
		3	Visible external and linguistic artifacts, low employee turnover, good competitive position of the company
The ability of the organization to evaluate external contacts—AX	The ability to find partners for cooperation that brings benefits to the organization in acquiring knowledge useful for development	1	The company maintains contacts with clients and suppliers and sees no need to extend them
		2	In addition to information from clients and suppliers, the company collects and analyzes all information about competitors
		3	In addition to the above-mentioned, the company has a system for collecting information from distributors, sellers, service technicians, the company maintains contacts with R&D sector units
Prediction function—assessment of project effectiveness			
Project investment assessment capability—AF	Knowledge of the financial and investment plan	1	The organization obtains a negligible positive financial result and does not plan any significant pro-innovation activities
		2	The organization achieves a profit of 5–19% of revenues and allocates up to 39% of this profit to innovative activities
		3	The organization achieves a profit of over 20% of revenues and allocates over 40% of this profit to innovative activities

Category of the company's ability to evaluate and hand over the project and characteristics		System Assessment	
		Pts.	Characteristics of the indicator
1		2	3
Ability to perform technical and technological evaluation of the project—ATT	Knowledge and ability to use new technologies	1	Lack of services and activities related to the assessment of the technical effectiveness of the project
		2	The organization conducts its own research on the technical effectiveness of the project to a limited extent
		3	There is a production department dealing with the adaptation of company solutions to the production needs of the organization

S o u r c e: Author's own elaboration.

The overall index of the company's ability to implement the project (AIP), taking into account weighting factors, expressed on a scale from 1 to 3, can be calculated from the formula:

$$AIP = \frac{3(AQ + AM + AI + ZSI) + 2(AF + ATT) + AT + AL + AH + AM + AC + AX}{22}$$

where: *AQ*, *AM*, *AI*, …, *AX*—designate specific numerical values based on the previously performed assessment of individual categories (Table 4).

Table 4. Values of company functionality analysis in terms of project handover

Category	Assessment value	Characteristic
A	2.51–3.00	Reference quantity
B	2.01–2.50	State of high fitness, appropriacy
C	1.51–2.00	Useful condition
D	1.00 –1.50	Uselessness

S o u r c e: Author's own elaboration.

There is a clear organizational orientation in the perception of project transfer measurement presented. In innovation companies, single events turn into long-term activities. Due to the lack of fast results, reluctance to take action arises. An important aspect of verifying the correctness of adopted solutions is risk assessment, which may be described in strategic documents or the organization may prepare appropriate guidelines for an innovation project. Measurement of uncertainty influences decision-making and supports it, especially in the context of the cause and probability of events, time and planned response (Thirion, 2018).

An important issue is also the preparation of an early warning system, the task of which is to inform the company about threats. Risks can be minimized by discipline and organization, which can be stimulated by an internal compass and radar. The compass measures the

internal direction of action, while the radar collects signals from the outside. Innovative companies can improve their skills to use these two instruments simultaneously, which results in effective and timely implementation of innovation projects.

4. Self-evaluation of projects in the implementation of innovations

Self-evaluation is the primary way of evaluating an innovation project during the transfer of innovation.[3] This technique is derived from self-monitoring and gives an idea of how far the company is on the innovation roadmap and what it needs to do in order to achieve market success. In addition, it easily indicates the strengths and weaknesses of the organization, it also helps to find the cause of the existing condition in order to identify real opportunities for further improvement of the quality of work, systems or processes. It also fulfills other functions (Kwintowski 2015, pp. 346–350), i.e.:

- it is a subjective review of an innovation project (verification function);
- it works by comparing one project with another, which helps in early diagnosis of any irregularities that may contribute to future problems (benchmarking function);
- it allows collection and analysis of information relating to individual areas of the project management system and organization (information function);
- it helps in the implementation of corrective and preventive actions (diagnostic function);
- it connects separate problems thanks to individual self-assessment criteria (integrating function);
- it improves the innovative culture of the company (culture-forming function).

The most important issue in self-assessment is that the organization can independently, without the participation of external experts, assess the innovation project (using a universal question sheet) in key areas, i.e. feasibility, desirability and viability.[4] Before analyzing the questionnaires, it is necessary to define, in agreement with the management, the threshold which if exceeded will indicate weakness of the innovative project in a given area, e.g. 50% of negative answers of all those received for a specific question. It is also possible to determine which areas or features of an innovative project are considered by the management of the company as crucial from the point of view of the effectiveness and efficiency of innovation implementation (e.g. production technology, materials used, etc.).

After assessing and analyzing the conclusions of the study, it may be necessary to conduct additional (detailed) checks in the process of organizational learning in order to discover the causes of the indications and to establish corrective actions (Beckman and Barry, 2007, p. 29). Self-evaluation of an innovative project is an important step to evaluate the completed project, as well as to review the organization in order to take possible corrective and preventive actions using selected organizational and management methods, e.g. Total Innovation

[3] Self-assessment is the first step in taking all corrective and preventive actions, as well as in the field of product, technology and organization improvement in an innovation project.

[4] Self-evaluation brings measurable benefits: systematic striving for improvement; consistency in defining what to do; focus on priority actions aimed at fast process improvement; a specific course of action, starting with individual organizational units and ending with the entire organization; the possibility of comparing and matching the achievements of the organization in its individual cells, as well as in relation to other competing companies from the same industry (see Kwintowski, 2015, p. 347).

Management—TIM, Total Quality Management—TQM, Lean Management, etc. during the implementation of innovations (Furr and Dyer, 2014, p. 5).

5. Conclusion

In conclusion, it is worth emphasizing that every project consists of difficult choices and decisions and is characterized by uncertainty and risk. Additionally, an innovation project is complex and can be interpreted in many ways, among which the conclusions presented in this article are worth considering. The research conducted so far shows that in the innovation implementation system, the most important elements are the strategy and culture of innovation, the features and effects of projects, and methods supporting the organization in the process of controlling the change caused by a new product or service during its dissemination.

Project transfer is not only a specific phase that lies between the project (deliverables) and the process, but a structure that consists of such elements as: project management, acceptance of the achieved deliverables and the complicated process of planning and preparing the operating system for production and distribution or maintenance of a new product or service.

Indeed, performance management in implementing innovation is holistic. It is generally accepted that little can be said about the future of innovation, therefore it is required that the developed project handover system, apart from self-regulating, is adaptable throughout the organization. Management still plays the most important role in the diffusion of new products or services, which rather than constantly improving the organization based on effects, most often deals with the analysis of deliverables that, contrary to appearances, are not easy to identify and measure.

References

Association for Project Management. (2017). *How can we hand over project better*. Buckinghamshire: APM Research Fund Series.

Axelos. (2014). *Prince2. Skuteczne zarządzanie projektami*. Londyn: TSO. ISBN 9780113312245.

Bargh, J. A., (1999). Automatyzmy dnia powszedniego. *Czasopismo Psychologiczne*, *5*(3), 209–256.

Beckman, S. L., Barry, M. (2007). Innovation as a learning process: Embedding design thinking. *California Management Review*, *50*(1), 25–56. DOI: 10.2307/41166415.

Brown, J. (2018). How to hand off an innovation project from one team to another [online, accessed 2020-10-20]. *Harvard Business Review*. Retrieved from: https://hbr.org/2018/08/how-to-hand-off-an-innovation-project-from-one-team-to-another.

Cadle, J., Yeates, D. (2008). *Project management for information systems*. 5th ed. Harlow: Pearson Education Limited. ISBN 9780132068581.

Furr, N., Dyer, J. (2014). Choose the right innovation method at the right time [online, accessed 2020-10-20]. *Harvard Business Review*. Retrieved from: https://hbr.org/2014/12/choose-the-right-innovation-method-at-the-right-time.

Hansen, T. M., Birkinshaw, J. (2007). The innovation value chain. *Harvard Business Review*. June.

Hargadon, A., Sutton, I. R. (2006). Twoja firma też może stać się fabryką innowacji. In: W. Ch. Kim (ed.). *Zarządzanie innowacją*. Transl. by T. Rzychoń. Gliwice: Helion. ISBN 8373619046.

Highsmith, J. (2010). *Agile project management: Creating innovative products*. 2nd ed. Upper Saddle River, NJ : Addison-Wesley. ISBN 9780321658395.

IPMA. (2006). *ICB-IPMA Competence Baseline Version 3.0*. Nijerk: International Project Management Association. ISBN 0955321301.

Karyłowski, J. J., Wallace, H., Motes, M., van Liempd, D., Eicher, S. (1999). Próba wykorzystania techniki torowania (*priming*) do badania kategoryzacji społecznej. *Przegląd Psychologiczny*, *42*(1–2), 111–120.

Khan, A. S., Kajko-Mattsson, M. (2010). Demarcating the scope of a handover process. In: *Fifth International Conference on Software Engineering Advances* (pp. 244–251). ISBN 9781424477883. DOI: 10.1109/ICSEA.2010.44.
Kwintowski, A. (2015). Samoocena jako narzędzie doskonalenia. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, *376*, 346–356. DOI: 10.15611/pn.2015.376.25.
Langley, J. D., Pals, N., Ortt, J. R., Bijmolt, T. H. A. (2009). Early prediction of the market demand for major innovations. *European Journal of Innovation*, *12*(1), 5–24. 10.1108/14601060910928157.
McIntosh, S. A., (2017). *The importance of project handover documentation* [online, accessed: 2020-11--17]. Retrieved from: http://www.long-intl.com/articles/Long_Intl_The_Importance_of_Proj_Handover_Docs.pdf.
OGC. (2005). *Managing successful projects with PRINCE2*. London: The Stationery Office. ISBN 978-0113309474.
Priming (psychology). (2020). In: *Wikipedia. The Free Encyclopedia* [online, accessed: 2020-11-30]. Retrieved from: https://en.wikipedia.org/wiki/Priming_(psychology).
Sońta-Drączkowska, E. (2018). *Zarządzanie projektami we wdrażaniu innowacji*. Warszawa: Polskie Wydawnictwo Ekonomiczne. ISBN 9788320823264.
Thirion, C. (2018). *Effective handover of projects to operations teams* [online, accessed: 2020-11-17]. Retrieved from: https://www.ownerteamconsult.com/wp-content/uploads/2020/04/Insight-0Article-49-Handover-to--Operations-Teams.pdf.
van Heerden, F. J., Steyn, J. W., van der Walt, D. (2015). *Programme management for owner teams: A practical guide to what you need to know*. Vaalpark: OTC Publications. ISBN 9780620658379.

Koncepcja oceny projektów we wdrażaniu innowacji

Abstrakt: Innowacyjność to zbiór unikalnych projektów, portfeli lub programów projektów. Na obecną zmianę mają wpływ zjawiska, które znajdują się w organizacji i w jej otoczeniu. Nadal zadajemy sobie pytanie, szczególnie w czasie kryzysu pandemii, w jaki sposób budować zaufanie i bezpieczeństwo zespołów projektowych, jeżeli przyjęte założenia, które do tej pory były bezsporne, stały się wyzwaniem. Celem artykułu jest identyfikacja ograniczeń i barier, które towarzyszą zespołom projektowym podczas wdrażania innowacji, oraz prezentacja metod ich pokonywania. Dla osiągnięcia tego celu przygotowano propozycję własnych narzędzi diagnostycznych, ze zwróceniem szczególnej uwagi na zjawisko torowania (ang. *priming*) w projektowaniu oraz upowszechnianiu innowacji. Wybrano też czynniki determinujące skuteczność przekazywania projektów między zespołami. Według autora *priming* to usuwanie przeszkód, robienie przejścia w projektach innowacyjnych. Zaprezentowana autorska metoda oceny wewnętrznych bodźców określa funkcjonowanie zespołów projektowych. W artykule przyjęto tezę, że skuteczność transferu projektów innowacyjnych zależy od przygotowania zespołów projektowych do spełnienia tej misji w przedsiębiorstwie. Na podstawie wniosków z dyskusji – przekazywanie projektu innowacyjnego to wypełnienie oczekiwań interesariuszy w zgodności z kryteriami wykonalności, funkcjonalności i opłacalności projektu. Aby to osiągnąć, zespoły (przyjmujący/ przekazujący) powinny posiadać wspólne ustalenia co do ostatecznych wymogów dotyczących projektowanych produktów i oczekiwanej jakości.

Słowa kluczowe: zarządzanie innowacjami, projekty innowacyjne, wdrażanie projektów innowacyjnych, transfer innowacji, przekazywanie projektów

Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie
The Małopolska School of Economics in Tarnów Research Papers Collection
ISSN 1506-2635, e-ISSN 2658-1817
2020, 48(4), 111–120
DOI: 10.25944/znmwse.2020.04.111120
© 2020 MWSE, distributed under the Creative Commons Attribution 4.0 International License (CC BY-NC-ND 4.0)

Study of work safety culture in the company

Leszek Kozioł

Małopolska School
of Economics in Tarnów, Poland

E-mail: leszek.koziol@mwse.edu.pl
ORCID: 0000-0003-3321-9386

Jacek Siewiora

Małopolska School
of Economics in Tarnów, Poland

E-mail: jacek.siewiora@mwse.edu.pl
ORCID: 0000-0003-0472-7381

Michał Korbelak

Małopolska School
of Economics in Tarnów, Poland

E-mail: michal.korbelak@mwse.edu.pl
ORCID: 0000-0001-8078-0972

Abstract: The article presents a discussion on the essence and scope of the concept of work safety culture and indicates the importance of this phenomenon in the process of increasing work safety and security in a company. Selected classifications of safety culture factors are described, and the more important ones are characterized. In particular, attention is paid to the issues of analyzing and developing work safety culture. The aim of the article is to present the concept of diagnosing work safety culture in a modern company and the conditions for its implementation. The results of empirical research obtained with the use of the abovementioned analysis methodology are also presented. In the process of diagnosing the culture of occupational safety, the case study method and the technique of document analysis as well as discussions and interviews with management and employees were used. The article concludes with general substantive recommendations and methodological guidelines for companies.

Keywords: work safety culture, fundamental company values, analysis of safety culture factors

Financed by:
Małopolska School of Economics
in Tarnów with support
of the Ministry of Science
and Higher Education
("Support for scienitific journals")

Correspondence to:
Leszek Kozioł
Małopolska Wyższa Szkoła
Ekonomiczna w Tarnowie
Katedra Zarządzania
ul. Waryńskiego 14
33-100 Tarnów, Poland
Tel: +48 14 65 65 535

1. Work safety culture—the essence and meaning

The aim of the article is to present the concept of diagnosing work safety culture in a modern company and to present the results of empirical research.

The subject of the research was the identification and analysis of the factors of work safety culture resulting from the company's strategy, structure and leadership (hierarchical dependencies) as well as values appreciated by the company in the area of cooperation with customers, employees and competitors.

It is worth emphasizing that the analysis of elements or aspects of work safety culture is still a poorly recognized and understood issue of economic and ergonomic analysis of a company.

Another, no less important issue of the analysis is the determination of the importance of work safety culture in increasing the well-being of employees, considered in the context of the functioning and development of the company.

The concept of safety culture dates back to the beginning of the twentieth century, when it was observed that employees developed their own standards, values and methods of conduct within the workplace (ILO, 2015; Milczarek, 2002). The concept of safety culture in a company appeared in the literature after the Chernobyl disaster in 1986, when the report prepared by the appointed committee referred to safety culture (INSAG, 1991). It is worth adding that the sources of major breakdowns that have occurred in the world in recent years are believed to be insufficient levels of safety culture (Morrow, Koves and Barnes, 2014). Therefore, many industries are interested in safety culture in terms of the possibility of using it to prevent major breakdowns and accidents related to the performance of routine tasks. In the last twenty years, safety culture has increasingly appeared in studies on occupational safety and health (OSH) in companies.[1] In studies on these topics, the concept of safety culture is understood as a set of psychological, social and organizational factors that initiate or support activities that protect life and health both at work and in non-professional activities (Studenski, 2000). Selected, more important aspects of safety culture assessment, such as: values in the area of safety, relations between employees and their sense of belonging to the company, responsibility and awareness of OHS, safe behaviour, management commitment and employee participation, along with OHS training and accident analysis (see Figure 1), can also be considered as the nodal task areas of work safety culture.

[1] The interaction between the elements of culture creating the work environment and individual needs, aspirations, abilities and expectations of employees is of key importance for the interpretation of the work safety culture. Although elements of work safety culture affect attitudes towards work, the individually perceived quality of the work environment, conditions and applicable rules is a benchmark for the employee's situation and if it is not conducive to development (well-being), no other factors will be effective (Lipińska-Grobelny and Michałkowska, 2018, p. 35). Therefore, it is possible to indicate the relationship between work safety culture and the organizational climate. The organizational climate expresses the feelings and opinions of employees relating to selected elements of culture and organizational factors (Bitsani, 2013, p. 50; Wudarzewski, 2013, p. 59). Sobolak and Konodyba-Szymańska understand work safety culture differently. These authors emphasize that it is a part of organizational culture and, in essence, refers to the behaviour of the entire staff, the way of performing work and the ability to use equipment, as well as organizational conditions affecting occupational health and safety; the information system promoting activities in the field of labour protection has a strong impact on strengthening work safety culture (Sobolak and Konodyba-Szymańska, 2012, p. 261).

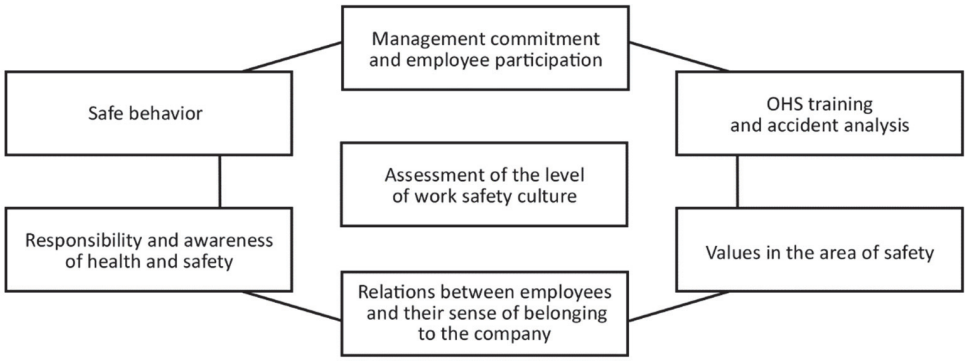

Figure 1. Safety culture in the company—assessment aspects

S o u r c e: Milczarek, 2002.

The main function of safety culture is to reduce uncertainty, both that resulting from functioning in a changing environment and internal uncertainty, and this is done by presenting a basic, common vision of the world of internal and external organization. In this way, it increases the predictability of organizational behaviour without having to resort to detailed regulation of all issues with the use of multiplying regulations (Kozioł and Wojtowicz, 2005, p. 11).

Admittedly, in recent years we have observed an increase in interest in the issues of occupational health and safety. However, despite the development and dissemination of the principles of system management (development of the ISO series standards), adaptation of Polish law to European standards, implementation of preventive programmes (BBS) in organizations, the growing popularity of initiatives aimed at building a safety culture—the level of safety in Polish organizations, measured by accident rates, is not undergoing significant changes (Roszko-Wójtowicz, 2015, p. 89; Kozioł, Muszyński and Kulwicki, 2018). In the area of occupational health and safety management, the traditional approach to OHS, based on compliance with legal requirements, still dominates, where the main motivator for entrepreneurs is the fear of sanctions, penalties imposed by state supervision authorities over working conditions (National Labour Inspectorate, State Sanitary Inspectorate, Office of Technical Inspection), there is no systemic approach to OHS and environmental management based on proactive measures and continuous improvement of processes. Most Polish entrepreneurs do not conduct health and safety cost analyses, thus the losses incurred by companies due to poor working conditions are not analyzed. Failure to perceive losses translates into economic consequences (Smoliński and Solecki, 2015).

The introduction of a differentiated compulsory insurance premium, the amount of which depended on the size of the total risk (occupational risk), resulted in little in this respect, i.e. the improvement of work safety (Sobolak and Konodyba-Szymańska, 2004). The reasons for these failures are seen mainly in the low level of safety culture. The lower level of safety culture among Poles compared to the British is mainly due to low awareness of the risks that almost every job carries, inappropriate attitudes of employees and the lack of genuine organizational commitment on their part (Studenski, 1996).

2. The results of research on work safety culture—a review

Safety culture sets out the rules of conduct and values recognized by members of a given group and defines people's attitude towards risk and safety. It also maintains the values, visions, work style, beliefs and results of the organization (Kopczewski, Pączek and Tobolski, 2012, pp. 923–929). When talking about safety culture, one should always bear in mind three main areas of management: human, information and organization. This is due to the fact that a human being is the subject of all management activities, as it is up to him whether safety management will be effective. Failure to understand and accept any changes may result in management being of little or no effect. In this context, two areas of cultural competence and communication seem important. Competences can be perceived as a set of interrelated elements (Glinka and Kostera, 2012):

– the ability to understand other people;
– the ability to cooperate and maintain intensive cultural contacts with them.

Safety culture consists of elements that are easy to observe, for example, safe work instructions, employees' compliance with safe work instructions and proper use of personal protective equipment, and less visible ones—the attitude of management and employees towards OSH matters, standards of behaviour in the area of safety, and the level of work safety cultures are defined by, among others, the standards of efficiency of information flow in the company.

The purpose of shaping the desired safety culture is to persuade employees to act in ways aimed at protecting the health and life of themselves, their colleagues and all people who are in any way affected by the company's operations. Thus, a company with a high safety culture is one whose employees are characterized by active, continuous care for their own and others' safety, going beyond their obligations when it comes to identifying corrective actions. It is particularly important to develop an appropriate safety culture during training in the field of occupational health and safety because it is an important time that allows the employee to instil appropriate attitudes in the field of safety, which in turn translates into an increase in the economic effects of the organization and the well-being of employees. Important prerequisites for the development of a culture of occupational safety are: the commitment of top management, open and effective internal communication, employee participation in management, accident analysis, reinforcement of safe behaviour and cooperation among employees (Ejdys [ed.], 2010). This list can be supplemented with additional conditions for shaping work safety culture, namely the management style and quality of safety management in the organization and ergonomic awareness, which includes (Berkowska, Drzewiecka and Mrugalska, 2014):

– awareness of the field of ergonomics;
– ensuring compliance with the principles of ergonomics;
– perception, which consists of knowledge from experience of how ergonomics is perceived in an organization;
– attention—understood as due care for ergonomic working conditions.

As it can be seen, the relationship between occupational safety management and safety culture is specific, which results from the fact that management is one of the indications of culture in an organization. Both of these factors regulate the behaviour of people in the organization, management of occupational safety through formal rules and procedures, and safety culture through informal standards that relate to, among others, the way tasks are performed, interpersonal relations, work motivation.

Extensive and adequately in-depth research on various aspects of work safety in the company has shown that the main reason for the low level of this phenomenon are primarily management errors. As an example, the results of an analysis carried out in large steel plants are given. Most of the employees surveyed considered the following factors as contributing to the emergence of accident hazards: low interest of the management and company employees in OHS issues, inappropriate and ineffective motivation and communication, and a low level of safety culture (Konodyba-Szymańska, 2010). Other, extensive research on occupational safety management, conducted among several hundred employees of mines, steelworks and timber industry plants, confirmed the given thesis that the low level and condition of work safety and its lack of improvement are the result of improper management (Sobolak and Konodyba-Szymańska, 2012). In particular, these studies show that among the three synthetic factors shaping work safety, personnel factors, i.e. work organization and human factor, have the greatest impact on its condition, while the material factor has a smaller impact.

The results of a survey of the level of employers' awareness of the subject of work safety culture indicate that only half (53% of respondents) are interested in this subject; only a quarter of them see the economic benefits of investing in safety.

In the context of employees' well-being, it should be noted that occupational safety should involve not only creating and respecting binding legal regulations regarding occupational health and safety, but also, inter alia, mitigating the negative consequences of making management more flexible in a given organization. Guy Standing (2016) states that job insecurity, fixed-term contracts and minimum job protection actually add up to a lack of career development opportunities; they do not provide a sense of professional identity. This flexibility and insecurity are a source of fear and frustration among employees. People are placed in precarious situations[2], leading to insecurity in the realm of existence, living in the present, with no identity providing a sense of security. For businesses, this means a decline in employee engagement. In this situation, the issue of promoting the well-being of employees takes on particular importance. This requires, first of all, recognizing their expectations for a safe working environment.

One more important issue from the point of view of safety culture, which is less well-known to the general public, concerns the combination of events and coincidences, i.e. overlapping of symptoms of danger, which causes a negative synergy effect.

Numerous studies on OHS emphasize the importance of techniques and technology. Although it is difficult to determine the causes of accidents at work, statistical data show that they are made up of (Gabrylewicz, 2016):

– human causes (about 60%);
– organizational causes (about 30%);
– technical causes (about 10%).

In search of reasons for a low level of occupational safety, certain features of the company, analyzed separately, may not show any signs of being causes or determinants of OHS. However, when they co-occur with other factors or circumstances, they may lead to a threat to the life or health of an employee, a reduction in the quality of production or a negative impact on the environment. It should therefore be assumed that irregularities in the functioning of the company occur as a result of a combination of events and coincidences, which causes a multiplied, negative effect.

[2] More on precariousness: Standing, 2016.

Extensive research on the assessment of the level of safety culture carried out by CIOP-PIB showed that in units with a higher level of safety culture more often a higher rate of expenditure on prevention per employee was observed, and these units were characterized by a good financial situation. Moreover, it was found that a higher assessment of work safety culture can be applied to almost all of its aspects (Fig. 1). The highest scores were: suitability and awareness of OHS, values in the area of safety and safe behaviour, while they were worst for OHS training (Galwas-Grzeszkiewicz and Rzepecki, 2017).

Other interesting studies on these topics have shown that employees participating in non-compulsory training in the workplace have a better perception and higher assessment of work safety culture than people who do not take advantage of additional training. However, in the case of both groups of employees, training was rated the lowest (Ocieczek, 2018).

The conducted analyses show that the culture of occupational safety consists of elements related to the area of techniques and technology, work organization and management, information flow, and the attitude of management and employees towards occupational health and safety and ergonomics. The last-mentioned issues are the most frequently studied subject and scope of research by authors dealing with work safety culture.

At the end of the analysis of selected issues of research and development of work safety culture in the organization, several comments and reflections of practical nature have been formulated:

- the effectiveness of occupational safety system depends, to a large extent, on the example and commitment of management to the issues of occupational safety culture;
- occupational safety regulations and technical safety measures applied without the support of the awareness of people promoting safety at work may turn out to be ineffective;
- irregularities in the functioning of the company in the area of OHS occur as a result of a combination of events and coincidences, i.e. overlapping symptoms, which causes a negative synergy effect; hence the conclusion of a comprehensive study of risk factors and the analysis of their dynamic complexity;
- an increase in expenditure on technical measures for occupational safety without making an appropriate change in work safety culture, especially in the ergonomic awareness of employees, does not bring the expected results in terms of improving safety at work;
- in the context of employees' well-being, work safety, especially work safety culture, should also involve the issue of the negative effects of making work organization and company management more flexible. Uncertainty of employment, fixed-term contracts, minimum job protection, lack of opportunities for employee development do not ensure a sense of professional identity and the development of a safety culture in the company.

Both the obtained research results and managerial pragmatics indicate quite unambiguously that safety culture is assessed highly at the declarative level, while when translated into actual actions it only covers the fulfilment of the requirements of Polish law. This means that the traditional approach to OHS is still the dominant one, which is confirmed by the statements made. It is worth noting that in companies with implemented management systems for specific awareness of employers in the field of cost analysis, investment in OHS is higher, and the culture of work safety is also higher.

3. The concept of diagnosing work safety culture

The study of work safety culture is based on the assessment of the distance between the empirically established features of culture and the features desired due to the existing reference points. Referring to the concept of J. M. Kobi and H. Wurtchitz[3], in the research the frame of reference is the so-called fundamental orientations of work safety culture, such as the company's development strategy, elements of structure and leadership, and values prized by the company, especially those that are in the area of cooperation with customers, business partners and colleagues.

The research was conducted in a service company operating in the financial sector that manages customers' receivables. Among others, it deals with legal services, economic information, and it provides lending services for customers. The company is a joint-stock company with a share capital of 20 million PLN—it operates in Poland and abroad. Employees working for the company perform office work using computers and other IT tools, and also participate in negotiations, meetings and seminars. Work takes place in comfortable physical conditions (as regards the material working environment), is characterized by high complexity and responsibility, causes stress, especially in the process of negotiations and discussions with customers and contractors. There have been no accidents at work in the last two years.

In the process of diagnosing the culture of occupational safety, the case study method was used, in particular the analysis of documents, discussions and interviews with management and employees. The research methodology included two stages of the analysis:

– identification of the fundamental values of the company from the point of view of the requirements of the strategy, structure and cooperation included in three areas of cooperation with stakeholders;
– verification and interpretation of cultural requirements resulting from the provisions in the strategy and other documents adopted as a reference system in the process of examining work safety culture.

The results of the analysis made it possible to identify and classify the values that guide the company—functional values in relation to the company's safety culture (see Table 1).

Table 1. The division of company values according to the criterion of the area of cooperation

Area of cooperation	Description
With customers	– treating customers with respect – ensuring the security of personal data – consulting, joint search for a solution to a problem – providing assistance in a difficult financial situation
With business partners	– being respectful of competitors – individual approach to the needs of partners – maintaining confidentiality of information – avoiding conflicts of interest – working on fair and transparent terms – striving for long-term and lasting relationships

[3] The "fundamental cultural orientations of a company" are mentioned by the authors as: customers, associates, results, performance, innovation, costs, communication, identification with the company, technology. (Cited after: Marcinkowski and Sobczak, 2000, p. 7).

With employees	– taking care of the company's reputation – taking care of good relations within the company – mutual assistance – tolerance – basing relationships on mutual respect and partnership – continuous improvement of qualifications

S o u r c e: Authors' own elaboration.

From this perspective, the following elements of work safety culture seem to be important:
– concern for the welfare and safety of oneself and others;
– ability to cooperate, including corrective actions in the field of ergonomics;
– staff members can count on help and support from colleagues;
– the ability to understand other people;
– defining the management style and the area of employee participation in management;
– shaping work safety culture during training and seminars, which are a good opportunity to instil and create favourable attitudes in the field of work safety culture, which ultimately translates into an increase in the company's effects and employee well-being.

As it can be seen, in the examined company, as well as in other knowledge-based organizations of this type, non-material conditions of the work environment dominate as factors of work difficulties; material conditions are of less importance in the process of examining and shaping work safety culture.

The results of the analysis constitute the basis for further diagnostic tests, in particular the preparation of a standardized questionnaire, which, according to the abovementioned researchers, should cover the following phenomena and processes: strengths and weaknesses of the company, cooperation, information and communication, employee characteristics, promotion mechanisms, climate in the company, the image of the chairman of the board (director), demographic and social data of employees, principles and tools of personnel policy and others (Marcinkowski and Sobczak, 2000; Jedynak, 2004).

4. Final remarks and conclusions

Based on the presented research results and the authors' own thoughts, it is possible to indicate general recommendations for companies concerning mainly the methodological issues of examining safety culture:
– the binding, formalized rules, established and adopted strategies, structures, systems of motivation and control strongly influence the behaviour of people in the work process and should constitute the initial stage of diagnosing work safety culture;
– the system of values and norms, unwritten rules of conduct and hidden assumptions (i.e. the de facto organizational climate) are an important supplement and support for the safety management system;
– before any intervention in the culture of occupational safety takes place, it is necessary to define the desired set of norms, values and meanings from the point of view of the re-

quirements of the strategy, i.e. the state of the desired culture, and on this basis to develop an appropriate research tool, e.g. a questionnaire;
– work safety culture should also be considered (examined) in terms of a subjective perspective, directly related to the individual interpretation of the work situation, strategy, structure, motivation and action.

The conclusion should indicate the conditions for implementing the methodology for diagnosing work safety culture in the company, and in particular, the nature of its activity, the level of modernity, formalization and values should be taken into account, as well as the assessment of the external environment and the industry in which it operates.

References

Berkowska, A., Drzewiecka, M., Mrugalska, B. (2014). Świadomość pracodawców o istocie bezpieczeństwa pracy a poziom wypadków przy pracy w małych i średnich przedsiębiorstwach. *Zeszyty Naukowe Politechniki Śląskiej. Organizacja i Zarządzanie*, *71*, 21–31.

Bitsani, E. (2013). Theoretical approaches to the organizational culture and the organizational climate: Exploratory research examples and best policies in health care services. *Journal of Human Resource Management*, *1*(4), 48–58. DOI: 10.11648/j.jhrm.20130104.11.

Ejdys, J. (ed.). (2010). *Kształtowanie kultury bezpieczeństwa i higieny pracy w organizacji*. Białystok: Oficyna Wydawnicza Politechniki Białostockiej. ISBN 9788360200926.

Gabryelewicz, I. (2016). Czynnik ludzki i warunki techniczne w procesie kształtowania bezpieczeństwa pracy – efekt synergii. *Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie*, *31*(3), 83–95. DOI: 10.25944/znmwse.2016.03.8395.

Galwas-Grzeszkiewicz, M., Rzepecki, J. (2017). Ocena poziomu kultury bezpieczeństwa a wybrane aspekty BHP. *Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie*, *34*(2), 99–107. DOI: 10.25944/znmwse.2017.02.99107.

Glinka, B., Kostera, M. (2012). *Nowe kierunki w organizacji i zarządzaniu*. Warszawa: Oficyna a Wolters Kluwer business. ISBN 9788326407611.

ILO. (2015). *Join in building a culture of prevention on OSH*. International Labour Organization World Day for Safety and Health at Work [online, accessed: 2017-05-30]. Retrieved from: http://www.ilo.org/wcmsp5/groups/public/-ed_protect/-protrav/-safework/documents/poster/wcms_36002.pdf.

INSAG. (1991). *Safety culture: A report by the International Nuclear Safety Advisory Group* [online, accessed: 2017-05-30]. Vienna: International Atomic Energy Agency. Retrieved from: http://www-pub.iaea.org/MTCD/publications/PDF/Pub882_web.pdf.

Jedynak, P. (ed.). (2004). *Audyt w zarządzaniu przedsiębiorstwem*. Kraków: Księgarnia Akademicka. ISBN 8371887426.

Konodyba-Szymańska, B. (2010). *Bezpieczeństwo pracy w zarządzaniu przedsiębiorstwami o podwyższonym ryzyku zawodowym*. Doctoral dissertation. Częstochowa: Politechnika Częstochowska, Wydział Zarządzania.

Kopczewski, M., Pączek, B., Tobolski, M. (2012). Istota kultury organizacyjnej w zarządzaniu przedsiębiorstwem produkcyjnym. In: R. Knosala (ed.). *Innowacje w zarządzaniu i inżynierii produkcji* (pp. 929–938). Opole: Oficyna Wydawnicza Polskiego Towarzystwa Zarządzania Produkcją. ISBN 9788393039944.

Kozioł, L., Wojtowicz, A. (2005). Kulturowe aspekty implementacji strategii. *Zeszyty Naukowe Akademii Ekonomicznej w Krakowie*, *673*, 5–20.

Kozioł, M., Muszyński, Z., Kulwicki, E. (2018). Ergonomiczne aspekty wypadkowości przy pracy. *Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie*, *37*(1), 85–101. DOI: 10.25944/znmwse.2018.01.85101.

Lipinska-Grobelny, A., Michałowska, W. (2018). Klimat organizacyjny a odkładanie pracy na później. *Organizacja i Kierowanie*, *1*, 35–48.

Marcinkowski, A., Sobczak, J. B. (2000). Kultura poszukiwana. *Przegląd Personalny*, *1*.

Milczarek, M. (2002). *Kultura bezpieczeństwa pracy*. Doctoral dissertation. Warszawa: Centralny Instytut Ochrony Pracy – Centralny Instytut Badawczy.

Morrow, S. L., Koves, G. K., Barnes, V. E. (2014). Exploring the relationship between safety culture and safety performance in U.S. nuclear power operations. *Safety Science*, *69*, 37–47. DOI: 10.1016/j.ssci.2014.02.022.

Ocieczek, W. (2018). Szkolenia nieobowiązkowe pracowników a postrzeganie kultury bezpieczeństwa pracy. *Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie*, *37*(1), 103–111. DOI: 10.25944/znmwse.2018.01.103111.

Roszko-Wójtowicz, E. (2015). Źródła informacji w obszarze BHP – ujęcie międzynarodowe. *Edukacja dla Bezpieczeństwa*, *9*(4), 89–111.

Smolinski, D., Solecki, L. (2015). Ekonomiczne przesłanki ograniczania ryzyka zawodowego. *Bezpieczeństwo Pracy*, *6*, 25–27.

Sobolak, L., Konodyba-Szymańska, B. (2004). Motywacyjny system ubezpieczeń wypadkowych – skuteczny symulator warunków pracy i bezpieczeństwa. In: M. Gierzyńska-Dolna, B. Konodyba-Szymański (eds.). *Doświadczenia i efekty funkcjonowania systemów zarządzania jakością w przedsiębiorstwach* (pp. 297–305). Częstochowa: Wydawnictwo Wydziału Zarządzania Politechniki Częstochowskiej.

Sobolak, L., Konodyba-Szymańska, B. (2012). Systemowe zarządzanie bezpieczeństwem pracy. In: R. Borowiecki, A. Jaki (eds.). *Zarządzanie procesami restrukturyzacji. Koncepcje, strategie, analiza*. Kraków: Fundacja Uniwersytetu Ekonomicznego. ISBN 9788362511815.

Standing, G. (2016). *The precariat: The new dangerous class*. London: Bloomsbury Academic. ISBN 9781474294171.

Studenski, R. (1996). *Organizacja bezpiecznej pracy w przedsiębiorstwie*. Gliwice: Wydawnictwo Politechniki Śląskiej. ISBN 8385718478.

Studenski, R. (2000). Kultura bezpieczeństwa w przedsiębiorstwie. *Bezpieczeństwo Pracy*, *9*, 1–4.

Wudarzewski, G. (2016). Początki zainteresowań problematyką klimatu organizacyjnego w polskiej literaturze naukowej. *Zeszyty Naukowe Wyższej Szkoły Bankowej we Wrocławiu*, *16*(1), 55–72.

Badanie kultury bezpieczeństwa pracy w przedsiębiorstwie

Abstrakt: W artykule przedstawiono dyskusję wokół istoty i zakresu pojęcia kultury bezpieczeństwa pracy oraz wskazano na znaczenie tego zjawiska w procesie zwiększania ochrony i bezpieczeństwa pracy w przedsiębiorstwie. Opisano wybrane klasyfikacje czynników kultury bezpieczeństwa oraz scharakteryzowano ważniejsze z nich. W szczególności zwrócono uwagę na kwestie analizy i rozwoju kultury bezpieczeństwa pracy. Celem artykułu jest przedstawienie koncepcji diagnozowania kultury bezpieczeństwa pracy we współczesnym przedsiębiorstwie oraz warunki jej implementacji. Zaprezentowano również wyniki badań empirycznych uzyskanych za pomocą wspomnianej metodyki analizy. W procesie diagnozowania kultury bezpieczeństwa pracy zastosowano metodę studium przypadku oraz technikę analizy dokumentów, rozmowy i wywiady z kadrą kierowniczą i pracownikami. W zakończeniu artykułu podano ogólne rekomendacje merytoryczne oraz wskazania metodyczne dla przedsiębiorstw.

Słowa kluczowe: kultura bezpieczeństwa pracy, fundamentalne wartości przedsiębiorstwa, analiza czynników kultury bezpieczeństwa

Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie
The Małopolska School of Economics in Tarnów Research Papers Collection
ISSN 1506-2635, e-ISSN 2658-1817
2020, 48(4), 121–131
DOI: 10.25944/znmwse.2020.04.121131
© 2020 MWSE, distributed under the Creative Commons Attribution 4.0 International License (CC BY-NC-ND 4.0)

Variables of application of collaborative robots in ergonomic assembly working stations

Michał Regus

Poznan University of Technology, Poland

E-mail: michal.regus@put.poznan.pl

Adam Patalas

Poznan University of Technology, Poland

E-mail: adam.patalas@put.poznan.pl
ORCID: 0000-0001-5476-6739

Marcin Suszyński

Poznan University of Technology, Poland

E-mail: marcin.suszynski@put.poznan.pl
ORCID: 0000-0001-7926-0574

Rafał Talar

Poznan University of Technology, Poland

E-mail: rafal.talar@put.poznan.pl
ORCID: 0000-0003-4355-9923

Abstract: Over the years industrial robots had been used for numerous of repeatable tasks in different fields of industry, especially in automotive. Due to the safety reasons, robotized working stations had to be isolated by safety cell. Nowadays we can observe a strong trend of automation and robotization of production processes, which is considered as the fourth industrial revolution. Industry 4.0 has brought new opportunities and challenges. One of the key directions of Industry 4.0 is Human-Robot Collaboration (HRC). According to this concept, collaborative robot, which is equipped with appropriate safety and collision avoidance systems, can assist the human in the most effortable and monotonic tasks in the same workspace without additional safety guard. In this paper the characteristic of Human-Robot Collaboration (HRC), safety regulations, as well as application examples of collaborative robots are presented.

Keywords: collaborative robots, ergonomics

1. Introduction

During the last few decades a great development of robotics could be observed, especially in relation to automotive industry. Industrial robots have been associated with automotive industry since early 1960s, when the first unit was installed in General Motors factory and it was used to lift the die-cast metal parts from the molds after forming process (Müller, Vette and Scholer, 2014). Since then, industrial robots have been widely used to automate a huge variety of production processes, including assembly operations, weld-

Financed by:
Małopolska School of Economics in Tarnów with support of the Ministry of Science and Higher Education ("Support for scienitific journals")

Correspondence to:
Rafał Talar
Politechnika Poznańska
Wydział Inżynierii Mechanicznej
Instytut Technologii Mechanicznej
ul. Piotrowo 3
60-965 Poznań, Poland
Tel.: +481 66 52 552

ing, painting, part transfer, die casting, etc. Over the years, due to the safety reasons and strict directives all industrial robots had to be separated from employees by protective cell. The most common industrial robots are characterized, among others, by high dynamic, accuracy and repeatability of positioning of large weight and power. As a result of mentioned hazards, humans were not allowed to share the workspace alongside with robots.

Apart from incontestable advantages of industrial robots, there are some limitations in terms of the type of tasks they can perform. Among others, low flexibility, high investment cost and low complexity of allocated task can be considered as the main drawbacks of conventional industrial robots (Kujawińska et al., 2018; Fast-Berglunda et al., 2016). Consequently, until today a significant number of assembly tasks, like for example engine assembly, are characterized by much lower Level of Automation (LoA) and must be supported by human (Schrötera et al., 2016; Patalas-Maliszewska and Kłos, 2018). Also, robots are used as supporting element in visual inspection tasks. Organization of visual inspection may have significant impact on the effectiveness of inspection (Kujawińska et al., 2018; Fast-Berglunda et al., 2016).

For years, the general strategy of the manufacturers has been to automate high volume production with small variety of product variants. Nevertheless, the automation of small and middle volume products is a problem that has been unsolved over the decades. The question, "How to face this challenge?", returns. The answer might be the Human-Robot Collaboration (HRC) as an element of Industry 4.0 intelligent system (Schrötera et al., 2016; Patalas-Maliszewska and Kłos, 2018).

In further parts of this paper characteristic of Human-Robot Collaboration, security systems of collaborative robots, safety regulations, as well as application examples are presented.

2. The fourth industrial revolution—robots come out of the safety cages

Industry 4.0 creates the production environment, which has been called "smart factory". According to this concept, humans and machines create the cyber-physical system, in which they communicate each other in order to organize themselves and cooperate (TUV Austria, 2017). The best example of human-machine interaction in modern production plants is the concept of Human-Robot Collaboration. Human-Robot Collaboration is defined as a direct interaction between human and robot who share the workspace (Ranza, Hummela and Sihnb, 2017; Hull and Minarcin, 2016). Robot can interact with human within workspace in different manners, which are presented in Figure 1.

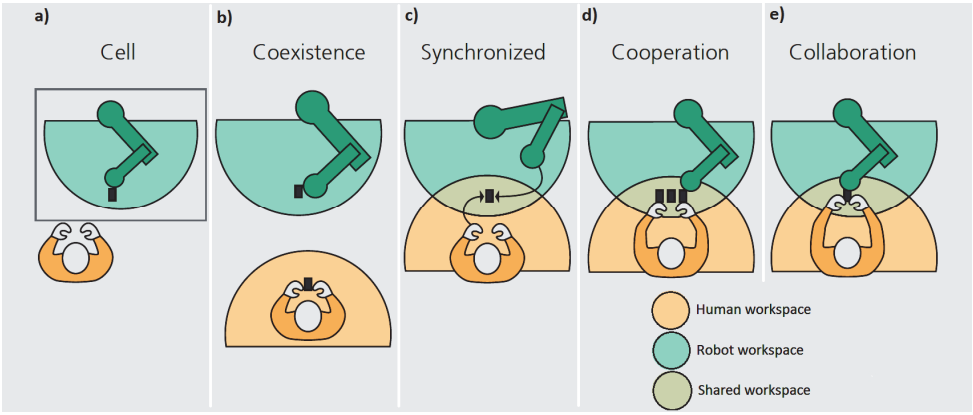

Figure 1. Different levels of interaction between human and robot within assembly station

S o u r c e: Bauer (ed.), Bender et al., 2016.

By coexistence the situation can be considered, where human and robot work alongside without the safety cage, but they do not share the workspace (Figure 1b). In synchronized process robot and human share the workspace, but the workflow of assembly object is organized in the way that only one of the partners is present in the operational area at any one time (Figure 1c). An example of such organization might be the collaborative robot which is applied to transport the assembly components. When object is delivered to the shared workspace, then employee can start the mounting process, while robot can prepare next part parallelly. Cooperation between human and robot takes place when both partners perform the assembly process in shared workspace at the same time, but they don't work simultaneously on the same component (Figure 1d). An example of such operation might be the assembly process of gear box, where human mounts the bearings in the housing and afterwards, robot installs the gear. The most advanced level of human-robot interaction is their collaboration, when both partners work simultaneously on the same component (Figure 1e).

The concept of collaborative robots (called also "cobots" or "co-robots"), which was initiated at the end of the last century, has redefined the safeguarding requirements concerning the robotized working station and robot by itself. Recently, the leading robot's manufacturers (Figure 2) have launched to the market collaborative robots equipped with advanced safety systems, which allow them to share the workspace with human without safety barriers (Ranza, Hummela and Sihnb, 2017).

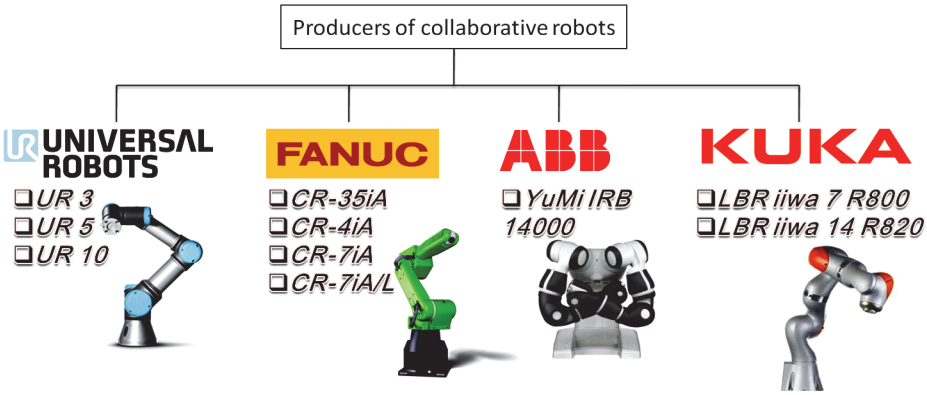

Figure 2. Main modern collaborative robots

S o u r c e: Authors' own elaboration based on: UR, 2009–2015; UR, 2018; FANUC, 2018; ABB, 2018; KUKA, 2018b.

High flexibility, adaptability and simplicity of use, that characterize modern collaborative robots, bring new opportunities to create effective and ergonomic assembly stations based on Human-Robot Collaboration. The added value of HRC is the synergy effect by combining the strengths of robot such as precision, repeatability of positioning and reliability alongside the human's strengths like fluent force regulation, cognitive skills, hand-eye coordination, ability to solve the problems and supervise the production process (TUV Austria, 2017; Ranza, Hummela and Sihnb, 2017). Therefore, HRC seems to be perfect solution for all fields of applications, where small and medium batches of products are manufactured (Figure 3). The marked intervals (V1–V5) on the ordinate indicate the production volume, ranging from unit to mass.

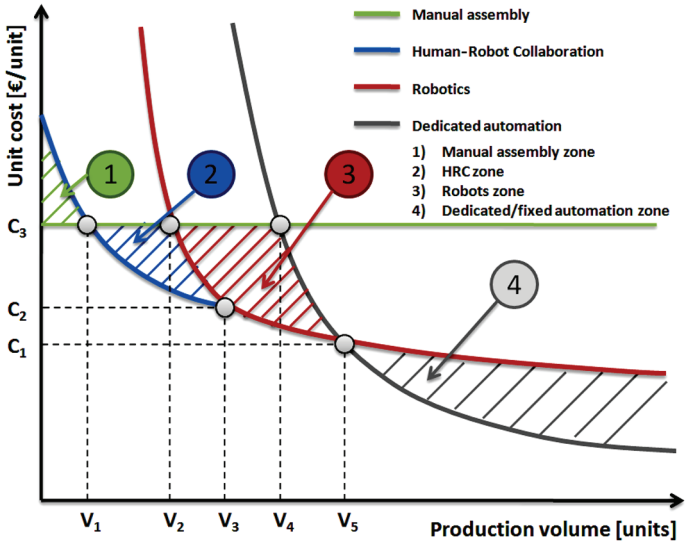

Figure 3. Profitability of automation solution depends on production volume

S o u r c e: TUV Austria, 2017.

In the face of decreasing birth rate and unemployment rate, even small and middle enterprises are looking for appropriate automation solutions for flexible production to keep them competitive on the market. Due to the high investment cost, low flexibility and long time of investment return, those companies couldn't afford the robotics or customized automation system, which were not profitable. Nowadays, more and more of them can take advantage from implementation of HRC on their production plants. Present trend in industry proves that companies prefer to implement flexible and fully adaptive automation solution, like collaborative robots, rather than fixed and highly specialized robotic cells.

3. Safety systems of collaborative robots

As long as human is involved in production process, the main point of automation system that has to be achieved is safe and reliable operation, while keeping possibly highest productivity. Consequently, all industrial robots that are dedicated to collaboration with human within shared workspace have to meet strict safety requirements. The main features of contemporary collaborative robots are presented in Figure 4.

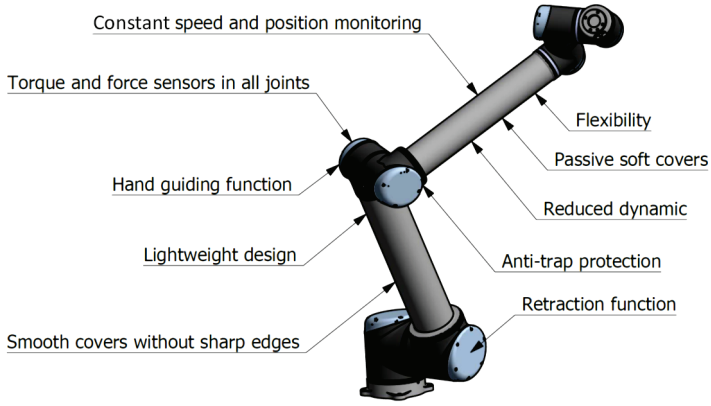

Figure 4. Main features of present-day collaborative robots

S o u r c e: Authors' own elaboration based on: UR, 2009–2015; UR, 2018; FANUC, 2018; ABB, 2018; KUKA, 2018b.

Most of the collaborative robots are characterized by lightweight design which reduces the energy accumulated during the operation. Lower kinetic energy decreases the risk of injury in case of unexpected collision with human. As a consequence, these robots are suitable mainly for small components, which weight does not exceed 10 kg. Fanuc CR-35iA might be considered as an exception, since it can handle with load up to 35 kg (FANUC, 2018). However, it is worth to mention that its mass is nearly 1000 kg, which is typical for traditional industrial robots (FANUC, 2018). Therefore, the operating speed is reduced comparing to other types of collaborative robots.

The primary protection system used in collaborative robots is constant monitoring of torque in all joints. In case of collision with unknown object or human, when the force threshold is exceeded, the robot stops immediately. The force limit can be adjusted depending on user needs and application.

To provide safe interaction with human all industrial robots have covers free of sharp edges. Body is usually made of soft materials to reduce the risk of injury in case of collision. The biggest robot from FANUC CR-series has additionally passive covers which reduce the contact pressure and ensure the energy absorption in the event of collision with human co-worker (FANUC, 2018).

Comparing to conventional industrial robots, cobots have significantly reduced dynamic and operating speed (which is monitored in real time), to reduce the kinetic energy accumulated during work. Despite the fact that linear speed of traditional robots can be even a few times higher than collaborative robots, Human-Robot Collaboration seems to be a good compromise between the productivity and safety.

4. Safety regulations

Both traditional industrial robot and collaborative robot are considered incomplete machines. The risk analysis and risk assessment refer to the entire workstation, including associated sensors, end effectors, co-workers, etc., which create complex and consistent system designed for particular application. The most important standards which refer to Human-Robot Collaboration are presented briefly in this paragraph.

European standards are classified into groups (Figure 5). ISO 12100 describes the basic guidelines for machinery designers to achieve safe construction. It also specifies the procedure of risk assessment in accordance with the Machinery Directive 2006/42/EC (TUV Austria, 2017). Standards from *B-group* refer to general aspects of machinery design. *C-standards* are associated with specific group of machines. Concerning the aspect of robotics and Human-Robot Collaboration, ISO 10218-1/2, ISO TS 15066 and EN ISO 11161 can be classified to *C-standards* group.

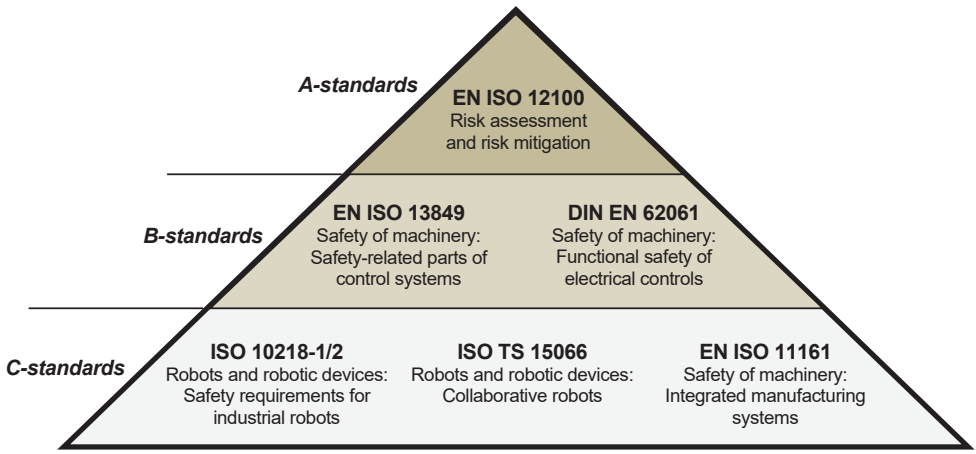

Figure 5. Pyramid of the relevant standards referring to Human-Robot Collaboration

Source: TUV Austria, 2017.

The first part of ISO 10218 describes the guidelines and requirements which have to be fulfilled in order to achieve safe design of industrial robots. ISO 10218-2 refers to the entire production environment, robotic system and robotic cells. Special attention should be paid on standard ISO TS 15066:2016, which specifies safety requirements for collaborative robots and workspace. According to ISO TS 15066, four possible forms of interaction between the human and collaborative robots can be distinguished (TUV Austria, 2017; ISO, 2016):

Safety-monitored immediate stop: the robot has safety zone which cannot be shared with human; when human enters the robot's workspace, it stops immediately; operation is continued when human leaves the workspace (Figure 6a).

Speed and distance monitoring: with decreasing distance between human and robot, the operational speed of robot is being gradually reduced; the robot can be stopped in case of unsafe distance from human (Figure 6b).

Output and force limitation: the dynamic of robot is limited to a value which provides safe operation alongside with human, even in case of collision; pain threshold for different parts of human body are defined in standard ISO TS 15066 and should be applied to the collaborative robots; when the limit is exceeded due to the collision, the robot should stop immediately (Figure 6c).

Manual guidance: the collaborative robot interacts with human in the passive manner, the robot arm is manually guided by human; an example might be the lifting of heavy components in order to reduce the physical load on human who is responsible only for guiding the robot's arm.

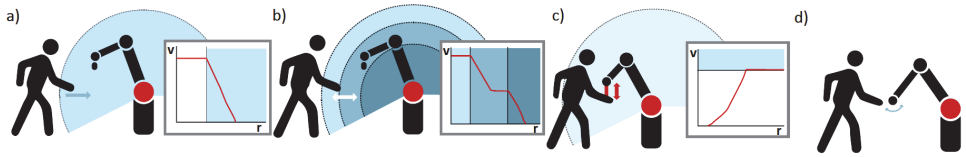

Figure 6. Possible forms of interaction between robot and human

S o u r c e: TUV Austria, 2017.

Despite the fact that collaborative robots have been significantly improved in recent years, in order to achieve strict safety regulations, Human-Robot Collaboration is still not common solution for automation of production processes (Müller, Vette and Mailahn, 2016). Very complicated and complex procedures of certification working station based on Human-Robot Collaboration seem to be the greatest obstacle from spreading collaborative robots in the industry (TUV Austria, 2017; Ranza, Hummela and Sihnb, 2017).

5. Application examples

Notwithstanding the above, a lot of research groups and companies have been focused on the enablement of collaborative work between human and robots. The reason of this effort is contemporary requirements of production to achieve high product customization by implementing flexible and highly reconfigurable production systems, which can be swiftly

switched between different products of varying lot sizes. A few application examples of collaborative robots are presented in further part of this paragraph.

In the work by Grahn et al. (2016), the potential advantages of using collaborative robots in assembly process were described. Grahn et al. distinguished specific assembly tasks in car manufacturing in which collaborative robots could be used: placement of aero panels under a vehicle or aid the fitter in assembling the cover on engine block. Each of these operations can be supported by the robot to carry the heavy load and prevent human from non-ergonomic positions. Other examples of similar application, in which the collaborative robot is used to decrease the human physical efforts, were described by Gopinath et al. (Gopinath, Oreb and Johansen, 2017). The authors proposed the use of collaborative robot in assembly process of flywheel housing cover on the engine block. Another application presented by FANUC (2017) might be an assembly process of spare wheel in the car. KUKA introduced a collaborative robot into sensitive assembly line of bevel gears in BMW Group's Dingolfing Plant (KUKA, 2017; 2018a). This application is an example of cooperation between human and robot (according to Figure 1d). Human co-worker mounts the distance plates and bearings, afterwards she gives a confirmation (by pushing green *enable* button visible on Figure 7a) to the robot, that her task has been finished. Then, cobot installs a gear. The robot is equipped with special function for setting the proper mesh of the assembled gears. Collision detection is provided by torque sensors built-in robot joints (ISO TS 15066). When force threshold is exceeded, robot stops immediately (Figure 7b). The main advantages of described solution are better process flow and significantly reduced human workload. Implementation of such solutions often precedes simulations which consider not only safety but also production flow and scheduling (Varela et al., 2018; DPCCars, 2017).

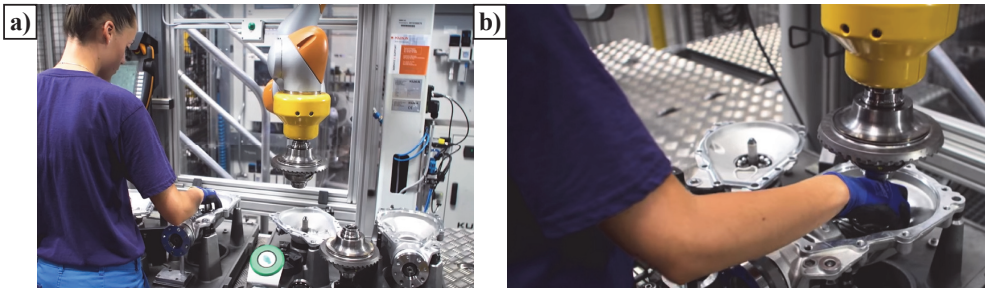

Figure 7. Assembly line of bevel gears based on HRC

Source: KUKA, 2017.

Collaborative robots can also be used in quality control process. For instance, UR units equipped with 3D scanners are used in BMW Dingolfing Plant for inspection of gaps in car bodies (Varela et al., 2018; DPCCars, 2017). Formerly this process was led manually by human equipped with feeler gauge.

6. Conclusion

In this paper the characteristic of Human-Robot Collaboration, safety regulations, as well as application examples of collaborative robots were presented. Human-Robot Collaboration is considered as a one of the key trends of the fourth industrial revolution. In recent years many research efforts have been taken to develop collaborative robots and put them into practice. Nowadays, especially small and middle enterprises are looking for flexible and fully adaptive automation solution, like collaborative robots, rather than highly specialized robotic cells.

Despite the significant development of *cobot's* safety systems, Human-Robot Collaboration is still rare solution on the market. From users and manufacturers perspective, complicated and complex certification procedures are the greatest obstacle to disseminate collaborative robots in the industry. In spite of the flexibility and adaptability of collaborative robots, every single application requires recertification and reassessment.

Notwithstanding the above, HRC brings great potential by combining the strengths of robot such as precision, repeatability of positioning and reliability alongside the human's strengths, among others, ability to solve the problems and supervise the production process. Combination of co-workers strong points leads to synergy effect (Figure 8).

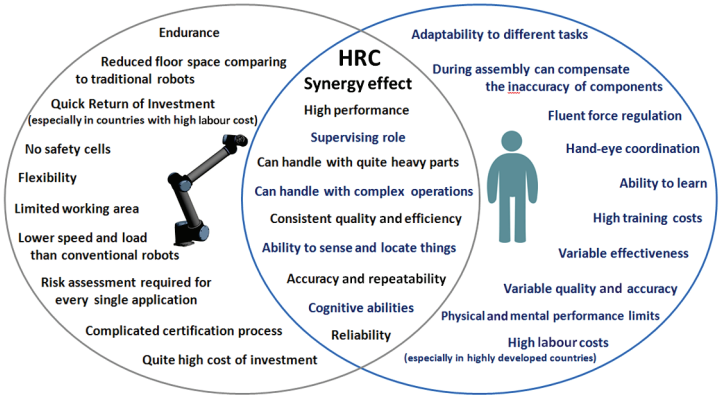

Figure 8. Human and collaborative robot characteristic

S o u r c e: Authors' own elaboration.

Presented examples show that automotive industry is leading field of application for Human-Robot Collaboration. Further research focused on security systems, safety regulations and certification are needed, before collaborative robots will be widely used in the industry.

References

ABB. (2018). ABB Group official website [online, accessed: 2018-03-12]. Retrieved from: http://www.new.abb.com.

Bauer, W. (ed.), Bender, M., Braun, M., Rally, P., Scholtz, O. (2016). *Lightweight robots in manual assesmbly – best to start simply!*. Stuttgart: Fraunhofer Institute for Industrial Engineering IAO.

DPCCars. (2017). *BMW Factory humans and robots work togeter at Dingolfing Plant* [online, accessed: 2018--03-12]. Retrieved from: http://www.youtube.com/watch?v=Dm3Nyb2lCvs.

FANUC. (2017). Promotion materials [online, accessed: 2018-03-12]. Retrieved from: www.youtube.com/watch?v=tlgKsTMmywk.

FANUC. (2018). FANUC official website [online, accessed: 2018-03-12]. Retrieved from: www.fanuc.eu.

Fast-Berglund, Å., Palmkvist, F., Nyqvist, P., Ekered, S., Åkerman, M. (2016). Evaluating cobots for final assembly. *Procedia CIRP*, *44*, 175–180. DOI: 10.1016/j.procir.2016.02.114.

Gopinath, V., Oreb, F., Johansen, K. (2017). Safe Assembly Cell Layout through risk assessment—an application with hand guided industrial robot. *Procedia CIRP*, *63*, 430–435. DOI: 10.1016/j.procir.2017.03.160.

Grahn, S., Langbeck, B., Johansen, K., Backman, B. (2016). Potential advantages using large anthropomorphic robots in human-robot collaborative, hand guided assembly. *Procedia CIRP*, *44*, 281–286. DOI: 10.1016/j.procir.2016.02.036.

Hull, T., Minarcin, M. A. (2016). Considerations in collaborative robot system designs and safeguarding. *SAE International*, *9*(3), 545–551.

ISO. (2016). ISO/TS 15066:2016: Robots and robotic devices—Collaborative robots. Geneva: International Organization for Standardization.

Kujawińska, A., Vogt, K., Diering, M., Rogalewicz, M., Waigaonkar, S. D. (2018). Organization of visual inspection and its impact on the effectiveness of inspection. In: A. Hamrol, O. Ciszak, S. Legutko, M. Jurczyk (eds.). *Advances in manufacturing: Lecture notes in mechanical engineering* (pp. 899–909). Cham: Springer International Publishing. ISBN 9783319686196. DOI: 10.1007/978-3-319-68619-6_87

KUKA. (2017). Promotion materials [online, accessed: 2018-03-12]. Retrieved from: www.youtube.com/watch?v=OxNC8yvsZ6s.

KUKA. (2018a). *First HRC system at BMW Group's Dingolfing Plant* [online, accessed: 2018-03-12]. Retrieved from: http://www.kuka.com/en-us/industries/solutions-database/2017/06/solution-systems-bmw-dingolfing.

KUKA. (2018b). KUKA official website [online, accessed: 2018-03-12]. Retrieved from: www.kuka.com.

Müller, R., Vette, M., Mailahn, O. (2016). Process-oriented task assignment for assembly processes with human-robot interaction. *Procedia CIRP*, *44*, 210–215. DOI: 10.1016/j.procir.2016.02.080.

Müller, R., Vette, M., Scholer, M. (2014). Inspector Robot—a new collaborative testing system designed for the automotive final assembly line. *Procedia CIRP*, *23*, 59–64. DOI: 10.1016/j.procir.2014.10.093.

Patalas-Maliszewska, J., Kłos, S. (2018). An intelligent system for core-competence identification for Industry 4.0 based on research results from German and Polish manufacturing companies. In: A. Burduk, D. Mazurkiewicz (eds.). *Intelligent systems in production engineering and maintenance – ISPEM 2017* (pp. 131–139). Cham: Springer International Publishing. ISBN 9783319644646. DOI: 10.1007/978-3-319-64465-3_13.

Ranza, F., Hummela, V., Sihnb W. (2017). Capability-based task allocation in human-robot collaboration. *Procedia Manufacturing*, *9*, 182–189. DOI: 10.1016/j.promfg.2017.04.011.

Schröter, D., Jaschewski, D., Kuhrke, B., Verl, A. (2016). Methodology to identify applications for collaborative robots in powertrain assembly. *Procedia CIRP*, *55*, 12–17. DOI: 10.1016/j.procir.2016.08.015.

TUV Austria. (2017). *Safety in Human-Robot Collaboration* [online; accessed: 2018-03-12]. Vienna: TÜV Austria Holding AG, Fraunhofer Austria Research, Joanneum Research. Retrieved from: www.tuvat.asia.

UR. (2009–2015). *User manual UR 10/CB3: Version 31: Original Instructions* [online, accessed: 2018-03-12]. Universal Robots. Retrieved from: http://fab.cba.mit.edu/content/tools/universal_robot_arms/ur10_user_manual_en_global.pdf.

UR. (2018). Universal Robots official website [online, accessed: 2018-03-12]. Retrieved from: www.universal-robots.com.

Varela, M. R. L., Trojanowska, J., Carmo-Silva, S., Costa, N. M. L., Machado J. (2017). Comparative simulation study of production scheduling in the hybrid and the parallel flow. *Management and Production Engineering Review*, *8*(2), 69–80. DOI:10.1515/mper-2017-0019.

Zastosowanie robotów współpracujących w ergonomicznych stanowiskach montażowych

Abstrakt: Od wielu lat roboty przemysłowe były stosowane do wielu powtarzalnych zadań w różnych dziedzinach przemysłu, zwłaszcza w branży motoryzacyjnej. Ze względów bezpieczeństwa zrobotyzowane stanowiska pracy musiały zostać odizolowane w osobnych komórkach. Obecnie możemy zaobserwować silny trend automatyzacji i robotyzacji procesów produkcyjnych, uważany za czwartą rewolucję przemysłową. Przemysł 4.0 przyniósł nowe możliwości i wyzwania. Jednym z kluczowych kierunków przemysłu 4.0 jest „robot współpracujący" (Human-Robot Collaboration – HRC). Jest to robot wyposażony w odpowiednie systemy bezpieczeństwa. Może on pomóc człowiekowi w najbardziej wymagających i monotonnych zadaniach w tej samej przestrzeni roboczej bez dodatkowych zabezpieczeń. W niniejszym artykule przedstawiono charakterystykę Human-Robot Collaboration (HRC), przepisy bezpieczeństwa, a także przykłady zastosowań robotów współpracujących.

Słowa kluczowe: robot współpracujący, ergonomia

Zeszyty Naukowe Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie
The Małopolska School of Economics in Tarnów Research Papers Collection
ISSN 1506-2635, e-ISSN 2658-1817
2020, 48(4), 133–145
DOI: 10.25944/znmwse.2020.04.133145
© 2020 MWSE, distributed under the Creative Commons Attribution 4.0 International License (CC BY-NC-ND 4.0)

The impact of digitalization and Industry 4.0 on the optimization of production processes and workplace ergonomics

Robert Rogaczewski

State School of Higher Professional Education in Konin, Poland

E-mail: r.rogaczewski@konin.edu.pl

Robert Cieślak

State School of Higher Professional Education in Konin, Poland

E-mail: robert.cieslak@konin.edu.pl
ORCID: 0000-0002-1320-0410

Marcin Suszyński

Poznan University of Technology, Poland

E-mail: marcin.suszynski@put.poznan.pl
ORCID: 0000-0001-7926-0574

Abstract: Terms such as *Industry 4.0*, *Logistics 4.0*, *smart factory*, *smart logistics* as well as *digitalization* can nowadays be regarded as keywords in both scientific and economic practice. What is taking place at the moment is the beginning of the fourth industrial revolution, which is driven by rapid technological advancements, especially visible in the field of digital transformation, autonomous machines or fully automated warehouses. Strong competition on the domestic and foreign market and growing customer expectations suggest that manufacturing companies should not only increase production on a constant basis, but they should find also a way to personalize it, which means manufacturing short series of products designed to meet the needs of specific customers, but also personalizing human work itself. In this system, or a kind of set-up, the role of the human and the consequent workload associated with a given job change. Technology is increasingly replacing not only physical human work, but also human beings as decision-makers. It is giving rise to completely new situations, in which it is necessary to search for new forms of cooperation between human beings and the technological/ environmental ones. This kind of production is the ultimate goal of the fourth industrial revolution. The purpose of this paper is to analyze the impact of digitalization and Industry 4.0 on the optimization of production processes, supply chain and human work. The authors discuss the concept of Industry 4.0, hence the fourth industrial revolution concerning system integration and networking. They present the assumptions of Logistics 4.0 and include adaptive, resource-efficient and user--friendly approaches, concepts. The authors also discuss the application of Lean management in the concept of Industry 4.0, and the ergonomic inclinations of the individual pillars of Industry 4.0. The conclusion summarizes the considerations on the impact of digitalization and Industry 4.0 on the improvement of production processes and work ergonomics.

Keywords: Industry 4.0, production process, ergonomics at work

Financed by:
Małopolska School of Economics in Tarnów with support of the Ministry of Science and Higher Education ("Support for scienitific journals")

Correspondence to:
Robert Rogaczewski / Robert Cieślak
Państwowa Wyższa Szkoła Zawodowa w Koninie
Wydział Nauk Ekonomicznych i Technicznych
Katedra Nauk Ekonomicznych
ul. Przyjaźni 1
62-510 Konin, Poland
Tel.: +48 63 24 97 166

1. Introduction

The *4.0* term is increasingly being used in various areas of human activity and in different fields of knowledge. Other related terms such as *Industry 4.0*, *Logistics 4.0*, *smart factory*, *smart logistics* as well as *digitalization* can nowadays be regarded as keywords in both scientific and economic practice. What is taking place at the moment is the beginning of the fourth industrial revolution, which is driven by rapid technological advancements, especially visible in the field of digital transformation, autonomous machines or fully automated warehouses. The influence of *Big Data*, a term referring to large, variable and diverse sets of data, is enormous and is making companies face tremendous challenges. A further level of complexity is appearing due to the inevitable transformation of various industries, companies and logistics, which forces a given company to adapt by introducing systems based on cyber-physicality and to remodel the whole structural organization and all techniques used within it. The purpose of this paper is to analyze the impact of digitalization and Industry 4.0 on the optimization of production processes, supply chain and human work, starting with placing orders and supplying manufacturing plants with components and finishing with shipping goods to customers. The processes of integrating systems and creating networks of deliveries as well as integrating the humans, machines and technology result in a synergy between the individual elements of production processes. In this system, or a kind of set-up, the role of the human and the consequent workload associated with a given job change. Technology is increasingly replacing not only physical human work, but also human beings as decision-makers. It is giving rise to completely new situations, in which it is necessary to search for new forms of cooperation between human beings and the technological/ environmental ones.

2. Industry 4.0 as a modern trend in the organization of production processes

At the moment a considerable number of companies are still uncertain and indecisive as to how to interpret the concept of Industry 4.0. This idea originates from the project *Forschungsunion Wirtschaft-Wissenschaft* and was presented for the first time during the trade fair in Hannover in 2011. Industry 4.0 is the ultimate goal of the German industry, which should be responded to globally. This strategy aims at protecting the technological leadership and the visionary role in the industrial production (Schäfer and Pinnow, 2015). This idea will undoubtedly become a revolution and will have an impact on the first half of the twenty-first century. Germans are particularly predisposed to the development of smart production and logistics that are referred to as 4.0.

The concept of Industry 4.0 aims at integrating smart machines, systems and making it possible to introduce changes in production processes. The purpose of this strategy is to increase performance effectiveness and introduce the possibility of flexible changes in the offered range of products. This concept does not rule out the creation of new ways of working and a new role of human recourses in the production process, and furthermore, it is a significant pillar besides technologies implemented into production processes by companies (Bousonville, 2017). The term *4.0* was secondarily developed for the needs of German business and it

is mostly used there, although it has already started to spread to other linguistic areas. In the English literature on the subject the terms such as *smart factory* or *smart manufacturing* are approved and most commonly used, and in some areas they are synonymous to the German concept of Industry 4.0 (Bounsoville, 2017).

The suffix 4.0 denotes the fourth industrial revolution (Figure 1) and is the beginning of the ubiquitous digitalization processes nowadays. The previously mentioned three industrial revolutions were caused by (Bauerhansl et al., 2014; Industry 4.0, 2018):

a) 1.0—the development and introduction of the steam engine, and the subsequent mechanization of production (partial replacement of human workforce with mechanical production) and the development of railroads in the second half of eighteenth century (the industrialization era);
b) 2.0—the use of electric power (steam engines were supplanted by electric motors) and a new division in forms of labour in the organization of mass production (the electrification era);
c) 3.0—production automation after the Second World War, achieved by the growing use of electronics and computer technology in the form of CNC machines and industrial robots (the digitalization era). Faster and more efficient computers or data processing systems had a significant influence on controlling machines by means of computer software. Thanks to such efforts machines became more efficient, whereas the digitalization process facilitated automation.

The factors that helped to achieve complete digitalization include: improvement in efficiency, miniaturization and a cost-effective manufacturing process with the use of sensor technology, data transmission technology and display screens. Thanks to such efforts, there has been an increase in capacities of storing, transferring or processing large amounts of data (Janewers, 2017). As a result, diverse data is accessible in a digital form nowadays.

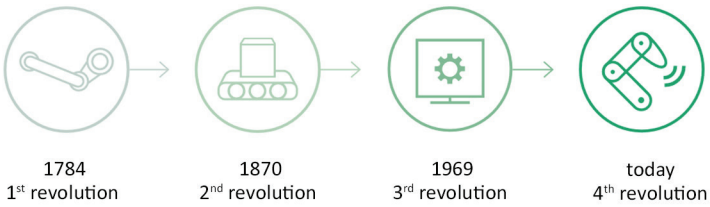

Figure 1. States in the development of the concept of Industry 4.0

S o u r c e: Astor, 2018.

The concept of Industry 4.0, which means the fourth industrial revolution, refers to the integration of systems and creation of networks. The crux of this approach is the integration of humans and digitally-controlled machines, with the simultaneous use of the Internet and information technologies. The benefits of implementing and acting in compliance with this concept result, above all, from coordination activities. The demand for effective production coordination that goes beyond a given company is treated as the background of high technological pressure in the industrial practice (Jahn, 2016).

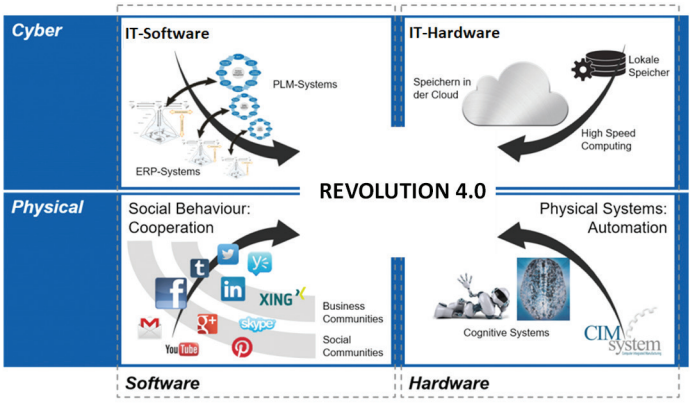

Figure 2. Areas of the fourth industrial revolution

S o u r c e: Voss (ed.), 2015.

In the literature on the subject it is sometimes claimed that Industry 4.0 can be understood as a potential of the fourth industrial revolution (Figure 2). Four technological areas of this revolution should be distinguished, namely (Prosence):

a) technological area 1—Single Source of Truth;
b) technological area 2—globalization of IT;
c) technological area 3—automation;
d) technological area 4—cooperation.

The basis of the concept is the availability of all the essential information in real time by connecting all the participating links inside and outside the company while the added value is assessed, and the ability to create optimal flow of materials and information from available resources at any time (Czaja, 2016). Connecting people, facilities and systems makes it possible to develop dynamic, time-effective and self-organizing networks for creating an added value. Such networks can be optimized on the basis of such criteria as costs, availability and resource consumption (Industrie 4.0, 2018).

The literature on the subject abounds with numerous definitions which touch the meaning of Industry 4.0 as a synonym for the development of production processes and value added chains by connecting the physical and digital worlds. From the technical point of view, this concept relies on the so-called cyber-physical systems (CPS) implemented into the communication structures within the Internet of Things and Services. The subject matter of the Industry 4.0 concept are physical components called entities (machines), which, in the process of being integrated with the computer capacity and being connected to the Internet, form CPS systems (Figure 3). Thanks to this an entity becomes an intelligent and active entity which perceives its surroundings and is able to influence them. Such entities are equipped with communication modules which make it possible to transmit and receive data. Owing to this, the integration of factors in the process of creating an added value within the manufacturing chain takes place at the moment of product lifecycle planning from pre-use to post-use inside or outside the company. In accordance with this observation, intelligent devices autono-

mously organize logistics production processes (Bayme vbm, 2018). Basically, the following features of CPS systems can be distinguished:

a) identification;
b) sensory data collection;
c) tracking position;
d) data processing and control;
e) network communication.

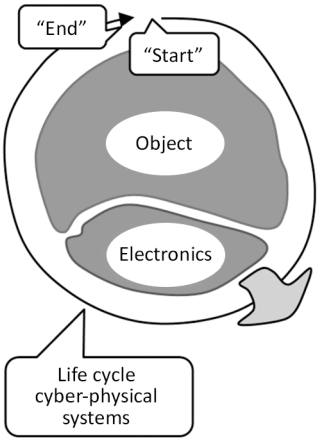

Figure 3. Cyber-physical system of the concept of Industry 4.0

S o u r c e: Fischer, 2016.

To sum up, a CPS system is concerned with the connection and synchronization between production in a physical meaning of the word and its digital representation. This process occurs in the centre by means of sensors which are able to communicate with each other. These sensors transmit their data to systems equipped with software where they can be processed, as a result of which information can be obtained. Apart from completely new business models, vertical networks of implemented systems offer considerable prospects in the field of production and logistics (Fischer, 2016).

3. Logistics 4.0—industry which is on the move

Nowadays logistics should be regarded as the crux of business processes. Globalization and digitalization enhance the flow of goods between companies, and even to final users (Pocket, 2016). Today's challenges faced by logistics are more serious. The digital revolution has accelerated not only communication between people, but it is also revolutionizing logistics. The development in information technologies used in logistics is a driving force of changes, digitalization or innovation. It can be witnessed in various functional areas of logistics, and especially in the area of fast-growing e-commerce. Owing to simplified ways of shopping, selling and distribution based on online trading platforms, there has been an increase in demand for supply and distribution structures not only in the area of industry, but

also in the area of consumer goods markets where networks of supply chains between manufacturing and sales markets are created. The trending decline in the significance of dominant factors, such as time and place, is being observed. It is mainly caused by transport processes, which take into account customer requirements, goods availability and the quality of deliveries. What should also be taken into consideration is the implementation of various modes of transport into the concept of shipment processes.

All the involved supply chains should be compared separately and depending on individual purposes. Supply chains in B2B and B2C models mix together and intersect each other, which implies an increase in their development complexity. Due to globalization processes and ubiquitous industrialization processes the following steps should be taken into account: time and cost optimization as well as reduction in the CO_2 emissions.

On the account of the changes in industry structure and organization, changes in services connected with industry, and especially with logistics and transport are also appearing. Such changes can be diverse. A number of more important aspects are given below (IND4LOG4, 2015):

a) digitalization contributes to a bigger integration of logistics and transport with industry, transport processes play an important role in production process management;
b) technology in the area of vehicle technology (conducted separately) and extensive automation of logistics operations (in connection with robotics) are changing the classic business models of logistics and transport economy and are leading to the consolidation within this line of business;
c) automation is leading to the disappearance of classic operations in the area of transport and logistics, the loss of less skilled jobs is taking place, although, on the other hand, it involves creating new jobs in the area of information technology.

On the basis of the abovementioned development tendencies, the concept of logistics digitalization, nowadays referred to as Logistics 4.0, can be formulated. The so-called fourth industrial revolution, which also influences logistics and transport processes in companies, is happening thanks to individualization (in serial production) or hybridization (connecting production and services) as well as the integration of customers and business partners. Logistics 4.0 should be understood, defined in a narrow sense, as a connection of processes, data and systems into a joint supply chain of all the participant companies. Collaboration and cooperation of all the participants in a given supply chain facilitates its optimization.

Logistics 4.0 includes approaches, concepts and adaptive technologies, which are resource-efficient and user-friendly. Their implementation has an influence on the development of sustainable forms of transport and logistics. The emphasis is placed on both horizontal and vertical integration of an added value. Connecting both digital and physical technologies is also essential in this case (Filler, 2014). In order to satisfy customers' high requirements in relation to individualization and flexibility, the following approaches are applied:

a) new automation concepts;
b) self-optimization, self-configuration, self-diagnosis;
c) Internet of Things, which combines all systems, vehicles, companies, employees, and customers.

The concept called Internet of Things is particularly important. Internet of things, services and data is currently becoming an infrastructure which defines the next industrial revolution.

Thanks to a consistent and continual process of making connections between digital and physical worlds, the growing dynamics and complexity are becoming exceptionally easy to control. The extent of decentralization and self-organization increases with the complexity of the system. The Internet of Things is a concept that involves connecting objects with the Internet, the purpose of which is to enable communication in the area of data exchange, transmission of warning messages or messages concerning failure rates (Sendler, 2018). The level of digitalization in selected countries is presented below (Figure 4). The factors which were subject to assessment include: strategy, product, sales and value stream mapping.

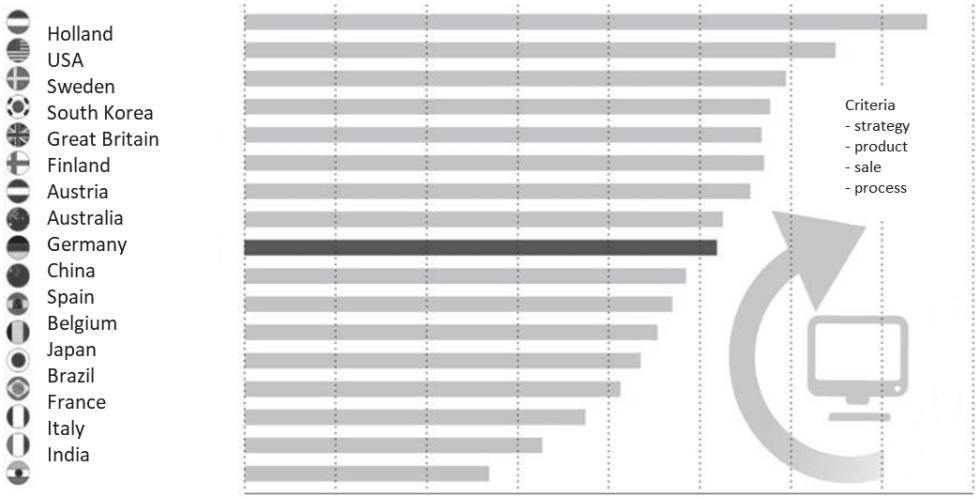

Figure 4. The index of digitalization in 100 leading companies carrying business activity

S o u r c e: Becker et al., 2017.

The process of digitalization should be perceived as a future trend for the development of industry and logistics. It is based on information systems which make it possible to increase functionality and create a network of contacts.

It is worth taking the opportunity here to pay attention on the individual activities and their characteristics implemented as part of the Logistics 4.0 and Industry 4.0. The concept of logistics is undoubtedly a significant factor in activating the concept of Industry 4.0. Logistics processes are subject to integrating and merging processes through the consistent use of Internet-based technologies. Apart from the main logistics processes, support systems and devices equipped with artificial intelligence are also included in the logistics networks. The use of the Logistics 4.0 concept enables the improvement in competitiveness by shortening reaction times and the flexible production of diverse and customer-tailored products with a minimum use of specific resources.

Companies should achieve a high degree of maturity in the following areas in order to be able to introduce subsequent stages of automation, merging and interpenetration of IT systems (Benfer, 2016):

a) management of permanent data (as the central assumption for each process controlling, these processes run in a decentralized and automatic way and are required in relation to completeness, correctness and up-to-dateness of data, the purpose of which is to transparently deal with situations on an ongoing basis);
b) product standardization (in order to be able to achieve the highest possible degree of flexibility, companies should appropriately adapt their product structures accordingly);
c) process-oriented organization of the company (the classic task of logistics optimization involves making fast deliveries of customer-oriented products, there are "agile" processes in keeping with the "lean management" philosophy as an ideal basis for further development of Industry 4.0);
d) IT support given in real time while orders are planned (transparency and up-to-dateness in the area of order entry and construction, procurement processes and after-sales service must be guaranteed in order to be able to make decisions concerning the goods flow and the production control based on simulations carried out in real time). Basically, Logistics 4.0 leads to higher complexity (Wegner and Wegner, 2016).

4. Industry 4.0 and lean management as the concepts of modern economy

The starting point for the following deliberations is a contrastive perspective on the relationship between Industry 4.0, the digital factory and lean management (Figure 5). Both digitalization of the factory (based on IT technologies and the concept of the Internet of Things) and the lean management tool (mainly focused on the process and organization) create a traditional assortment of tools with the help of which a significant improvement in productivity is possible.

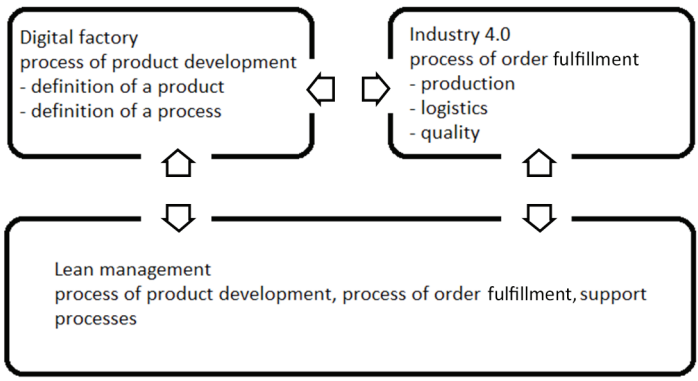

Figure 5. Instruments of production processes optimization

S o u r c e: Authors' own elaboration.

As far as machine-to-machine communication is concerned, individual machines exchange data among each other, and the same exchange takes place among robots in production processes. This communication, resulting from the interaction, offers possibilities of optimization or correction, and thus a reduction in complexity. Due to the fact that more and more

discussions about connecting machines to the Internet or using data clouds are being held, IT protection plays a significant role. In addition, if there is no connection to the Internet, appropriate measures should be taken to eliminate the spread of viruses on computers and possible damage that such viruses can cause (Andelfinger and Hänisch, 2017).

It is particularly important to carry out a factual and temporary integration of all the information, which means nothing less than information being matched within an appropriate period of time. Therefore, in order to be able to bring large amounts of data under control, it is necessary to use such technologies as InMemory or Big Data (Fasel and Meier, 2016). As far as integration processes are concerned, horizontal and vertical integrations should be mentioned. They are concerned with integration towards suppliers and customers, or, possibly, integration through individual processes within the company.

Whereas the basis of lean management and, in this case, lean production is the continuous process of eliminating waste, standardizing flows, reducing the level of stock to the absolute minimum and centralizing the customer service (only what the customer wishes is produced) and, as a consequence, it is achieving high flexibility.

Below there is a synthetic list of the common areas for the concepts of lean management and Production 4.0 and their selected discrepancies. As far as the common areas are concerned, the most important ones should include (Lödding et al., 2017):

a) standardization;
b) customer-orientated approach;
c) staff training;
d) flexible production;
e) decentralized production planning;
f) conservative handling of resources;
g) modularity and reusability;
h) high requirements in problem-solving skills.

It is worth noting that the above-mentioned concepts do not contradict each other but, on the contrary, they follow common goals. Industry 4.0 implements many principles of the concept of lean management, using the Internet consistently. Indeed, Industry 4.0 constitutes a further level of development in industrial production, which has its roots in the concept of lean management.

The following key areas are mainly responsible for the implementation of the 4.0 Industry concept (Göpfert et al., 2017):

a) robotics (increasing flexibility, easy and intuitive operation and programming, intelligent controlling);
b) automation technology and production systems (cyber-physical systems, decentralized controlling and the ability to self-configure, a complete connection of devices and machines with the production system);
c) IT (security, Big Data, InMemory, mobile solutions, real time enterprise, digitalization as well as vertical and horizontal integration);
d) logistics;
e) sensory integration (inherent and integrated intelligence, real time, reliability).

5. Industry 4.0, and ergonomics of work in a changing environment

Bringing about changes in work processes, Industry 4.0 is an extraordinary challenge for broadly defined ergonomics, and at the same time, it is an answer to earlier problems of ergonomics. It is not insignificant to note that it was Germany where the work on developing the concept of Industry 4.0 began. It is one of the oldest countries in the world, with an average age of over 47 (CIA, 2018). For this reason, dynamic changes brought about by the concept of Industry 4.0 can be considered both in terms of threats and opportunities for the ergonomic aspects of production processes. Table 1 lists the previously discussed pillars of approach with the opportunities and threats associated with them.

Table 1. Ergonomic inclinations of individual pillars of Industry 4.0

Pillar—impact area	Opportunities and advantages of implementation	Possible threats
Robotics (increasing flexibility, easy and intuitive operation and programming, intelligent controlling)	– Eliminating the physical and psychological burden imposed on the worker – Moving humans away from the production process or, in the field of cooperating robots, cooperating in order to supplement human abilities – Reducing production costs – Reduction of production time – Increase in capital from sales	– Dependence on technologically advanced robotics – Population-wide loss of human ability to produce things (in the event of a robot failure, it can not be replaced) – Introducing the robot into the production line where people are still working, it is necessary to take into account the differences resulting from the work conditions of individual units
Automation technology and production systems (cyber-physical systems, decentralized controlling and the ability to self-configure, a complete connection of devices and machines with the production system	– Psychological relief resulting from technological solutions derived from AI – Access to the latest solutions	– Increased complexity of systems – Dependence on qualified automation personnel – The most monotonous jobs will be carried out by robots, and people will take on the role of specialists who are to programme and supervise the processes carried out by the machines
IT (security, Big Data, InMemory, mobile solutions, real time enterprise, digitalization as well as vertical and horizontal integration)	– Relieving people of information processing tasks – The ability to filter information and to give operators only selected information using algorithms	– Loss of the ability by the operators to process information – Making it difficult to check whether the decision-making process has been carried out in accordance with the adopted criteria

Table 1. Ergonomic inclinations of individual pillars of Industry 4.0

Pillar—impact area	Opportunities and advantages of implementation	Possible threats
Logistics	– Eliminating dependency on cheap labour – Humanization of work—work will be more developmental – Reducing transport costs	– Lack of jobs for people with the lowest qualifications, including people who cannot acquire new ones (e.g. people with intellectual disabilities) – Higher costs of purchasing specialized machines
Sensory integration (inherent and integrated intelligence, real time, reliability)	– Bringing relief to the human sensory system – Eliminating long-lasting and monotonous supervisory work	– The system recognizes only the predicted types of situations (programmed errors, until the machines learn to recognize unpredictable and contextual situations)

S o u r c e: Authors' own elaboration.

A very important reason why human presence in production processes should be limited is that it reduces the risk of the human fallibility and the risk of exposing the human to situations where there is a high probability of committing mistakes by them (Butlewski et al., 2015). The consequence of the continuous pushing of humans out of production processes requiring skills possessed by machines, such as reaction speed, inability to get tired, repetitiveness should be an introduction of a new concept of cooperation based on the principle of sharing responsibility (Butlewski, 2017). Ultimately, technology aims to support the human giving them a sense of control, which will create reliable production systems.

6. Conclusion

High production efficiency, low costs, good quality assurance as well as a wide variety of products and the ability to easily change the scope of business activity are the main goals of today's manufacturing companies. Since the beginning of the industrial history, these goals have been achieved thanks to new technological solutions and human labour. Many of them have brought about revolutionary changes in industry, consequently leading to economic, social and cultural changes, as well as changes in work ergonomics.

Strong competition on the domestic and foreign market and growing customer expectations suggest that manufacturing companies should not only increase production on a constant basis, but they should find also a way to personalize it, which means manufacturing short series of products designed to meet the needs of specific customers, but also personalizing human work itself. This kind of production is the ultimate goal of the fourth industrial revolution.

References

Andelfinger, V., Hänisch, T. (eds.). (2017). *Industrie 4.0. Wie cyber-physische Systeme die Arbeitswelt verändern*. Wiesbaden: Springer Gabler. ISBN 9783658155568.

Astor. (2018). Official website [online, accessed: 2018-03-10]. Kraków: Astor. Retrieved from: www.astor.com.pl.

Bauernhansl, Th., ten Hompel, M., Vogel-Heuser, B. (eds.). (2014). *Industrie 4.0 in Produktion, Automatisierung und Logistik. Anwendung, Technologien, Migration*. Wiesbaden: Springer. ISBN 9783658046811.

Bayme vbm. (2018). Official website [online, accessed: 2018-03-10]. Retrieved from: www.baymevbm.de.

Becker, K. et al. (2017). *Digitalisierung des Einkaufs und der Logistik*. Kiel: Fachhochschule.

Benfer, D. (2016). Industrie 4.0 verwirklichen. *Logistik Heute*. 12–13.

Bounsoville, T. (2017). *Logistik 4.0. Die digitale Transformation der Wertschöpfungskette*. Wiesbaden: Springer Gabler. ISBN 9783658130121.

Braun, T. (2017). *Chancen und Risiken von Industrie 4.0 für kleine und mittlere Unternehmen*. Hamburg: Diplomica Verlag. ISBN 9783961465408.

Butlewski, M. (2017). Taxonomy of responsibility allocation in Human-Machine Systems with different levels of automation. *MATEC Web of Conferences*, *137*, 01002. DOI: 10.1051/matecconf/201713701002.

Butlewski, M., Jasiulewicz-Kaczmarek, M., Misztal, A., Sławińska, M. (2015). Design methods of reducing human error in practice. In: T. Nowakowski et al. (ed.). *Safety and reliability: Methodology and applications, proceedings of the European Safety and Reliability Conference, ESREL 2014, Wrocław, Poland, 14–18 September 2014* (pp. 1101–1106). London: CRC Press and Balkema Book. ISBN 9781315736976.

CIA. (2018). *The World Factbook* [online, accessed: 2018-03-22]. Washington, DC: Central Intelligence Agency. Retrieved from: https://www.cia.gov/library/publications/the-world-factbook/fields/2177.html.

Czaja, F. (2016). *Auswirkungen von Logistik 4.0 auf Mittelstand und Handwerk*. Hamm: Hochschule für Logistik und Wirtschaft.

Fasel, D., Meier, A. (eds.). (2016). *Big Data. Grundlagen, Systeme und Nutzungspotenziale*. Wiesbaden: Springer Fachmedien. ISBN 9783658115883.

Filler, I. (2014). *Auswirkungen von Industrie 4.0 auf die Informations- und Kommunikationssysteme der Produktions- und Lagerlogistik*. München: Grin.

Fischer, R. (2016). *Logistik 4.0: Herausforderung für Industrie und Logistikdienstleister*. Regensburg: Fraunhofer.

Göpfert, I., Braun, D., Schulz, M. (eds.). (2017). *Automobillogistik. Stand und Zukunftstrends*. Wiesbaden: Springer Gabler. ISBN 9783658111021.

IND4LOG4 (2015). *Industrie 4.0 und ihre Auswirkungen auf die Transportwirtschaft und Logistik*. Berlin: bmvit.

Industrie 4.0. (2018). Industrie 4.0 Plattform [online, accessed: 2018-03-10]. Berlin: Bundesministerium für Wirtschaft und Energie, Bundesministerium für Bildung und Forschung. Retrieved from: www.plattform-i40.de.

Industry 4.0. (2018). Industry 4.0. Portal nowoczesnego przemysłu [online, accessed: 2018-03-10]. Warszawa. Retrieved from: www.przemysl-40.pl.

Jahn, M. (2016). *Ein Weg zu Industrie 4.0. Geschäftsmodell für Produktion und After Sales*. Gruyter de Oldenbourg. ISBN 9783110449518.

Janewers, J. (2017). *Auswirkungen von Logistik 4.0 auf das Controlling*. Hamburg: Tredition GmbH. ISBN 9783743986091.

Lödding, H., Riedel, R., Thoben, K.-D., von Cieminski, G., Kiritsis, D. (eds.). (2017). *Advances in production management systems: The path to intelligent, collaborative and sustainable manufacturing*. Cham: Springer Nature. ISBN 9783319669229.

Pocket, B. (2016). *Logistik auf der ersten und letzten Meile im Wandel*. Berlin: Beuth. ISBN 9783410268604.

Schäfer, S., Pinnow, C. (2015). *Industrie 4.0. Grundlagen und Anwendungen. Branchentreff der Berliner Wissenschaft und Industrie*. Berlin, Wien and Zürich: Beuth Verlag GmbH. ISBN 9783410257806.

Sendler, U. (ed.). (2018). *The Internet of Things: Industrie 4.0 unleashed*. Berlin and Heidelberg: Springer Vieweg. ISBN 9783662572146.

Voss, P. (ed.). (2015). *Logistik – eine Industrie, die (sich) bewegt. Strategien und Lösungen entlang der Supply Chain 4.0*. Wiesbaden: Springer Gabler. ISBN 9783658106096.

Wegner, U., Wegner, K. (2016). *Einführung in das Logistik-Management. Prozesse, Strukturen, Anwendungen*. Wiesbaden: Springer Gabler. ISBN 9783658136741.

Wpływ cyfryzacji i przemysłu 4.0 na usprawnianie procesów produkcyjnych oraz ergonomię pracy

Abstrakt: Pojęcia takie jak: *Przemysł 4.0*, *Logistyka 4.0*, *smart factory*, *smart logistics* oraz *digitalizacja* są aktualnie słowami kluczowymi zarówno w nauce, jak i w praktyce gospodarczej. Obecnie ma miejsce czwarta rewolucja przemysłowa, której początki obserwujemy i która jest napędzania przez gwałtowny rozwój technologiczny, szczególnie w zakresie transformacji cyfrowej, autonomicznych maszyn czy w pełni automatycznych magazynów. Silna konkurencja na rynku krajowym i zagranicznym i rosnące oczekiwania klientów sprawiają, że nie tylko należy nieustannie zwiększać produkcję, ale także znaleźć sposób na jej personalizację, czyli wytwarzanie krótkich serii wyrobów zaprojektowanych pod kątem potrzeb danego klienta, lecz i samej pracy człowieka. W tym systemie lub rodzaju konfiguracji rola człowieka, a co za tym idzie – obciążenie pracą związane z danym stanowiskiem, zmieniają się. Technologia coraz częściej zastępuje nie tylko pracę fizyczną człowieka, ale także samych ludzi jako decydentów. Daje początek zupełnie nowym sytuacjom, w których konieczne jest poszukiwanie nowych form współpracy między ludźmi a technologią i środowiskiem. To właśnie taka produkcja ma być efektem czwartej rewolucji przemysłowej. Celem artykułu jest przedstawienie wpływu digitalizacji i Przemysłu 4.0 na optymalizację procesu produkcji, łańcucha dostaw i pracy ludzkiej. Autorzy omawiają koncepcję Przemysłu 4.0, a więc czwartej rewolucji przemysłowej, dotyczącej integracji systemów i tworzenia sieci; przedstawiają założenia Logistyki 4.0 – podejścia, koncepcje adaptacyjne, zasobooszczędne i przyjazne dla użytkownika. Autorzy prezentują także zastosowania *lean management* w koncepcji Przemysłu 4.0 oraz ergonomiczne inklinacje poszczególnych filarów Przemysł 4.0. Zakończenie zawiera podsumowanie rozważań dotyczących wpływu cyfryzacji i Przemysłu 4.0 na usprawnianie procesów produkcyjnych oraz ergonomię pracy.

Słowa kluczowe: Przemysł 4.0, proces produkcyjny, ergonomia pracy

Reviewers of the articles published in 2020

Prof. Sofia Asonitou, PhD—University of West Attica, Greece
Prof. Agata Balińska, PhD—Warsaw University of Life Sciences—SGGW, Poland
Prof. Beata Barczak, PhD—Cracow University of Economics, Poland
Kazimierz Barwacz, PhD—University of Applied Sciences in Tarnow, Poland
Prof. Agnieszka Bitkowska, PhD—Warsaw University of Technology, Poland
Doc. Gabrijela Budimir Šoško, PhD—Nikola Šubić Zrinski University College in Zagreb, Croatia
Prof. Marcin Butlewski, PhD—Poznan University of Technology, Poland
Prof. Mirosława Capiga, PhD—University of Economics in Katowice
Prof. Jolanta Chluska, PhD—Czestochowa University of Technology, Poland
Prof. Arkadiusz Durasiewicz, PhD—Janusz Korczak Pedagogical University in Warsaw, Poland
Prof. Joanna Działo, PhD—University of Lodz, Poland
Prof. Krzysztof Echaust, PhD—Poznań University of Economics and Business, Poland
Prof. Adam Figiel, PhD—Cracow University of Economics, Poland
Prof. Justyna Franc-Dąbrowska, PhD—Warsaw University of Life Sciences—SGGW, Poland
Prof. Barry A. Friedman, PhD—The State University of New York at Oswego, USA
Prof. Mariola Grzybowska-Brzezińska, PhD—University of Warmia and Mazury in Olsztyn, Poland
Prof. Małgorzata Gruchoła, PhD—The John Paul II Catholic University in Lublin, Poland
Prof. Witold Grzywiński, PhD—Poznań University of Life Sciences, Poland
Prof. Edyta Gwarda-Gruszczyńska, PhD—University of Lodz, Poland
Krzysztof Hankiewicz, PhD—Poznan University of Technology, Poland
Prof. Wojciech Jarecki, PhD—University of Szczecin, Poland
Prof. Bartosz Jasiński, PhD—Wrocław University of Economics and Business, Poland
Tomasz Jedynak, PhD—Cracow University of Economics, Poland
Prof. Sławomir Kalinowski, PhD—Polish Academy of Sciences, Institute of Rural and Agricultural Development, Poland
Prof. Androniki Kavoura, PhD—University of West Attica in Athens, Greece
Prof. Sylwester Kozak, PhD—Warsaw University of Life Sciences—SGGW, Poland
Prof. Robert Kurek, PhD—Wrocław University of Economics and Business, Poland
Prof. Jerzy B. Lewandowski, PhD—Lodz University of Technology, Poland
Ass. Prof. Krzysztof Łyskawa, PhD—Poznań University of Economics and Business, Poland
Prof. Agnieszka Majewska, PhD—University of Szczecin, Poland
Prof. Anna Marciszewska, PhD—Wrocław University of Economics and Business, Poland
Prof. Agnieszka Misztal, PhD—Poznan University of Technology, Poland
Prof. Mirosław Moroz, PhD—Wrocław University of Economics and Business, Poland
Prof. Dorota Murzyn, PhD—Pedagogical University of Krakow, Poland
Prof. Ivars Muzis, PhD—University of Latvia in Riga, Latvia
Prof. Beata Nowotarska-Romaniak, PhD—University of Economics in Katowice, Poland
Prof. Jerzy Olszewski, PhD—Poznań University of Economics and Business, Poland
Prof. Daniel Puciato, PhD—Opole University of Technology, Poland
Prof. Elisabete Rodrigues, PhD—Polytechnics Institute of Portalegre, Portugal
Prof. Małgorzata Rozkwitalska, PhD—WSB University in Gdańsk, Poland

Prof. Edyta Rudawska, PhD—University of Szczecin, Poland
Prof. Małgorzata Rutkowska, PhD—Wrocław University of Science and Technology, Poland
Prof. Alexandros G. Sahinidis, PhD—University of West Attica in Athens, Greece
Prof. Józef Sala, PhD—Cracow University of Economics, Poland
Prof. Małgorzata Striker, PhD—University of Lodz, Poland
Prof. Joanna Szczepankiewicz-Battek—WSB University in Wrocław, Poland
Prof. Danuta Szwajca, PhD—Silesian University of Technology, Poland
Prof. Katarzyna Świetla, PhD—Cracow University of Economics, Poland
Prof. Anna Tokarz-Kocik, PhD—University of Szczecin, Poland
Prof. Vanya Tsonkova, PhD—St Cyril and St Methodius University of Veliko Turnovo, Bulgaria
Prof. Edward Wiszniowski, PhD—Wrocław University of Economics and Business, Poland
Prof. Robert Włodarczyk, PhD—Cracow University of Economics, Poland
Prof. Mariusz Zieliński, PhD—Opole University of Technology, Poland

Information for the Authors

The Editorial Board accepts for publication only scientific articles dedicated to economics and finance or management and quality problems. Articles earmarked for publication shall be submitted exclusively in electronic form in our Open Journal System (at: http://zn.mwse.edu.pl). Submission is available for registered users only. Submitted papers should meet the journal's scope and aims and be prepared in accordance with our guidelines. The length of submission (including illustrative material, bibliography and abstracts) must not exceed 15 pages. The publication should be divided into parts and contain headings. The text must be accompanied by abstracts in English and Polish (150–200 words), including: purpose, methods, obtained results and conclusions, as well as keywords in English and Polish (3–5 words or phrases).

The detailed information on how to prepare a text print (format of the footnotes, bibliography, descriptions of tables and figures) is posted on the journal's website: http://zn.mwse.edu.pl. Submissions which do not adhere to the editorial guidelines will not be accepted for publication. We kindly ask the Authors to attach their full contact details (including telephone number and e-mail address), as well as affiliate information (title, name of institution or other entity) and ORCID. The Editorial Board does not accept submissions that have been published in other publications. The condition for publication are the positive editorial reviews. The Editorial Board does not pay royalties. Papers published in *The Małopolska School of Economics in Tarnów Research Papers Collection* are protected by copyright; they may only be reprinted with the consent of the Editorial Board.

Informacja dla Autorów

Redakcja przyjmuje do publikacji wyłącznie teksty o charakterze naukowym poświęcone problemom ekonomii i finansów oraz zarządzania i jakości. Artykuły do publikacji są akceptowane jedynie w formie zgłoszeń elektronicznych dokonanych przez użytkowników zarejestrowanych w systemie publikacji czasopisma (http://zn.mwse.edu.pl). Zgłaszane do publikacji artykuły powinny być zgodne z profilem wydawniczym czasopisma i spełniać wymogi formalne dotyczące przygotowania prac do publikacji. Objętość pracy (łącznie z materiałem ilustracyjnym, bibliografią i streszczeniami) nie może przekraczać 15 stron. Opracowanie powinno być podzielone na części i zawierać śródtytuły. Do tekstu należy dołączyć streszczenia w językach: angielskim i polskim (150–200 słów), zawierające: cel, metody, uzyskane wyniki oraz wnioski, a także słowa kluczowe odpowiednio w językach streszczeń (3–5 słów lub fraz).

Szczegółowe informacje o sposobie przygotowania tekstu do druku (format przypisów, bibliografia, opisy tablic i rysunków) są zamieszczone na stronie internetowej czasopisma: http://zn.mwse.edu.pl. Teksty przygotowane w sposób niezgodny ze wskazówkami redakcji nie będą przyjmowane do druku. Autorów prosimy o dołączenie do pracy pełnych danych adresowych (wraz z numerem telefonu i adresem e-mail), jak również informacji afiliacyjnej (tytuł naukowy, nazwa uczelni lub innej jednostki) oraz identyfikatora ORCID. Redakcja nie przyjmuje tekstów opublikowanych w innych wydawnictwach. Warunkiem publikacji są pozytywne recenzje wydawnicze. Redakcja nie wypłaca honorariów autorskich. Prace opublikowane w „Zeszytach Naukowych Małopolskiej Wyższej Szkoły Ekonomicznej w Tarnowie" są chronione prawami autorskimi, ich przedruk może nastąpić wyłącznie za zgodą Redakcji.