

INNOVATION and **ENTREPRENEURSHIP**

Theory and practice



Edited by
Zdzisława Dacko-Pikiewicz
Katarzyna Szczepańska-Woszczyńska
Krystyna Poznańska

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WSB University

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Table of contents

Introduction	7
Katarzyna Szczepańska-Woszczyzna, Tomasz Zjawiony, Tomasz Solecki	
Support systems for the development of small and medium-sized enterprises	9
Ewa Osuch-Rak	
The innovation capacity of small and medium-sized enterprises in the space sector in Poland	43
Agata Buczak	
Business environment institutions in Lower Silesia – how the COVID-19 pandemic defined support for female entrepreneurs	65
Marcin Cywiński	
The implications of innovation in the digital economy	97
Jolanta Kotelska, Marcin Lis	
Analysis and Assessment of Relationship Management Exemplified by Bituminous Coal Companies in Poland	109
Krzysztof Rutkiewicz, Julia Płonka	
The management system of a company operating on the liquid and gaseous helium distribution market – a case study	127
Marzena Góralczyk	
The value of innovation compared to other values in enterprises as perceived by the young generation	153

Piotr Antończyk	
The use of assisted reality to improve processes in accordance with the philosophy of Lean Management in enterprises	163
Monika Płońska	
Digital sustainability – the importance of sustainable and digital transformation in decarbonising enterprises and achieving sustainable development goals	173
Robert Janik, Mateusz Chłąd	
Transport versus Ecology. Consequences for Management	183
Sławomir Króliczek	
Leaders of the future in turbulent times of change and uncertainty	197
Andrzej Kulis	
The impact of the COVID-19 pandemic on the pass rate for the state driving exam at regional road traffic centers in Słupsk and Zielona Góra	213
Bartosz Straszak	
Protection of genetic data in light of the provisions of law	225

Introduction

In the rapidly evolving landscape of the 21st century, the symbiotic forces of innovation and entrepreneurship have emerged as the catalysts propelling societies, economies, and industries forward. Innovation and entrepreneurship seeks to explore the multifaceted dimensions of these dynamic concepts, casting a spotlight on the symbiotic relationship that exists between them. As the global marketplace undergoes unprecedented shifts, individuals, businesses, and nations alike find themselves at the crossroads of challenge and opportunity, where the ability to innovate and the spirit of entrepreneurship stand as indispensable pillars for success. Innovative activity is a complicated and multi-faceted process that is always initiated by a human being.

Innovation of an organization is closely linked to the market mechanism, understood as a mega-regulator of innovation processes and verifier of new products and services. The market, as a regulator, enforces the need for a new solution, determines the direction of the search for and selection of a new solution, sets the date and method of introducing an innovation to the market, determines the scale of its application and the moment when a product is withdrawn from the market and replaced by another innovation. Information from the market influences the shape of innovation decisions of an operational and tactical nature, and facilitates the decision to adapt production to market needs.

This monograph delves into the interplay between innovation and entrepreneurship, unravelling the threads that weave together ground-breaking ideas, daring ventures, and transformative progress. From the inception of modern ideas to the strategic implementation of visionary initiatives, this monograph navigates the intricate pathways that entrepreneurs tread while pushing the boundaries of innovation. Drawing on a rich tapestry of case studies, theoretical frameworks, and practical insights, this work aims to dissect the anatomy of successful ventures and the creative processes that drive them. As we stand on the brink of a new era defined by unprecedented connectivity, rapid technological advancements, and global

interdependence, innovation and entrepreneurship serves as a beacon guiding us through the creativity, risk-taking, and forward-thinking.

In the first part of the monograph the authors evaluate support systems for the development of enterprises, use of financial instruments offered by the European Space Agency and European Union by small and medium-sized space enterprises in Poland for the innovative capacity of these enterprises, the development of a model for assessing the innovative capacity of space industry SMEs and the verification of this model on the basis of an empirical study using the multiple case study method, the support they are able to obtain from the dedicated entities – business environment institutions (BEIs).

The second part of the monograph is devoted to the implications of innovation in the digital economy. It presents the case studies of innovative activities and management systems in the different branches as well. Through a comprehensive examination of the latest trends, challenges, and opportunities, readers will embark on a journey through the transformative landscapes of technology, business, and society.

The third part of the monograph is devoted to digital sustainability – the importance of sustainable and digital transformation in decarbonising enterprises, achieving sustainable development goals, aspects of sustainable development in relation to the historical transport approach.

The monograph not only serves as a roadmap for aspiring entrepreneurs and innovators but also as a resource for policymakers, educators, and industry leaders seeking to understand and harness the immense potential that lies at the intersection of innovation and entrepreneurship.

Editors

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Support systems for the development of small and medium-sized enterprises

Introduction

Small and medium-sized enterprises (SMEs) around the world play a major role in shaping the economy. Not only are they a source of economic growth, they are a source of innovation in all industries, while providing jobs (Praag et al., pp. 351–382; Szczepańska-Woszczyna, 2014, p. 3; Wennekers et al., 2009, p. 6; PARP, 2022, p. 22). SMEs play an important role in mitigating labour market imbalances, exploiting local factors of production and creating private ownership of real capital. They lead the transformation of industry from traditional forms of production to advanced technologies, and play an important role in the development of innovation. In Poland, the sector is the largest employer, with small and medium-sized enterprises generating nearly half the value of GDP (49.6% in 2019), and is also the main source of competition and a prime driving force of the market (PARP, 2022, p. 6). The success of any enterprise is the aggregate of its growth, development, competitive position, development plans and also the current equilibrium of the enterprise, both in material and social terms (Zioło, 2017, pp. 8–24). SMEs are also susceptible to negative influences from the business environment, experience difficulties in accessing capital and expertise, and sometimes lack experience. Barriers to their development are primarily formal and procedural issues in the legal-administrative and tax and financial areas; technological, human resources and information, organisational, and market barriers are also identified (D. Klonowski, 2009, p. 6).

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1. Business development and support cycle

For the vast majority of companies, the transition from an idea, a concept to a high-growth enterprise (and it is these that contribute more than average to job creation, increased competitiveness and innovation in economies and, consequently, economic growth) is separated by several lifecycle stages (see Table 1).

Table 1. Characteristics of growth levels of small businesses

Specification	Life cycle stage			
	Start-up	Expansion	Maturity	Diversification
Key growth factors	<ul style="list-style-type: none"> • R&D • Commercialisation • Acquisition of resources 	<ul style="list-style-type: none"> • Sales and marketing • Production • Acquisition of resources 	<ul style="list-style-type: none"> • Management capacity • Internal control 	<ul style="list-style-type: none"> • Identification of new markets
Contextual characteristics	Young company (4 years)	Growth company, growth phase (7 years)	Consolidating company (10 years)	Mature company (16 years)
Characteristics of the organisational structure	Simple organisation Small formalisation Small specialisation Major centralisation	Functional organisation Increasing formalisation Medium specialisation Major centralisation	Functional organisation Low formalisation High specialisation Major centralisation	Divisional structure High formalisation High specialisation Low centralisation
The importance of entrepreneurial characteristics	Ability and motivation to identify opportunities Entrepreneurial motivation	Capacity, management skills Entrepreneurial motivation	Capacity, management skills	Capacity, management skills
Entrepreneurial behaviour	Identifying opportunities, possibilities Recognition of the framework	Recognition of the framework Identifying and exploiting opportunities and possibilities	Identifying and exploiting opportunities and possibilities Business consolidation	Business consolidation Strategic reorganisation Seeking opportunities

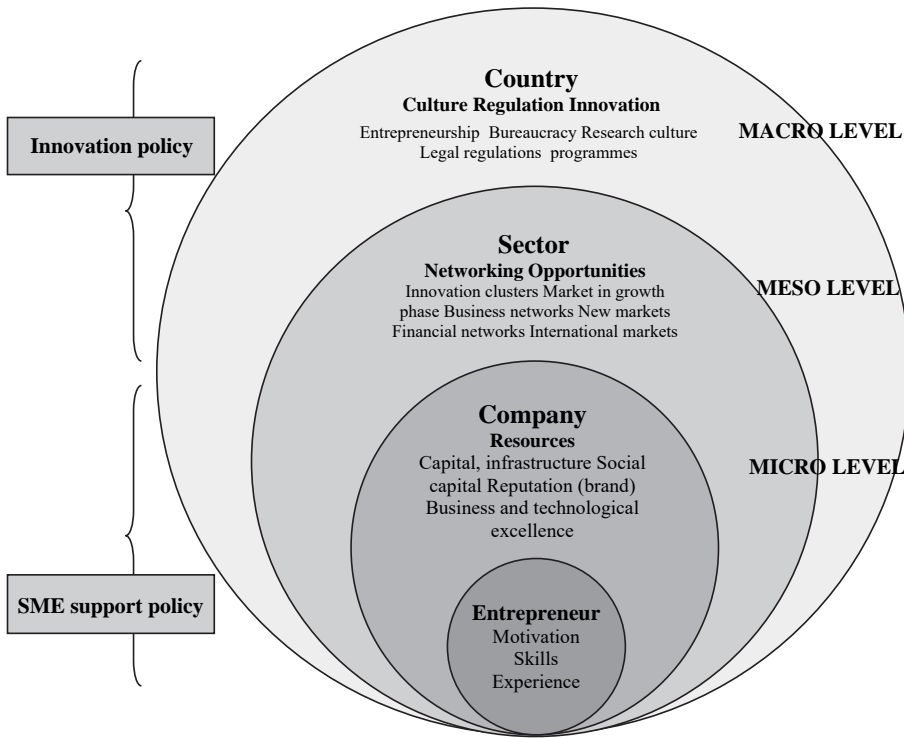
Source: based on Autio, Kronlund, Kovalainen, 2007, p. 12.

At the first stage of a company's operation, the process of its development is strongly determined by the entrepreneur's strengths and competences as well as work experience (Shane, 2000, pp. 448–469; Szczepańska-Woszczyna, Kurowska-Pysz, 2016, p. 58). For companies at the start-up stage, it is important to be ready to apply emerging technological and market opportunities and to transform, as for most such companies the first concept usually turns out to be overly simplistic and sometimes even misguided (Autio et al., 2007, p. 12). Critical to the further development of the company are the ability to identify opportunities and possibilities, as well as the entrepreneur's motivation. Competence and organisational considerations vary at successive stages of a company's development. During the growth stage, there is a growing need for managerial skills to initiate, manage and sustain growth. This is probably the most difficult stage in any company's management life cycle. After successful growth, the company needs to consolidate its position and gradually start looking for diversification opportunities and new ideas. However, the next stages of development go beyond the domain of support systems and policies. The active participation of small and medium-sized enterprises in the growth of social and economic potential depends on the continuous development of their organisational systems, scale of operations and market opportunities. This development takes place through changes, the object of which may be the individual elements of the organisational system and the way in which individual management functions are carried out (Kaczmarek, Sikorski, 1995, p. 225).

The process of support and development for entrepreneurship takes place in a given national, cultural and economic context (however, it is emphasised that entrepreneurship is largely a local phenomenon,⁴ determined by a particular (favourable) configuration of elements of the socio-economic environment, the configuration of support policy applications for entrepreneurial growth (Figure 1).

4 See: Malecki 1994, pp. 119–153; Feldman 2003, p. 93.

Figure 1. Levels of analysis of SME development support systems



Source: based on work: Autio, Kronlund, Kovalainen, 2007, p. 14.

The list of success factors for SME companies is not fixed, as the structure of the environment is changing and the uncertainty associated with the business environment is constantly increasing. The determinants of the growth and development of small and medium-sized enterprises are diverse in nature, being both external and internal conditions which, by affecting the nature of the small or medium-sized business entity, influence the development processes taking place within it. External determinants can be analysed in the context of the dimensions of the environment, i.e.: macro-, meso- and micro-environment (Skowronek-Mielczarek 2011, pp. 28–43), including (Lisowska 2015, pp. 120–123):

- the spatial and material scope of the market, including products and capital;
- globalisation processes and the consequent changes in production processes, the new division of labour, the development of research and science, the use of IT tools;
- the increased importance of research and development;
- access to information when making business development decisions;
- systemic environment factors;

- the nature of relationships with suppliers and customers;
- the company's relationships with other entities;
- relations with regional institutions;
- relations with the business environment.

Internal determinants include: demographic parameters of the entrepreneur (e.g.: age, education, management experience), company characteristics (e.g.: age, sector, size, ownership, resources) and strategy (e.g.: market fit, customer focus, market positioning, workforce training; entrepreneurial orientation, strategic management, modern HRM [human resource management], contemporary management methods, market relations, monitoring practices, information systems, ICT) (Storey, 1994, p. 123).

Small and medium-sized enterprises play an important role in the socio-economic development and increased competitiveness of regions, while at the same time facing increasingly complex development conditions (Krupski, 2011, pp. 3–5). Therefore, various initiatives are being promoted and undertaken in the regional environment to support the development of small and medium-sized businesses. Authorities in many countries, recognising the importance and impact of SMEs on the economy, are creating agencies and companies to support the development and operation of this sector. In European Community policy, too, this group of companies is the subject of particular concern and support. The European Commission, aiming to strengthen the competitiveness and economic convergence of the Community, is launching a number of instruments to, inter alia, equalise the competitive position of the SME sector vis-à-vis large companies, while at the same time contributing to the dynamisation of regional and national economies and the achievement of market equilibrium in the supported area (Słownik podstawowych terminów samorządu terytorialnego, 2007, p. 37). An institutional support system is being set up that includes support for the processes of development and growth of competitiveness growth of existing enterprises, on the assumption that they cannot achieve adequate economies of scale and scope due to their size. They are in the nature of instruments to reduce barriers to activity or to reinforce positive development factors, both internal and external, stimulating changes in small and medium-sized enterprises leading to their development.

Support schemes aim to achieve the intended structural, economic and social effects by supporting the creation of new companies and increasing the innovation and competitiveness of the SMEs sector. The current form of support schemes is the result of the evolution of the nature of economic policy from sectoral to horizontal, where public aid is shifted from specific disadvantaged entities or industries to the activation of qualitative phenomena such as entrepreneurship, improvement of competitiveness, and innovation (Matusiak, 2006). The entrepreneurship support system is based on programmes (selective instruments targeted at specific regions, industries and social groups) and institutions. The support (grant)

programmes created by public institutions include purpose and intended effects, the budget, technical measures, human resources, and the institutional base. There is no one-size-fits-all organisational and functional template for these types of institutions. The development of support systems depends on the socio-economic situation of individual countries, as well as their traditions and cultural backgrounds – for example, Anglo-Saxon countries (e.g., the United Kingdom, the Netherlands) take a more cautious approach to support systems, as opposed to countries of the protectionist ‘protected culture’ tradition, which formalise and bureaucratised operations to a greater extent (e.g., France, China, South Korea) (Guzdek, 2010, p. 165).

Support for SMEs can affect their development directly or indirectly. Indirect support, implemented through the so-called indirect instruments, is related to the creation of favourable meso-economic and meso-social conditions for the operation of entities in the SME sector. Among these are those priorities of development policy that are directed at supporting entrepreneurship, e.g., (Matejun, 2012, pp. 86–87):

- the development of the region’s technical and IT infrastructure;
- supporting investment by both small and medium-sized companies as well as investors from other regions, including abroad;
- supporting the development of business environment institutions, especially those undertaking innovative and high-technology activities, as well as supporting the development of the information industry and consultancy and advisory services;
- measures for the development of human resources, resulting, *inter alia*, in an increase in business efficiency.

Instruments for direct support of the development of small and medium-sized enterprises are instruments of selective support, directly obtained and used by entities of the SME sector meeting access criteria defined for a given instrument related to the implementation of indirect aid instruments. These instruments are offered by business environment institutions, which are involved in providing support to SMEs. Instruments to support SMEs can be divided into two main groups:

1. financial instruments (direct),
2. non-financial (indirect) instruments: legal-administrative and institutional.

In the group of financial instruments, (Wozniak, 2012, pp. 73–74; Kowalski, 2014, no. 2, p. 35) are used:

- direct aid instruments, e.g., grants and subsidies, tax relief, more favourable depreciation terms, facilitated public procurement procedures;
- instruments facilitating access to bank credits, loans and other financial market services: credits on preferential terms, special credit lines, bank credit subsidies, credit guarantees and loan guarantees, leasing, factoring;
- equity instruments: venture capital investment funds and access to the stock market;

- tax instruments.

Non-financial (indirect) instruments include:

- various simplifications of administrative and legal procedures, e.g., accounting, tax law;
- cooperative structures and networks enabling contact between SMEs, incubators, clusters, technology parks;
- training activities for entrepreneurs and SME employees, counselling and information points, promotion of internationalisation;
- promoting innovation among SMEs and encouraging the implementation of new technologies, the use of R & D centres in technology transfer;⁵
- promoting awareness of intellectual property rights;
- support for public-private partnerships;
- provision of adequate technical infrastructure.

S. Lachiewicz and M. Matejun (2016) also identified environmental potential factors that influence the level of innovation development of small and medium-sized enterprises. Three groups of external conditions were identified: subjective, relational and reactive, potentially determining the extent to which SME companies implement innovations (Tab. 2).

Table 2: Ambient potential factors shaping the level of innovation of small and medium-sized enterprises

Subjective factors	Relational factors	Reactive factors
– state and local government institutions	– contractual relations	– the level of variability of the environment
– banks	– equity relationships	– the extent of predictability of changes in the environment
– loan funds	– network relationships	– the extent of the company's response to changes in the environment
– credit guarantee funds business angels	– cluster relations	– the level of competition in the company's environment
– venture capital funds	– partnership relations	
– insurance companies	– transactional relationships	
– universities	– companies	
– research and development units	– licences	
– scientific and technical associations	– outsourcing	
– technology parks		
– business incubators		
– technology transfer centres		

5 Wozniak, 2012, pp. 73-74.

Subjective factors	Relational factors	Reactive factors
<ul style="list-style-type: none"> – enterprise agencies and foundations – chambers of commerce – special economic zones – training, advice and information centres – media and press – company clients – the company's competitors – suppliers and strategic allies 		

Source: S. Lachniewicz, M. Matejun, *The potential of the environment in the development of innovativeness of small and medium-sized enterprises – research results*; Studia Ekonomiczne. „Zeszyty Naukowe Uniwersytetu Ekonomicznego w Katowicach”, No. 280 – 2016

2. European Union policy in favour of small and medium-sized enterprises

Treating the role of SMEs in the economy as particularly important, the EU has taken many measures to strengthen the sector's position in the market. Ultimately, they were to result in SMEs gaining as much benefit as possible from the globalisation of the economy and the creation of a common European market. These included an economic information system, promotion of business-to-business interaction, financial assistance and more. (Bańka, Gołembski, 2010, pp. 63–82). The European Union's policy towards the SME sector can be summarised in the following areas:

- reducing and simplifying administrative, tax and accounting obligations;
- mobilisation of Member States to modify civil and commercial law, Community support programmes;
- support from Community funds.

The European Union provides support to European small and medium-sized enterprises by offering assistance in the form of various instruments such as grants, loans and, in some cases, collateral. Both direct support and support through programmes managed at national and regional level, such as those funded by the EU Structural Funds, are available. SMEs can also benefit from a range of non-financial assistance measures in the form of business support programmes and services (*Union Programmes...*, 2012, p. 2). The European Union's policy towards small businesses is mainly based on resolutions and recommendations of the Council of the European Union, as well as initiatives and programmes of the European Commission. These acts create a framework of common actions for small and medium-sized companies that support their activity in the single market.

The SME policy includes support for the processes of development and growth of competitiveness of enterprises. This policy – which has been shaping its tenets in European countries since the 1980s – is an emerging field of formal public intervention since the 1990s. It encompasses the phases of generating a venture idea, setting up a business and the first years of operation, with the assumption that new businesses stimulate economic growth and innovation (Audretsch, Beckmann, 2007; De, 2000, pp. 87–106).

The SME sector has been subject to special competition rules in the unifying Europe since as early as 1982. 1983 was declared the period of small and medium-sized enterprises and crafts. In 1986, the Council of the European Communities adopted an action programme for small and medium-sized enterprises. The adoption of the programme is considered the beginning of the shaping of a common (Community) SME policy (Huczek, 2012, pp. 48–60). The aim of this Programme was to harmonise the laws of the member countries, to ensure the principle of fair competition, to stimulate simplification in tax systems, and to promote investment and exports.

The Treaty on European Union concluded in Maastricht in 1992 stipulated the need to create conditions for the development of SMEs and for the solutions adopted through directives aimed at minimising the administrative, financial and legal constraints that would hinder the creation and development of small and medium-sized enterprises. Community policy towards SME operators has been subordinated to the EU's competition policy, which prohibits all practices that infringe the principle of free competition in the internal market and abuse of monopoly positions (Lenkiewicz, Hutyra (eds.), undated).

The Lisbon Strategy, adopted by the European Council in 2000 and redefined in 2005, with the aim of transforming the European economy into the world's leading economy, has as a core element an emphasis on delivering stronger and sustainable economic growth, and creating more jobs, through innovation and building a knowledge-based economy and improving business performance. Small and medium-sized enterprises were to play a decisive role in achieving these goals. SMEs are an important source of jobs, entrepreneurship and innovation, as well as social and economic cohesion in the EU. 23 million small and medium-sized enterprises, i.e., 99% of all European enterprises, contribute to the creation of 75 million jobs (*SMEs in the renewed...*, undated).

In a communication titled *Small Business Act for Europe*, drawn up in June 2008 by the European Commission in accordance with the guidelines of the Lisbon Strategy, a European programme for the development of small and medium-sized enterprises was published, which, according to the Commission, is an essential element in managing the transition to a knowledge-based economy. This will guarantee a competitive and dynamic economy, better and more jobs and a higher level of

social cohesion. As part of the *Small Business Act*, the implementation of ten principles to stimulate and support small and medium-sized enterprises was declared. Specific actions were addressed not only to EU structures, but also to national institutions, assigning them the necessary tasks (*Communication from the Commission on the revision of the method for setting the reference and discount rates*, 2008).

In relation to Poland, the most important actions leading to the successful fulfilment of the assumptions of the renewed Lisbon Strategy were identified as, among others:

- increasing the efficiency of investment in knowledge and innovation and raising the quality of R&D through public research sector reform;
- dynamic development of entrepreneurship and increasing the potential for competitiveness and innovation generation especially by SMEs through the creation of a favourable institutional, legislative and financial environment.

After the end of the Lisbon Strategy implementation period in 2010, its functions were taken over by the Europe 2020 Strategy, based on the lessons learned, together with the instrument for the implementation of the EU development strategy 'Horizon 2020' (including the 'Innovation Union' flagship initiative). The EU's Horizon 2020 Framework Programme for Research and Innovation has placed a strong emphasis on innovation and focuses funding on testing, prototypes, pilot projects, business R&D, promotion of entrepreneurship and business risk-taking, standard-setting, public procurement of innovation, and support for non-technological innovation: innovative design, creativity and innovation of services, novel business models and social innovation. The task of the 7-year framework programme was, among other things, to develop the innovative SME sector through the creation of the 'SME Instrument'. A supporting function was provided by the programme for the competitiveness of enterprises, including SMEs – the COSME programme.

Horizon 2020 has been replaced by Horizon Europe (2021–2027), an ambitious research and innovation programme. Its budget is approximately €95.5 billion. On 2 February 2021, the European Commission and the Portuguese Presidency held a symbolic opening of the new programme.

Table 3 presents examples of EU action on Community policy for small and medium-sized enterprises.

Table 3. Examples of EU action on Community SME policy

Years	Selected programmes	Key objectives and action lines
1983–1987	<i>Community Policy towards SMEs</i> (first Community policy towards SMEs)	Three core objectives in SME action: 1) improving market and administrative conditions 2) expanding their funding opportunities 3) support for innovation and improved governance
1987–1989	<i>SME action programme 1987–1989</i> (the so-called zero programme)	Main lines of action: <ul style="list-style-type: none"> • improving the administrative environment • creating structures that foster fair competition • simplification of tax legislation • strengthening the functioning of social networks • export promotion • support for the establishment of new businesses and the application of innovation, promotion of entrepreneurship • support and improving access to external sources of finance • 1987 – Euro Info Centre (EIC) established – information, advice and training for SMEs • establishment of the Business Cooperation Network BC-NET – to support cross-border cooperation between SMEs • 1989 – creation of Directorate General XXIII dedicated exclusively to SME activities
1990–1993	<i>Integrated Programme in favour of SMEs and the Craft Sector</i> (first integrated programme in favour of SMEs and the craft sector for the period 1990–1993)	Main activities: <ul style="list-style-type: none"> • removal of administrative, financial and legal obstacles to the development and establishment of businesses • assistance to businesses on policies, regulations and activities undertaken by the Community and member countries • support for cooperation between SMEs from different regions
1994–1996	<i>SME Multiannual Programme</i> (second integrated programme for small and medium-sized enterprises and the craft industry for the period 1994–1996)	Two main components: improvement of the general features of the business environment and direct assistance to SMEs The programme set out 8 objectives: <ul style="list-style-type: none"> • taking into account the needs of SMEs in the development of Community legislation • improving the conditions for the transfer of business ownership • improving the fiscal environment for SMEs • improving payment periods for receivables between SMEs • facilities for the creation of new jobs • improving access to finance • support for cooperation between companies • supporting the improvement of management quality in SMEs

Years	Selected programmes	Key objectives and action lines
1997–2000	Third Multiannual Programme for Small and Medium-sized Enterprises in the European Union 1997–2000	Primary objectives: <ol style="list-style-type: none"> 1) simplification and improvement of the administrative, legal and financial conditions for the operation of business 2) assistance to SMEs for Europeanisation and internationalisation 3) improving the competitiveness of SMEs and facilitating their access to research, innovation and training 4) improving policy instruments for SMEs Effects: <ul style="list-style-type: none"> • among others, two funds were set up to finance SME activities: CREA –<i>seed capital</i> fund and <i>Joint European Ventures</i> (JEV) – aid fund for SMEs undertaking international cooperation • the introduction of the <i>Business Impact Assessment</i> (BIA), an assessment of the potential impact of legislative projects on SMEs • conducting surveys and statistical reports on SMEs (e.g., ‘<i>Statistics in Focus</i>’ and ‘<i>Enterprises in Europe</i>’ and ‘<i>The European Observatory for SMEs</i>’) • 2000 – adoption by EU Member States of the <i>European Charter for Small Enterprises</i>; 10 priorities for SMEs have been adopted: <ol style="list-style-type: none"> 1) education and training in entrepreneurship 2) lower costs and faster start-up 3) more streamlined legislation and better regulations 4) availability of skills 5) improving <i>online</i> access 6) broader activities beyond the single market 7) taxation and financial issues 8) increasing the technological capabilities of SMEs 9) more efficient e-commerce models 10) developing stronger and more effective representation of SME interests at EU and national level
2001–2006	<i>Fourth Multiannual Programme for Enterprise and Entrepreneurship and in particular for Small and Medium-Sized Enterprises 2001–2005</i> PHARE, ISPA, SAPARD pre-accession programmes for candidate countries	Main programme objectives: <ul style="list-style-type: none"> • promoting the growth and competitiveness of enterprises in a knowledge-based economy • promotion of entrepreneurship • improving the administrative and legal framework for doing business so that there is a significant increase in research, innovation and business creation • improving the financial environment for business, especially SMEs • providing businesses with access to Community services, programmes and business support networks

Years	Selected programmes	Key objectives and action lines
2007–2013	<p><i>V Entrepreneurship and Innovation Program (Fifth Entrepreneurship and Innovation Programme)</i></p> <p><i>Competitiveness and Innovation Framework Programme – CIP</i></p> <p><i>7. FP7 – Seventh Framework Programme for Research and Technological Development (2007–2013)</i></p> <p><i>2008 – Small Business Act for Europe</i></p>	<p>Main objectives of the EIP programme:</p> <ul style="list-style-type: none"> • facilitating access to finance for business start-up and development and innovation activities • creation of an environment conducive to cooperation between SMEs, particularly cross-border cooperation • promoting innovation in enterprises • supporting eco-innovation • promoting an entrepreneurial and innovative culture • supporting administrative and economic reforms related to entrepreneurship and innovation <p>Framework Programme for Research and Technological Development (7. FP) refers to SMEs in various programmes, including: 'Cooperation' (€32.3 billion), 'Ideas' (€7.5 billion), 'People' (€4.7 billion) and 'Capacities' (€4 billion)</p> <p>EC document setting out 10 principles to make life easier for small businesses in EU countries</p>
2014–2020	<p><i>Competitiveness of small and medium-sized enterprises (SMEs) as one of the 11 thematic objectives of the 2014–2020 programming period.</i></p> <p>The <i>Small Business Act Programme for Europe</i> is also one of the EU's actions aimed at implementing a comprehensive SME framework policy within the EU to intensify and promote entrepreneurship.</p> <p><i>COSME (Programme for the Competitiveness of Small and Medium-Sized Enterprises)</i> (continuation of the CIP Programme 2007–2013)</p>	<p>Simplification of common rules</p> <p>SME assistance on:</p> <ul style="list-style-type: none"> • gaining access to finance in the form of grants, loans, loan guarantees, <i>venture capital</i> funds, etc. • gaining better access to global markets and reducing business risks • exploiting new sources of growth, such as the green economy, sustainable tourism, health and social services and others • investment in human capital and in organisations providing practical vocational education and training services • establish valuable links with research centres and universities to promote innovation <p>Main programme objectives:</p> <ul style="list-style-type: none"> • strengthening the competitiveness and sustainability of EU SMEs • supporting job creation and SME growth <p>Programme budget: EUR 2.3 billion, of which at least 60% (EUR 1.4 billion) for financial instruments</p>

Source: based on Surdej, Wach, 2011, pp. 75–96; Afktyka, Chmielewski, 2005, pp. 171–175; *Union programmes...*, 2012, p. 6.

The EU provides support to financial intermediaries in member countries, such as banks, leasing funds, guarantee funds, mutual guarantee funds, public support banks and other institutions that provide funding to the SME sector by providing loan guarantees. This reduces their credit risk, opening up the SME sector to access more credit that they would not have been able to obtain on their own.

Entrepreneurs can receive help to finance their projects from EU funds in the form of loans, guarantees and equity.

Community legislation, relating to SMEs, includes documents covering (Borowiecki, Siuta-Tokarska, 2008, pp. 116–117):

- conditions for starting and running a business;
- labour law, including, inter alia, health and safety at work, maximum working time, equal treatment of men and women, recognition of qualifications;
- tax law, including VAT, excise duties, direct taxes, among others;
- competition law, including antitrust law, state aid to companies, counteracting unfair competition, advertising;
- protection of intellectual property, including invention rights, trademarks;
- public procurement;
- quality standards;
- environmental protection, including, inter alia, automotive, waste management, industrial pollution control, regulation of chemical products and others;
- personal data protection;
- assistance to SMEs.

The EU's SME policy allows for various forms of assistance to be provided to operators in this sector, both within the Community as a whole and within individual Member States. These policies include, among others, trade liberalisation, harmonisation of economic law, enforcement of fair competition rules, simplification of tax systems, promotion of investment, innovation and exports. In doing so, the EU uses various types of instruments, both traditional (e.g., tax breaks and exemptions, financial assistance, public procurement, etc.) and new tools, e.g., development and transfer of new technologies, advice and training, information networking, etc.

3. SME support systems and instruments in selected EU countries

Western European countries have strongly developed ways of supporting entrepreneurs, shaped over decades, and even systemic solutions that have produced and continue to produce very good results. SME development support programmes, implemented at both EU and national level, are a sustainable element of wider economic policy. SME support schemes and programmes in the EU are primarily aimed at supporting innovation and R&D in companies, improving their competitiveness and their international cooperation and internationalisation, facilitating the acquisition of capital and developing human resources. In contrast, national programmes have focused on creating an enabling administrative, legislative and financial environment, making the labour market more flexible and improving research and development activities and the skills of workers. The support tends to be qualitative rather than quantitative.

An element of support for the development of SME operators is the simplification of administrative and legal procedures in each country. One indicator that illustrates this condition is the World Bank's Ease of Doing Business Index. It is determined by an average of 10 categories, including but not limited to: (1) setting up a company – procedures, time and minimum initial contribution required (currently lowest costs – among EU countries – in Denmark, UK and Sweden); (2) time needed to prepare and pay corporation tax, VAT and social security contributions (currently lowest in Luxembourg and Ireland); (3) obtaining building permits – procedures, time and cost of inspection and obtaining a permit (most favourable in Estonia, Denmark and Lithuania); (4) procedures, cost and time of registering a company (most favourable in Estonia and Denmark); (5) contracting – procedures, time and cost of entering into and enforcing debt contracts (Austria, Belgium, Luxembourg, Netherlands); (6) quality of public services and degree of independence from political pressure, quality of policy formulation and implementation and credibility of government commitment to such policies (most favourable in Finland, Denmark and Sweden) et al. Most EU countries treat these measures as part of a broader economic reform agenda (Aristovnik, Obadić, 2015, pp. 761–774). The ranking of this indicator by EU country is presented in Table 3, while the countries with the highest scores in each category are presented in Table 4.

Table 4. Ease of doing business index ranking in EU countries

Place in the ranking	Country	Entrepreneurship reforms 2014	GEI 2017	Place in the ranking	Country	Entrepreneurship reforms 2014	GEI 2017
5	Denmark	0	74.1	38	France	1	64.1
10	UK	2	71.5	39	Cyprus	0	38.5
12	Finland	0	66.9	45	Poland	2	46.6
14	Sweden	1	75.5	49	Slovakia	0	44.1
15	Ireland	0	71.0	52	Spain	1	45.3
17	Lithuania	2	49.6	54	Hungary	0	36.3
21	Germany	0	64.9	58	Bulgaria	0	
22	Estonia	1	55.5	60	Luxembourg	0	58.1
24	Latvia	4	43.0	65	Italy	3	37.0
28	Netherlands	2	67.8	72	Greece	3	34.6
30	Austria	0	63.5	73	Romania	3	37.1
31	Portugal	1	47.2	75	Czech Republic	1	42.2
33	Slovenia	1	51.5	89	Croatia	5	30.8
36	Belgium	0	63.0	103	Malta	1	

Source: based on work: *Doing Business 2014...*, 2013;; Szerb, Komlosi, Páger, 2016.

The aggregate score from the 10 categories places Denmark and the UK highest in the index ranking, among EU countries. The publication of the index has improved regulation in many countries. Some have set themselves the target of being among the top 25. There was particular activity in this area in 2006–2007 (200 reforms in 98 countries). In 2014, 34 reforms were introduced in 17 European countries.

The *global entrepreneurship index (GEI)* is also worth noting. The *GEI* measures a country’s entrepreneurial ecosystem by linking individual data, such as opportunity recognition, start-up skills and risk acceptance, to the use of institutional resources, urbanisation, education and economic freedom. The index is used to diagnose the main challenges of entrepreneurial development. Denmark, Sweden, the UK and Iceland were found to be the most entrepreneurial in Europe in 2017 (see Tab. 5).

Table 5. Support instruments for operators of the SME sector in selected EU countries

Country	Support area	Characteristics of the support instrument
Denmark	Financial support	Numerous programmes financed solely from the national budget and focusing on facilitating the development of SMEs through the guarantee and surety system and on supporting innovation through grants for research and development activities, among others: <ul style="list-style-type: none"> • Danish Growth Fund (<i>Vækstfonden</i>) – provides guarantees for loans taken out by companies with no more than 100 employees, for a loan of between 10–700k. EUR and a repayment period of 3–10 years, for the purpose of, inter alia, implementing innovative technology, developing production capacity or setting up a new business; • the Danish National Advanced Technology Foundation (<i>Højteknologifonden</i>) supports projects to develop a completely new product using advanced technology.
	Non-financial instruments	parks offering additional services
	Institutional support	The Danish Commerce and Companies Agency (DCCA) handles most of the matters that determine the efficiency of the Danish business support system, especially for small and medium-sized enterprises: registration of companies, administration of legislative acts, control and monitoring of compliance with the law without unduly interfering with the control of their operational functioning, reduction of the administrative burden, and digitisation of the administrative service (by means of user-friendly and easy-to-use applications). The Trade Council is an organisational unit of the Ministry of Foreign Affairs within which function all instruments responsible for promoting Danish exports and foreign investment in Denmark.

Country	Support area	Characteristics of the support instrument
Germany	Financial support	<p>SMEs are financed to a greater extent by commercial loans, while direct support from the budget is at a low level.</p> <p>Great importance is attached to fostering innovation and improving the skills in companies.</p> <p>In project financing, private capital plays an important role in Germany, especially the fast-growing <i>venture capital</i> funds – in this respect Germany ranks first in Europe.</p>
	Tax instruments	<p>Exemption from taxation of labour costs, increased write-offs of movable fixed assets up to a certain value, reduction of income tax rates, more favourable VAT taxation for businesses with annual revenues of less than EUR50,000.</p>
	Direct financial instruments facilitating access to foreign capital	<p>Preferential loans; start-up loans for persons who have previously accumulated savings for the purpose of setting up a business; interest subsidies on bank loans granted by commercial banks, guarantee banks, guarantee communities with counter-guarantees from the states and federations.</p> <p><i>Seed capital</i> (investment in high-tech companies operating for less than one year, investment of between EUR 500,000 and EUR 1 million); <i>venture capital</i>; <i>business angels</i>.</p>
	Financial instruments that indirectly facilitate access to foreign capital	<p>Tax exemptions (investment by <i>business angels</i> not exceeding 1% of the company's shares); funding of the fund's investments – <i>seed capital</i>: loans (100% guarantees) granted for half the value of investments made in the high-tech sector; maximum duration up to 10 years.</p>
	Institutional support	<p>Compulsory membership of chambers, which play a central role in defending the interests of entrepreneurs and effectively implement economic policies developed jointly with the government.</p> <p>The Chambers of Industry and Commerce (Industrie- und Handelskammern) work closely with Germany Trade & Invest to coordinate and represent the interests of German entrepreneurs vis-à-vis local, state and federal authorities.</p>

Country	Support area	Characteristics of the support instrument
United Kingdom	Financial support	The government has a policy of encouraging self-employment start-ups while creating a favourable environment for them to operate in the market; start-up grants are given to young entrepreneurs (up to the age of 30) who accumulate savings in order to start their own business.
	Tax instruments	Deductions from income tax of R&D expenditures from the tax base up to a certain amount; one-off deductions of expenditures incurred for the purchase of buildings for business purposes in enterprise zones, exemption from VAT for businesses with less than EUR 80,000; exemption from property tax in enterprise zones.
	Direct financial instruments facilitating access to foreign capital	Soft loans and credits for setting up a business.
		Loans and credits for enterprise development (e.g., loans for the restructuring of industrial areas in various regions, loans for the high-tech sector; loans for micro-enterprises, etc.).
	<i>Investment readiness, seed capital, venture capital, business angels.</i>	
Financial instruments that indirectly facilitate access to foreign capital	Tax exemptions (<i>business angels</i> investments) longer than three years and not exceeding 30% of the company's shares. Tax credit.	
Institutional support	<p>The system of government support for entrepreneurship in the UK is extensive and varied, with support provided directly by government departments and agencies and through grants to business organisations, e.g., the British Chambers of Commerce; funding through indirect routes takes the form, for example, of awarding government contracts to chamber members only.</p> <p>Assistance to companies, as well as many activities aimed at supporting SME operators, are carried out locally.</p> <p>There are Regional Development Agencies in all regions, set up with the participation of local authorities, large corporations and banks, consortia of smaller companies and universities.</p>	

Country	Support area	Characteristics of the support instrument
Austria	Financial support	Little state support. Start-up capital aid applies only to enterprises that are innovative or fast-growing.
	Financial instruments indirectly facilitating access to foreign capital	Guarantees (50–100% for small investments over 5–10 years).
	Institutional support	Entrepreneurs are obliged by law to register their companies with the chambers, to which they pay a compulsory membership fee; associations of chambers of commerce play a central role in the practical support of entrepreneurship, and the government complements the activities of the chambers by focusing on ensuring the creation of a business-friendly legal, educational and social climate, and are responsible for cooperation and foreign investment strategies; among others, the state organisation Austria Wirtschaftsservice ensures the promotion and financing of enterprises, especially: small and medium-sized enterprises, start-ups, innovative and technological companies providing pro-production services, investors and capital providers. The aid includes the granting of low-interest loans; the Austrian Federal Economic Chamber coordinates and represents the interests of Austrian entrepreneurs nationally and internationally; it is made up of 9 regional chambers and 110 branch chambers and associations. Each region has offices providing services to local entrepreneurs.

Source: based on work: Wozniak, 2012, pp. 73–74

These developed economies are characterised by highly developed technology and innovation, the ability to benefit from the resources of the EU internal market, and high quality infrastructure and institutional facilities. Of the most populous EU countries, only the UK was ranked in the top 10. Other large countries ranked further down, with Germany (12), France (13), Spain (32), Italy (48), the UK, Germany and France showing a balance of the indicators considered. In contrast, Spain, Italy and also Poland are less efficient in some parameters. Switzerland, Ireland, Finland and the UK have seen the biggest increases in entrepreneurship levels among European countries since last year. In contrast, the largest decline in Europe was in Croatia. A detailed summary is shown in Table 3. The authors estimate that improving the conditions to help entrepreneurs create new businesses could add US\$22 trillion to the global economy (Acs et al., 2017).

The importance of SMEs varies between member states. The approach to SME support is different in each country, changing over time, offering a different type

and scope of support. Table 9.4 shows examples of SME support instruments used in selected EU countries.

There are noticeable changes in the structure of SME financing, with an increasing share of external capital in the form of bank loans and instruments offered by non-bank institutions, e.g.: leasing and factoring, loans from loan funds, instruments from EU funds, venture capital funds or business angels. There are significant differences in the financing of SME operators across EU countries. At one extreme are Spain and France, where numerous financial support programmes for small and medium-sized enterprises are in place, and at the other is Sweden, with a system in which the state does not intervene in the functioning of the market. There are also differences in the share of origin of capital invested in business development.

The tax systems of the countries that make up the European Union are subject to continuous unification, which is undoubtedly one of the effects of European integration. The process of European integration, increasing competition and globalisation processes have influenced changes to tax systems in European countries. Nevertheless, each change is implemented and assessed depending on the effects expected on the country's economy, particular groups of economic entities (including SMEs) and citizens. When talking about a tax system favourable to SMEs, one should have in mind its general structure and features, i.e.: the level of tax rates, principles of tax settlements, solutions stimulating the development of the volume of economic activity (job creation), innovativeness of enterprises. An analysis of the tax systems of the different countries shows that VAT exemptions are important for SMEs (due to the lack of qualified staff for fiscal accounting). The possibility of using other tax instruments depends on the company making a profit of a certain amount. These solutions allow a company's growth to be financed from retained earnings, which mainly supports SMEs, as they are usually the ones who have more difficulties in obtaining bank loans (Wozniak, 2012, pp. 78–79). Such a solution has been introduced by France, the UK and Germany, among others.

Another group of instruments used in EU countries, to which a great deal of importance is now attached in SME assistance programmes, are financial instruments that facilitate access to external sources of equity capital: venture funds such as seed capital, venture capital, private equity. They affect SMEs directly or indirectly. Pre-seed capital and investment readiness are new types of financial instruments. Pre-seed capital involves pre-financing seed-stage companies and helping them to obtain funding from seed capital or business angels funds. Pre-seed instruments are intended for innovative companies, while investment readiness is for companies from all sectors. In some countries (Portugal, England, Finland), public venture capital funds are also being set up (*ibid.*, pp. 84–87).

An analysis of the economic structures of highly developed countries allows the conclusion that in most of them SME entrepreneurs receive systemic direct support (through government agencies) or indirect support (through statutory assistance to private agencies or national chambers of commerce), based on mechanisms operating within and outside the country (Samborski, 2011).

4. System and instruments for supporting small and medium-sized enterprises in Poland

The main objective of the Polish policy on supporting the SME sector is to stimulate economic activity of enterprises, ensuring an increase in employment in this area and an increase in their competitiveness and ability to function in the Single European Market. Poland has adopted some of the solutions modelled on Western European countries and has also developed new ones, taking ideas from Western European and American solutions and adapting them to the conditions of the emerging free market economy. Activities in organising the system of support for entrepreneurship and innovation processes include a wide range of instruments – from stimulators embedded in the economic and social system and the legal order, through programmes and tasks undertaken directly by public administration at various levels, to specialised institutions of the civic sector (Matusiak (ed.), 2010). In Poland, a system of support has taken shape, involving the independent activity of independent entities with spot funding for the implementation of tasks included in strategic plans at various decision-making levels.

The government's support system for small and medium-sized enterprises includes legal, financial, organisational and information and training instruments (Matejun, Szczepańczyk, 2003, pp. 134–155):

- legal instruments – relate to the review and amendment of legal acts affecting the SME sector, as well as amendments aimed at harmonising legislation with European Union acts; they also aim to regulate the sphere of economic activity and economic self-government as well as business organisations;
- financial instruments – are related to the development of financial guarantee schemes and the development of criteria for providing assistance to small and medium-sized enterprises, including the definition of rules for granting preferential loans;
- organisational instruments – support the creation and development of local credit guarantees, insurance companies or non-bank financial institutions;
- information and training instruments – include support for the development of regional institutions for the promotion of the SME sector and access to technology and industrial design; assistance in educating entrepreneurs is implemented in the form of launching curricula promoting

entrepreneurship, developing and implementing a system for monitoring the state of the SME sector as well as the sensitivity of small and medium-sized enterprises to changes in financial and economic instruments.

The development of the SME support system in Poland can be divided into several periods:

- 1990–1993 – a pioneering period, which involved the recognition of western experience in this field and initiatives to transfer them to domestic solutions, culminating in an attempt to consolidate the environment within the Association of Organisers of Innovation and Entrepreneurship Centres in Poland and the Association of Regional Development Agencies and Foundations;
- 1993–1996 – a period of solving labour market problems; the breakthrough here was the implementation of the ‘Small Business Development Project’ (TOR#10) – the tenth component of the government programme ‘Promotion of Employment and Development of Employment Services’ implemented with a World Bank loan in 1993–1998 by the Ministry of Labour and Social Policy; the project was aimed at creating a system of institutions actively supporting entrepreneurship in Poland, aimed at organising self-employment assistance for the unemployed or those at risk of losing their jobs;
- 1998–2000 – stabilisation of the support system and new ideas;
- 2001–2003 – the pre-accession period in which entrepreneurship policy, after years of declarations, began to be covered by programmes and funding;
- 2004–2006 – the first period of EU experience (Guzdek, 2010, pp. 168–169);
- 2007–2013 – a gradual consolidation of regional innovation systems utilising experience and lessons learned from previous years, resulting in a diversified programme offer; Polish companies have since been able to apply for support from operational programmes such as: ‘Innovative Economy’, ‘Human Capital’ and ‘Infrastructure and Environment’, as well as under Regional Operational Programmes, etc.

In Polish law, under Articles 8 and 103 of the Act of 2 July 2004 on freedom of economic activity, the state authorities are obliged to support the development of entrepreneurship by creating favourable conditions for taking up and pursuing economic activity.

Improving the exploitation of the potential of SMEs is also addressed in the *Small Business Act*,⁶ which sets out ten basic principles that should guide Member States to enable the SME sector to develop. Between 2007 and 2009, Poland implemented

6 Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions of 25 June 2008.

measures in all 10 areas identified in the *Small Business Act*. Among other things, legislative changes were introduced as part of the *Entrepreneurship Package*, comprising 20 pieces of legislation designed to simplify business law. The use of European funds has also succeeded in raising the level of financial support for SMEs. The document titled *Directions for the Development of Loan and Guarantee Funds for Small and Medium-sized Enterprises in 2009–2013*, adopted by the Council of Ministers in February 2009, defines instruments enabling SMEs to have greater access to external funding sources, including guarantees issued by Bank Gospodarstwa Krajowego and the creation of a network of local and regional guarantee funds. A portal (<http://www.eu-go.pl/>) with useful information for businesses, consumers and authorities has been set up to help service providers to operate within the single market (advice on procedural and formal requirements). In order to implement and coordinate government policy programmes concerning the support and development of small and medium-sized enterprises, the Polish Foundation for the Promotion and Development of Small and Medium-sized Enterprises was established in 1995, which in 2001 was transformed into the Polish Agency for Enterprise Development (PARP). The agency operates on the basis of the provisions of the Act of 9 November 2000 on the establishment of the Polish Agency for Enterprise Development (Dz. U. of 2000, No. 109, item 1158) and relevant executive acts.

Companies in the SME sector can benefit from the support of EU funds

- at the European level – the HORIZON 2020/Horizon Europe programme, and
- at the national level, the European Funds for a Modern Economy 2021–2027 Programme.

The European Funds for the Modern Economy (FENG) Programme 2021–2027 envisages support in particular for the development of micro, small and medium-sized entrepreneurs and their consortia. One of the four priorities of the programme is the SMART Pathway, which allows different stages of an innovative venture to be included in a single project in the modules of research and development (R&D), implementation of new solutions, R&D infrastructure, internationalisation, competence development, digitisation and the green economy. The modules that make up the SMART (PARP) pathway are:

- R&D –module oriented towards the financing of all or selected elements of the research process – from industrial research, through development, including the creation of a demonstrator/prototype, to testing, the result of which should be the development of a nationally innovative solution that can be implemented in business;
- implementation of innovation – financing the implementation of the results of research and development work in the form of innovative solutions in the company's activities;

- development of R&D infrastructure – funding for investment in infrastructure necessary to implement the research agenda, for the creation of innovative products or services, with the aim of establishing or developing a research and development centre;
- internationalisation – internationalisation of products, i.e., foreign promotion of products or services under the company's product brand or products owned by the entrepreneur, support for the process of commercialisation of research and development results abroad;
- development of competencies of employees and persons managing the enterprise – improving competencies of employees and persons managing the enterprise, acquiring new skills and knowledge, as well as acquiring qualifications, in particular covering the scope of R&D works, smart specialisations, transformation of the industry towards 4.0, technology transfer, innovation management, commercialisation of R&D results, competences in the field of internationalisation, industrial property protection, digitisation, climate policy, eco-design, closed economy, low-carbon economy, as well as competences necessary to operate the research infrastructure financed under the project;
- digitisation of enterprises – financing investments related to the application of digital solutions in the enterprise, with the aim of digitally transforming production activities, services, the business model, processes and ensuring cybersecurity;
- 'Greening' businesses – the transformation of businesses towards sustainability and a circular economy, including the development of new business models geared towards it.

Support in the project will be provided in the form of a non-refundable grant, with the exception of the innovation implementation module, where the entrepreneur will receive a conditional grant, the reimbursement of which will depend on the achieved revenues from the implementation of the innovative solution.

Institutional support for SMEs is provided by innovation and entrepreneurship centres, information, training and advisory centres, guarantee and loan funds, business incubators, high-tech centres, industrial parks, and centres of excellence. The number of innovation and entrepreneurship centres has been growing steadily since 1990. In 1990 there were 27, and by mid-2009 the number of innovation and entrepreneurship centres had risen to 717. There is great diversity among the entrepreneurship support institutions operating in Poland. In 2012 there were 40 technology parks and 14 park initiatives; 29 technology incubators; 30 technology platforms; 73 pre-incubators and academic business incubators; 58 business incubators; 69 technology transfer centres; 68 seed capital funds; 10 business angel networks; 86 local and regional loan funds; 55 credit guarantee funds; and 319 training, consulting

and information centres.⁷ They operate in all provinces, however, it should be noted that there is a large disproportion in their distribution: they are concentrated in regions with high economic potential – the largest number is located in the provinces of Mazowieckie (84) and Śląskie (81), Wielkopolskie (69) and Małopolskie (59). The lowest saturation of these centres, on the other hand, is found in the Opolskie Voivodeship (11). In economically weaker regions, the low saturation of these centres results in the maintenance of a low level of provision of the infrastructure to support innovative ventures (Wójcik-Karpacz, Rudawska, 2016, pp. 258–259).

Poland is currently using solutions previously implemented in countries such as the UK, Spain and Italy. These have been given Polish mutations and even original solutions: very similar to the Spaniards, the Poles provide financial services – loan guarantees, and quite innovative financial support – providing loans to SMEs, through a system of loan funds, managed by NGOs and commercial law companies. The adult education system operates in a similar way: public and private schools, foundations and associations, agencies and centres provide training and counselling services to improve the skills and qualifications of entrepreneurs and their employees. They are mostly registered in the National Service System, which has no equivalent in Europe. Nevertheless, the SME support system in Poland is not comprehensive and coherent, responding to only some SME needs. The above view is confirmed, inter alia, by research conducted by the Ministry of Economy (*Development Trends...*, 2013).

5. Case study – examples of support for SMEs

5.1. Regional Chamber of Commerce – educational, informational and advisory activities for entrepreneurs in the SME sector

The Regional Chamber of Commerce and Industry in Katowice is an economic self-government organisation established on 13 February 1990, bringing together entities engaged in economic activity. RIG continues the tradition of the Chamber of Commerce established in Katowice in 1922 and, from 1927, the Silesian Chamber of Industry and Commerce that was operational until 1950. Among its aims and objectives are the following points:

- representing the economic interests of the associated entrepreneurs in their business activities, in particular vis-à-vis the central state authorities and local authorities at all levels;
- organising assistance to Chamber members in solving economic, organisational and legal problems relating to business;

⁷ Based on PARP data for 2012.

- helping Polish entrepreneurs, especially those operating in the Silesian Voivodeship, to build their position internationally;
- taking action to develop the Silesian Voivodeship in the context of creating conditions conducive to business activity and increasing the region's attractiveness for domestic and foreign investors.

During the pandemic, entrepreneurs needed wide-ranging support, not only the usual financial support, but also in terms of training employees and themselves, appropriate to the prevailing market situation. The events organised in 2021 by RIG were a response to the expectations of entrepreneurs, above all those representing the SME sector, particularly local ones. Training courses, workshops or information meetings arranged by the Chamber were in the vast majority free of charge for entrepreneurs or in some cases required a small fee. Due to nationwide restrictions on the organisation of events, the initiatives took place predominantly online, although some were stationary, with all precautions taken (small training groups, closed groups, practical parts of the training, and requiring a proper workshop).

From 2021 onwards, the Regional Chamber of Commerce's targeted activities for entrepreneurs in the SME sector were implemented through the following projects:

- **SME Support Centre**

The centre was established in March 2020, with the City of Katowice as co-organiser from 2021. The aim of the project was to provide crisis counselling to companies in Katowice with the aim of reducing the negative economic impact caused by COVID-19 and its associated restrictions. One comprehensive crisis counselling package for an entrepreneur included one hour of consultation with a first contact person and four hours of consultation with an expert or experts. Between July and December 2021, 50 Katowice entrepreneurs benefited from the Centre's assistance.

- **Silesian Academy of Internet Commerce, 2nd Edition**

The Silesian Academy of Internet Commerce was a project aimed at increasing the competitiveness of micro, small and medium-sized enterprises in Silesia by improving their competences in the transition from traditional trade to online sales and promotion, in the context of the Covid-19 pandemic and ongoing changes in the economy. A series of eight full-day online training courses and workshops led by experts in e-commerce, e-marketing, social media, virtual communication, and online law took place between 1–24.03.2021. 20 companies participated.

- **Katowice Academy of Digital Marketing**

The aim of the project was to increase competence among Katowice-based entrepreneurs in digital marketing, the sale of products through e-commerce, the application of the Internet for B2B activities and knowledge in the field of artificial

intelligence applied to customer acquisition. The project delivered 4 editions of free webinars consisting of 4 training days, each of 8 hours, between 21.09–17.11.2021. The project helped 40 participants, based on the knowledge and practical skills they acquired, to take full advantage of the opportunities offered by the Internet as part of promotion, communication with customers and in the process of developing companies on the local, national and international markets. The project was co-hosted by the City of Katowice, with content partners: WSB Academy, SoniqSoft Company and Silesia Business Hub.

- **Katowice Academy for Entrepreneurial Development**

The aim of the project was to provide entrepreneurs doing business in the City of Katowice with comprehensive knowledge that would enable them to develop their business activities more effectively and efficiently. The project consisted of 5 free training courses, each devoted to a different topic: starting a company's export activities; export management in a company; networking and personal branding – i.e., how to make yourself known to the largest possible group of people; choosing the right model for conducting marketing activities in a company; and non-standard ways of motivating employees in the specialist market. Each of the five training courses lasted two days, with each training day consisting of an 8-hour webinar. As part of the project, a total of 50 participants were trained between 18.11.–03.12.2021.

- **Micro, Small and Medium Enterprises Managerial Academy 2 – Macro-region 4**

This is a project co-financed by the EU under the European Social Fund as part of Measure 2.21: improving management, human capital development and support for innovation processes in enterprises, Operational Programme Knowledge Education Development and implemented by the Chamber of Commerce and Industry in Łódź (project leader) in partnership with RIG in Katowice, the Opole Chamber of Commerce and HRP Group Sp. z o. o. (project partners) in the period 1.07.2020 to 31.12.2022. Its main objective was to develop the managerial potential of micro, small and medium-sized companies from the three provinces by raising (by a minimum of 90% of the supported 750 participants) business management competences. The project involved the reimbursement of development services in business management, including human resources management. Support under the project was targeted at 750 employees of 375 SMEs, including 300 people from Śląskie Voivodeship (150 companies), 150 companies from Łódzkie Voivodeship and 75 companies from Opolskie Voivodeship. Of those supported, among others, 35% are representatives of small enterprises and a maximum of 25% are staff of micro-enterprises, of which a maximum of 10% are sole proprietors. In 2021, 99 contracts were concluded with Silesian entrepreneurs for a total value of PLN 2,239,513.95. The project is worth PLN 10.5 million, of which the budget of the GIS in Katowice is PLN 176,000.

- Digital Transformation Academy for SMEs

The Digital Transformation Academy for SMEs is a nationwide consultancy and training project implemented by the Łódź Chamber of Industry and Commerce (project leader) in partnership with RIG in Katowice and HRP Group Sp. z o. o. (project partners) in the period 01.01.2022 to 30.09.2023 and co-financed by EU funds under the European Social Fund within the framework of Measure 2.21: improving management, human capital development and support for innovation processes in enterprises, Operational Programme Knowledge Education Development. The aim of the project is to develop the adaptive management potential of 300 SMEs from all over Poland by improving the managerial competence of employees in the field of digitisation. The project targets 600 employees of SMEs – owners, managers or employees planned to become managers. Support under the project will include: the preparation of an analysis of the needs of SMEs (a strategic analysis of the enterprise, an assessment of digital maturity and an analysis of managerial competence) and the delivery of development services (training and counselling) for managers in accordance with the aforementioned analysis.

5.2 Małopolska Centre for Entrepreneurship

The Małopolska Centre for Entrepreneurship (MCP) is an organisational unit of the Małopolska Voivodeship Self-Government. The institution was established on 29 October 2007. The MCP carries out tasks related to, among other things, the implementation of the Małopolska Regional Operational Programme 2007–2013 (MROP) within the scope of Priority Axis II: Economy of a regional opportunity. It also acts as the Intermediate Body for the Regional Operational Programme for the Małopolska Voivodeship 2014–2020 (MVROP). With funds from this programme, the MCP supports Małopolska in the areas of entrepreneurship, social policy and education. In addition, the MCP implemented two projects between 2008 and 2015: Małopolska Scholarship Programme for Talented Students and Doctus – Małopolska Scholarship Fund for Doctoral Students. These projects were co-financed by the European Social Fund.

As part of the MVROP 2014–2020, the MCP conducted competitions for entrepreneurs under the sub-tasks listed below.

- Business research and development projects

This was funding for projects in the field of the implementation of industrial research and experimental development work, including the creation of demonstration and pilot lines, including the launch of the first production and preparation for the implementation of the results of R & D work in business activities. Within the framework of the sub-task, 6 calls were carried out, for which PLN 706,396,447.81 was allocated. In response to the announced competitions, 756 applications were submitted with a funding value of PLN 2,018,476,944.01 and a total value of PLN

3,162,884,973.12, which resulted in 183 agreements being signed with entrepreneurs with a total funding value of PLN 488,582,207.46 and a total value of PLN 884,204,944.34.95 projects have completed the implementation of ideas, and funds amounting to PLN 339,451,640.50 have been transferred to beneficiaries. To date, 165 new full-time positions have been created for researchers as part of the support received by 156 unique companies. Fifty-four companies undertook cooperation with research centres. 55 R&D results were implemented, 105 innovations (mainly product innovations) were introduced and 30 patent applications were filed.

- Research and development infrastructure of enterprises

Under the competition, support could be given to enterprises' projects concerning the creation of infrastructural conditions for research and development activities aimed at producing and introducing new products, processes or services into their own business. Within the framework of 3 calls, entrepreneurs submitted 126 applications with co-financing of PLN 175,822,417.54 and a total value of PLN 490,451,154.31. As a result, 63 contracts were signed with a grant value of PLN 75,523,641.67 and a total value of PLN 236,112,488.50. In the end, 47 projects were implemented and funds amounting to PLN 54,099,918.67 were transferred to the beneficiaries. To date, 52 new researcher posts have been created in support of 52 unique businesses. 58 research laboratories were supported. Using the supported research infrastructure, 109 R&D projects are being implemented.

- Innovation vouchers

Support under the innovation voucher included the purchase of research and development services: industrial research and/or experimental development services and design services or pro-innovation services: services for: the development of a feasibility study, advanced market research and pre-implementation analysis, research on quality and compliance with specific requirements/standards, certification of new/significantly improved solutions and intellectual property protection. Seven calls for proposals were carried out, under which entrepreneurs submitted 914 applications with a funding of PLN 155,010,092.35 and a total value of PLN 221,475,622.33. 359 contracts were signed with a total grant value of PLN 46,920,984.85 and a total value of PLN 68,057,764.19. As part of 300 projects, funds amounting to PLN 29,054, 580.36 were transferred to beneficiaries. The support received so far by 262 unique companies has resulted in 241 companies working with research centres. 691 innovations (mainly product innovations) were introduced.

- International activity of SMEs in the Małopolska region

Within the framework of the competition, support could be given to companies' projects concerning the development and implementation or only the implementation

of a strategy/plan for the company's international activities. Of the 453 applications submitted under the 4 calls, 188 agreements were signed with a funding value of PLN 26,766,476.68 and a total value of PLN 63,783,260.86. Within the 162 projects implemented, PLN 17,987,935.26 was transferred to the beneficiaries, which resulted in 144 beneficiaries making organisational and process changes. The support of 175 companies in the internationalisation of their activities allowed 15,870 business contacts to be established and 2,676 foreign trade contracts to be signed.

- **Grants for SMEs - early phase of development**

Co-financing is available for projects involving the implementation of R&D results owned by the company or the implementation of R&D results acquired by the company, or the implementation of an invention (covered by a patent) or a utility model (covered by protective rights). Support was targeted at companies operating in the market for no longer than 24 months. Companies with a funding value of PLN 48,112,096.53 and a total value of PLN 124,876,825.56, were selected from the 29 submitted applications, and 6 agreements were signed with a funding value of PLN 7,407,491.62 and a total value of PLN 23,504,122.69. Under the 4 projects already completed, funds amounting to PLN 6,964,618.11 have been transferred to beneficiaries. To date, six companies have introduced 14 innovations and created five new full-time jobs.

- **Subsidies for SMEs**

Support under the grant for SMEs included the implementation of R & D results owned or acquired by the company, or the implementation of an invention (covered by a patent) or a utility model (covered by protection rights), as well as investments by SMEs producing equipment necessary for the production of energy from RES. The competition was open to projects by companies operating on the market for more than 24 months. In the course of 4 calls, 87 agreements were signed out of 210 applications with a co-financing value of PLN 453,358,716.46 and a total value of PLN 1,269,030,463.84 with a co-financing value of PLN 209,956,665.29 and a total value of PLN 601,187,916.46. As part of the implementation of 80 projects, PLN 182,108,132.96 was transferred to the beneficiaries. To date, 81 unique companies have introduced 195 innovations and created 95 new full-time jobs.

- **Consultancy vouchers**

Funding is provided for specialist advisory services projects that are not related to the normal operating costs of a business, such as routine tax advice, regular legal services or advertising. The aid led to an increase in the competitiveness and productivity of the company. In the call for proposals, 163 applications were submitted, with a funding of PLN 2,980,471.62 and a total value of PLN 4,026,238.31. As a

result, 80 contracts were signed with a total grant value of PLN 1,409,153.18 and a total value of PLN 1,962,671.50. In all 80 projects, eligible expenditure amounted to PLN 1,525,750.58. As part of the implemented projects, companies were supported with specialist advice.

- Eco-enterprises

This measure is intended for SMEs investing in energy efficiency improvements and the use of RES, through deep energy retrofitting of buildings, investments in renewable energy generation facilities, comprehensive projects involving energy retrofitting of buildings, and the development of energy-efficient and passive construction. Within the framework of one organised call, 359 applications were accepted with a funding of PLN 308,054,996.03 and a total value of PLN 557,791,337.08. Out of 105 signed contracts with a grant value of PLN 83, 518,438.66 and a total value of PLN 158,699,621.64, 75 projects have already been completed. The beneficiaries received funds amounting to PLN 65,395,708.80. So far, 98 unique businesses have received support and have made energy upgrades to 101 buildings. 75 RES electricity generation units and 51 RES heat generation units were built. Final energy consumption has already been reduced by 95,005.89 GJ/year. 60,383.07 GJ/year of heat energy and 7,408.23 MWh/year of electricity were saved. The estimated annual reduction in greenhouse gas emissions as of this writing is 12,331.79 tonnes of CO² equivalent.

- Entrepreneurship package

‘Małopolska Anti-Crisis Shield – Entrepreneurship Package’ was implemented through a grant project aimed at supporting Małopolska SMEs facing financial difficulties as a result of the COVID-19 epidemic and those whose financial situation deteriorated due to the epidemic. The main premise of the project was to provide entrepreneurs from the SME sector with non-refundable grants intended to meet their liquidity needs in order to maintain the declared number of full-time employees from Małopolska in the period of 3 months from the date of submission of the application for the compensation voucher and, in the case of the self-employed, to maintain their business activity in the period of 3 months from the date of disbursement of the funds. In implementing the grant project, the MCP conducted 2 calls for proposals: The first call for entrepreneurs employing employees with an allocation of PLN 247, 086,000 and the second call targeted at the self-employed with an allocation of PLN 33,291, 000. The total amount earmarked by the Management Board of the Małopolska Region for assistance to Małopolska entrepreneurs under the Entrepreneurship Package was PLN 280,377,000.00. Under both calls, 8,040 micro, small and medium-sized enterprises benefited. These projects targeted the retention of 30,911 people in employment (3,650 self-employed

and 27,261 SME employees). The total value of support provided to entrepreneurs amounted to PLN 278,199,000.00.

A total of 43 calls addressed to entrepreneurs were implemented under the measures supervised by the MCP in the MVROP 2014–2020, to which PLN 2,903,489,595.86 was allocated. Most funding has been directed towards research and innovation in businesses. In response to the announced competitions, entrepreneurs submitted 3,114 applications for a funding amount of PLN 4,451,203,678.65. 1,119 agreements were signed with a funding value of PLN 2,042,072,985.96 and a total value of PLN 3,209,338,534.82. The implementation of ideas was completed in 861 projects. MCP staff have already approved 4,096 payment claims. Beneficiaries received PLN 1,733,804,043.19, which represents more than 70.33% of the allocation launched in competitions and 84.90% of the value of co-financing in the agreements being implemented.

13,180 unique companies were supported, creating 345 full-time jobs and 217 full-time jobs for new researchers. Science-business cooperation was established by 295 units. To date, 1,116 innovations have been introduced, mainly product innovations. There have also been 30 patent applications. As a result of the projects, 144 beneficiaries made organisational and process changes. Supporting 4,316 companies in the internationalisation of their activities allowed 22,709 business contacts to be established and 2,898 foreign trade contracts to be signed.

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The innovation capacity of small and medium-sized enterprises in the space sector in Poland

Abstract: The Polish space sector is still developing, but it has huge potential for innovation. A breakthrough moment for the sector came in 2012, when Poland became a member state of the European Space Agency (ESA). Poland's accession to the ESA and the increased access of Polish entities to its financial instruments provided the general impetus for increased efforts to develop the space industry in Poland. The main aim of the study is to evaluate the significance of the use of financial instruments offered by the European Space Agency and European Union by small and medium-sized space enterprises in Poland for the innovative capacity of these enterprises. The study included the development of a model for assessing the innovative capacity of space industry SMEs and the verification of this model on the basis of an empirical study using the multiple case study method.

Keywords: space industry, space policy, SMEs, innovation capacity, financial instruments

Introduction

The space industry is currently identified as one of the drivers of innovation development, not only in Poland but also worldwide. Its significant role in this process stems from a number of external effects that it generates, contributing to the technological development of other sectors of the economy and to raising the standard of living and security of citizens. However, innovation processes occurring in this industry have a specific character. Their most important features include, among others, a high level of complexity and interdisciplinarity, technological advancement, the necessity of engaging significant financial resources and the long period of return on investment. Therefore, financial instruments offered by international organisations such as the European Union (EU) and the European Space Agency (ESA) play a special role in stimulating innovation processes in the space sector.

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Poland became a member state of the European Space Agency in 2012. Poland's accession to the ESA and the increased access of Polish entities to its financial instruments provided the general impetus for increased efforts to develop the space industry, especially small and medium-sized enterprises (SME) which constitute approximately 80% of all Polish companies in the space sector and approximately 50% of all entities involved in space activities in Poland. Polish SMEs in the space sector are actively pursuing financial instruments available under the European Space Policy. Since 2012, the number of Polish entities declaring interest in participation in ESA programmes has increased from 50 to over 350, of which almost 100 entities are SMEs. Within the framework of a programme dedicated exclusively to Polish entities – the Polish Industry Incentive Scheme (PLIIS) – the value of contracts concluded with the ESA between 1 January 2015 and 30 September 2019 amounted to EUR 28.9 million, which means a “return” of the Polish contribution to ESA of around 77%. The success rate of Polish entities is approximately 40%, which proves the high substantive quality of the submitted applications and the high development potential of the beneficiaries.

Innovation processes in the space industry and the ways in which financial instruments affect the actors in this industry constitute an important research problem from the perspective of both theory and practice. The main goal of this paper is to examine the significance of the use of financial instruments offered by the European Space Agency and the European Union and by small and medium-sized space enterprises in Poland for their innovation capacity. The growing importance of innovation capacity is the result of the assumption that companies compete through the ability, among others, to develop and commercialise new products, or reorganise operations, rather than with new products (Lawson B., Samson D. 2001); hence, the innovation capacity of the company can be considered an indicator of innovation success (Stawasz E. 2014: 97).

The following research methods were used in this paper:

- literature studies on innovation capacity, the space industry, financial instruments for the space industry from the EU and the ESA, and methods for measuring innovation capacity, in particular for SMEs;
- analysis of secondary research on the space industry, space SMEs and their activities within EU and ESA support programmes, the innovation activities of these enterprises, EU and ESA policies in the field of support for SMEs, as well as the innovation, industrial and space policy of Poland and the EU;
- an empirical study on the impact of EU and ESA financial instruments on the innovative capacity of space SMEs in Poland using a multiple case study method, as well as a questionnaire survey among managers and specialists of SMEs in the Polish space sector.

Due to the complexity of the issue of innovation capacity of space SMEs in Poland, this study cannot be free of limitations. Attention has mainly been focused on the concept of the innovative capacity of enterprises, which to a large extent refers to the internal processes taking place in these companies. To a lesser extent, it takes factors related to the environment of these entities into account. The proposed conceptual model is also not free of limitations. The identified areas will certainly not exhaust the complex issue of the possibility of actively forming the innovative capacity of SMEs. They constitute a set of what are, in the author's opinion, the most important factors that can affect the innovative activity of enterprises, and which the use of external sources of financing can significantly influence.

Methods for assessing the innovation capacity of enterprises

The concept of innovation capacity is derived from the resource-based theories of the firm, which assume that competitive advantage is gained by firms through the use of scarce and unlimited resources – human, material and capital – at their disposal (Wernerfelt B. 1995: 171–174), as well as from the theory of dynamic capabilities, which implies the ability to reconfigure internal and external competencies in response to rapid changes in the external and internal environment (Teece D. J., Pisano G., Shuen A. 1997: 515).

The source of a company's innovative development may be the resources it possesses, but its success or lack thereof depends directly on its ability to use them (Pierre Fernandez, 2018; Teece D. J., Pisano G., Shuen A. 1997: 515). The creator of the concept of 'dynamic capabilities', D. J. Teece, uses the term 'dynamic' to refer to the ability of an organisation to renew competencies to achieve compliance with the changing business environment. The term 'capability', in turn, emphasises the role of strategic management in adapting, integrating, and reconfiguring internal and external resources to achieve compliance with the demands of that environment (Teece D. J., Pisano G., Shuen A. 1997: 515). Thus, dynamic capability helps to maintain, improve, and also reconfigure the set of resources and skills in response to changes in a dynamically changing environment. Innovation capacity is a kind of bundle of resources, skills, and dynamic capabilities focused on innovation activities (Pierre A., Fernandez A.-S., 2018).

The complexity and diversity of innovation processes in the economy, the intangible, inherent and dynamic nature of innovation capacity, as well as the need to take into account a number of different factors in its assessment, resulting from the conditions of the industry and the national innovation system, mean that there is no single universal method for assessing an enterprise's innovative capacity. Despite many challenges related to the evaluation of innovation capacity, numerous attempts have been made in the literature to develop a set of measures reflecting this particular dimension of a company's development capability. Classifications and examples of innovation

capacity measures are discussed in detail in studies by L. Se (2020), M. Dziallas and K. Blind (2018), F. Gault (2018), and the OECD (2018), among others. The purpose of this review is therefore to present the most important methods for assessing the innovation capacity of firms with a particular focus on measures suitable for SMEs.

The most common approach to assessing innovation capability is the measurement of *inputs* that stimulate innovation (*innovative inputs*) and the measurement of innovation effects (*innovative outputs*) (Doroodian M., Nizam Ab Rahman M., Kamarulzaman Y., Muhamad N. 2014: 2). The indicators belonging to the first group include expenditures on research and development (R&D) activity, the number of employees employed in research and development departments and the involvement of risk capital, among others (Rutkowska-Gurak A. 2010: 1). Indicators in the second group most often include measures based on patent statistics, as well as the number of innovations implemented by a company. Both approaches have been integrated within the *Oslo* methodology, widespread in the European Union and the OECD, in which the focus is on measuring the innovative activity of enterprises rather than on innovation itself. Therefore, the focal point of the analysis is the so-called “innovation dynamo”, i.e. a complex system of factors shaping innovation at the enterprise level (Geodecki T. 2010: 32).

Currently, as noted by both theoreticians and practitioners who evaluate innovative capacity, the evolution of measures related to the innovativeness of enterprises is observed. E. Milberg and N. Vonortas distinguish four generations of innovation measures (Milberg E., Vonortas N. 2004: 1–4)

- the first generation, in which indicators reflected a linear model of innovation emergence, focused on input metrics such as R&D investment, education expenditure, capital expenditure, research personnel, number of university graduates employed, and technology intensity;
- the second generation, in which input measures are supplemented by indicators of the direct and indirect output of S&T activities (throughput and output indicators), e.g. the number of patents, scientific publications, the number of new products and processes, trade in advanced technologies, and changes in the quality of products supplied;
- the third generation, during which aggregate innovation indicators and indices (e.g. Global Innovation Index, European Innovation Scoreboard) were predominant, based on research and the integration of publicly available data, used mainly to assess the innovation capacity of national and regional innovation systems (Vértesy D. 2016: 5);
- the fourth generation, which is developing nowadays and includes in particular measures related to innovation processes in the areas of knowledge (e.g. technical and management knowledge, intangible assets), cooperation networks (e.g. the number of ties within the R&D network in which the

given enterprise participates) and conditions for the development of innovative activity (e.g. size of market demand, quality of public policy and infrastructure, social attitude and conditions for development of innovative activity).

Classical input and output measures of innovativeness are widely used to assess the innovative capacity of enterprises. The greatest challenge which lies therein is to capture the essence of innovative capacity. Researchers of the issue most often set it in the innovation processes of companies; therefore, the central element of contemporary models of evaluation of innovative capability of companies are measures connected with these processes (the fourth generation of measures).

It should be noted that some methods of assessing innovative capacity are of a universal nature, i.e. they apply to all categories and types of enterprises. One of them is proposed by R. Adams, J. Bessant and R. Phelps, who pay special attention to the process of innovation management in an enterprise, considering innovation capability a direct result of this process (Adams R., Bessant J., Phelps R. 2006: 38). To evaluate the innovation management process, they qualify seven areas of a company's activity, characterised by the following factors (Adams R., Bessant J., Phelps R. 2006: 38):

- resources – financial and material resources, human resources, tools;
- knowledge – knowledge generation, knowledge resources, information flow;
- innovation strategy – strategic orientation, strategic leadership;
- organisation and culture – culture, structure;
- *portfolio* management – risk/return levels, use of optimisation tools;
- project management – project effectiveness, tools, communication, collaboration;
- commercialisation – market research, market testing, marketing and sales.

The authors of this concept base the evaluation within the identified areas and factors on classical measures such as R&D expenditures, the number of employees involved in innovation processes, the availability and use of tools and techniques for supporting creativity (resources); the number and value of patents, the number of ties maintained with external organisations and sources, and the number of contacts with customers (knowledge); involvement in diversified financing channels, and a clear expression of whether the organisation has an innovation strategy (innovation strategy). However, they stress that any assessment of a company's innovation capability is a complex process, and the choice of metrics depends on the individual needs of the user in terms of, among other things, the comprehensiveness of the assessment, the data available and the amount of effort the user can devote to the task.

V. Boly, L. Morel, N. G. Assielou, and M. Camargo presented a model for assessing innovation capacity in relation to small and medium-sized enterprises,

proposing 196 criteria for assessing innovative capacity within 15 areas of so-called “good practice”. These areas include, among others (Boly V., Morel L., Assielou N. G., Camargo M. 2014: 611):

- design activities,
- project management,
- an integrated strategy,
- project portfolio,
- knowledge management,
- skills management,
- collective learning processes,
- research and development activities,
- customer relations.

Focusing also on management processes in the company, the authors propose a model for the evaluation of innovation capacity based on innovation practices or “observable phenomena”, which include identifiable processes, documentation and records, tools and implemented systems. For example, when evaluating design activity, they consider the existence of a design department within the structure, the use of design methodologies, or the use of professional design software (CAD), among other things; when examining integrated strategy, they consider the formalised planning processes (roadmap) and reports prepared after strategic meetings, among other things; and when analysing R&D activity, they consider the appointment of an R&D manager within the company, a separate R&D budget, and research infrastructure, among other things. This model can be a useful tool for assessing the innovative capacity of SMEs due to its open, progressive nature. It can be modified depending on the character and industry in which the enterprise operates, adding new measures in the form of observable processes and phenomena.

Another method of assessing innovative capacity is proposed by H. Forsman, who directly refers to the concept of dynamic capacity, identifying three variables of innovative capacity of small and medium-sized enterprises, namely (Forsman H. 2011: 743):

- the level of R&D expenditure, as a variable representing a firm’s internal resources;
- the level of innovation skills, reflecting the dynamic innovation capacity of the enterprise;
- contributing to the development of innovation through *networking*, exemplifying the company’s external relationships.

In this model, individual variables are characterised by specific sets of measures. Thus, in relation to skills, the following are assessed: entrepreneurial skills, knowledge utilisation, risk management, *networking*, business development, change management and market and customer knowledge. On the other hand, under

the variable external contribution to innovation development through *networking*, in particular, three elements which determine the value of *networking* are assessed – the impact of networking on knowledge creation, resource acquisition and enterprise development activities.

Models for assessing the innovative capacity of enterprises have also been developed on Polish soil. One of these was proposed by L. Koziół, who, on the basis of the results of studies of companies from the Malopolska Region, identified the following factors of innovative capability: managerial and employee competences, IT infrastructure used, organisational structures and processes, cooperation, so-called knowledge alliances and knowledge (Koziół L., Wojtowicz A., Pyrek R. 2014: 116). On the other hand, a method for assessing the eco-innovative capabilities of enterprises was proposed by M. Pichlak, who very clearly distinguished the dynamic capabilities component in her model. This is understood as the ability of an enterprise to identify market opportunities, the ability to use these opportunities for its own purposes and the ability to reconfigure resources and competencies in response to changes in the environment. Dynamic capabilities were separated from eco-innovative capabilities, defined in this model as the ability to generate streamlining and radical innovations. In her model, the author also integrates components such as organisational effectiveness defined by financial and non-financial indicators, leadership style, as well as the turbulence inherent in the environment (Pichlak M. 2020: 141).

In the development of the innovation capability model, the conclusions of the study carried out by M. Dziallas and K. Blind. These authors have assigned particular measures to the areas of enterprise functioning involved in consecutive stages of the innovation process (Dziallas M., Blind K. 2018: 1). The differentiation of measures in terms of the level of advancement of the innovation process is an innovative approach, but also a very desirable one, because in the case of many burgeoning high-tech industries, including the space sector in Poland, many ideas do not go beyond the research and development sphere. However, thanks to their innovative activity, e.g. within industry cooperation networks and acquiring contracts from the European Space Agency, enterprises increase their capacity for innovation. Indicators concerning the first phases of the innovation process are important for organisational processes in the enterprise, in particular for the decision-making and strategic process, as well as for the allocation of resources and decisions concerning further activity.

The assessment of innovative capacity is also of interest to institutions offering support to enterprises. For example, a report from the Interregional Cooperation Operational Programme 2007–2013 assessed the relevance of projects funded under this programme to the innovative capacity of SMEs. Innovative capacity was evaluated according to criteria such as access to finance, the ability to improve

skills in innovation process management, marketing and promotion of innovative activities and innovative products and services, R&D capacity, *networking* and co-operation with external partners.

Models of the evaluation of innovative capacity can play a significant role in the assessment of the effectiveness of spending public funds, and therefore can have significant implications for the creation of innovation and industrial policy in terms of the development of support instruments, or the formation of a system of incentives for innovative activity in specific industries. Methods for the evaluation of innovative capability are also necessary to manage and control the process of selection of innovative ideas and concepts that appear in the enterprise and, in particular, to effectively allocate the resources of the enterprise and to assess their efficiency at each stage of the innovation process (Dziallas M., Blind K. 2018: 1). Indicators of the innovative activity of the enterprise can also be used for benchmarking in the field of innovativeness, determining the development gap in fields such as technology, knowledge, specialised personnel, organisational structures, as well as when acquiring external financial resources for innovative activity (Białoń L. 2010: 184).

Model of innovation capacity of space enterprises in Poland

In order to construct a model for assessing the innovation capacity of space enterprises in Poland, a conceptual model has been developed which takes into account the results of the literature research. In accordance with the theory of innovation systems, this study also takes the conditions arising from the national innovation system and the industry innovation system into account. However, in order to achieve the research objective of, in particular, presenting the nature of the impact of EU and ESA financial instruments on the innovative capacity of space enterprises in Poland, it is necessary to isolate the enterprise as a specific subsystem. Such an approach is useful for the purpose of creating a theory of relations between different elements of the system involved in the process of technological and organisational change. Moreover, according to the approach of A. Pierre and A.-S. Fernandez, the study focused on factors specific to the group of small and medium-sized enterprises, and – where possible – on high-tech enterprises. At the same time, due to the early stage of development of the space industry in Poland and the limited possibility of commercialisation of products through a complex and lengthy process of validation and testing of innovations in real conditions (e.g. in space), the model took the area of internal processes in the company into account to a greater extent than the area related to the results of innovative activities.

The adopted methodology for the development of the conceptual model of innovative capacity of space industry SMEs in Poland is sequential in nature and includes, in particular, the following stages:

1. operationalisation of the concept of innovative capacity of space industry enterprises on the basis of the study of the literature on the subject and the author's own experience of working in a space industry enterprise;
2. identification of the most important areas and factors of innovation capacity of small and medium-sized space enterprises on the basis of the literature survey, using the author's practical knowledge of the space industry;
3. developing a research model based on the data obtained from the literature survey to guide the study and develop a survey questionnaire;
4. conducting a multiple case study using the constraints established by the model on the example of selected companies;
5. conducting an inference based on the multiple case study of the companies conducted specifically using the questionnaire and the answers to the research questions posed.

Based on the review of the literature in the field of economics and finance, as well as management and quality sciences, the basic aggregated areas and factors which have the greatest potential in terms of shaping the innovation capacity of space enterprises, as well as their corresponding measures, were identified. In addition, those with the greatest potential to be influenced by financial instruments and the way they are used by the enterprise are included. The model for assessing the innovation capacity of space enterprises, according to the adopted theoretical assumptions, takes into account:

- enterprise resources (whether and how EU and/or ESA financial instruments can affect particular groups of resources which are key to the innovative capacity of the enterprise):
 - financial resources (means of evaluation: value of contracts/projects, R&D expenditures, training expenditures, diversity of financing sources)
 - human resources (means of evaluation: the number of employees with higher technical education, the involvement of the management in the innovation process),
 - technical resources (means of evaluation: technical infrastructure, patents);
- innovation process (whether and how financial instruments can influence the innovation process, the central element of innovative activity of the company):
 - sources of innovation (means of evaluation: diversity of sources of knowledge and innovation);
 - number of ties (means of evaluation: ties within the industry);
 - organisation of the innovation process (means of evaluation: formalisation of organisational processes in the enterprise);

- innovation strategy of the company (means of evaluation: having an innovation strategy, mission, vision, goals, overall evaluation of the project portfolio);
- products (means of evaluation: number of implemented products in the space industry, number of implemented products outside the space industry, share in the value chain of the space economy);
- dynamic capabilities (whether and how financial instruments can affect the dynamic capabilities of companies, determining their ability to adapt to the requirements of the environment):
 - ability to reconfigure the resources and competencies of enterprises in response to the requirements of the changing environment (means of evaluation: determining the readiness and how to analyse changes in the environment, determining the readiness for change in the enterprise).

Another important element of the model is the context of the innovation environment, including in particular the conditions arising from the EU innovation system, the country and the industry. All the abovementioned areas and factors are closely interrelated and may play an important role in shaping the innovative capacity of small and medium-sized space enterprises in Poland.

Results of a study of the innovative capacity of enterprises based on the examples of three space SME case studies

Sampling was carried out using the results of the space industry enterprise survey. The survey of companies operating in the space industry was conducted in January 2021. It covered companies with the status of small or medium-sized enterprises, which were verified using the following criteria:

- belonging to the group of SME companies (verification on the basis of the company declaration);
- having a registered office or a subsidiary in Poland (verification on the basis of KRS entry);
- active in the space sector (membership of the Polish Space Industry Association (SPACE PL) and registration on the ESA competition portal, EMITS).

Thanks to such a set of criteria, the research sample included only enterprises that are actually actively involved in the creation and development of space technologies in Poland. An enterprise strictly providing consulting services was eliminated from the research group. Thus, 39 small and medium-sized enterprises developing space technologies, mainly in the fields of the use of satellite data and databases, ground and on-board space software, as well as electronics, mechanics

and automation, took part in the survey. The survey was carried out independently. On 10 January 2021, a survey questionnaire was sent to space SMEs in Poland in the form of an email, covering 39 questions, including:

- four general questions (number of employees, percentage of technical graduates employed, ownership structure, period of operation of the company);
- eight questions on the EU and/or ESA financial instruments used (number of instruments, total value of instruments and types of support schemes);
- 27 questions in the areas of innovation capability identified in the literature survey, i.e. the resource area, the innovation process area and the dynamic capability area.

By 20 January 2021, 13 responses had been received, including eight survey returns and five refusals. The overall return rate was 21%. In the refusals, the respondents stated the following reasons: the questionnaire raises strategic issues of the company's activity (one company from the Wielkopolskie voivodeship); the company is currently in the process of being liquidated (one enterprise from the Mazowieckie Voivodeship); the enterprise's employees are not able to fill in the questionnaire because of the number of projects implemented (two enterprises, one each from the Małopolskie and Mazowieckie Voivodeships); the enterprise does not use EU and/or ESA financial instruments (one enterprise from the Dolnośląskie Voivodeship). Due to the low rate of return, the survey questionnaire was sent again to 26 enterprises on 21 January 2021. By 26 January 2021, three returns had been received. The total return rate was therefore 29%. The survey questions were answered by company executives, e.g. CEOs, CIOs, CFOs and technology development directors.

Of the companies from which questionnaires were returned, cases were selected that were most relevant to the aims of the study (Stewart J. 2012: 73). They are exploratory in nature, i.e. through them the author will attempt to answer the main research question of whether EU and/or ESA financial instruments affect the innovative capacity of space SMEs in Poland, and if so, how. The selection of these cases was based on a preliminary analysis of the general conditions of the activities of the enterprises (genesis of establishment, size, location, number of EU and/or ESA projects implemented, period of activity, media visibility). Three enterprises qualified for the study: one based in Łomianki near Warsaw (Mazowieckie Province), one based in Gliwice (Silesian Province), and a third located in Gdynia (Pomeranian Province).

All the companies surveyed actively use the financial instruments of the European Space Agency. The ESA space project portfolio of two of them includes five R&D works, while one of the SMEs indicated that the number of contracts it has with the ESA is six. However, the total value of contracts at each of the companies surveyed does not exceed EUR 1.5 million. Two of the companies surveyed

have implemented ESA space projects only under the PLIIS programme intended exclusively for Polish entities. Under this programme, the most recent tenders were announced and awarded by ESA in 2020. One of the companies has also used financial instruments under the auspices of European Space Agency's optional programmes aimed at entities from all ESA member states, in particular the Future EO – Earth Observation programme, which includes the application of artificial intelligence to the use of satellite data.

It should be emphasised that none of the surveyed companies used financial instruments offered by the European Union. On the other hand, the portfolio of projects implemented by the surveyed entities includes space projects of a research and development nature co-financed by the European Union under the auspices of national operational programmes, e.g. the Intelligent Development Operational Programme or the Regional Operational Programme for the Mazowieckie Voivodeship 2014–2020.

Results of the study

The study found that the use of ESA financial instruments affects all areas of the innovation capacity of firms as identified by the author of this paper. However, it has a varying degree of impact on the factors classified within these areas and characterised in the model. Unfortunately, due to the lack of detailed data and information on the remaining SMEs in the space sector in Poland, the impact of financial instruments offered by the EU was not demonstrated. However, the very fact that none of the enterprises which returned completed questionnaires are implementing projects under the auspices of EU space programmes may constitute an important conclusion of the study.

The author of this paper has identified several reasons for this. Firstly, most of the competitions under LEIT – Space “Horizon 2020” were addressed to entities implementing research at a low level of technological readiness (58% are implemented as research and innovation actions) (Horizon Dashboard 2021), mainly to scientific and research institutions. Therefore, the very design of the programme may have discouraged SME entities from applying for funding. Secondly, enterprises taking part in EU competitions were evaluated in terms of criteria such as scientific excellence, the impact of the results of the project on the areas defined in the competition programme, as well as the manner of project implementation and the composition of the consortium (Horizon 2020 LEIT-Space 2016–2017 2021). For Polish space sector SMEs, the priority is, above all, to ensure their financial liquidity and remain active on the market. At the same time, EU financial instruments represent a much higher level of formalisation than ESA contracts. They require the preparation and submission of an extensive project application, the execution of the project launch procedure (signing of the consortium agreement,

determination of staff salaries), and then the settlement of the funding according to strictly defined requirements. ESA contracts are characterised by a lower level of formalisation; furthermore, the funds constitute a payment for work done and are not subject to the procedure of settlement as grants are.

Access to financial resources related to the use of ESA financial instruments by Polish SMEs in the space sector plays a key role in increasing their innovation capacity. This confirms the views of many authors in Poland and abroad, identifying factors in the innovative capacity of enterprises (e.g. M. Pichlak (2020), K. Poznańska (2017), W. Pełka (2007), E. Mansfield (1988), R. Simonetti, D. Archibugi and R. Evangelista (1995), M. J. Madeira Silva et al. (2014)). The highly specialised nature of the space industry, which is inextricably linked with R&D, requires large financial outlays to carry out the work, i.e. to maintain adequate scientific and technical staff, to equip laboratories and workshops, to purchase components to develop concepts and build prototypes, to conduct tests and to validate the work, often over a long period of time. Companies that have not obtained external support are often unable to continue operating in this high-investment industry; hence, the observed phenomena of change of industries or liquidation of their activities.

The area of financing plays a multi-faceted role in the innovative activities of space SMEs. Firstly, as already mentioned, it constitutes an important resource, allowing companies to maintain financial liquidity, as well as to develop their own technical infrastructure (in the form of laboratories, specialised apparatus and equipment), which is necessary for the implementation of European Space Agency contracts. Secondly, it can actively influence the area of new knowledge in the field of disposition of financial resources, knowledge of finances, controlling and disbursement of financial resources, as these areas also constitute an important factor of the innovative capacity of the company (Illmeyer M., Grosch D., Kittler M., Priess P. 2017: 69). Thirdly, the use of financial instruments, in particular within the framework of government programmes and other institutions financing research and development, allows companies to increase the stock of industrial and technical knowledge, which can positively affect the innovative capacity (Audretsch D. B., Link A. N. 2019: 1112). The quality of certain types of resources, in particular knowledge and human resources, depends to a large extent on the financial resources of the enterprise (Dymitrowski A. 2014).

The study also confirmed the assumption that the use of ESA financial instruments acts as a kind of catalyst for obtaining external funding from other sources. Thanks to the implementation of ESA contracts, companies initiate space ventures and develop them initially to TRL 4. This level is sufficient to obtain additional funding. In addition, a positive evaluation of the conceptual solution by the European Space Agency is confirmation of the company's knowledge and competence. However, in this context, attention should be paid to the types of

programmes under which enterprises participate in ESA contracts. In fact, most entities have used instruments under the PLIIS programme, addressed exclusively to Polish entities, where the international competition factor has been eliminated. The use of ESA financial instruments therefore usually results in projects that are national in scope. The use of ESA financial instruments does not translate into raising external private funding. This is because such financing is associated with high barriers both on the part of the investor (long period of investment return, division of rights from profits) and the enterprise (high level of innovativeness of the venture, strictly defined business model, high entrepreneurial competence). However, the participation of Polish SMEs in acceleration programmes for the space sector may indicate growing competences in applying for funds from private external entities.

In most concepts of innovative capacity of SMEs, in particular high technology ones, knowledge and competences of employees are emphasised as key determinants of generating new ideas and creating innovative projects. For the innovative capacity of this specific group of enterprises, specialised staff with a technical education profile are also important (Romijn H., Albaladego M. 2002). Most of them are increasing the involvement of employees, especially in research and development works. Young entities, which are developing most dynamically and whose structure is just beginning to take shape, may significantly increase the level of employment thanks to the use of ESA instruments.

Moreover, among the most important factors of the innovative capacity of enterprises, the strong role of leadership and the involvement of management in the innovation process is mentioned (as indicated by: M. Doroodian et al. (2014); M. Saunila and J. Ukko (2012); A. Pierre and A.-S. Fernandez (2018)). The competence, skills and attitude of management, which gives direction to the innovative activity, activates the potential hidden in the tangible and intangible resources of the companies and co-creates the organisational culture of the entity conducive to innovative activity. The use of ESA financial instruments influences this factor, albeit mainly in organisations at the initial stage of development, as in the case of human resources. This may indicate a high level of involvement of the managerial staff in the innovation process in entities operating on the market for more than 10 years, or a low readiness for changes in the management area. Meanwhile, the increased involvement of management in the innovation process could be a signal that space activities are an important aspect of the company's present functioning, as well as a direction for future development.

Weak impact in the area of resources has been identified particularly in relation to employee training and obtained and/or filed patents. The researched entities did not increase expenditures on training, which may lead to the conclusion that the innovative character of research and development works is oriented towards

obtaining knowledge from other sources and in a different, more individualised way. Therefore, this may be an important feature of the innovation system of the space industry and a conclusion concerning the pattern of the learning process occurring in this industry in Poland – the space industry is dominated by the method of acquiring knowledge based on experience and learning through interaction (Doing, Using and Interacting, or DUI), and to a lesser extent based on the production and use of codified scientific and technical knowledge (Science, Technology and Innovation, or STI). In the industry innovation system, inter-organisational learning plays a special role, which is reflected in the establishment of alliances, strategic alliances and other forms of inter-organisational cooperation by companies (Dolińska M. 2015: 294).

The research shows that, in the space industry in Poland, patents are not an important tool for intellectual property protection. This property, being a derivative of knowledge, R&D processes, and the coordination of activities, is a strategic resource of enterprises, the disclosure of which may mean a potential loss of technological advantage and high profits in the future. Therefore, the most common form of protection of intellectual property of space industry SMEs is keeping it secret. This conclusion can also be applied to the area of the innovation process – in order to assess the results of innovation activities of space companies in Poland, a different measure than the number of patents should be used, related, for example, to the place of these entities in the space economy value chain in Europe or worldwide.

Sources of innovation among SMEs in the space sector in Poland are relatively diverse. According to the companies surveyed, the most important are R&D works carried out within SMEs. This confirms the theory that enterprises of a higher innovation level base their activity mainly on their own research and development works. However, it should be pointed out that these enterprises also use external sources of innovation to a large extent, which they do not declare directly. Examples of these sources of innovation are external contacts and relations with the European Space Agency and with system integrators – customers for whom solutions are developed.

The importance of the use of ESA financial instruments by the enterprises surveyed for the development of ties and cooperation networks should be emphasised. It may be stated that regulatory bonds, i.e. rules resulting from legal solutions, as well as customs or good practices promoted and disseminated by industry organisations, are of key importance in the developing space industry in Poland. ZPSK, to which all surveyed entities belong, was identified as the most important industry organisation. Its importance is underlined by the fact that, according to the author of this paper, the Union's membership constitutes one of the criteria of delimitation of the space industry in Poland.

In the context of the space sector in Poland, the importance of participation in the European and global space economy value chain should also be noted as a key element of the learning process and transfer of knowledge and innovation (Zeng D. Z. 2017: 298). In order to increase innovation capacity, it is important to establish inter-organisational cooperation, but also to strive to include as many Polish entities as possible as suppliers and sub-suppliers to tier 1 enterprises. The formation of an effective learning pattern in the space industry in Poland and the development of absorption capacity, which means the ability of enterprises to search for and identify the value of new, external information, assimilate it and apply it for their own purposes (Bessant J. R., Tidd J. 2011), will be an important catalyst for the development of their dynamic capabilities.

Most models for assessing the innovative capacity of SMEs emphasise the strategic importance of the structured innovation process (e.g. R. Adams, J. Bessant and R. Phelps (2006); V. Boly, L. Morel, N. G. Assielou, M. Camargo (2014); M. Dziallas, K. Blind (2018)), so less emphasis is placed on the outcome of this activity. The lack of an innovation strategy, formalised processes and a defined organisational structure in enterprises can be a significant barrier to development, especially given the limited resources of small and medium-sized enterprises. The use of ESA financial instruments by Polish SMEs in the space sector has an impact on increasing the level of formalisation of processes in enterprises, primarily through the introduction of regulations, new methods of documenting R&D works, notification of new projects, the introduction of work quality policy and innovation strategy. Thus, by imposing standards, enterprises have limited the freedom of action, which may, however, result in a higher level of organisational and technical culture.

According to the author, the formalisation of processes in space sector SMEs in Poland has facilitated the declaration of the level of readiness for changes concerning resources, goals and the way enterprises operate, among other things. Readiness for change is one of the most important factors in the area of dynamic capabilities of enterprises. It reflects the potential actors have to generate change, and it also indicates the positive orientation of actors towards change. Organisations that perceive change as a positive phenomenon, bringing with it opportunities for development, are more effective in implementing changes than organisations that perceive change as a negative and risky phenomenon (Werkman R. A. 2009: 674). In addition, the increase in financial, human and technical resources allowed the entities which were the subjects of this study to be more flexible in shaping organisational and innovation processes. Readiness for change determines the potential of enterprises to introduce changes, but it does not prove the ability to implement them. Therefore, it can be assumed that the condition for maximising results in this area of innovation capability is for enterprises to simultaneously build the ability to implement changes. However, the study shows that SMEs in the space sector in

Poland do implement changes. These mainly concern resources, both human and technical (employment of employees, extension of technical infrastructure), as well as processes in the field of marketing and promotion (launching a website, new ways of promoting products).

Readiness for change can also be related to the intensification of the process of analysing changes taking place in the business environment. Thanks to the use of ESA instruments, it has a more organised and systematic character. However, in SMEs this process is mainly carried out by the management, which may be an additional confirmation of the key role of the management in creating conditions for the innovative development of the enterprise and shaping its innovative capacity. Additionally, enterprises do not use dedicated tools for analysis. The analysis of the environment is therefore performed systematically, but still in a non-professionalised way. Meanwhile, the analysis of changes taking place in the environment surrounding SMEs from the space sector in Poland is important because of the high level of complexity of the environment, the dependence of the functioning of the space sector on decisions of national and international bodies, the commonly occurring spillover effects of space activities, and the necessity of taking into account the needs of individual customers in their activities to an increasing extent.

Conclusions

The research proved that the most important factor in the emergence of the space industry in Poland was the accession of that nation to the European Space Agency in 2012. Poland subsequently received access to financial instruments in the form of tenders organised under ESA's mandatory and optional programmes, including the PLIIS programme, directed exclusively to Polish entities, whose task was to prepare them to compete for ESA contracts in international competition. On the basis of empirical studies, it was shown that small and medium enterprises are the core of the Polish space industry, with the greatest potential for development.

However, the use of the potential of SMEs in order to ensure a permanent effect of the development of this specific group of enterprises for the economy in the form of new jobs or an increase in innovativeness and competitiveness depends on a continuous and systematic development of organisational systems of these enterprises, the expansion of the scale of their activities and the use of opportunities on the market. Therefore, it can be concluded that a sustainable effect in the form of continuous accumulation of knowledge in the industry and a constant presence at higher and higher levels of the global value chain of the space economy depends precisely on the innovation capacity of individual enterprises.

The research shows that the European Union grant procedures, which are the main mechanism for the distribution of funds in the EU space industry support system, are rooted in priorities that are the essence of the entire economic and

social system of the European Union. These priorities primarily include free competition, cooperation, the pursuit of excellence, especially scientific excellence, and support for groups of entities encountering the greatest barriers to development (e.g. SMEs). In turn, the procedures of tenders and contracts, under which ESA financial instruments are distributed, reflect the most important principles of the Agency's industrial policy, i.e. the principle of preference of entities from member states or participating in ESA programmes (domestic preference) and the principle of geographical return. ESA industrial policy also implements tools for the management of ESA space technologies, aimed primarily at increasing the technological capabilities of space companies. It should be emphasised that in terms of both EU and ESA support systems for the space industry, an important place is occupied by small and medium-sized enterprises, to which a number of specially dedicated financial instruments are addressed. The EU instruments go mainly to scientific and research entities and public institutions, enterprises with an extensive structure (large companies) and already with an extensive network of international contacts. ESA instruments, on the other hand, are mainly used by companies, especially SMEs, to improve their technological competence and to develop products that can secure their place in the European or global space economy value chain.

As a result of the study, it was also confirmed that the use of ESA financial instruments affects all areas of the innovative capacity of enterprises, identified by the author of this paper, in particular the areas of resources (financial, human, technical), innovation processes (innovation sources, number of ties, organisation of the innovation process, innovation strategy, products) and dynamic capabilities (the method of analysing changes in the environment, readiness for changes in the company). However, it affects the factors classified within these areas to varying degrees.

The study showed that the use of ESA financial instruments has the greatest impact on the financial resources of SMEs in the space sector in Poland, the increase in which also determines the increase in expenditure on research and development in these companies. As a result of the technologically advanced nature of the SME space industry, enterprises mainly create and expand the existing technical infrastructure in connection with the implementation of ESA contracts. Depending on the stage of development and the number of projects implemented at the same time, these companies make changes in the area of employment. However, one of the priorities is the development of engineering staff, which is a strategic resource of small and medium-sized space enterprises in Poland.

The study also confirmed that the use of ESA financial instruments acts as a kind of catalyst for obtaining external financing from other sources. However, it should be noted that in most cases these are external national sources in the form of public instruments. In light of the empirical research carried out, it has also been shown that the use of ESA financial instruments influences the involvement

of managers in the innovation process. However, the scale of changes in this area depends, as it does in the case of employment, on the time when enterprises operate on the market. For entities at the initial stage of development, the scale of changes may be much greater.

It should be stressed that all the aforementioned areas and factors of innovative capacity of space industry SMEs in Poland are closely interconnected. ESA financial instruments influencing one of the areas of innovative capability also generate effects within another area. The study demonstrated a significant impact of ESA financial instruments on the innovative capacity of space SMEs in Poland. The broad impact of ESA financial instruments, going far beyond the impact in the financial area, was also confirmed. Additionally, the areas and factors of innovative capacity of space industry SMEs in Poland identified and characterised in the model were positively verified. However, according to the author, the model of evaluating innovation capacity requires modifications in light of empirical research, e.g. in the scope of taking into account to a greater extent the effects of innovative activity of SMEs from the space sector in Poland, which will become more significant along with the development of this sector, or extending the scope of assessing dynamic capabilities so as to obtain a picture of not only the potential changes, but also the actual changes occurring in companies.

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Business environment institutions in Lower Silesia – how the COVID-19 pandemic defined support for female entrepreneurs

Motivation: The contribution made by women to developing the economy remains a highly topical issue. The considerations regarding the support they are able to obtain from the dedicated entities – business environment institutions (BEIs) – are also justified. An essential and innovative contribution to addressing the problem seems to be focusing the research on cities with poviats located in the Lower Silesian Voivodeship: Jelenia Góra, Legnica, Wałbrzych and Wrocław, as well as connecting it with the COVID-19 pandemic, which began in Poland in 2020. This allows for the formulation of the research problem presented in the following questions: What forms of support did BEIs make available to female entrepreneurs in the years 2020–2021? Did female entrepreneurs constitute a special target group for BEIs covered by the study? Were the aid programmes proposed by BEIs appropriate regarding the subject matter and scope of the offer in terms of the ongoing COVID-19 pandemic?

Aim: The analysis of the forms of support offered by BEIs carried out by means of a critical assessment of website content provided by the selected business support institutions in the cities covered by the research allowed for the formulation of the following research hypotheses: 1. BEIs provided numerous offers of support for entrepreneurs at their disposal regardless of gender – no forms of assistance dedicated exclusively to female entrepreneurs were developed; 2. the COVID-19 pandemic resulted in monothematic offers of support for entrepreneurs, i.e. only in the scope of temporarily counteracting the effects of the pandemic rather than in relation to supporting the long-term pro-development activities of the entrepreneurs-beneficiaries.

Results: In the years 2020–2021, the BEIs covered by the presented research offered dedicated support to all entrepreneurs, regardless of gender. However, along with the

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development and continuity of the pandemic, the support offer was diversified, including projects related to counteracting the effects of the coronavirus crisis enhanced by the set of pro-development activities expanding beyond the subject of the COVID-19 epidemic.

Keywords: women entrepreneurship, business environment institutions, Lower Silesia, COVID-19

Introduction

In terms of the recent history of the world, the year 2020 has been recorded as the beginning of a crisis of tragic proportions: economic, epidemic, social, and entrepreneurial. “Coronavirus”² was chosen as the 2020 Word of the Year in Poland, which is not surprising in light of the COVID-19 pandemic. Although at the end of 2019 hardly anyone could have predicted such a turn of events, and in fact the modern world at that point in time was focused on unlimited development, consumption, and the material dimension of existence without making allowances for the possibility of such a slowdown or shuddering halt to economic activity, this nonetheless did occur. A significant symbol of this is the word “lockdown”, which has been used up to now, and has been inflected by all cases. However, while for some this means the end of a certain stage, e.g. in business or production activity, for others it is an opportunity to “get into the game”, to develop a new idea for a company, to introduce innovations, and to take action. This type of behaviour can be called entrepreneurial because it meets the criteria of resourcefulness, looking for and taking advantage of emerging opportunities, taking risks, and being active and profit-oriented. In the literature, the issue of entrepreneurship is considered multidimensionally, multifacetedly, and the analyses are undertaken by researchers from various fields of science, including economics, sociology, and psychology, among others. All this means that the studies on this issue are disproportionately large in relation to the equally crucial aspect of female entrepreneurship, which is extremely important to modern society. The emphasis on the role of women in the economy, especially in Poland, is historically justified, if only in view of the dynamic development of female entrepreneurship after 1989, when following the socioeconomic changes, feminised workplaces began to be closed, as a result of which a huge number of women lost their jobs. At such a difficult time, women began to start their own business activities, although entrepreneurial activities are often considered a male domain. The Polish Agency for Enterprise Development reports that during the entire transformation period, there were relatively more

2 <https://www.uw.edu.pl/wyniki-plebiscytu-slowo-roku-2020/> – accessed 10.03.2022.

self-employed women than working men [PARP, 2011: 15]. A female business owner shows entrepreneurial traits that allow her to effectively overcome social barriers and actively participate in economic processes. She is ambitious, determined, and does not take decisions hastily; she is communicative, prudent, able to initiate dialogue and is less prone to sharpening conflicts. Unfortunately, women are often prescribed the role of caregivers, mothers, custodians and guardians of domestic bliss, incapable of making risky decisions, fearful, who are to devote themselves to their loved ones above all, and use any entrepreneurial skills in managing daily errands. Unfortunately, this type of “stigmatisation” is mostly culturally conditioned; it results from deeply entrenched stereotypes, religious beliefs and social roles assigned to men and women, whose attempts to change or modify are often met with a lack of understanding or acceptance of the environment. A number of barriers, inequalities or difficulties are also noticeable in relation to women, e.g. in terms of returning to the labour market after maternity leave and childcare leave, in the scope of exercising the rights resulting from caring for a child under four (e.g. forced consent to working night shift hours). The research interests of the author of this study have for several years been focused on the broadly understood issue of entrepreneurship, including with particular emphasis on the entrepreneurial behaviour of women in Lower Silesia. The problems indicated are highly topical and require further exploration in order for the cognitive gap in this area to be continuously filled and updated. Certainly, the time of the COVID-19 pandemic has not been easy for any group of participants in economic or social life. However, it provides unique research material, namely fields for exploring issues related to, for example, support that entrepreneurs obtained during this difficult period from institutions whose activities are dedicated to providing pro-development tasks, implementing innovative production, management and technological solutions, allocating benefits, and financing or co-financing the business activities of entrepreneurs. In the literature, they are referred to as business environment institutions (BEIs) or the institutional business environment. Embedding the issue of female entrepreneurship in this context fulfilled the abovementioned research interests of the author of the study.

The issue and subject of research included in the presented study result from the consistent completion of the author’s interests. The article is focused on reviewing offers of support available for female entrepreneurs in selected cities of the Lower Silesian Voivodeship, where these locations were selected based on the key factor of being cities with powiat rights: Jelenia Góra, Legnica, Wałbrzych and Wrocław. Women entrepreneurs are defined as those who either started or were already running a business in the years 2020–2021. The analysis is based on the reports and databases provided by the Statistical Office in Wrocław, whereas the information available on the websites of business environment institutions over the abovementioned period constituted crucial research material.

The detailed identification of the subject and scope of the research allowed for the formulation of the research problem embedded in the following questions: What forms of support did BEIs make available to female entrepreneurs in the years 2020–2021? Did female entrepreneurs constitute a special target group for BEIs covered by the study? Were the aid programmes proposed by BEIs appropriate regarding the subject matter and scope of the offer in terms of the ongoing COVID-19 pandemic?

The implementation of the research problem was based on the following research hypotheses covering the years 2020–2021:

1. In the analysed period, the BEIs analysed in the research offered support to all entrepreneurs regardless of gender – no forms of assistance dedicated exclusively to female entrepreneurs were developed,
2. the COVID-19 pandemic resulted in monothematic offers of support for entrepreneurs, limiting them to temporary, immediate proposals, resulting from the “need of the moment” in order to counteract the effects of the epidemic situation, thus depriving them of long-term forms of support dedicated to the pro-development activities of the entrepreneurs-beneficiaries.

The research findings and the conclusions formulated constitute a significant contribution to the subject matter of support offered by the institutional business environment to women entrepreneurs in Poland, especially in the context of locating the problem in the Lower Silesian Voivodeship, set against the background of the COVID-19 pandemic. The source literature database is enriched with a structured study based on the literature review, the available statistical data referring to the analysed area, and a reliable, critical analysis of the information provided by the business environment institutions, which, in accordance with the assigned function, presented and offered their services in turbulent times to support the potential beneficiaries in their business activities. The article follows the formula of a “direct addressee” because it is based on the analysis of the existing data available on BEI websites, which in times of limited direct contacts, quarantine and social distancing, were the main source of knowledge pertaining to the available forms of aid for all entrepreneurs. The presented study has also become the basis for the author to undertake and carry out qualitative research among women entrepreneurs from cities with powiat rights in the Lower Silesian Voivodeship, remaining within the research focus.

Research methods

For the purposes of the research goal, the following were performed:

1. A source literature review addressing:
 - entrepreneurship – in terms of definitions, types and determinants,
 - business environment institutions (BEIs) – in terms of definitions and types,

2. Analysis of the selected statistical data concerning:
 - women entrepreneurs from cities with poviat rights in the Lower Silesia Voivodeship – regarding the number of newly established and closed-down business entities in 2020,
 - cities covered by the research observation,
3. Compilation of an inventory of BEIs existing in cities with district rights of the Lower Silesian Voivodeship: Jelenia Góra, Legnica, Wałbrzych, and Wrocław,
4. Analysis of the information placed and available at the time of the study on the websites of the inventoried BEIs relating to 2020 and 2021,
5. Desk research and deduction were adopted as the research methods.

On the basis of the subject literature and the inventory of BEIs in the abovementioned cities, it was assumed that the study would cover the following business environment institutions, along with an indication of their type of activity:

- regional development agencies: the Lower Silesian Regional Development Agency (DARR S.A.) in Szczawno-Zdrój (DARR S.A. is located among the Wałbrzych business environment institutions – it is purposeful and intended due to the vicinity of both cities. DARR S.A. was set up in Wałbrzych and over time changed the seat of its organisation), the Karkonosze Regional Development Agency (KARR S.A.) in Jelenia Góra, ARLEG Regional Development Agency in Legnica, and the Wrocław Regional Development Agency;
- District Employment Agencies (as an intermediary in the transfer of EU funds): Jelenia Góra, Legnica, Wałbrzych, Wrocław;
- business incubators: Integration Incubator of Entrepreneurship, Wałbrzych Business Incubator, Venture Capital Fund in Wrocław;
- academic business incubators: the Lower Silesian Incubator of Entrepreneurship in Wrocław, University Incubator of Entrepreneurship at the University of Economics in Wrocław;
- credit guarantee funds: Credit Guarantee Fund in Jelenia Góra, Lower Silesian Economic Fund in Wrocław, Lower Silesian Park of Innovation and Science in Wrocław, **POLFUND Loan Guarantee Fund** Branch in Wrocław;
- loan funds: Wałbrzych Region Fund, the Polish Entrepreneurship Foundation in Jelenia Góra, Association of Social-economic Investments Branch in Wrocław, Leasing and Finance Agency in Wrocław;
- technology parks: Wrocław Technology Park, Legnica Technology Park LETIA SA;
- technology transfer centres: Wrocław Technology Transfer Centre, Technology Transfer Centre of the University of Medical Sciences in Legnica, and

the Centre for Innovation and Technology Transfer at the University of Life Sciences in Wrocław;

- Special Economic Zones (SEZ): Wałbrzych SEZ, Legnica SEZ.

It seems reasonable to include a supplement here: in the case of some BEIs, e.g. Wrocław Technology Park (WPT) or the Lower Silesian Regional Development Agency (DARR S.A.), the scope of their activities includes technology parks, business incubators, and technology transfer centres, among others. In order not to mislead the reader as to the number of BEIs surveyed, a comprehensive analysis of the WPT and DARR S.A. offer available on their websites was made.

Definition of key terms and literature review

For the purposes of the completion of this study, it is necessary to explain the key terms that appear throughout. The following subsections present:

- selected definitions of the concept of entrepreneurship, the determinants and types thereof, including the profile of women entrepreneurs from the cities with poviats rights in the Lower Silesian Voivodeship, along with their statistical characteristics, and
- business environment institutions, along with the differentiation thereof by type.

Entrepreneurship – definitions, types, determinants

Entrepreneurship is considered a key factor in economic growth, improving the competitiveness of economies and the prosperity of regions and local communities. The review of economic literature classifies entrepreneurship as an ambiguous term, encompassing economic, cultural, social, ethical, philosophical and psychological aspects and topics. For this reason, the meaning of the term ‘entrepreneurship’ is related to the researcher who describes it, because the typology will depend on the field in which entrepreneurship is considered – which differs for a philosopher, an economist, and a psychologist. Undoubtedly, however, entrepreneurship has been “always” with human being, although at various stages of his development it is more or less noticed and subjected to detailed research and observation. This is evidenced by the lack of a single definition in the literature that would correspond to all disciplines. Entrepreneurship and deliberations on the essence thereof seem to be endless due to the developmental nature of the phenomenon, adapting to the existing economic and social conditions, the prevailing fashion, customs and laws. Therefore, it is impossible to create one definition that is always up-to-date and comprehensive. Hence, in this part of the study, some terms and the sources thereof will be presented.

In a different approach, entrepreneurship has been characterised as an activity that strengthens potential, which consists of attitude, skills and competences

in the fields of inventiveness, innovation, and launching new ventures, among others; entrepreneurship itself comes down to [Sobiecki. 2003: 20] organising economic resources, taking risks related to running a business, and being an innovator (introducing new products, production techniques, forms of business organisation).

Entrepreneurship is often combined with an effective way of thinking and acting, with the intention to make independent economic decisions, with the ability to act rationally and achieving measurable market benefits in the form of profit [Popowska. 2015: 14]. In the literature, entrepreneurship is also described as the human ability to create, visualise and use opportunities, take control of opportunities, and organise the necessary measures leading to the creation of new goods [Klimek J., Klimek S. 2010: 27].

Researchers who have analysed the issue [Asc, Audretsch. 2003: 6] highlighted the presence of entrepreneurship in all new and dynamically developing enterprises, regardless of their size or business profile. They searched for failures in old companies that required restructuring changes.

Entrepreneurship is treated as a set of features describing the unique behaviour of human teams, institutions, the entire economy, or as an act of creating and building something new – organising and running a business and taking the risk related thereto [Griffin. 1998: 730–731]. In the context of entrepreneurship as a means of creating and building something new, features such as the ability to use ideas and resources that are invisible to others are emphasised [Otoliński. 1996: 15]. These types of skills are certainly extremely important in turbulent times burdened with uncertainty about the coming future, the kind of reality typical of the COVID-19 pandemic.

A multitude of concepts is noticeable in the systematics of types of entrepreneurship. Only selected ones will be cited for the purposes of the study.

S. Kwiatkowski presented the concept of intellectual [Kwiatkowski, 2000: 24] entrepreneurship, emphasising the importance of knowledge and skills possessed by an entrepreneur in entrepreneurial activity. The entrepreneur's general knowledge, knowledge of foreign languages and foreign cultures allow the entrepreneur to notice and take advantage of the opportunities that appear in the environment and opportunities that others do not notice or are unable to take advantage of.

Another significant type of entrepreneurship is family [Klonowska-Matynia, 2017: 37] entrepreneurship, which is determined by the involvement of family members. The family creates a favourable environment that can be the starting point for large-scale entrepreneurship. The main feature here is the interdependence of business and family. Family members share work and property.

The current economic and technological situation as well as widely implemented innovations do not go unnoticed when it comes to the introduction of

the concept of knowledge-based entrepreneurship. Some scientists are certainly right in saying that it is not a “breakthrough” as such, because knowledge has always been needed to start and maintain a business. However, never before has knowledge been viewed as a product, or a factor in development [Powichrowska, 2011: 72].

The terminology of knowledge-based entrepreneurship is very rich and constantly developing. Many researchers believe that any consideration of knowledge-based entrepreneurship should be done through the prism of knowledge itself as the basis of entrepreneurial activities³. In this context, the concept is based both upon existing and new knowledge as well as on the integration and coordination of all knowledge resources. According to many authors, knowledge-based entrepreneurship is strongly oriented towards the creation and use of scientific and technological knowledge, which is very important for the development of the knowledge-based society and economy [Popowska. 2015: 67].

In the subject literature, considerations on knowledge-based entrepreneurship also focus on the development of the idea of academic entrepreneurship. The source of these concepts are the activities of universities that employ enterprising, business-active lecturers. Researchers often have the knowledge and skills to generate new ideas and subsequently utilise their full potential in the commercialisation process. As a result, business and scientific relationships are formed that can be used by both parties. It would not be wrong to say that knowledge-based entrepreneurship is a socio-economic driving force, thanks to which innovations are created and developed, and economic growth is noticeable. This is a particularly important problem related to the activities performed by business environment institutions, the characteristics of which are presented in the part of this study below.

The issue of entrepreneurship of small and medium-sized enterprises should not be overlooked, as they are the driving force of, for example, the Polish economy. Entrepreneurship as a concept related to small and medium-sized enterprises is understood as establishing and running small and medium-sized enterprises which are the result of entrepreneurial behaviours [Buczak. 2020]. However, it should be remembered that equating the concept of entrepreneurship only with small and medium-sized enterprises is an unjustified narrowing, as “the concept of entrepreneurship is not synonymous with small enterprises” [Wennekers,

3 1) Audrestch D., Thurik R., Verheul I., Wennekers S. (eds.), *Entrepreneurship: Determinants and Policy in a European – US Comparison*, Kluwer Academic Publishers: Boston/Dordrecht, 2002; 2) Delmaf F., Wennberg K., *Knowledge Intensive Entrepreneurship. The Birth, Growth and Demise of Entrepreneurial Firms*. Edward Elgar Publishing, Cheltenham, UK and Northampton MA, 2010, USA, 2010; 3) Malerba F., (eds.), *Knowledge – Intensive Entrepreneurship and Innovation Systems. Evidence from Europe*. Routledge, London, New York, 2010; 4) Witt U., Zellner, C., *Knowledge-based entrepreneurship: The organizational side of technology commercialization*. WP, Ecole Polytechnique Federale de Lausanne, 2005.

Thurik. 1999: 47]. Narrowing the definition of entrepreneurship only to activities related to individual entities establishing or running a small enterprise destroys the “spirit” of entrepreneurship, characteristic also of large enterprises, in which entrepreneurs (“intrapreneurs” or “corporate entrepreneurs”) also undertake entrepreneurial activity. However, as emphasised by G. T. Lumpkin and G. G. Dess, small companies are an above-average medium in which entrepreneurial individuals can accomplish and develop their ambitions with a full sense of control and responsibility.

For this reason, entrepreneurship defined as the activities of micro, small and medium-sized enterprises plays the role of a “guiding principle” in this study focusing on women who, in the years 2020–2021, established or were already running a business in the following cities: Jelenia Góra, Legnica, Wałbrzych and Wrocław.

In addition to the definition of entrepreneurship and the types thereof, it is worth mentioning the determinants, or factors which affect the founding initiatives of the newly emerging economic entities. It is believed that they can be related to a human being and be of either a local or a universal nature [Siemięniak, Rembiasz. 2017: 350]. In turn, the following features are associated with an entrepreneur: independence, age, education, and gender [Łuczka. 2013: 21].

The source literature presents the concept of factors influencing entrepreneurship, which does not result solely from human action, defined as an effect of both motivational and cognitive factors, including abilities, intelligence and skills [Locke. 2000: 408–429], because external factors also play an important role, e.g. the state of the economy, the availability of venture capital, the activities performed by the competition, as well as government regulations [Shane, Locke, Collins. 2004: 2]. In the context of the coronavirus pandemic situation, it is impossible to refute this theory.

The research results published in the Global Entrepreneurship Monitor Polska 2021 Report [GEM. 2021: 12], in which the main factors responsible for initiating entrepreneurial activities, manifested in starting a business, were also considered to be the desire to earn the living resulting from the absence of job offers on the market as well as an attempt to become wealthy through the possibility of obtaining higher remuneration than when working a full-time job.

The above considerations do not present all the resources concerning the definitions, types and determinants of entrepreneurship. However, they constitute a solid basis for discussing the problem of entrepreneurship among women, who represent a sensitive group of participants in the labour market, and also address the activities related to running a business. In addition to their professional duties, women fulfil many social roles (related to taking care of children, running a household, etc.). They also face certain difficulties in running a business; hence, they need additional support for their ideas connected with entrepreneurial activities.

Female entrepreneurship

In order to meet all the goals identified at the beginning of the presented study, in this part it is necessary to introduce the issue of female entrepreneurship, firstly as a specific branch of entrepreneurship, and secondly as an extremely important phenomenon for the economic and social processes of developing countries, among which Poland can unquestionably be included.

The situation of women in terms of broadly defined entrepreneurship requires them to overcome various barriers, which certainly include socio-cultural conditions, sometimes deeply rooted in stereotypical terms, which unilaterally, uncompromisingly and in a simplified way indicate which roles and features are typically 'female' as opposed to typically 'male'. A woman is generally perceived as emotional, submissive, caring and capable of sacrifice, whereas a man is supposed to be success-oriented, self-confident, rational, aggressive and competitive [Turczak. 2017: 4]. Therefore, 'male' characteristics are certainly considered to be more predisposed towards performing entrepreneurial activities, providing greater competences to run a business. Confirmation of this approach can be found in research by S. Shane and S. Venkataraman, who pointed out that there is a persistent, albeit invisible, gender bias in the entrepreneurial discourse; therefore, women are perceived as merely complementary to the activities carried out by men [Shane, Venkataraman. 2004].

The future of women (labour market participants) and the need to provide equal opportunities were regularly addressed during the World Economic Forum⁴ deliberations in the years 2018 and 2020⁵, among others. It was emphasised that although there has been a significant increase in the number of women developing or entering entrepreneurial activities over the years, it will take at least another 108 years to fully eradicate the gender gap in global terms. On the other hand, the gender gap in economic opportunities remains the dimension requiring the longest time to become entirely eradicated, and may even take up to 202 years [GGG. 2018: 15]. Gender parity also represents an important issue, as in 2020 it was assessed at the level of 68.6% [GGG. 2020: 5]. Therefore, a great deal remains to be done in terms of levelling the opportunities, e.g. economic, social or entrepreneurial, available to both genders.

As such, it seems necessary to provide support to women entrepreneurs. This has also been indicated in the latest (2021) research findings by Naldi, L., Baù,

4 The World Economic Forum is the International Organization for Public-Private Cooperation. The Forum engages the foremost political, business, cultural and other leaders of society to shape global, regional and industry agendas. It was established in 1971 as a not-for-profit foundation and is headquartered in Geneva, Switzerland. It is independent, impartial and not tied to any special interests. The Forum strives in all its efforts to demonstrate entrepreneurship in the global public interest while upholding the highest standards of governance. Moral and intellectual integrity is at the heart of everything it does; [in]: <https://www.weforum.org/about/world-economic-forum> – accessed 13.02.2022.

5 1) The Global Gender Gap Report 2018 (GGG 2018). Switzerland: World Economic Forum. ISBN-13: 978-2-940631-00-1.2) Global Gender Gap Report 2020 (GGG 2020). Switzerland: World Economic Forum. ISBN-13: 978-2-940631-03-2.

M., Ahl, H., and Markowska, M., who described the results of their research conducted among Swedish female entrepreneurs–mothers of young children in the publication entitled *Gender (in)equality within the household and business*, regarding the motivation for undertaking entrepreneurial activity. The conclusions highlighted that the partner's participation in sharing childcare (e.g. taking paternity leave) and employment conditions (institutional support in parenthood) are important factors for women who are considering entrepreneurship [Naldi, Baù, Ahl, Markowska. 2021: 914]. Particular attention was paid to the role of formal institutions, which, by promoting a balance between work and family life, can also contribute towards changing the expectations related to gender as regards the roles and responsibilities in households, and thus provide specific legislative support for women's entrepreneurship, making it socially acceptable – and even create a norm based on the fact that fathers take over the role of the child's primary caregiver [ibid., 915].

The source literature focused on female entrepreneurship, as well as the characteristics, barriers and determinants thereof is experiencing a phase of intensive development, which is not surprising when 50% of the women surveyed perceive opportunities for their own business and, in this respect, do not differ significantly from the men surveyed (53%) [GEM Polska. 2021: 58]. This allows one to draw the conclusion that researchers will not fall short of problems to explore.

Female entrepreneurship in cities with poviats rights in the Lower Silesian Voivodeship

At this point, it is worth outlining the image of an entrepreneurial profile characteristic of entrepreneurial women (based on the data provided by the Statistical Office in Wrocław⁶) in four cities with poviats rights in the Lower Silesian Voivodeship, which is the platform for the research, and the results of which will be presented in this study. Due to the fact that at the date of submitting the article for publication, detailed data for 2021 were not available as yet, the abovementioned characteristics will be based on the data for 2020, which is in line with the adopted timeframe as well as the subject matter of the presented study – it outlines the situation in the year of the COVID-19 pandemic outbreak. Table 1 provides the summary of information on the number of economic entities entered in the REGON [*Statistical Business Identification Number*]⁷ register, broken down by the owner's gender and the legal personality of the registering entities.

6 Based on data provided by Statistics Poland on 16 March 2021 and 29 July 2021.

7 The basic function of the REGON register is the identification of the national economy entities in an unambiguous and unique manner, which is achieved by assigning unique REGON identification numbers to them [Statistics Poland (GUS). 2014: 8].

Table 1. The structure of national economy entities in the REGON register in four cities with poviats rights in the Lower Silesian Voivodeship in 2020, broken down by the owner's gender and the legal personality of the registering entities.

Year	City	The total number of entities registered in REGON	Number of entities registered by women	Number of entities registered by men	Number of entities registered by the group "Other" ⁸
2020	Jelenia Góra	589	204	261	124
	Legnica	661	198	244	219
	Wałbrzych	457	174	200	83
	Wrocław	7791	1851	2802	3138
TOTAL		9498	2427	3507	3564

Source: author's compilation based on the data provided by Statistics Poland on 16 March 2021 and 29 July 2021.

In order to present a comprehensive picture, supplementing the information with the number of entities that were closed down in 2020, but for which 2020 was also the year of commencing the entrepreneurial activity, is justified. A summary of the detailed data in this respect is included in Table 2 (below).

⁸ The value "Other" for the 2020 data is the sum of the following entities: associations, foundations, sports clubs, constituency offices, housing communities, election committees, level one and two vocational schools, local government nurseries, primary school and nursery units, trade unions, social cooperatives, volunteer fire departments, and religious associations.

Table 2. Cities with powiat rights in the Lower Silesian Voivodeship in 2020 – the number of business entities registered and closed down for which the year of registration in REGON was also the year of closing down their activity.

		TOTAL NUMBER OF ENTITIES REMOVED FROM THE REGON REGISTER IN 2020 WHICH WERE ESTABLISHED BY WOMEN		Year	
		2020	Year		
71	181	7791	The total number of entities registered in REGON	2020	Wrocław
		1851	Number of entities registered by women		
		123	The total number of entities removed from the REGON register		
		53	Number of entities removed from the REGON register which were established by women		
		457	The total number of entities registered in REGON		Wałbrzych
		174	Number of entities registered by women		
		21	The total number of entities removed from the REGON register		
		5	Number of entities removed from the REGON register which were established by women		
		589	The total number of entities registered in REGON		Jelenia Góra
		204	Number of entities registered by women		
		12	The total number of entities removed from the REGON register		
		4	Number of entities removed from the REGON register which were established by women		
		661	The total number of entities registered in REGON		Legnica
		198	Number of entities registered by women		
25	The total number of entities removed from the REGON register				
9	Number of entities removed from the REGON register which were established by women				

Source: author's compilation based on the data provided by Statistics Poland on 16 March 2021 and 29 July 2021.

The presented summary data clearly indicate the predominance of the city of Wrocław over other cities with powiat rights located in the Lower Silesian Voivodeship. This, however, should not come as a surprise – Wrocław is the capital of the voivodeship, the seat of its authorities, and surpasses the other cities covered by the research observation in terms of territorial size and total population. It is unquestionably an international agglomeration with a highly developed cultural, linguistic and educational structure, a city offering potential for life, work and development. It is also evidenced by the number of newly registered business activities, both in the total number thereof and in terms of those registered solely by women in 2020.

In times of crisis, in this case the COVID-19 pandemic, which brought about a period of additional difficulties for participants in all kinds of entrepreneurial activities starting from 2020, it is worth looking for such aid initiatives in the institutional business environment, because it creates conditions for enhancing the establishment of new small and medium-sized enterprises and the functioning of existing ones [Dominiak. 2016: 100]. The characteristics of business environment institutions (BEIs) are presented in the following section.

Business environment institutions - definitions, types

In the subject literature there are various approaches to the institutional business environment, as well as various terms, the most common of which are business environment institutions, economy development support institutions, institutional infrastructure, support institutions, support infrastructure, non-commercial business environment, innovation and entrepreneurship centres, innovation infrastructure and technology transfer, bridge institutions, and innovation catalysts⁹. They differ mainly in the scope of the set of institutions identified as business environment institutions.

The most important tasks of modern economic institutions include stimulating research and development activities and the implementation of results, as well as activities aimed at activating the creative potential in the internal resources of business entities, and increasing the economic potential of regions [Szopik-Depczyńska, Depczyński. 2013: 269]. The PARP report showed that “Innovation and Entrepreneurship centres are partners of the public and private sectors, whose overriding goal is to meet the needs of their key clients – entrepreneurs related primarily to the development of innovative entrepreneurship (increasing the tendencies to innovate in all dimensions, i.e. in terms of products, processes, marketing,

9 1) Burdecka W., *Instytucje otoczenia biznesu*, Badania własne PARP, Warszawa, 2004; Chojnicki, 1999; 2) Dominiak P., *Sektor MSP w współczesnej gospodarce*, Wydawnictwo Naukowe PWN, Warszawa, 2006; 3) Filipiak-Dylewska B., *Instytucje otoczenia biznesu: rozwój, wsparcie, instrumenty*, Centrum Doradztwa i Informacji Difin, 2009.

management and organisation), promoting experimentation, technology transfer and the commercialisation of knowledge and improvement of competitiveness (including competitiveness based on improved efficiency thanks to new technologies and on the development of know-how)” [Bąkowski, Mażewska. 2014: 8]. The authors of the report emphasise that these institutions are of a non-commercial nature, and their goal is not to maximise profit, but to support the development of entrepreneurship and innovation.

On the market, however, they fulfil service functions, creating a nationwide support network that enables the dynamisation of development processes of individual entrepreneurs.

The PARP [Górzyński, Pander, Koć. 2006: 13–16] report lists the main categories of business environment institutions:

1. units of central administration and their subordinates, e.g. the Polish Agency for Enterprise Development, the Information Processing Centre and the National Science Centre,
2. local government units, including public employment services, social assistance institutions, managing institutions and implementing aid programmes for entrepreneurs and investor service teams,
3. local and regional development agencies,
4. units of research and development facilities (including, for example, units of the Polish Academy of Sciences, laboratories, research and development units, research and development centres, centres of excellence and advanced technology centres),
5. organisations of employers and employees (including e.g. trade unions),
6. producer chambers and associations (including e.g. chambers of commerce and economy),
7. consulting, training and advisory institutions, non-public labour market institutions,
8. the higher education sector (public and non-public),
9. institutions supporting entrepreneurship, including business incubators and business accelerators, industrial parks, technology parks, science and technology parks and entities supporting *spin-off* and *spin-out* companies,
10. networks supporting entrepreneurship and innovation, which include:
 - the National System of Services with thematic sub-networks, such as the National Innovation System, Consulting and Advisory Points, Information Network for Business, and Euro Info Centres,
 - the National Association of Guarantee Funds,
 - the Polish Association of Loan Funds,
 - the National Contact Point,
 - the National Network of Patent Information Centres,

- the Innovation Relay Centres,
- the Polish Engineering Association – Federation of Scientific and Technical Associations,
- institutions focusing their activities on the process of supporting the innovativeness of companies from the SME sector, i.e. technology transfer centres, technology parks and pre-incubators,
- advisory and consulting institutions,
- financial institutions (banks, investment funds, loan funds, venture capital funds, credit guarantee funds).

When analysing the variety of tasks undertaken, target groups of service recipients or the necessary competences of the staff, business environment centres are classified as [Górzyński, Pander, Koć. 2006: 8]:

- entrepreneurship centres – promotion and incubation of entrepreneurship is offered (often in groups which are otherwise discriminated against), providing support services to small businesses and stimulating the development of peripheral regions or regions affected by a structural crisis (business incubators and / or training and advisory centres);
- innovation centres – the activity is based on the broad promotion and incubation of innovative entrepreneurship, technology transfer and providing pro-innovative services, the activation of academic entrepreneurship and cooperation between science and business. The assumed effect is the development of innovation in terms of products, processes and organisation (parks and / or technology incubators, technology transfer centres, academic business incubators);
- non-banking financial institutions – offering support in the scope of reducing financial discrimination against newly established and small companies without a credit history, and providing financial services adapted to the specifics of new business ventures.

The activity of innovation and entrepreneurship centres consists in supporting enterprises or potential entrepreneurs in three main areas:

- financial support, in which the main functions are performed by para-banking institutions;
- ensuring material (space, access to equipment) or formal (legal personality) conditions for establishing and running a business;
- soft services (providing information, consulting, training, technology transfer support, etc.) offered to companies and potential entrepreneurs.

Properly functioning business environment institutions should therefore significantly affect the development of innovative companies, undertaking new challenges and creating new jobs.

Findings – aid offer for enterprising women

The analysis of information posted on websites (concerning 2020 and 2021) of the analysed BEIs listed above in terms of formulating an offer of support dedicated exclusively to entrepreneurial women, and following the assumption that the proposals of aid solutions were developed by the studied BEIs and are not the offers provided within the framework of cooperation with external entities supporting entrepreneurship not covered by the research observation, showed the absence of such proposals.

The only references in the offers found on the websites of the analysed BEIs, both among their own ones – the specific BEIs covered by the research observation – as well as those provided as part of mutual assistance or cooperation with other entities which particularly signalled their specific dedication to women were as follows:

1. (2020) Project of the Poviát Labour Office in Wałbrzych entitled “Activation of young people unemployed in the Wałbrzych lands and Wałbrzych county districts (V)”¹⁰, where the provisions of the conditions for the recruitment of participants include the following: “The selection of unemployed people recruited to the project will be carried out in accordance with the principles of equal opportunities for women and men and the principle of equal opportunities and non-discrimination, and will aim to increase the professional activity of disadvantaged women on the labour market, which means that a minimum of 78% of the participants will be women”¹¹;
2. (2020) Project of the Poviát Labour Office in Wałbrzych entitled “Activation of unemployed people over 30 years of age in the Wałbrzych land and Wałbrzych County Districts (VI)”, where the following provision appeared: “The selection of people recruited for the project will be carried out in accordance with the principles of equal opportunities for women and men, non-discrimination and will aim to increase the professional activity of disadvantaged women on the labour market, which means that a minimum of 52.01% of the participants will be women”¹²;
3. (2020) “The Active Mums¹³ Project” – placed on the news page of the Legnica Special Economic Zone, albeit not by the LSEZ but by the Sudety Institute of Regional Development, which is its partner; both entities promote each other within the scope of partnership and cooperation. The aim of the Active Mums project was to activate women returning to work after parental leave;

10 Powiatowy Urząd Pracy w Wałbrzychu, ul. Ogrodowa 5, 58-306 Wałbrzych, <https://walbrzych.praca.gov.pl/>

11 <https://walbrzych.praca.gov.pl/-/11201870-projekt-aktywizacja-osob-mloдых-pozostajacych-bez-pracy-w-powiecie-walbrzyskim-ziemskim-i-walbrzyskim-grodzkim-v-> – accessed 14.02.2022.

12 <https://walbrzych.praca.gov.pl/-/11150121-projekt-aktywizacja-osob-powyzej-30-roku-zycia-pozostajacych-bez-pracy-w-powiecie-walbrzyskim-ziemskim-i-walbrzyskim-grodzkim-vi-> – accessed 14.02.2022.

13 <https://lsse.eu/projekt-aktywne-mamy/> – accessed 14.02.2022.

4. (2021) The project entitled “Entrepreneurial women 3.0.”¹⁴ – available on the website of the Poviát Labour Office in Legnica (21) in the Current Affairs tab. It is addressed to women aged over 30 living in the Lower Silesian Voivodeship and belonging to one of the following groups: unemployed, including those experiencing a special situation in the labour market, i.e. women aged 50+, women with disabilities, the long-term unemployed and low-skilled women; poor working women and those employed on the basis of short-term contracts and civil law contracts, whose monthly remuneration does not exceed 120% of the minimum wage; immigrants/re-emigrants; and those leaving agricultural areas. The EUROPROJEKT Advisory and Training Centre was the initiator of the proposal.
5. (2021) The project provided by the Poviát Labour Office in Jelenia Góra entitled “Activation of the unemployed aged 30 and over from the Karkonosze and Jelenia Góra poviats_2020-2021”¹⁵. The records indicated that the beneficiaries of this offer could include the individuals belonging to at least one of the following groups: the unemployed aged 30 and over, people registered as unemployed, especially those in a special situation on the labour market, i.e. seniors aged 50+, women, people with disabilities, the long-term unemployed, as well as those with low occupational qualifications. The word “especially” clearly indicates that women are not the only recipients of the programme, but are noted in the context of a group of people finding themselves in a specific situation on the labour market.
6. (2021) The project “Your company – Your success!” available on the website of the Poviát Labour Office in Legnica, in the Current Affairs tab¹⁶, as information from the Social Development Agency “ARS” Ltd.¹⁷ (in the amount of PLN 23,050), bridge support (PLN 1,000 each for the period of 12 months). The target group of the proposal includes, among others: unemployed individuals aged 30 and over, including those in a special situation on the labour market, i.e. aged 50 and over, women, people with disabilities, the long-term unemployed and people with low occupational qualifications; immigrants and re-emigrants; poor workers; people leaving the agriculture sector and their families.
7. (2021) The project “Independent Entrepreneurs” – provided on the website of the Poviát Labour Office in Legnica, in the Current Affairs tab¹⁸, as an

14 www.przedsiębiorczekobiety3.eu – accessed 14.02.2022.

15 <https://jeleniagora.praca.gov.pl/-/12641789-aktywizacja-osob-bezrobotnych-od-30-roku-zycia-z-powiatu-karkonoskiego-i-jeleniej-gory-2020-2021> – accessed 16.02.2022.

16 <https://legnica.praca.gov.pl/-/16499394-nabor-do-projektu-twoja-firma-twoj-sukces-> – accessed 16.02.2022.

17 <http://arslegnica.pl/> – accessed 16.02.2022.

18 <https://legnica.praca.gov.pl/-/15606442-projekt-samodzielni-przedsiębiorczy-> – accessed 16.02.2022.

incentive to take advantage of the offer posted by the INCEPT Foundation¹⁹. The target group of the initiative included: people residing, within the meaning of the Civil Code, in the territory of the Lower Silesian Voivodeship aged over 30 belonging to at least one of the following groups: the unemployed, including those experiencing a special situation on the labour market, i.e. people aged 50+, women, people with disabilities, the long-term unemployed and low-skilled people; poor workers; those employed on the basis of short-term contracts or civil law contracts, whose monthly earnings do not exceed 120% of the minimum wage.

8. (2021) The project provided by the Powiat Labour Office in Wałbrzych entitled “Activation of young unemployed people in Wałbrzych land poviat and Wałbrzych township (VI)”, in which the following entry appeared: “The selection of unemployed people to be recruited for the project will be carried out in accordance with the principles of equal opportunities for women and men as well as the principle of equal opportunities and non-discrimination and will aim to increase the occupational activity of women disadvantaged on the labour market, which means that women will constitute at least 69% of the participants”²⁰.
9. (2021) The webinar entitled “My own company – support for the beneficiaries of EU projects”, the announcement posted on the website of the Powiat Labour Office in Wałbrzych, in the Current Affairs tab²¹, as an invitation from the European Funds Information Point in Jelenia Góra. Participation was free of charge and, after prior registration and qualification, was addressed to professionally inactive individuals or unemployed people not registered with the labour office, aged 18–29, who lost their jobs after 1 March 2020, the unemployed aged over 30+, including: the unemployed and professionally inactive, low-skilled people, i.e. secondary school graduates, people with disabilities, women, and people aged 50+.
10. (2021) The project “Microloan for starting a business” – financial aid offered by the Polish Entrepreneurs Foundation in Jelenia Góra²², where the provisions regarding the target group of the offer indicate unemployed people aged 30 and over intending to start a business, especially people aged

19 <http://fundacjaincept.pl/projekty/samodzielni-przedsiębiorczy/> – accessed 16.02.2022.

20 <https://walbrzych.praca.gov.pl/-/16213338-projekt-aktywizacja-osob-młodych-pozostajacych-bez-pracy-w-powiecie-walbrzyskim-ziemskim-i-walbrzyskim-grodzkim-vi-> – accessed 16.02.2022.

21 <https://walbrzych.praca.gov.pl/-/15801612-webinarium-pt-wlasna-firma-wsparcie-dla-beneficjentow-projektow-unijnych-> – accessed 16.02.2022.

22 <https://www.pfp.com.pl/pozyczki/mikropozyczka-na-rozpozecie-dzialalnosci-gospodarczej> – accessed 17.02.2022.

over 50, women, people with disabilities, the long-term unemployed and low-skilled individuals.

Additionally, it is necessary to indicate that under the Act of 2 March 2020 on special solutions related to preventing, counteracting and combating COVID-19, other infectious diseases and the crisis situations²³ caused thereby, as of 2020 the District Employment Agencies of the cities studied carried out the tasks assigned to them in the scope of the implementation of the package known as the Anti-crisis Shield²⁴, as well as the so-called activation programmes and the agencies' own projects²⁵. A comprehensive analysis of all aid activities carried out by Poviats Labour Offices in the cities of Jelenia Góra, Legnica, Wałbrzych and Wrocław showed that women entrepreneurs did not constitute a special target group of these institutions at the time of the COVID-19 pandemic, because "they had equal chances with other entrepreneurs to take advantage of the statutory tools and aid offers provided for entrepreneurs and entrepreneurship, e.g. co-financing to start a business or obtaining a loan for the creation of a new job from the Anti-Crisis Shield government aid project, and in activation programmes and own projects provided by Poviats Labour Offices, the principle of equal opportunities and non-discrimination was followed, including accessibility for people with disabilities and the principle of equal opportunities for men and women, as well as the principle of sustainable development" [Buczak, 2021: 120].

23 Journals of Laws, 2020, item 374 as amended (PL: Dz.U. z 2020 r. poz. 374 z późn. zm.).

24 1) The Anti-Crisis Shield are instruments intended to amortize and reduce the negative impact of the coronavirus on the economy, and above all on society. It is one of the most comprehensive packages in Europe – [after:] <https://www.gov.pl/web/tarzaantykrzysowa/materialy> – accessed 06.04.2021.

2) The estimated total value of support under the Anti-Crisis Shield is 212 billion PLN (nearly 10% of GDP). What does this amount consist of?

- A government cash component amounting of approximately 67 billion PLN (2.9% of GDP). It consists of expenses of the state budget, ZUS [Social Insurance Institution] and special purpose funds.
- The government liquidity component amounting of approx. 75.5 billion PLN (3.3% of GDP). It consists of credit holidays and deferred levies, as well as liquidity financing in the form of loans and capital, mainly with the use of financial instruments of the Polish Development Fund Group (PFR, BGK, KUKI, ARP).
- The NBP liquidity package amounting to approx. 70 billion PLN, which will ensure the necessary liquidity and credit conditions [after:] <https://www.gov.pl/web/tarzaantykrzysowa/o-tarczy> – access 06.04.2021
- Information from 2021: The Anti-Crisis Shield is a package of solutions prepared by the government, the objective of which is to protect the Polish state and the citizens against the crisis brought about by the coronavirus pandemic. It is based on five pillars: Protection of jobs and safety of employees, Financing of entrepreneurs, Health protection, Strengthening of the financial system, and Public investments. The shield is supposed to stabilise Polish economy and act as an investment incentive. It is estimated that the value of aid offered within the framework of the Anti-Crisis Shield and the Financial Shield will amount to over PLN 312 billion.– accessed 16.02.2022.

3) <https://walbrzych.praca.gov.pl/dla-pracodawcow-i-przedsiębiorców/tarcza> – accessed 06.04.2021.

25 1) <https://walbrzych.praca.gov.pl/rynek-pracy/programy-aktywizacyjne-i-projekty> – accessed 06.04.2021.

2) <https://wroclaw.praca.gov.pl/rynek-pracy/programy-aktywizacyjne-i-projekty> – accessed 06.04.2021.

3) <https://legnica.praca.gov.pl/rynek-pracy/programy-aktywizacyjne-i-projekty> – accessed 06.04.2021.

4) <https://jeleniagora.praca.gov.pl/rynek-pracy/programy-aktywizacyjne-i-projekty> – accessed 06.04.2021.

After conducting a thorough inventory and reviewing the offers available in the years 2020-2021 posted on the websites of the analysed business environment institutions from the cities with poviata rights in the Lower Silesian Voivodeship, it can be clearly stated that the following hypothesis: “during the timeframe under analysis, the BEIs covered by the research offered aid to all entrepreneurs regardless of gender – no forms of support dedicated exclusively to women entrepreneurs were offered” has been positively verified.

In terms of approaching the second of the hypotheses put forward at the beginning of this paper, it seems necessary to assess the years 2020-2021 based on a critical analysis addressing the substance of the projects proposed by the analysed BEIs, which will make it possible to determine whether they were monothematic – focused on counteracting the effects of the epidemic situation alone, rather than supporting the long-term pro-development activities of the entrepreneurs-beneficiaries.

In 2020, the range of forms of support for entrepreneurs was significant, but it was dominated by the emergence and development of the COVID-19 pandemic, where aid measures were defined for all entrepreneurs without regard for the gender of the beneficiaries. The offer of some of the surveyed BEIs included the following forms of support for entrepreneurs during the COVID-19 pandemic: liquidity loans²⁶, development loans²⁷, revolving loans²⁸, other special purpose loans²⁹, and loan repayment extensions³⁰. The vast majority of the surveyed BEIs invariably provided their existing services, including webinars³¹, training and consultations³², financial support in the implementation of research and scien-

26 1) <https://frw.pl/14249/wznowiony-nabor-wnioskow-na-pozyczke-plynnosciowa-poir/> – accessed 29.04.2021.

2) <https://dawg.pl/projekty/pozyczka-plynnosciowa-covid-19/> – accessed 29.04.2021.

3) <https://dpin.pl/portfolio/pozyczka-plynnosciowa-covid-19/> – accessed 29.04.2021.

27 1) <https://alif.pl/pozyczki-unijne/pozyczka-rozwojowa-dla-dolnego-slaska/> – accessed 29.04.2021.

2) <https://invest-park.com.pl/pozyczki-rozwojowe-dla-mmisp/> – accessed 29.04.2021.

28 <https://frw.pl/13043/pozyczka-obrotowa-w-zwiazku-z-covid-w-ramach-pozyczki-rozwojowej-na-dolny-slask/> – accessed 29.04.2021.

29 1) <https://tise.pl/offers/pozyczka-na-efektywnosc-energetyczna-misp-w-woj-dolnoslaskim/> – accessed 29.04.2021.

2) <https://frw.pl/11995/mikropozyczka-znow-dostepna-dla-osob-bezrobotnych/> – accessed 29.04.2021.

30 1) <https://frw.pl/12139/zloz-wniossek-o-prolongate-w-splacie-pozyczki-online/> – accessed 29.04.2021.

2) <https://frw.pl/regionalna-pozyczka-hipoteczna2/> – accessed 29.04.2021.

31 1) <https://frw.pl/14547/tworzymy-ponadregionalna-siec-branzowa-pes/> – accessed 29.04.2021.

2) <https://frw.pl/14021/wsparcie-dla-przedsiębiorczych-dolnoslaskow-bezplatne-webinarium/> – accessed 29.04.2021.

3) <https://invest-park.com.pl/events/zachety-podatkowe-na-inwestycje-i-innowacje/> – accessed 29.04.2021.

32 1) <https://frw.pl/12565/szkolenia-pierwszy-biznes-w-sieci/> – accessed 29.04.2021.

2) <https://aip.link/oferta-26-minus/> – accessed 29.04.2021.

3) <https://www.darr.pl/jak-zadbać-o-relacje-i-radzić-sobie-w-trudnych-rozmowach-z-klientem-zaproszenie-do-udziału-w-webinarium/#more-579> – accessed 29.04.2021.

tific projects³³, renting offices and premises, as well as plots for investments³⁴, making specialist premises and devices available³⁵, and assistance in the commercialisation of scientific research³⁶. Among the aforementioned activities, no information about them being specifically dedicated to women was found. In the author's opinion, both the website design and content of the examined BEIs, primarily in the tabs entitled "implemented projects" or "our offer", played more of an image-oriented role in 2020 than an offer-oriented one, maintaining the place of a given BEI in the beneficiaries' knowledge space. It resulted, e.g. from suspending the implementation of tasks or freezing the inflow of external funds. Many disruptions in the functioning of the examined institutions were also noted, which resulted, among other things, from the temporary suspension of direct customer service (lockdown), or refusing to accept applications submitted for programmes outside the scope of "coronavirus" relief. 2020 was a difficult time because the pandemic struck suddenly and the decisions made were not based on any previous experience resulting from this dimension of the pandemic crisis. It is not a mistake to state that people acted in the dark, guided by panic, disorientation, and learning from their mistakes. The development of the pandemic situation, the advancement of efforts to develop vaccines, as well as the impact of a certain "getting used to it", "becoming more common" and "taking for granted" the coronavirus existence and the related risks, also significantly influenced the activities of business environment institutions in the following year covered by the research observation.

In 2021, offers of aid and support began to return to the pre-pandemic dimension, i.e. COVID-19 was no longer the main reason to take advantage of the available projects promoted by the specific BEIs, the element of activation and long-term development appeared therein, and the group of beneficiaries was diversified, e.g. through the dimension of creditworthiness (securing the contract execution by the borrower³⁷), the quality and purpose of the concept submitted for implementation (e.g. purchase of real estate, production and distribution of energy from renewable sources, projects related to eliminating territorial differences

33 1) <https://wctt.pwr.edu.pl/nowa-edycja-programu-mozart/> – accessed 29.04.2021.

2) <https://www.ventureinc.com/pl/> – accessed 29.04.2021.

34 1) <https://invest-park.com.pl/invest-park-center/> – accessed 29.04.2021.

2) https://www.paih.gov.pl/strefa_inwestora/parki_przemyslowe_i_tehnologiczne/legnica – accessed 29.04.2021.

35 <https://www.technologypark.pl/oferta-wpt/laboratoria-i-prototypownie/> – accessed 29.04.2021.

36 <https://wctt.pwr.edu.pl/oferta-uslugi/transfer-technologiei/dla-naukowcow/> – accessed 29.04.2021.

37 <https://tise.pl/offers/pozyczka-inwestycyjna-dla-small-midcaps-msp-i-pes-w-programie-efi-efg/> – accessed 17.02.2022.

in accessing high-speed broadband Internet, i.e. at least 30 Mb/s³⁸), the length of running a business (e.g. a loan only for the enterprises operating before 1 January 2020³⁹) – its location (e.g. for an enterprise, the organisational unit of which is situated in Jelenia Góra sub-region⁴⁰) or the location of the beneficiary himself, who is not an entrepreneur (e.g. residence or education in the area of Lower Silesian Voivodeship⁴¹), representing a specific professional group (e.g. for people desiring to leave the agriculture sector⁴²) and not dedicated to a specific gender. What is clearly noticeable is the predominance among the presented proposals of countless webinar initiatives, remote consultations, virtual training sessions and lectures, with the significant diversity therein highly visible in 2021, a departure from the subject matter of “how to survive the coronavirus” and a transition to the level of “find something for yourself and your industry”, e.g. the International Brokerage Meeting MOST PRZEMYSŁOWY 2021 [*INDUSTRIAL BRIDGE 2021*] for the following industry sectors: metal and steel, maritime and shipbuilding, transport and logistics, and renewable energy⁴³; cooperation meetings dedicated to the medical and pharmaceutical industry – Euro-Asia Medical & Technology Hub⁴⁴; “RYNEK NIEMIECKI [*GERMAN MARKET*] – are Covid and Brexit new opportunities on the German market for suppliers from Poland?”⁴⁵; cooperative meetings for the textile industry representatives such as Textile Connect 2021⁴⁶; Food eirEEN Meet the Buyer & Matchmaking Event 2021⁴⁷; “Conquer foreign markets with the European Funds. Missions and fairs for SMEs from the Lower Silesian Voivodeship”⁴⁸. The information presented above is extremely valuable for the purposes of verifying the hypothesis put forward at the beginning of this part of the study, because it allows

38 1) <https://www.pfp.com.pl/pozyczki/druga-regionalna-pozyczka-hipoteczna> – accessed 17.02.2022.

2) <https://tise.pl/offers/oze-w-woj-dolnoslaskim-pozyczka-na-produkcje-i-dystrybucje-energii-ze-zrodel-odnawialnych/> – accessed 17.02.2022.

3) <https://tise.pl/offers/pozyczka-szerokopasmowa/> – accessed 17.02.2022.

39 <https://www.warr.pl/pozyczka-plynnosciowa-dedykowana-covid-19/> – accessed 17.02.2022.

40 <https://karr.pl/?s=%E2%80%9EPARTNERSTWO+NA+RZECZ+ROZWOJU+DOLNO% C5%9A% C4%-84SKICH+MM% C5%9A+I+ICH+PRACOWNIK% C3%93W+%E2%80%93+EDYCJA+II%E2%80%9D> – accessed 17.02.2022.

41 <https://dpin.pl/portfolio/pomoc-dla-mlodych/> – accessed 16.02.2022.

42 <https://dpin.pl/portfolio/aktywizacja-dolnoslaskiego-ryнку-pracy-iii-edycja-2/> – accessed 16.02.2022.

43 <https://ib2021.b2match.io/> – accessed 17.02.2022.

44 <https://www.darr.pl/wirtualne-spotkania-kooperacyjne-b2b-euro-asia-medical-technology-hub/#more-803> – accessed 17.02.2022.

45 <https://www.darr.pl/bezplatny-webinar-pn-rynek-niemiecki-czy-covid-i-brex-it-to-nowa-szansa-na-rynku-niemieckim-dla-dostawcow-z-polski/#more-758> – accessed 17.02.2022.

46 <https://www.darr.pl/textile-connect-2021-virtual-matchmaking/#more-732> – accessed 17.02.2022.

47 <https://www.darr.pl/wirtualne-spotkania-dla-branzy-spozywczej/#more-672> – accessed 17.02.2022.

48 <https://karr.pl/?s=zdobrywaj+rynki+zagraniczne> – accessed 17.02.2022.

one to draw the conclusion that the offers of support for entrepreneurs-beneficiaries were not monothematic. It is correct to draw the conclusion that the years 2020 and 2021 were different in this respect – 2020 was a year of fear, difficulties in coping with a new, dramatic and unprecedented situation for the modern world, and in terms of the offers supporting entrepreneurs it was dominated by projects “helping to survive and endure” the COVID-19 pandemic. On the other hand, in 2021 “the world” was richer with the experiences of the past, the decisions made, both those which were correct and those less successful in retrospect, losses incurred, expenses incurred, setting directions for activities, opportunities used, noticing a niche and chances for action. This was reflected in the proposals offered by BEIs – the pandemic and counteraction of its negative consequences were not the only determinants of the programmes provided. Because the overall assessment of the “monothematic nature of the support offered” by BEIs concerns two years of the pandemic, it is logical to conclude that the formulated hypothesis has been negatively verified – entrepreneurs received a diversified, manifold offer, and only if they were willing to use it when they met the formal requirements as well as making the effort to fill in the necessary documents could they receive a package of solutions tailored to their needs and capabilities.

Conclusions from the research and proposed corrective actions

The purpose of the presented study was to analyse the proposed support solutions offered by the business environment institutions and dedicated to women entrepreneurs from the four cities with poviats rights in the Lower Silesian Voivodeship during the Covid-19 pandemic. The research was conducted within the following boundaries:

- temporal, covering the years 2020-2021;
- subject-related, focused on the content of websites provided by selected business environment institutions from the following cities: Jelenia Góra, Legnica, Wałbrzych and Wrocław;
- object-related, based on which “female entrepreneurs” were defined as women who either established or were already running a business activity in the abovementioned cities during the analysed period of time;
- conclusion and finalisation, owing to which it would be possible to answer the formulated research questions, verify the hypotheses put forward and, based on the conclusions drawn, propose future-oriented solutions.

In the course of the conducted research:

- the subject literature review was performed, covering the following problems:
 - entrepreneurship, primarily including female entrepreneurship, specifying the definitions, types, determinants thereof and barriers thereto,

- business environment institutions, indicating their definition and type;
- statistical analyses was conducted, covering:
 - four cities with powiat rights in the Lower Silesian Voivodeship, within the selected data ranges compatible with the subject matter of the entire study,
 - the profiles of female entrepreneurs from the abovementioned cities based on selected statistical data obtained from the Statistical Office in Wrocław, in accordance with the REGON register and PKD [*Polish Statistical Classification of Economic Activities*] codes;
- critical analysis of the content of websites provided by selected BEIs in the cities covered by the research in terms of the proposed forms of support for entrepreneurs in the years 2020-2021 was carried out, with particular emphasis on offers dedicated exclusively to women.

The research activities allowed the researchers to draw the main conclusions, which also fulfilled the role of answers to the formulated research questions; hence, it was possible to verify the adopted hypotheses:

- In the years 2020-2021, none of the numerous aid, support or activation-oriented offers prepared and presented on BEI websites covered by the study were dedicated exclusively to entrepreneurial women⁽⁵⁷⁾⁴⁹. Thus, women did not constitute a special target group for BEIs in the four cities with powiat rights located in the Lower Silesian Voivodeship.
- Women, as with other entrepreneurs, had the opportunity to take advantage of a wide spectrum of programmes, e.g. financial support (loans on preferential terms, non-repayable loans, subsidies), training, webinars, office rental services or specialist premises. In some of the cases listed in the study, women were indicated as a special, vulnerable group on the labour market; however, no individual projects were prepared for them. This clearly supports the positive verification of the hypothesis that, in the years 2020-2021, BEIs covered by the research offered support to all entrepreneurs without any gender dedication – no forms of aid addressed exclusively to women entrepreneurs were proposed.
- In the author's opinion, the aid proposals presented on BEI websites covered by the research were appropriate, regarding their scope and subject matter in the years 2020–2021. The COVID-19 pandemic, which began in Poland in March 2020 (the first confirmed case of the disease), remains an extremely difficult, complex experience which has changed every aspect

⁴⁹ In order to resolve doubts regarding the existence of aid programmes dedicated exclusively to women before 2020, it is worth mentioning, e.g. the project "Become a Successful Businesswoman", which was implemented in 2014 by the Wałbrzych Regional Fund – source: <https://frw.pl/2956/podsumowanie-projektu-zostan-kobieta-sukcesu/> – retrieved on 29.04.2021.

of existence, i.e. the social, economic, business-oriented, and daily lives of every person. Therefore, it is not possible to only negatively assess the first activities performed at the beginning of the pandemic, which are currently described as somewhat chaotic and unnecessary, e.g. a complete lockdown for some industries, and in the case of BEIs, suspending project implementation, closing institutions and switching to remote customer contacts, reducing the forms of support offered to webinars, remote training sessions and short-term actions to mitigate the “coronacrisis”. Uncertainty, ignorance and fear are feelings which frequently lead to irrational decisions, of which anyone who has ever experienced them is well aware. Another issue is the assessment of the number, or rather the absence, of offers from BEI in the cities with poviat rights in the Lower Silesian Voivodeship dedicated only to female entrepreneurs. It is obvious that they could take advantage of all the proposals that were on offer. However, the group of potential beneficiaries is long, as evidenced by the data for 2020 regarding the number of economic entities registered in REGON (see Table 1) – women entrepreneurs did not represent the dominant group registering business activities. Therefore, competition among entrepreneurs willing to take advantage of individual projects is enormous; the opportunities available to women naturally decrease as a result.

- The characteristics of BEI offers, further subdivided into 2020 and 2021, also result from the above conclusion, because in the initial stage of the pandemic development, the aid proposals, if not temporarily suspended, were primarily implemented using the on-line formula, whereas the subject matter of training sessions, webinars or consultations mainly revolved around the possibility of obtaining systemic support (e.g. the Anti-Crisis Shield) and searching for complete information related to the application process. In the second half of 2020, when the situation became more stable, the flagship projects of individual BEI were launched anew (e.g. funds for starting a business offered by Poviat Labour Offices); however, remote work and the need to limit direct contacts, including meetings in larger groups, has become the common practice of the institutional operating policy. This was also reflected in the number of virtual initiatives proposed to entrepreneurs in the subsequent year of the pandemic. In terms of the thematic variety of support activities in online form, 2021 was disproportionately richer than 2020, which allows for the rejection of the hypothesis that the offers provided for entrepreneurs by BEIs were monothematic. To support this negative verification of the research hypothesis, it should also be mentioned that entrepreneurs, both those already running a business and those intending to start a business, as well

as other groups of addressees requiring support (e.g. individuals desiring to improve their qualifications), received a manifold, thematically diversified – in terms of scope, time and funding – offer which still allowed using the determinant of fighting and counteracting the “coronacrisis”, but also referred the beneficiaries in: innovation, development, searching for new contacts, both local and international. Therefore, there is no question of the monothematic nature of aid proposals provided by BEIs in the four cities with poviats located in the Lower Silesian Voivodeship. If only the recipients of these supporting initiatives were willing to familiarise themselves with and take advantage of them, then, in the author’s opinion, no negative remarks can be made as to the diversity of the proposed activities supporting entrepreneurs and posted on the websites of the analysed BEIs.

- In the course of the analyses, a secondary conclusion was also formulated which coincides with the conclusions of the research conducted by J. Ładysz [2020: 102-116] within the whole area of Lower Silesia Province: “there are significant disproportions in the spatial accessibility of BEIs within the area of Lower Silesia Province. All kinds of these institutions are particularly concentrated in the capital of the voivodeship – Wrocław”.

The conclusions presented imply the formulation of guidelines which may play a corrective role for the highlighted deficiencies regarding the absence of support offers from BEI and dedicated exclusively to women entrepreneurs. In the author’s opinion, it is a significant problem that should not be marginalised or diminished, e.g. by statements about the opportunity which all the potential beneficiaries have to use numerous projects provided to. As the discussion presented above has revealed, women do not constitute the predominant group of entrepreneurs either starting or already running a business, not only in terms of the Lower Silesian Voivodeship, but also in relation to the nationwide trend, which puts them in a disadvantaged position when it comes to competing for access to programmes supporting business activities. Promoting the idea of equal, non-discriminatory access to BEI offers should remain in the interest of the institutions themselves, constituting an idea for promotional activities, a reason for and evidence of “being better than others”. In the case of the continuously developing group of women entrepreneurs, it would certainly act as an incentive if their needs were perceived individually, if the special requirements of this delicate and sensitive community taking up entrepreneurial challenges were taken into account. It seems worth considering the establishment of organisational units within the already existing BEI, dedicated exclusively to the implementation of projects related to women entrepreneurs, starting with obtaining funds by designing and conducting a promotional campaign and concluding with the settlement of the entire activity.

According to the author, business environment institutions should also consider the intensification of information and promotional activities covering their products and services, because, as research has shown [Buczak, 2019, 281], “the potential customers are not aware of them” and “the vast majority of entrepreneurs acquire the knowledge about BEI activities from friends and family”. However, in order to share such knowledge, they have to acquire it in the first place; therefore, information campaigns should reach the right recipients. For the purposes of achieving the research goal, the presented study analyses the website content provided by business support institutions in four cities with powiat rights in the Lower Silesian Voivodeship, and this medium should be considered highly common and even newsworthy, corresponding to the requirements of the modern times. Nowadays, recognition in the given industry means being available online, setting up an interesting website, and having a social media account. However, meeting the indicated conditions does not guarantee uniqueness, because Internet users are “flooded” by a wave of offers, advertisements and promotions. It is therefore necessary, firstly, to stand out among other offer providers; secondly, to identify the needs of the target group; and thirdly, to diversify methods for reaching the potential beneficiaries. These are the steps which should be taken into consideration by the business environment institutions in terms of their functioning.

The presented study should be considered complete – the adopted research goal was achieved as a result of verifying the formulated hypotheses and obtaining answers to the research questions defined in the introduction, which allowed for the presentation of both conclusions and the post-research recommendations.

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The implications of innovation in the digital economy

Abstract: Knowledge determines the development of the modern economy. Entrepreneurs who are able to successfully utilise resources create more added value than their competitors. A large number of political documents in the EU or Poland demonstrate the special role of innovation as a key factor in building the competitiveness of the economy, albeit to date there has been no significant improvement in our position in this terms compared to other leading areas. The main obstacle in introducing innovative technological solutions, products or organisational innovations are the lack of knowledge and openness to changes. Unstable legal regulations, deficiencies in the development of institutional infrastructure and staff shortages make the implementation of robotics and automation a necessity. The article attempts to assess the diffusion of innovation in the digital economy.

Keywords: Innovation, Internet of Things (IoT), Industry 4.0, economy, management, logistics

Introduction

Innovative activity primarily pertains to the development of the economy, society, ecology or technology. This type of activity is understood as an activity aimed at increasing the propensity to create, implement and apply innovations in the daily activities of each consumer. It is a complicated and multi-faceted process that is always initiated by a human being.

A developed and modern economy, the development of enterprises, decent working conditions, good living conditions, and a knowledge-based society are invariably the most important items in the functioning of each country. The Polish economy, after many years of experience and functioning in various legal systems, is attempting to achieve the indicated goals. However, the most important challenge for the Polish economy is the attempt to reduce excessive structural differences between Poland and highly industrialised countries. It is still necessary to build

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awareness and develop knowledge in society as well as research and implement the research results of innovative processes, without which the modern economy cannot function efficiently. A necessary condition for the implementation of the shaped trends is the consolidation of entrepreneurial and innovative attitudes; the implementation of these attitudes should be based on the integrated development of knowledge with the use of the available technical, economic, organisational and administrative standards. An important task is to observe changes in the mechanism of adaptation of various entities to innovative activity, understood as a tendency to introduce various forms of innovation in particular spheres of management in the face of the limitations of the labour market. The analysis of this mechanism should answer the question of the extent to which economic and social conditions are able, on the one hand, to stimulate and, on the other hand, limit the innovative activity of enterprises. There are many economic and social determinants of innovative processes in enterprises, and as such there are numerous economic and social conditions for innovative processes in enterprises. Among them are the shortages in the labour market and the development of the concept of Industry 4.0. Innovation as a result of cooperation amongst R&D units, taking the market needs of consumers into account, is most often manifested in specific consumer behaviours. Therefore, innovative activity is a sphere of human activity, without which the development of civilisation is impossible, and the choice of forms of functioning of an organisation on the market is a complex process requiring the determination of criteria for the selection of many factors that will affect the implementation of specific strategies.

The main purpose of the article is an attempt to evaluate and analyse the market changes focused on improving the efficiency of logistics processes in Poland and their effect on the diffusion of innovation. The main assumption is the thesis that robotics and automation of supply and distribution processes on the market will be a development trend, especially in the face of staff shortages and the progress of the fourth industrial revolution.

Challenges of the supply and distribution market

Variable customer requirements mean that the approach to the supply chain should be changed, regardless of whether they relate to the traditional market or the e-commerce market. Regardless of whether we are dealing with drones, the Internet of Things (IoT), robotics, or autonomous vehicles, the scope of ICT technologies in logistics is expanding. One may observe this phenomenon especially in the e-commerce industry. Most of the entities active on the market, including those just beginning their activities on the market, are present in the global Internet network. Problems may arise in the scope of using the available Internet tools used by enterprises (Big Data, IoT or Industry 4.0). The specificity of the industries makes it necessary to use the available ICT (Internet and Communication Technology) tools

in their activities, which is the cause of rapid changes on the market. On the other hand, however, this fact should motivate other entrepreneurs to impose available IT tools and solutions and to diffuse related innovations. Process efficiency increases, and distribution channels are shortened. The wide range is distributed to the customer in real time, and sales can be made from anywhere in the world. The dynamic development of purchases brings about the development of large logistics operators and other market participants (4PL / 5PL). The prevailing way of thinking about the process of planning and building a supply network is changing. Process efficiency, optimisation and quality management are no longer a modern solution but an everyday practice. With the development of artificial intelligence, information processing services (cloud computing) are spreading, and the market forces changes and innovations. This is due to increased consumption (despite declines in 2020) and the increasing concentration of the population in urban areas [GUSa, 2022]. According to the UN, in 2030 more than 60% of the population will live in cities, a figure which will rise to as many as 70% in 2050 [ONZ, 2022]. We are slowly seeing the emergence of a new world in which machines and artificial intelligence ensure security of supply and convenience. The development of cellular technology (5G) has made it possible for a very large number of users and devices to use the network at the same time. The next stage of social evolution is beginning before our very eyes. It is possible to observe that the main beneficiary of development is the courier industry. The value of express and parcel services in Poland in 2014 reached a value of PLN 4.3 billion PLN. The following year brought an increase to PLN 5.1 billion PLN, which accounted for 2% of the European market and had a huge impact on the development of the economy [Kawa, 2020]. In 2019, the value of this market in Poland was over PLN 7.9 billion PLN, and in 2020 almost PLN 12 billion PLN [GUS, 2020]. Polish society is increasingly willing to buy merchandise on the Internet (73%), guided by convenience, a wide assortment of products, price and flexibility [Gemius, 2022]. The industry faces many challenges such as, on the one hand, meeting the constantly growing volume of parcels (778 million parcels in 2021, with a forecast of 848 million in 2023), and on the other hand, growing consumer expectations [Gemius, 2022]. According to the data of the Office of Electronic Communications in Poland, in 2020 there were almost 300 courier (parcel) entities. Almost half of all parcels in Poland are delivered in the B2C (Business to Customer) segment as part of e-commerce, and the percentage of online buyers is growing every year. The dynamic development of e-commerce is influenced by the growing mobility and great popularity of mobile devices. The value of the entire e-commerce market in Poland, along with the on-line services, is constantly growing. In 2017, it amounted to PLN 44 billion, in 2019 PLN 61 billion, and in 2021 as much as PLN 93 billion [PwC, 2021]. In terms of logistics, the high volatility of demand is problematic. Nobody refers only to the research on the trend or the classic seasonality of certain products, but to the large accumulation of

orders on certain days. The requirements and expectations of the e-commerce market customers are different in comparison to other sectors of the economy. Courier service providers must tailor their offers to the needs of both the seller and the customer (4PL/5PL). For the seller, quality, reliability, and system integration are most important, while for the buyers, convenience, flexibility, time and price are. In addition, shippers expect extended delivery times and customers expect flexibility with regard to delivery times.

Robotics and automation in the economy

Robots are increasingly often found in the world of logistics. The largest retail chains are constantly increasing their robotics resources, which improve the selection and completion processes. Robots may be found in the e-commerce industry, logistics operators, and suppliers of large retail chains. The robot market has been developing since the 20th century and is characterised by continuous development and sales growth. Manufacturers compete with each other in terms of the quality of the solutions offered, precision, efficiency and responsiveness. Tasks resulting from unfavourable working conditions, high efficiency and accuracy of the work performed, as well as increasing customer requirements result in increased expenditure on innovation and technological development. The robotisation of processes is a global trend. A systematic increase in the number of robots and manipulators used in logistics is currently observed. Industrial robots and manipulators can be used practically in the process of supply, production and distribution.

On a global scale, one may observe a significant increase in the number of robots and manipulators in logistics processes, from 1 million units in 2007, to 2 million in 2017, and up to 3 million in 2020 [Weger, 2022, p. 37]. In terms of categorisation by industry, 39% of robots service the automotive industry, 20% are for the electronics industry, 9% for the metal industry, 7% for the plastics industry and 4% for the food industry. Robots carry out many activities related to the production process. We are currently seeing the rise of a new type of robot – cobots, which are robots designed for direct cooperation with humans, supporting physical, dangerous or precise processes. The price of such cobots has decreased significantly; they are cheap to maintain, simple and safe to use and easy to programme. Thanks to the new software, users without a great deal of IT experience can programme, configure and use them. It is also an area for building new innovative companies. The robotisation of logistics processes undoubtedly allows one to achieve a great many benefits, not only including greater efficiency and effectiveness of the process, the consistent quality of merchandise and generation of fewer material losses, but also better working conditions. It increases work safety and enables the further development of employees through the acquisition of new professional skills. Another advantage of robotic machine handling is the ability to specify the exact date of order fulfilment, which

greatly facilitates the management of production and distribution processes. The key features of workstations are the possibility of controlling the quality of products directly on the production line and the total measurability of the process. It seems that companies using automation need to be aware of the fact that the use of robots is associated with sales growth. Most often, robots are used for welding, assembly, palletising, packaging and depalletising, painting, material processing, object manipulation, pallet transport and loading operations, wrapping pallets, disposal and protection of waste. There are also filling, dosing, inspection and testing robots. The described phenomenon fits well with the market of warehouse processes or courier (parcels) deliveries. Autonomous means of transport are increasingly often observed, such as forklifts, mobile racks (warehouses) and delivery of parcels. The use of autonomous vehicles in transport is particularly important in terms of independence from congestion of communication routes and numerous administrative constraints in the processes of loading and unloading (e-mobility). There is an implication of autonomous vehicles in the distribution of parcels to their destination. Examples include DHL Paketokopter, Amazon prime deliveries, French operator La Poste's drones, or Alibaba store deliveries in Shanghai, Beijing or Guangzhou. Especially noteworthy is the initiative of the American star-up Nuro, which presented an autonomous delivery vehicle equipped with an air-conditioned cargo space and an electric motor [Reuters, 2018]. During the Consumer Electronics Show, Pizza Hut and Toyota jointly presented an autonomous vehicle for meal deliveries [Insider, 2018]. Autonomous vehicles are also present in freight and passenger transport at the company Udelv [O'Dell, 2018]. The service market is also full of autonomous solutions. Vehicles aimed at business customers who are afraid to transport cash are serviced in the banking sector by autonomous vehicles in which cash can be deposited [Grabiec 2015]. This relieves entrepreneurs of the need to limit the transport of cash to the bank on their own. Production processes are a promising field in which to evaluate and analyse the application of robotics. Automatic parcel machines are common in Poland. Statistics show that there are almost 3,000 of them nationwide [Kawa, 2018, p. 14]. They enable one courier to leave several dozen parcels in one place without having to visit each recipient. In practice, this means that the recipient does not wait for the package, but the package waits for the customer. In contrast to classic delivery processes, the route here is fixed and predetermined. The very process of delivering a parcel to a parcel machine does not involve the consumer in any way.

There is a common, though subjective, belief that industrial automation has mainly been introduced in the parcel delivery industry. Robots are already present in warehouse processes, and more companies are applying automation to improve efficiency. Order processing time may be reduced from two hours to five minutes [Cieszyński, 2018, p. 17]. In one of the observed companies, employees do not move around the warehouse. It is the robots that provide them with the necessary components.

Products are stored at a high density (which is impossible in standard warehouses); for example, containers placed side by side in several layers. The robots move on overhead cranes and collect the necessary containers to deliver them to a particular employee. This allows for the elimination of classic communication routes and the densification of the storage area. The most frequently rotating products are stored in the highest value (type X according to XYZ analysis), while less frequently rotating ones are stored at low levels. This allows for better use of the warehouse with the same amount of work by employees in the picking department. The entire process is managed by a computer system. In the new Jeronimo Martins distribution centre in Gorzów (Lubuskie region), modern autonomous forklifts are being tested, accompanying the picker at every step. The vehicle always follows the employee, remaining a safe distance from the rack. This kind of autonomous helper focuses on order picking, avoids obstacles and always adjusts the speed to the current situation. This is possible thanks to sensor systems and lasers that recognise obstacles and empty racks, which are available in both automatic and manual modes.

It is not merely parcel delivery or warehouse processes that struggle with product transportation issues. The supply sector is also facing the challenge of optimising deliveries. A good example is the InterMarche network operating in Poland, which has introduced the possibility of online shopping and personal collection of products (pick-up drive-thru).

Most of the current innovations are designed to adjust the manufacturers' offer to the changing requirements of customers. Robots, in addition to improving the picking process, help to introduce a new assortment to the distribution network. Thanks to this, the storage space is better used, and the costs and risk associated with the introduction of a new product are reduced.

Low employment costs in the industry are one of the basic barriers to the development of automation and robotics. Unfortunately, they do not constitute an incentive to implement innovative process and production solutions in which manual labour is replaced by machines. Employment costs in Poland are still high (despite being competitive with Western countries). The challenge is the availability of employees on the market. Undoubtedly, this phenomenon is conducive to the development of robotics in Poland (especially in the face of the relatively low unemployment rate in the country (5.5%)). Robotisation always eliminates the pressure associated with searching for employees, especially at low levels. Additional barriers related to the purchase of vending machines and robots are the costs of their acquisition, but also of recruiting staff to operate them. According to research by the Market Economy Research Institute, entrepreneurs are afraid of robots due to their complicated activities [Łapiński, 2015]. Additionally, many entrepreneurs (approximately three-quarters thereof) did not implement innovations due to passivity and a lack of good ideas or lack of financing [Łapiński, 2015]. Another reason why robots are not used in

business practice is the small scale of production (production economics). There is also a belief that the implementation of automation will not bring tangible economic benefits [Michałowski, 2021]. Many entrepreneurs do not consider the implementation of robots due to the lack of analyses of how the application thereof will affect efficiency [Michałowski, 2021, p. 22]. Therefore, it is worth noting solutions from the USA, where the benefits of optimisation were noticed by Creator, a company that installed an automated line for the production of burgers, turning restaurants into an assembly line. Distribution centres of chain stores are increasingly often becoming mainly automated, offering intelligent (AI) ordering points, where the role of a human is limited to controlling and expanding the product offer.

Industrial robots and manipulators used in logistics processes most often perform manipulation, transport, packing and palletising operations. The main advantages of robotic applications include: [Dobrzanski, 2016, p. 83]

- round-the-clock availability,
- repeatability, increasing the quality of packed or palletised elements,
- increased efficiency,
- increased flexibility of production, reduced costs,
- reduced risks to the health of employees,
- increased security.

In some production processes, they also ensure that there is no contact between humans and products.

Polish reality shows that human-machine integration is only a plan that is limited mainly to technological changes. It is worth investigating the question of what causes a specific dissonance between industrialised countries and the Polish economy.

Humans against the concept of Industry 4.0

Three elements drive innovation – data, information and knowledge. Data becomes useful when turned into information and subsequently into knowledge. To date, the conversion process has been carried out through human-computer interactions. In the process of social evolution (Society 5.0), we may observe the emergence of a new super-smart society model, based on data (data-driven society) or on knowledge (knowledge-intensive society) [Chaber, 2021, p. 52].

The fourth industrial revolution, commonly known in the literature as Industry 4.0, is a term that most often means the combination of machines, computers and software in an integrated network, controlling production processes, among other things, in order to improve the efficiency of human integration with technology. The new revolution in the industry not only means changes in technology. We may observe the implementation of this concept in new ways of performing work and the role of humans in industry [Januszkiewicz, 2019, p. 67]. Thanks to digitisation, machines have achieved better efficiency, flexibility and precision,

which in turn has resulted in the implementation of automation. Planning and control systems were developed to coordinate the operation of machines and devices within production. One may currently witness system integration and networking. Digitally controlled machines are integrated with people on the Internet using ICT solutions. Materials and finished products can always be identified; they also have the possibility of uninterrupted communication with each other, realising the flow of information between machines and the production system and vice versa.

The direction of changes we are dealing are profound, comprehensive, and can concern in general:

- the elimination of people from work processes – the robotisation and automation of production processes will also lead to changes in the way how economic organisations function; the current challenges we are facing nowadays rather concern changes in and the disappearance of particular professions and the formation of new ones, which is connected with the need to acquire new competences [Ford, 2016];
- changes in the relationship between humans and technology [Kehl, Coenenen, 2016], which are related to the broadly understood subjectivity of humans. Among other things, there are problems that concern, for example, the causative abilities of humans, the scope of their freedom, the conditions and requirements of the responsibility of humans as moral subjects or changes in their rationality [Kiepas, 2021, p. 4];
- social and cultural changes.

Significant changes have already taken place regarding the development of new media and the digitisation processes of various areas of the social and cultural world. Developments in Industry 4.0 are leading to the formation of a post-digital society as a result of progressive digitalisation [Berry, Dieter, 2015]. The areas or directions of changes indicate only the different, currently perceivable possibilities that may arise in the future. The perspective of changes towards Industry 4.0 and Society 5.0 is assessed differently. There are, for example, those who believe that the logic of the development of civilisation was the pursuit of independence from nature (achieved thanks to technological development). However, the progress of civilisation taking place through the subordination of nature and the creation of an artificial world took place in the name of the good of individual individuals, economic organisations and countries. The fourth industrial revolution has definitely changed this point of view in favour of subordinating the interests of individual interests to the interests of the community, which is possible thanks to modern information technologies (Rifkin, 2016, p. 23). These technologies create new opportunities for people to collaborate on a global scale. At the same time, they also allow one to control the consequences of these activities, eliminating negative effects and creating conditions for a fair distribution of the effects

obtained. This results in the emergence of a prosumer society in which newly established technology platforms create the conditions for the development of a culture of sharing, as opposed to mere appropriation (Rifkin, 2016, p. 28). The development of smart technologies, based on digital technologies, has a variety of applications and can be used, *inter alia*, to monitor the state of the environment, control various devices and processes, and shape various forms of cooperation between people as a consequence. Network dependencies should transform all activities into collaborations as they are implemented because of the interdependencies and relationships with others. Therefore, are the technologies related to Industry 4.0 treated as those that will automatically lead to the creation of optimal relations between humans and the world around us, and consequently between people on a global scale? Perhaps employees are afraid of professional exclusion in favour of robots due to the prevailing belief that they will be replaced by vending machines and robots.

Poland has a population of 38 million people, of whom almost 18 million are professionally active [GUSa, 2022]. As indicated above, progress in the robotisation of industry is progressing ever more rapidly. In 2007, there were 1 million robots. By 2017, that figure had grown to 2 million, and in 2020 more than 3 million. Despite the positive trend, the level of innovation in Poland is below the EU average; for many years Poland has been referred to as a moderate innovator [Osieczka, Stec, 2019, p. 84]. The share of innovatively active enterprises in the industrial enterprise sector in 2020 amounted to 36.7%, and in the Lubuskie region 26.8% [Wegner, 2021, p. 27]. Taking into account the size of enterprises, the highest percentage of innovatively active entities, as in the previous years, was recorded among large companies, or units employing 250 people or more.

The preliminary results of the pilot research conducted by the author using the Delphi method on the population of entrepreneurs in the Lubuskie region show that the reasons for the lack of robotisation result from the fact that entrepreneurs are not familiar with the existing solutions. Therefore, without detailed analyses, entrepreneurs remain convinced that robotisation in their company is unnecessary or they cannot afford such projects.

Conclusions

Each enterprise should undertake all activities aimed at the diffusion of scientific, technical and technological ideas for market success through the constant transfer of knowledge and information between organisations. Determinants of the emergence of innovative processes may be of a complex nature (sociological, psychological, philosophical, historical, organisational, and economic). Of course, they change over time, and each of them may have a different meaning and impact, but they are undoubtedly interchangeable and depend on factors that have an impact on the political and economic situation of the country at a given moment.

When attempting to identify the factors stimulating innovative activity, they can be defined as follows:

- the natural environment,
- state of knowledge,
- the condition of infrastructure,
- the organisational level of companies,
- consumer requirements,
- economic factors,
- sociological factors,
- psychological factors,
- the socio-political situation.

The foundations of innovative activity are the law of nature and the environment in which we live. Nature has the most universal character and influences the environment. Exogenous factors such as social, political, psychological, sociological and economic factors are most important. Thanks to them, it is possible to implement diversified and competitive activities on the market, and to verify them in terms of product and process innovations. Although the trend of diffusion of innovation is increasing, it is currently assessed as moderate. The main parameters limiting the level of innovation in Poland are limited financial resources and a lack of knowledge. Overcoming financial barriers is now possible thanks to many solutions from the financial markets, EU subsidies, Polish government subsidies and organisational solutions of companies providing services in the field of the implications of innovative solutions in the operations of enterprises. For example, managers who perceive the need for robotisation, but who are faced with the barrier of insufficient financial resources at their disposal, will find entities offering robots and industrial manipulators on the basis of equipment leasing. In such a way, costs may be significantly reduced. The company only needs to invest money in a position that can be designed in such a way that it can be used for another process after a certain period of time. The cost of the robot is comprised of a returnable deposit and a monthly fee for its use.

Thanks to cooperation between science and business, the diffusion of knowledge is possible, thanks to which it is possible to create an effective climate for creating innovation, especially in the digital world. This means that the key is to move away from the classic models of implementing innovation (push/pull) towards the coupled (mixed) model. Thanks to cooperation, it is possible to support and shape pro-innovation activities, setting the direction, strength and effectiveness thereof, and stimulating development, because a fear of robotics, automation and the digital world often results from a lack of knowledge.

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Analysis and Assessment of Relationship Management Exemplified by Bituminous Coal Companies in Poland

Abstract: The activities of coal mining companies in Poland are subject to a long process of transformation. Their operation is closely linked to certain external conditions that shape their internal relations. At the same time, through skilful management of relations, they influence their environment and the whole economic system in which they participate. The way coal mining is organised must ensure that the planned activities are carried out, so an effective management and execution system plays a key role. The article discusses the theoretical aspects of managing and leading people. It also analyses and evaluates the management of the activities of coal mining companies against the background of the current situation of this industry in Poland, based on the diagnostic survey method and the opinions of stakeholders.

Keywords: management, leadership, relations, coal mining

Introduction

The concept of management is a complex one, which communicates the significance and the content of actions taken as a result of it (Koontz, 1961, p. 186; Boddy, 2017, p. 11; Kaehler, J. Grundei, 2019, p. 7). Management consists in ensuring stability of daily action performance. Management encompasses activities comprising current and strategic planning, proper organisational infrastructure, and incentive and control activities. In turn, the core of HR management consists in causing the subordinates to take actions compliant with the superior's intention, which are aimed at meeting a defined goal.

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The concept of management also depends on the definition of leadership. The difference lies in the fact that management is a group of activities related to the managerial position within the structure of an enterprise, while leadership should primarily be associated with a specific person. Depending on the rank and area of management and the specific nature of organisation and its environment, various breakdowns of managers' qualifications, features, knowledge and skills become useful. The significance of conceptual skills grows at higher management ranks, while the importance of technical skills is reduced. Hence, a modern manager should have leader skills, be able to manage relations, and persuade others to follow his vision of development. He should have knowledge and high professional qualifications and manifest professionalism with respect to all processes taking place in an enterprise.

The purpose of the paper is to present the essence of organisation and HR management. Subsequently, the efficiency of the management and the executive system of a bituminous coal company will be analysed and assessed by its stakeholders. The goal defined in this way is conducive to adopting the following research hypotheses:

1. The current management system of a bituminous coal company is ineffective.
2. The currently functioning executive system of a bituminous coal company requires significant investment expenses.

Review of Reference Books

Operation of every company, organisation or state comprises management processes, which are supplementary and intertwine, but which also may stand in opposition. In multiple academic publications management may be defined in an ambiguous way. Management may be exercised in a functional mode, as an act of management, and institutional one, referring to managers and persons holding managerial positions. In turn, HR management is tantamount to 'guiding the individuals.'

Most researchers, starting with H. Fayol, believe that management is a set of actions encompassing such functions as planning, organisation, motivation and control, focused on the organisation's resources (HR, financial, material, information and knowledge) implemented with the intention of accomplishing the organisation's goals in a skilful and efficient mode (Fayol, 1916, p. 6; Godwin, 2017, pp. 78–85). At the same time, the efficiency of management and the success of an organisation entail the ability to use proper means to accomplish the desired goals and tasks (Drucker, 1954; Stroh, Northcraft, Neale, 2002). Based on the concept of function, R.W. Griffin determined management as a whole series of actions (leading to making a decision, planning and organisation of work, control and guiding human resources) focused on accomplishing precisely defined and efficiently implemented goals of an organisation, wisely and purposefully using all

the organisation's resources to this aim (Griffin, 2013, p. 5; Daft, 2016 p. 4). The next definition characterises management in a similar way: management is called the coordination of an organisation's resources, acting with people and through people, in an efficient mode (Robbins, Coulter, 2016, p. 39). Hence, management consists in the impact of an entity (a manager, owner) on an object (an enterprise or its elements) in line with the designated goal and leading to its implementation, in line with the will of the entity, via human factors, which are the primary capital of an organisation (Drucker, 1954, p. 17). In another interpretation of the concept of management, special emphasis is put on the survival of an enterprise and afterwards the aspect of its development is tackled. In this approach, the concept of management consists in conscious performance of tasks allowing for survival and determination of a direction of operation, creation of a mission and goals related to development (Bleicher, 2011). Management may also be seen as a process of exercising authority and leadership, a concept of a system and a game process (Naylor, 2004, p. 355; Gulati, Mayo, Nohrian, 2017, p. 8; Bateman, Snell, Konopaske, 2018, p. 226). Furthermore, management should be discussed as eliciting behaviour or shaping important factors related to the dynamic of organisational changes. In this approach, management consists of rational formation of dependences among elements of an organisational system and between the system and its environment. It goes without doubt that management is furthermore connected with observance of specific provisions of the law and rights forming a basis for the initiation of managerial activities.

The management system forms an important element of an enterprise, even though it is a concept inadequately defined in the area of management and quality sciences. However, the deficiencies do not refer to the questions how to manage (normative statements), which are embedded in the economic practice and used to solve specific problems of management, yet to cognitive statements, referencing the sole essence of management. The management system is an element of an operating system; a sub-system used to manage and one of the elements of an enterprise. It is its driving force, which should generate efficiency and allow for (Kast, Rosenzweig, 1972, pp. 447–465; Bieniok, 2018, p. 33:

1. harmonisation and dynamisation of growth,
2. increased efficiency of resource management,
3. improved work organisation,
4. precise determination of competence and accountabilities of employees,
5. reduction in the volume of documents and costs of archiving,
6. improved image of an enterprise and increased competitiveness at the markets.

Furthermore, a management system is defined as a consistent set of rules, goals and criteria, means and methods of making decisions, connected to managerial

and executive elements. It is thus assumed that an enterprise management system is a dynamic construct, dependant on its author, which is created, lasts, is shaped and subject to transformations. It forms an integral, critical sub-system of an enterprise's system, comprising information and decision-related elements, technology, market and human resources (Witczak, 2008, p. 25, 104, 127, 208, 212, 245).

In the concept of the enterprise management system, L.J. Mullins and H. Ulrich distinguish managerial activities bound to executive activities, i.e. a management sub-system and an executive sub-system (Ulrich, 1978; Mullins, 1993, p. 368, 373). A similar standpoint is presented by A. Stabryła, who divides an enterprise system into the management and executive sub-systems and then defines the latter as the production system (Stabryła, Trzcieniecki, 1980, p. 302). Furthermore, the researcher formulated a definition that says that the 'production system is a dynamic one, functioning as a process, in the course of which – on the one hand – an information and decision-making relationship takes place among the individual sub-systems and on the other, there are executive activities, referring to a specific object (Stabryła, Trzcieniecki, 1986, p. 131; Stabryła, 1991, p. 102). At the same time, the management system transforms information into decisions, fulfils the superior roles and performs managerial functions that are indispensable for the functioning of the executive system. Hence, existence of every company determines the goal of operation, has basic impact on the structure and the process of management and on the formation of all types of relations. This is of particular importance for individual sub-systems of an enterprise, which exert a significant impact on the entire course of the production process. In every production enterprise, the executive system and the division into individual sub-systems is different. This follows from the performed functions and the specific determinants of operation as well as the subordination to specific rules of HR management.

Management is a process aimed at coordination of actions of teams. In this aspect, the process of impact of the superiors on the subordinates takes place on two levels: in a direct way, by communicating instructions, creating a climate within the organisation and a coordinated system of supervision, and in an indirect mode, by determining the material and financial conditions of work, standards of conduct and scopes of authority, duties and accountabilities for meeting the organisation's goals. HR management is thus a process of motivating, leading and impacting the activities of the subordinates, according to the defined rules and directly refers to persons who remain in a professional relationship (Drucker, 1973, p. 400; Kaehler, Grundei, 2019, p. 24). Its core is the inter-personal impact, pertaining to the mode in which a director influences his subordinates to accomplish the pre-defined team and organisational goals. It consists in continuous solving any problems that emerge in the superior – subordinate relationship. It is related to the differentiation of human behaviour, reactions and feelings, because persons who have

different views, who carry their own baggage of experience and harbour specific expectations differently perceive their role in an organisation and the role of the superior managing the organisation.

Management should be effective, i.e. it should consist in performance of proper actions and lead to the accomplishment of the desired goal. The efficiency of management is understood both in the categories of economic efficiency, in reference to the effects compared to the incurred costs, but also to non-economic efficiency, related to the benefits for the employees and their professional development. Management that is efficient should rely on rational decisions made in consultation with peers. A person managing an organisation or a team is in charge not only of own actions, but also the actions of persons reporting to him/ her. Due to this, making decisions is considered the most important part of the management process, while the efficiency of action is assessed most often on the basis of its results. A director or a manager should be able to shape people in a way to make them capable of shaping themselves, act as their own bosses and creatively share what they have accomplished with people with whom they work (Blackburn, Rosen, 1993, pp. 49–66; Okpara, 2016; Szczepańska-Woszczyzna, 2020). Furthermore, the idea of modern HR management is to impact the employees in a way that they strive for improvement of the situation and results of their work of their own volition.

Managers are active in various organisations and use diverse forms and measures of impact, defined by cultural and legal standards in various periods of economic and scientific development. Modern managers should be comprehensively educated and should have the ability of flexible adjustment to every situation. They should have, primarily at higher management levels, not only professional education, but also specialist knowledge. They should be characterised by professionalism and cooperation skills with respect to work with employees and fostering friendly atmosphere. The efficiency of managers' work, both in an organisation and within the environment, is confirmed by the accumulated social and relational capital, built in observance of such fundamental values as wisdom, knowledge, objectivity, intelligence, logic, open mind and extensive horizons. In turn, managers at the medium and lower level of professional relationship should be familiar with the process of task performance in the subordinate teams. In such case, professionalism frequently tends to be the only determinant of accomplishing a status and their actual authority. Furthermore, a manager – if work is performed in an international environment – should have knowledge about cultural diversity and speak in the peers' language. The managers should set high moral standards, related to such traits of character as, among others, reliability, honesty, veracity, sincerity and kindness, which seems to be the basic determinant for building trust in professional relations. They should have the ability to strategically plan the future accomplishments of an organisation, think and act in a creative way in order to create a vision of prospective development of an organisation.

An important factor is also the ability to engage the employees in the preparation of a strategy of operation of an enterprise. Apart from it, such aspects as: management of information and communication, building intellectual capital of an organisation, organisational culture and structure and adjusting it to the needs of the organisation, functioning in a specific economic-social and cultural context are also basic issues.

Efficient management may be accomplished by following various management styles, such as autocratic, transactional, consulting, co-participating or delegating (Taucean, Tamasilaa, Negru-Strauti, 2016, pp. 66–75; Namiq, 2018). Furthermore, management as a group of activities performed by a manager within the structure of a company is inseparably associated with leadership. Leadership consists in affecting the conduct of others. It takes place when one person is capable of causing desired behaviour of another person with a view to accomplishing a common goal and success of an organisation (House, Hanges, Ruiz-Quintanilla, 1999, p. 184; Zabolotniaia, Cheng, Dacko-Pikiewicz, 2019; Ahadiat, Dacko-Pikiewicz, 2020). Reference books present the following types of leadership (Conger, 2004, p. 162; Riggio, 2004, p. 159; Brown, Eisenhardt, 1997, pp. 1–34; Gemmill, Oakley, 1992, pp. 113–129; Hartog, House, Hanges, 1999, pp. 219–256):

- charismatic, ideological or emotional, focused on accomplishing objectives of an organisation, its members and the leader who has a clearly defined vision of development;
- coordinative, when the manager shapes the interpersonal relations and shares power;
- anarchic, when it is created in a network structure, when the idea of a specific project emerges and the employees organise their work on their own;
- transactional, which forms a contract for an exchange of reciprocal services between a leader and an employee;
- transformative, which is a response to the specific vision of development of an organisation.

It is nowadays believed that a manager or a leader becomes more efficient when the range of his management or leadership styles is greater and a proper style can be matched to a specific situation.

Leadership is a part of management; a manager plans and organises, while a leader has to make sure that people will follow him (Maccoby, 200, pp. 57–59). A given person can be a manager or a leader, a manager and a leader or none of the two. Apart from it, a leader enjoys authority among people and has power that is voluntarily accepted (Toor, Ofori, 2008, pp. 61–67). In an informal organisation, leading means causing things to be done by others, but in compliance with the leader's will.

All of the factors listed above make up a certain whole, form the basis of the practice of human management and constitute determinants of efficiency of managing modern organisations encompassing (Fayol, 1949; Homburg, Workman, Jensen,

2002, pp. 38–60; Boyt, Lusch, Naylor, 2001, pp. 321–330; Uzuegbu, Nnadozie, 2015, pp. 58–72; Pathak, 2014; Rodrigues, 2001, pp. 880–889; Rajiani *et al.*, 2018):

- knowledge, skills, managerial competence,
- responsible choice of personnel,
- proper style of management, mode of impacting the subordinate team,
- reasonable decisions, based on consultations with peers,
- continuous improvement of teams and actions,
- in-depth analysis of opportunities and risks to actions taken,
- efficient communication within and outside the organisation and sharing knowledge,
- care for professional development and motivation of team members,
- control of team actions.

Summing up the discussion above: managers take care of the best performance of the entrusted tasks (Cieślińska, 2007, 3–12). In turn, leaders persuade others to accept their vision, set the directions of long-term growth of an organisation and its strategic goals, treat people in a more intuitive and empathic mode. The difference lies in the fact that a manager pays attention to how something is done, while a leader to how the actions and decisions affect the participants of such actions (Zaleznik, 2004). Modern organisations need both managers and leaders. In particular, they need leaders with managerial skills and managers with leader features. Competence of this type should be a part of the adopted strategy, because it is a source of competitive edge. Unfortunately, it has to be noted – as follows directly from the observation of economic practice – that not all managers are efficient in managing human resources. What is more, very few managers deserve the name of organisational leaders (Bhasin, 2016, Mtengezo, 2009).

Situation of Bituminous Coal Mining in Poland in SWOT Analysis

Bituminous coal mining in Poland has significant geological coal deposits at its disposal, which guarantees continuity of extraction in order to ensure energy security of the state. Furthermore, the extraction industry has experienced mining personnel and modern scientific and research potential, characterised by a high level of knowledge about risks related to mining and efficient prevention of such risks, at hand, which is also greatly important. The competence of this type is necessary with respect to the extraction of coal in the area of Upper Silesia (Górny Śląsk). At the same time, the mining industry is struggling with a considerable paralysis in adjusting the production capacity to the demand for coal, and is incurring individual cost of exploitation as compared to other coal producers at international markets. This calls for the modernisation of mines with large deposits which are, however, located at great depths, and the necessity of incurring high cost of other work in mining pits. On the other hand, significant concentration of mining

companies offers a possibility of introducing organisational changes consisting in merging companies into multi-mining area plants, which greatly shortens the way of mining personnel to the workplace.

Bituminous coal mining is characterised by a high technological potential related to the mechanisation of walls, yet the low level of its use (time of operation of machines and mining devices in many mines does not exceed 40% of the wall availability time) remains a still unsolved problem. All the factors above, combined with high costs of mining investments, result in insufficient scope of replacement investments and a low level of the production process innovation (processing and sale of bituminous coal), especially bearing in mind the unilateral nature of its use (as a resource for the production of electric energy and heat in the simple combustion process), which aggravates the difficult economic and financial situation of coal producers.

Furthermore, bituminous coal mining has inefficient organisational structure, which extends the decision-making process and compromises efficient flow of information. In turn, the excessive quantity of IT systems and the insufficient degree of their integration results in 'information chaos.' A significant problem in the bituminous coal mining sector is the system of wages, and specifically lack of a link between the increases in wages and work efficiency and excessive fragmentation of wage components. In turn, advantageous circumstances offer a possibility of efficient cooperation among the entities of bituminous coal mining sector in the area of production and in auxiliary realms, such as, among others: financial solutions, exchange of information about suppliers, information about technological and market trends.

Bituminous coal mining sector generates approx. 1 percent of the state's GDP and is an important employer at the labour market. Bituminous coal in Poland is still considered a priority resource, while coking coal is seen as strategic in the European Union. Hence, the Polish state accepted the obligation of implementing an energy security policy and pursues an efficient coal policy along with stabilisation of the situation on the coal markets. The overall energy balance in Poland is characterised by a high demand for primary energy, including electricity and heat from coal-based fuels (approx. 45%), which means that in the medium time perspective, it will remain the main component of the energy mix. Furthermore, even though certain seasonal changes in coal purchases for households have been noted, there is a significant demand for peak power for the industry, which is conducive to the supply of bituminous coal.

The difficult situation of the industry is further aggravated by the dropping prices of petroleum and gas and an increase of targets of carbon dioxide (CO₂) emission reduction, tightening of environmental standards, as well as changing socio-economic situation in the region, which translates to an increase in prices of electricity for the industry and households (Kasztelewicz, 2015, p. 4, 11; Makięła *et al.*, 2022; Makięła, Michałek, Stuss, 2022). Accounting for a significant dependence of the

domestic coal market on the international trends and sale prices of coal and other energy resources, investments in technical development become a must. Lack of investments or significant delays in their performance in mining and in energy sector entities relying on bituminous coal leads to reduced competitiveness, especially due to the fact that there is excess bituminous coal at the global markets and the competition is severe, in particular in the east and in areas that so far played a marginal role, such as Australia, the Republic of South Africa, the US and Mozambique.

When assessing (SWOT analysis) the internal factors and those from the external environment that affect the operation of the mining industry, it must be stated straightforwardly that the strong sides and the opportunities do not counterbalance the effects of adverse factors (weak sides and threats), which affect their operation. The analysis of internal factors shows the adverse economic and financial situation of coal producers on account of high unit costs of extraction, which are related to exploitation under strongly urbanised areas and at increasing depths. Attention is drawn to the insufficient degree of investments in new longwalls and a low level of innovation of the process of production. Problems related to ineffective organisational structures are highlighted, along with disadvantageous employment structure and low optimisation of work systems; they are combined with the consequences of management errors. Furthermore, external factors of mining activities, on account of their character and dominance, may considerably hinder and in consequence lead to liquidation of bituminous coal mining in Poland.

Even though the operation of the mining industry in Poland – given the range and the force of impact on the economic environment – is still an important branch of industry, yet the changing environment is formulating another approach to the industry. Hence, it becomes necessary to work out such mining and energy policy that assumes increase of technical and economic efficiency of extraction by striving to reduce the costs of production and to increase the working time productivity. Investments in modern and efficient coal extraction technologies should be boosted and clean carbon technologies should be developed, curbing the effects of fossil fuel combustion in the energy sector.

Postulated further rigorous limitation of carbon dioxide emission to the atmosphere and specific decisions on climate protection taken by the European Union pose a significant threat for the Polish economy. However, they are also becoming an opportunity for changing the way of looking at the role of bituminous coal. The European Union leads the way in fighting with global warming and sets specific objectives for the reduction of emission and all its members are liable for observing the adopted regulations.

A theoretical discussion about company management and the essence of HR management, along with presentation of an overall situation of bituminous coal mining in Poland is an introduction to a research process pertaining to the

assessment of efficient functioning of the management and the executive systems of mining companies in the opinion of their stakeholders.

Study Methodology

The research process regarding the analysis of operation of the management system and the executive system of a bituminous coal mine encompassed quantitative and qualitative studies. 380 persons took part in the questionnaire survey, 357 men (93.9%) and 23 women (6.1%). Ten experts, practitioners and theoreticians of bituminous coal mining who hold the positions of presidents, deputy presidents of coal companies, directors of mines/ groups of mines and their cooperating partners at managerial positions took part in individual in-depth interviews (100% men). The choice of experts for quality studies depended on their familiarity with the specific nature of operation of a bituminous coal enterprise, position held, professional knowledge and competence in the area of bituminous coal mining restructuring. The specific nature of activities conducted by the bituminous coal enterprises affected the structure of respondents on account of sex.

Questionnaire surveys were carried out in four groups; the largest group of respondents were managers of mines/ groups of mines, working at three positions: maintenance managers, higher level supervisory personnel and supervisory personnel – almost 48% of the respondents. Furthermore, clients – coal recipients (over 21%), clients – suppliers of machines, mining devices and services who formed the smallest group (7.6%) and trade unions as the representatives of the employees (over 23%) also took part in the survey. Taking the respondents' age into account, 45+ persons were dominant, who constituted over half of the respondents. The second group comprised persons aged 36–45 (over 31%), while the smallest group of the respondents were persons younger than 25 (less than 1% of the respondents). As far as the age of experts is concerned, six persons were aged 50–60, two persons were aged 36–49 and two persons were older than 60.

Study Performance

Performance of the study process presented in the paper was aimed at assessing operation of the management and executive system of a bituminous coal facility with a view to verifying the adopted study hypotheses:

1. The current management system of a bituminous coal facility is ineffective.
2. The currently functioning executive system of a bituminous coal facility requires significant investments.

Table No. 1 presents an outline of frequency for the respondents' opinions about lack of efficiency of the management system in the compared professional groups.

Based on the value of the reliability quotient, a statistically significant dependence was found between affiliation to one of the compared professional groups

and the opinion on lack of efficiency of the management system, $\lambda(24)=61.48$, $p<0.001$.

Table No. 1. Respondents' opinions about lack of efficiency of the management system

Management system is ineffective	Group													
	1.		2.		3.		4.		5.		6.		7.	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Disagree strongly	2	4.3	8	11.9	7	10.3	2	4.0	7	23.3	1	3.4	10	11.1
Disagree	21	45.7	27	40.3	35	51.5	18	36.0	15	50.0	17	58.6	22	24.4
No opinion	11	23.9	21	31.3	9	13.2	26	52.0	6	20.0	2	6.9	31	34.4
Agree	11	23.9	8	11.9	13	19.1	4	8.0	2	6.7	6	20.7	22	24.4
Strongly agree	1	2.2	3	4.5	4	5.9	0	.0	0	.0	3	10.3	5	5.6
Total	46	100	67	100	68	100	50	100	30	100	29	100	90	100

n – number of respondents, % – group percentage, 1- maintenance managers, 2 – higher level supervision, 3 – supervision, 4 – electric utilities, 5 – coal vendor, 6 – supplier of machines, devices and services, 7 – trade union representative.

Source: author's own study based on the performed studies ($n=380$).

The majority did not agree with the presented opinion. The managers strongly disagreed with the opinion. In the group of trade union representatives, 32 persons in total disagreed and strongly disagreed with the opinion that the management system was inefficient; 27 persons in total agreed and strongly agreed with the opinion that the management system was inefficient. Apart from it, this professional group had the most respondents who had no opinion (31 persons, i.e. 34.4%). In the group of persons who worked in the energy industry, there were more persons (26 i.e. 52% of the respondents) who did not have any opinion.

Next, table No. 2 presents an outline of frequency for the respondents' opinions about underinvestment of the executive system and the necessity of its restructuring in the compared professional groups.

Table No. 2. Opinions of respondents about underinvestment of the executive system and the necessity of its restructuring

Executive system is underinvested	Group													
	1.		2.		3.		4.		5.		6.		7.	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Strongly disagree	7	15.2	7	10.4	11	16.2	3	6.0	5	16.7	1	3.4	18	20.0
Disagree	28	60.9	36	53.7	41	60.3	21	42.0	19	63.3	18	62.1	49	54.4
No opinion	9	19.6	12	17.9	12	17.6	24	48.0	4	13.3	8	27.6	17	18.9
Agree	2	4.3	11	16.4	3	4.4	2	4.0	2	6.7	0	0	5	5.6
Agree strongly	0	0	1	1.5	1	1.5	0	0	0	0	2	6.9	1	1.1
Total	46	100	67	100	68	100	50	100	30	100	29	100	90	100

n – number of respondents, % – group percentage, 1 – maintenance managers, 2 – higher level supervision, 3 – supervision, 4 – electric utilities, 5 – coal vendor, 6 – supplier of machines, devices and services, 7 – trade union representative.

Source: author's own study based on the performed studies (n=380).

Based on the value of the reliability quotient, a statistically significant dependence was found between affiliation to one of the compared professional groups and the opinion on underinvestment, $\lambda(24)=46.07, p<0.01$. The managers (130 persons, i.e. 78.9% of this professional group) strongly disagreed with this opinion. In the group of trade union representatives, 67 persons, i.e. 74.4% in total, disagreed and strongly disagreed with the opinion that the executive system was underinvested. Furthermore, the group of persons working in the energy sector had the most respondents (48.0%) who did not have any opinion.

Hence, most respondents did not agree with the opinion that the current management system of a bituminous coal facility is effective and that the currently functioning executive system requires significant investments.

In the quality studies, the experts were asked the following questions:

1. How do you assess the system of management of mines/ groups of mines?
2. How do you assess the currently functioning executive system, is it necessary to restructure it?

In their responses, the experts assessed the management system diversely. The assessment differed depending on their outlook on the determinants of operation of mines and groups of mines.

With respect to the second question, in the experts' opinions, the basic issue of correct operation of the executive system is: *selecting and properly assigning the personnel to the tasks and improving their qualifications. Next, by means of simplifying the system of wages, better work performance and motivation to work should be enforced. If one has a team that one can rely on, it is necessary to take care of modernisation of the machine park.*

Apart from it, efficient restructuring of the executive system also requires:

- *improvement of work organisation, system of management and motivation of employees and management of the executive system,*

while the following aspects are of fundamental significance for the correct functioning of the executive system:

- *correctly performed preparatory work;*
- *investments in new longwalls and assessment of deposits;*
- *diversification of production activities.*

A significant obstacle in the management of mine executive systems is:

- *absence of managerial personnel from medium to top level;*
- *lack of independent thinking on the part of supervisory personnel.*

Furthermore, decisions are required which will allow for:

- *rebuilding the extraction potential and making the state independent from coal import, in order to function independently from market fluctuations and prices of coal around the world;*
- *creating good conditions of work for the employees;*
- *supplying proper coal extraction equipment, compliant with their expectations and needs.*

Only one expert – when responding to the question asked – positively assessed the executive system in his mine/ group of mines by saying:

- *in our mine, I would only slightly modify the executive system. Generally, it responds to the needs; in case of necessity it should be adjusted to them. The mode of work organisation in the executive system has to guarantee performance of tasks – there are relevant people responsible for it. Bad work organisation prevents performance of stipulated plans and accomplishment of quality; you always have to react on an ongoing basis.*

The majority of study participants had numerous reservations as to the currently functioning executive system. They mentioned that extraction activities are complex and only uninterrupted work (organisational and managerial interaction) of all system elements allows for its efficient operation.

When presenting their remarks, the experts – performing the assessment – offered specific solutions to increase the efficiency of the executive system of extraction. In their opinion, people have the greatest impact on the functioning of the executive system. At the present moment, lack of qualified employees and

managerial personnel is noticeable who would be accountable for the managerial decisions made. Apart from it, a rapid change is needed in the incentive scheme, the system of employee wages and the management system which is going to guarantee efficient management of the executive system.

Study Results

Moving on to the specific results of the questionnaire survey pertaining to the assessment of the management system, it must be stated that there is a significant dependence between affiliation to one of the compared professional groups participating in the survey and their opinion. Most respondents did not agree with the statement about lack of efficiency of the management system (Table No. 1). The managers from all professional groups strongly disagreed with it. In the group of trade union representatives, 32 persons believed that the management system was efficient, because in spite of all the difficulties related to coal production, extraction was taking place. Only 27 respondents expressed opinions about inefficiency of the management system. Apart from it, this professional group included the most respondents who did not indicate their assessment (31 respondents had no opinion, which makes up 34.4%). These persons were wary of speaking about the subject or were not aware of the overall economic situation of the bituminous coal mining sector. In the group of persons working in the energy sector there were 26 respondents (i.e. 52% of the respondents) who also had no opinion. In this case, it may be concluded that they preferred not to assess the system with respect to which they cannot take a stance. The above study results have shown that the majority of managers did not see the necessity of changes in the management system in which they participate, which may follow from growing accustomed to such mode of management and the fact that they are unable to critically assess their own actions. However, in spite of such opinion, according to the author of the study, the management system may become more efficient and should better perform the functions for which it has been designed.

In turn, with respect to the analysis of the executive system and the necessity of its restructuring (Table No. 2), the respondents – depending on the type of professional group to which they belonged – differed in their opinions. Nevertheless, they strongly disagreed with the opinion about the necessity of additional investments. Only the ‘I have no opinion’ group had more persons working in the energy sector than in other professional groups. The respondents believed that the executive system performs its role, even though it is still encumbered with many years of neglect as far as opening new longwalls is concerned. If there are no investments of this type, prepared in advance (in the mining industry, investment planning is extended and it amounts to – depending on the scale of investment – even up to 5 years; as a rule, there are 2–3 year periods), there is no coal, no profit or it is proportionately

lower. In the past period of competitive coal prices at the world market, lack of development and preparatory work resulted in lack of coal from the Polish mines.

This type of approach to the necessity of growth of investments in the mining industry in the opinion of authors of the paper attests to the respondents' tendency to abide by the old standards of operation, which rule out a change in the mode of operation of the mines. Changes are perceived as threatening and they are accompanied by a feeling of mistrust to the decisions made by the top level managers and fear of loss of jobs.

In line with the conclusions presented above pertaining to the assessment of efficiency of the management system and the assessment of operation of the executive system and the necessity of its restructuring, the respondents and the experts for the most part presented completely opposite stances. In the questionnaire survey, the respondents believed that the executive system fulfilled its role and the management system was acceptable. In turn, the experts, making a general assessment, pointed to long-term investment neglect in the executive system in multiple aspects and shared their critical views on the managerial skills of the managers. They pointed to specific examples of neglect, incompetence and cardinal investment and management errors (among others when setting up networks of integrated mines), which influenced a drop in the level of coal extraction.

However, taking into account the results of the performed studies and the opinions of all stakeholders of the bituminous coal mine facilities, it may be stated that the study hypotheses analysed in the paper have not been confirmed.

Discussion

The conclusions from questionnaire surveys offered unexpected results. In spite of numerous negative opinions and examples of lack of efficiency of the management system of coal production and underinvestment of the executive system, the majority of the respondents concluded that the present-day situation was satisfactory or decided not to share their views. This situation reveals a low level of awareness of individual professional groups, in particular the group of managers, and lack of knowledge about the market situation and limited prospects for performing mining activities in the present-day shape. Furthermore, it shows the overall discouragement and lack of interest in changes introduced in the mine operation systems. However, taking the experts' opinions into account which manifest great care and concern about the irregularities in the functioning of the executive system (exploitative deposit management related to resignation from extracting remnants of coal deposits, failures of mining equipment), necessity of investments in opening new longwalls (without investments there is no development), modernisation of the machine park, introduction of innovative coal extraction and processing technologies and changes in the mode of perception

and combustion of bituminous coal, it must be concluded that performance of this study procedure has been fully justified.

The executive system of individual mines is identical because it stems from certain mining standards. All the elements that make it up, i.e. development work, preparatory work, reinforcement of walls, extraction and transport of coal to the surface, require investments in replacement of worn machine park and modernisation of the underground infrastructure (guarantee of transport of employees to the work place) and ground-level infrastructure (among others: shafts, means of coal transport, coal processing plants) of the mines. Very considerable financial outlays must be made that should – eventually – comprise the profit from every ton of sold coal, allowing for stable operation. If one thinks about the coal mine industry seriously, coal mines should be wound up in locations where extraction is not economically justified.

According to the study, individual groups of stakeholders are not aware of all the problems faced by the bituminous coal mining sector. During the discussions held with the respondents, it was ascertained that the management system should undergo thorough restructuring. Serious problems with work organisation were highlighted, which are visible in general and in individual mines. Spontaneous administrative decisions were mentioned, which have adverse impact on the level of extraction, add up to employee dissatisfaction and reduced motivation to work. It was explained that the bituminous coal mining has a hierarchical system of management, where any sort of human initiative has been lost. Employees do not wish to be held accountable for the decisions made because they are not treated like partners. Such regime of subordination to the superiors is primarily related to the necessity of discipline of work underground and threats resulting from coal exploitation. Nevertheless, incorrect managerial decisions affect the entire extraction process, evoke significant resistance and dissatisfaction of the employees and directly impact the relationship management in whole.

Conclusions

Managers of bituminous coal mines should be aware of the necessity of changes, in particular in the area of work organisation and improved efficiency of extraction. Nevertheless, in the course of the study process they claimed – which was surprising – that the executive system fulfilled its role and did not need restructuring, while the management system was acceptable. In turn the experts, making a general assessment, pointed to long-term investment neglect in the executive system in multiple aspects and shared their strongly critical views on the managerial skills of the managers.

The presented study results attract special attention to the absence of interest of the owners and managers of various levels in increasing the efficiency of operation

of the coal production systems in individual mines and significant backlogs in handling the information policy for the mining personnel.

Transformation of the bituminous coal industry is a necessary and difficult task which is happening here and now. It is all the more difficult because the mining industry is one of the elements of the energy system, a guarantor of the state's energy security, which requires comprehensive political decisions. Scheduled liquidation of mines, even though dispersed over time, will have economic, technical and social effects for the mining industry and mining-related environment of individual employees. Hence, it is important to make use of the existing productivity, the employees' intellectual capital and the development potential of the region to guarantee the prospective potential. This development potential may be pursued in the next several years of the operation of the mining industry and subsequently transferred to other spheres of operation.

The discussion initiated in the paper does not exhaust the extensive issues related to the management of bituminous coal production in Poland. However, it forms an important and valid aspect of economic activities, leading to specific remedial actions and encouraging further theoretical and empirical discussions on the subject.

The management system of a company operating on the liquid and gaseous helium distribution market – a case study

Abstract: The liquid and gaseous helium distribution market is highly specific and unique due to the extraordinariness of the raw material, the properties, applications and rarity thereof, and the topic encompasses a great deal of interdisciplinary research. This paper focuses on the assessment of the enterprise management system operating on the Polish and international liquid and gaseous helium distribution markets. The research focused on a detailed market, strategic, personnel, financial and process analysis. A triangulation method was used, including: 1) individual interviews with the owner and employees; 2) direct observation of the processes taking place in the organisation, and 3) a critical-cognitive analysis of the available primary materials (derived from the company) and secondary materials (literature review and information from electronic databases). The data on the activity of the enterprise under study was obtained from the Polish Central Register and Information on Economic Activity. Information on the administrative, strategic and technical processes related to helium obtained from a quality manual, instructions and safety data sheets for liquid and gaseous helium. The financial analysis of the company's operations included data from reports on the national public tenders. The results of the study showed the many strengths of the company. All sub-systems (market-driven, strategic, personnel, financial and process) had a favourable effect, which resulted in a positive final evaluation of the entire management system of the enterprise. The effectiveness of the management system of a company operating on the helium distribution market is influenced by the following factors: 1) high competitiveness of the enterprise, associated with a very good reputation among market participants (suppliers, recipients, cooperators); 2) a high level of customer satisfaction manifested in a constantly growing group of both new and returning customers from all over the world; 3) high work efficiency resulting from a properly developed action strategy

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covering every smallest aspect of the company's operation, including a highly motivating personnel policy; 4) continuous improvement and development of each activity and process carried out in the company, including the skills and knowledge of all employees; 5) constant adaptation of the strategy to the changes in the environment.

Keywords: management system, liquid and gaseous (compressed) helium, marketing and distribution of helium

Introduction

The aim of the study is to evaluate the management system of a company operating on the Polish and international liquid and gaseous helium distribution market. The research focused on a detailed market, strategic, personnel, financial and process analysis. The choice of the enterprise to be examined resulted mainly from the fact that the company has a well-developed management system, which additionally focuses on continuous improvement. It consists of smaller subsystems, the task of which is, *inter alia*, building, streamlining, modernising and developing individual departments of the organisational structure and sectors of activity in terms of the processes taking place therein.

In the context of market analysis, the scope of the research included the determination of the groups of recipients of the company's services and suppliers of liquid helium, as well as domestic and foreign competitors. The strategic analysis included the analysis of risks and opportunities as well as the definition of the company's mission, vision, strategy and quality policy. An important part of the research was the diagnosis of the personnel management methods, which were the determinant of the effectiveness of the entire enterprise. In terms of financial analysis, the annual financial results within the period of 2010–2018 were examined. The scope of the last segment concerned the analysis of internal processes in the company, including the management and control policy.

The hypothesis verified in this paper is the statement that the correct and effective functioning of an enterprise management system on the liquid and gaseous helium distribution market is determined by a number of parameters, including the company's competitiveness on the market, the optimal value of financial indicators, the level of customer satisfaction, the effectiveness of the work performed, continuous improvement of all activities and processes in the organisation and continuous adaptation to the changes taking place in the environment.

In order to analyse the enterprise management system, triangulation was used (Stańczyk, 2011) consisting of collecting theoretical and empirical information gathered from various research methods, comparing and generalising the final results. In this context, the following methods were used: an individual interview (Czarniawska,

2002; Stachak, 2006) with the owner and employees of individual departments of the company; a direct observation (Kostera, 2003) of the processes taking place in the organisation; and a critical-cognitive analysis of the available primary materials (derived from the company) and secondary materials (from the literature review and electronic databases). The set of formal data on the activity of the surveyed enterprise was obtained from the Polish Central Register and Information on Economic Activity (CEIDG, 2021). Part of the information on the administrative, strategic and technical processes related to helium was obtained from the quality manual, instructions, safety data sheets for liquid and gaseous helium and the official website of the company. The scope of the financial analysis of the company's operations included data from the annual reports from national public tenders conducted in the period of 2010–2017.

Literature review on systems theory and company management analysis

Systems theory is a comprehensive theory that applies to every system in nature, in society and in many fields of science where phenomena are considered holistically (Mele et al., 2010). The systemic approach, initiated by Ludwig von Bertalanffy (1968) and Norbert Wiener (1948), the creator of cybernetics, became popular in the 1950s. Its essence is to treat enterprises as open systems, composed of sets of elements that make up a distinctive whole in the environment (Ng, Maull and Yip, 2009; Gadomska, 2008). One of the most popular definitions considers the system to be a set of elements (things, objects, components) with properties (attributes), and these elements are interrelated (Kast and Rosenzweig, 1972). Systems theory is therefore based on a shift in attention from the part to the whole (Jackson, 2003; Weinberg, 2001) and implies a dialogue between holism and reductionism.

When perceiving an organisation as a system, four elements can be distinguished: 1) inputs – in the form of material, human, financial and information resources taken by the organisation from the environment (Katz and Kahn, 1978; Burns and Stalker, 1961); 2) transformation processes – covering technical and managerial processes, thanks to which inputs are transformed into results (Emery and Trist, 1960); 3) results – i.e. products and services, profits or losses, information and staff behaviour (Clark, 1993); 4) feedback – obtaining information about the state of the environment, including potential disturbances, allowing for changes in the transformation processes (Beer, 1972; Griffin, 2004).

According to H.J. Leavitt (1965), the organisation is an ordered system composed of four subsystems, including: 1) goals and tasks performed in the organisation; 2) people with their individual and collective aspirations and patterns of behaviour; 3) material and technological equipment and specific rules of use thereof; 4) formal structure, i.e. the adopted rules for the division of tasks and responsibilities (Sokołowska, 2009).

Taking into account the viable system approach, Golinelli (2005) and Barile (2008) suggested two consolidated organisational and managerial models: 1) sub-system – focusing on the analysis of relationships among the internal components of a company; and 2) supra-system – paying attention to connections between enterprises and other entities in their context.

J.W. Gościński (1968) and A.K. Koźmiński (1979), in defining the role of the management system in the organisation, stated that it has a superior function over other subsystems and is responsible for their operation. Self-regulation of the management system is manifested in the concentration of management on prospective issues, creating and redesigning subsystems (Beer, 1975). The basic forms of external operation of the management system are the emission, collection and processing of information, among others. In particular, the implementation of the entire complex of managerial activities, consisting of making planning and organisational decisions, as well as motivating and controlling the course and results thereof, should be emphasised (Dźwigoł, 2013).

The process of self-regulation aimed at maintaining the state of equilibrium in the system is called the process of homeostasis (Hannan and Freeman, 1977). Homeostasis can be defined as maintaining one or more variables at the same level despite changes in the environment. It allows enterprises to remain in a state of dynamic equilibrium (Jajuga, 1993).

The key factors in shaping an organisation are at the same time fundamental determinants of its management system. They include the dynamics and level of competitiveness of markets and products, the size of the enterprise, the expectations and power of key stakeholders (Christopher, 2007), the potential of the members of the organisation, the advancement and prevalence of key technologies, cultural conditions of the organisation and the environment (Brownlie, 1994; Belz and Skalik, 2011). Entrepreneurs have to plan and implement structural adjustments to guarantee the survival of the company's management system, formulating new business scenarios, including positioning, transformation and redefinition of the organisational structure, in order to provide sustainable development of the company from a long-term perspective (Vicari, 1992; Mele et al., 2010).

Fundamental issues related to helium and its application

Helium is the second most abundant chemical element in the universe after hydrogen, although it is present on Earth only in trace amounts (Wheeler, 2015). It is a colourless, odourless, tasteless, non-toxic inert gas that belongs to the group of noble gases (Niechciał, 2013).

In 1868, Pierre Janssen discovered helium in the spectrum of the sun while observing an eclipse by spectroscopy. In 1895, the Scottish chemist William Ramsay was the first to discover helium on Earth during experiments with a

mineral containing uranium. After the examination of the samples by spectroscopy by Janssen and Lockyer, helium which was identical to that found in the sun was identified (Heather, 2007). In 1903, helium was first found in natural gas deposits at a mine in Kansas in the USA (McKinney, 2019).

Global extraction of helium takes place in only a few countries. This is due to, inter alia, limited access to sources with a sufficient percentage of the element and the profitability of its extraction. This often involves the use of an expensive low-temperature condensation process, which separates the raw helium gas stream from a liquid consisting of hydrocarbons, and then purifies it in cryogenic installations or using the PSA (pressure swing adsorption) method (Szwast et al., 2014).

Helium is obtained mainly in five countries (Fig. 1), of which the leader (approximately 73% of global gas production) is the United States, where the annual production of helium is 75 million cubic meters. The largest area of these sources is in the states of Kansas, Oklahoma and Texas, where the element concentration is 0.3 – 2.7% (www.blm.gov).

Fig. 1. Helium mining sites



Source: www.airliquide.com (access: May 15, 2021).

Algeria is also at the forefront of global helium production with a 13.5% share (extraction of 40 million cubic meters per year), while Qatar has a 9% share in production (15 million cubic meters per year). Fourth on the list is the city of Orenburg

in the western part of Russia, where up to 8.8 million cubic meters of helium is produced annually (www.blm.gov).

In terms of Europe, the only country that obtains helium from natural gas is Poland, which has a 1.5% share in the global production with an annual extraction of 3 million cubic meters. This process takes place at the Polish Oil and Gas Mining Plant (PGNiG S.A.) located in Odolanów (Perez, 2017). The national resources of deposits contain about 0.1–0.4% of the element, most of which is found in Kościan (www.parkiet.com).

In addition to the abovementioned areas of global helium extraction, more helium-containing deposits are being discovered over time. One of the most famous discoveries in recent years is in the Rift Valley in Tanzania, the size of which has been estimated at over 1.5 billion cubic meters, which is the largest discovery of this type in the world (www.pcsa.org.pl). Each obtained amount of helium and each newly discovered source of helium is of great importance on the global market, both in terms of price creation and wide possibilities for application.

Due to its remarkable properties, helium is widely used in a variety of fields, ranging from commercial industries to scientific research. The beginnings of the helium industry date back to the interwar period, when helium was of interest to the US armed forces due to its lightness and inertia (Nuttall et al., 2012a). At present, this element is mainly used in seven areas, namely cryogenics (30%), lifting gas (17%), semiconductors, superconductors, optical fibres (14%), welding (9%), engineering and science (8%), detection leakage (6%), and gas chromatography (6%).

It is worth paying attention to the use of helium in international defence systems, including observation units, science balloons, testing rocket engines and air-to-air missile guidance systems. Moreover, this gas is used in space programs by major agencies, including NASA and Arianespace, which are leading users of helium for the compression of hydrogen fuels, as well as the production and use of rockets, machines and spacecraft (Nuttall et al., 2012b).

Liquid and gaseous helium distribution market

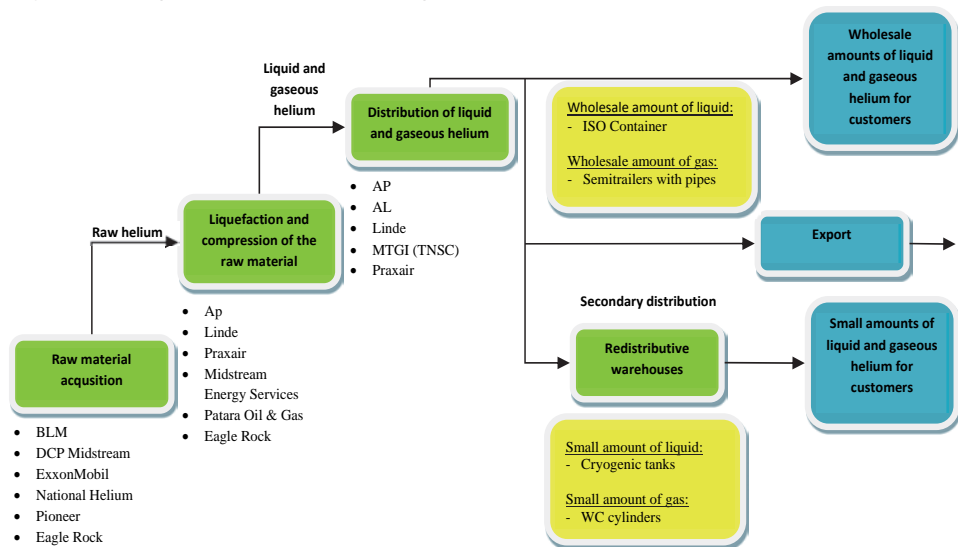
The helium trading market is highly specific, as it is not a commodity that is sold and bought on public stock exchanges. Its prices fluctuate much more than oil prices. For this reason, entrepreneurs distributing helium should be characterised by high levels of management flexibility in the event of unexpected changes.

The key issue regarding the characteristics of the liquid and gaseous helium distribution market is the analysis of the factors that drive it. Taking into account the specific characteristics of mineral resources, four factors are distinguished that affect the supply, demand and price of helium. These include geological uncertainty, volume of demand, helium producers and suppliers, and the natural gas production market (National Research Council, 2000).

Geological uncertainty is a factor on which humans have no significant influence. This is due to the fact that helium is a non-renewable resource with limited sources on Earth. The US Scientific and Research Agency and the US Department of Internal Affairs jointly estimated global helium reserves at 51.9 billion cubic meters in 2019. Assuming current demand at a constant level, the Earth's helium reserves will last for about 230 years (Danabalan, 2017). The demand for helium, which increases every year, may contribute to a critical drop in its supply even within several dozen years. This factor means that sudden changes in prices and the limited availability of helium may occur at any time. Interrupted deliveries are extremely harmful in selected industries and in medicine, where in many aspects there are no substitutes for helium (Stokes, 2013). Managing inventory and distribution becomes a significant challenge for enterprises. The ability of companies to adapt to unpredictable market situations is the key to their maintenance and development.

The second factor influencing the helium distribution market is the size of demand. The greater the demand, the more dynamically developing the market. The demand for helium, as with most other raw materials, is primarily derived therefrom. This means that many helium consumers do not use helium as an end product, but as an input to the production of other goods and services. An example is helium for cooling magnetic resonance systems or optical fibre bundles in telecommunications.

Fig. 2. Supply chain of liquid and gaseous helium



Source: own elaboration based on Campbell (2013).

There is some potential for consolidation among international helium suppliers and producers to ensure internal industry cohesion. The distribution market has many stages, ranging from the extraction and storage of raw helium to refining, to liquefaction and compression, to transportation and final use. These processes require the work of many companies, enabling effective communication between the various phases of the market. A diagram of the distribution process based on the example of the United States is presented in Fig. 2.

The supply chain begins with the extraction of raw helium from natural gas deposits. Examples of agencies and enterprises in the USA dealing with this stage are BLM, Pioneer, and Eagle Rock, among others. Raw helium undergoes a further stage of purification, liquefaction or compression. It is then shipped to large customers, export terminals and secondary redistribution warehouses for repackaging and delivery to small and medium-sized customers.

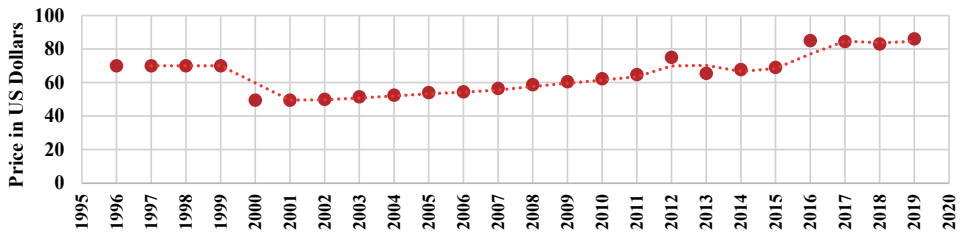
The fourth factor influencing the liquid and gaseous helium distribution market is the natural gas production market, from which raw helium is directly obtained. This is due to the fact that the process of extracting this element from selected sources of energy raw material is the first stage of shaping its initial prices. This issue is closely related to the costs of specially designed and extremely expensive installations (the cost of membrane installations is approximately PLN 50 million), refining the obtained gas and storing supplies (National Research Council, 2000).

Helium prices and their forecasts, 1996–2019

The helium distribution market consists of global competition from private companies dominated by as many as six powerful leaders: Air Products of Pennsylvania, Air Liquide of Paris, Linde Group and Messer of Germany, Praxair of Connecticut and Matheson of New Jersey. An additional market participant whose task is, inter alia, controlling the global price level is the government of the United States. The intervention of the federal Bureau of Land Management creates uncertainty for all those companies that have to respond to any changes and trends in natural gas extraction. Moreover, it suppresses the inflated helium prices after market crisis situations (Nuttall et al., 2012b).

The data shown in Figures 3 and 4 show significant differences in the prices set by private helium sellers and the US government. The quoted prices in dollars (\$) are for a specific quantity of 1000 cu ft. In terms of Figure 3, helium prices for the first four years of monitoring remained at the level of \$70, which could then result from having the world's largest reserves of resources and, at the same time, weaker competition on the market. In 2000, they dropped suddenly to \$50, and then slowly increased with each passing year. Since 2016, prices have stabilised again, albeit at around \$85, the highest price set by the US government to date.

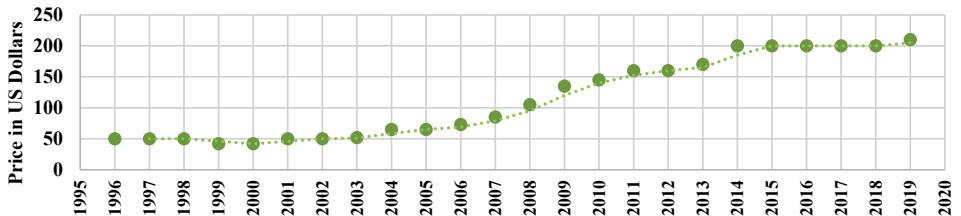
Fig. 3. Government prices of helium per 1000 cu ft



Source: own study based on (www.usgs.gov).

In Figure 4, which shows the average helium prices set by private production and distribution companies, the data from 1996 to 2019 show a clear upward trend. The first stage of their rise from \$50 to \$60 per 1000 cu ft came in 2004 during a temporary period of supply volatility. Current helium prices are over \$200, which is as much as 400% of the original 1996 helium price. Moreover, when one compares the prices set by the government and private companies, it is possible to observe that each year the differences in their levels increase significantly. It is much more expensive to purchase helium through private sellers, where the current helium prices exceed the government prices by almost 150%.

Fig. 4. Prices of private sales of helium per 1000 cu ft



Source: own study based on www.usgs.gov.

Characteristics of the activity of the examined enterprise

The investigated enterprise began operating in 2003 in the town of Odolanów (in the Greater Poland Voivodeship) in Poland. The company belongs to the group of suppliers of liquid and compressed helium on the Polish and foreign markets. In 2004, the first significant investments were made, in the form of the purchase of a delivery vehicle and expensive specialised tanks for the transport of liquid helium. Taking into account the dynamic development of the company, including the constant acquisition of new employees, customers, suppliers, equipment and tanks, the decision was made to move the company's headquarters to the town of Czarnylas in the Ostrów district. Czarnylas is located 45 km from the Wrocław bypass, as well

as 10 km from the trunk road no. 11 connecting Poznań and Bytom. Another advantage is the airport in Wrocław, 90 km away. The area of activity is on the route where magnetic resonance imaging (MRI) machines are most often transported, which requires helium to be replenished during transport.

Currently, the company is engaged in the wholesale of chemical products and related services. The company specialises in the supply of liquid and gaseous helium throughout Europe and to various parts of the world. It offers helium refilling services in imaging diagnostics (MRI) equipment located in Poland, and additionally enables the storage and servicing of magnetic resonances at the company's premises.

Liquid helium is the most frequently sold product; therefore, the management of its stocks and distribution is one of the most important tasks undertaken by the company. To meet the expectations of customers, the company offers three types of tanks with capacities of 100, 250 and 500 litres, respectively. Taking into account the different width of the entrances to the rooms, the working width of the tanks was modified so that they could fit into any location (image 3 and 4). Each of the tanks is designed as a dewar vessel, which is the only way to store and transport liquid helium (Van Sciver, 2012).

Photo 1. Company headquarters



Source: own study.

Photo 2. A delivery truck with a tank for the transport of liquid helium



Source: Company archives.

Photo 3. A set of cryogenic tanks for the transport of liquid helium



Source: Company archives.

Photo 4. Types of cryogenic tanks

Source: Company archives.

Photo 5. Gas cylinders for the storage and transport of compressed helium

Source: Company archives.

Photo 6. The process of replenishing helium levels in an MRI machine



Source: Company archives.

Another service offered by the company is the filling of magnetic resonance systems used in private health care facilities and public hospitals (photo 6). Thanks to highly qualified personnel, the company achieves a high level of efficiency of helium filling in both long-term devices and in the latest models of well-known MRI equipment manufacturers.

The last item on the list of services offered is the possibility of storing magnetic resonances on the premises of the company, along with the servicing thereof. Since 2010, the company has stored more than 70 MRIs, mainly brands from leading companies in the industry such as Siemens and Philips. The company has excellent technological facilities, including devices and parts for all MRI brands. The company guarantees the high quality of all products and services offered. Every year, the experience gained, acquired knowledge and specialised technical facilities allow the company to build strong cooperation with customers and maintain a leading position on the market.

Mission, vision and strategy of the organisation

Mission, vision and strategy are the three pillars of any business that should not be lacking in any successful enterprise. The surveyed company precisely specifies the course of action and the most important short- and long-term goals. The company's activity regarding internal processes and the environment is based on detailed plans, adapted to the current market situation. These plans, transformed into the concept of the company's mission and vision, are an expression of the aspirations of

the management board and the team of employees. Taking into account the development of the company and the fulfilment of customer expectations, the surveyed company defined the mission of its activity: “We are a professional supplier of liquid and gaseous helium and a trusted provider of MRI magnetic resonance storage. We are for you – everywhere”.

The content of the company’s mission is based on three main messages, including professionalism in business, trust and dedication to the customer. Sales and service specialists provide help and advice in every situation, are never indifferent to the problems of recipients, and consider each case and request individually.

The surveyed company also created a vision of its future, which was clearly communicated and embraced by the entire community of the organisation. It is a picture of the future, which includes the stability of a company enjoying broadly understood respect and trust in the industry and a successively increasing number of returning customers. In addition, this idea is developed by the development of the company in the form of hiring new employees, expanding the technology park, means of transport and expanding a specialised research laboratory. This vision is associated with an optimistic attitude towards success, the achievement of which is both real and credible.

Based on the purpose of the company’s existence and its meticulously created future, an action strategy has been developed and implemented, which is an answer to the question of how to most effectively implement the company’s vision and mission. For this purpose, a number of factors determining the effectiveness of strategy building have been analysed. An analysis and assessment of the company’s environment was carried out, including all the elements that may affect the functioning of the company. They concerned changes which have taken place on the market in the last few years and growing customer expectations. Another key issue was a thorough qualitative and quantitative analysis of the potential of the organisation.

In order to complete the plan to construct an accurate and effective strategy, the company identified its strengths and weaknesses, which include:

1. Strengths – a small family business; a high level of involvement of the owner and the entire management in all activities and processes; highly trained staff; the rapid flow of information between the various levels in the hierarchy of the organisational structure; high flexibility, mobility and openness to various customer needs; readiness to operate seven days a week, 24 hours a day; a global range of products and services offered; ideal locations both in Poland and in Europe; constant cooperation with numerous clients from Poland and Europe; a cheerful and friendly atmosphere amongst all employees; high mobilisation related to competition in the

form of large corporations; legal form of the enterprise – limited liability company; well-developed technological base; own means of transport.

2. Weaknesses – periodical shortages of raw materials on the local market; difficulties in finding appropriately qualified staff on the market; devices that are difficult to find on the market (liquid helium tanks); differences in the price of the raw material depending on its supply.

The company's operating strategy includes the development and improvement of all branches of activity. In order to meet the increasing expectations of customers, the decision was made to create a production organisation that would ensure the uninterrupted possession of liquid and gaseous helium and a flexible and modern supply system. This goal is achieved every day by constantly learning about the needs and expectations of customers; adjusting and planning deliveries in terms of individual customer needs; the proper implementation of all services in terms of timeliness, quantity of helium delivered, speed and quality of service; the analysis of the availability of raw material on the global market and rational production planning, including storage reserves; minimising losses in technological processes by using modern machines and devices; improving the staff by means of regular training in the fields of management systems, language learning, first aid, etc.; improving the quality management system by conducting internal and external audits and updating the quality manual; and the systematic analysis and evaluation of the effectiveness of the management system.

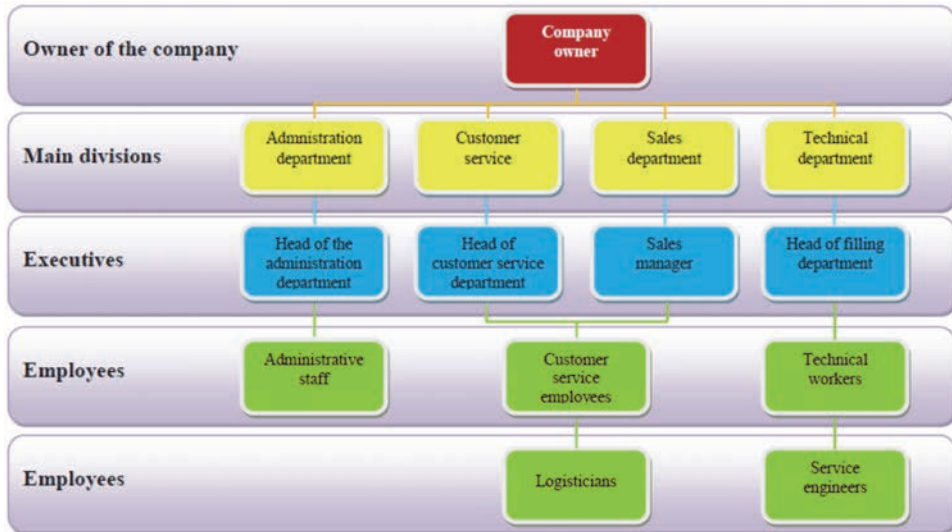
Organisational structure and personnel management

For the first few years, the company operated as a sole proprietorship. The owner was obliged to perform all works related to administration, service and delivery of liquid helium. Over time, the increasing number of orders resulted in the need to hire additional employees responsible for transport, technical matters and order fulfilment. In 2019, 50 people worked at the company. The organisational structure consists of four departments:

1. The administrative department, which deals with running the office, reporting, solving current affairs, invoicing, accounting and maintaining the human resources and payroll book. This department is also responsible for the functioning of the quality management system.
2. The customer service department and 3) the sales department are responsible for developing and updating the sales strategy, calculating the prices offered, analysing the market situation, monitoring the activities of the competition and entering frequent negotiations with customers and suppliers of liquid helium.
3. The technical department supplies the company with an appropriate amount of helium stocks in warehouses, prepares the product for customers,

fills cylinders and cryogenic tanks with compressed and liquid helium, and supervises the technical condition and service of magnetic resonances entrusted to the company by the principals.

Fig. 5. Organisational structure of the researched company



Source: own study based on the company's quality book.

The personnel management methods used in the enterprise are based on a specific process, the stages of which begin with the planning of human resources and end with remuneration for the work performed. Human resources management begins with the selection of employees, i.e. their recruitment and selection. The detailed process of hiring new people for the company includes: 1) job analysis in terms of demand, 2) recruitment decision, 3) recruitment, 4) selection of application documents, 5) a recruitment interview followed by the candidate's withdrawal or 6) preparation of a job offer, and then 7) hiring and onboarding the employee.

In terms of employee improvement, which is another stage in the personnel management process, systematic training has been introduced in the company, divided into internal and external training. Internal training is aimed at creating a better organisation of work processes, including the improvement thereof, so that the employee feels more comfortable and confident. Among the large number of employee training courses, the following should be distinguished: ISO 9001:2016 requirements – quality management system; effective management of the employee team; personal and team time management; change management; team communication; charismatic leadership; fire safety and first aid.

The main goal of external training is to raise and develop professional qualifications. Technical employees participate in courses on energy, welding, forklift and crane service, among others. There are also training sessions for service engineers and liquid helium suppliers, including ADR transport and various magnetic resonance systems, the construction thereof, and the filling process.

The most important competitors

The surveyed company operates on the market in an industry that is strictly focused on specific areas of science and life. Customers who are interested in the activities of the organisation constitute specific groups of consumers focused mainly on the specific application of the service or product offered. The company's most frequently sold product – liquid helium – is not a commodity that can be found in ordinary stores. Its offer requires specialised companies that are guided by specific types of demand in their activities.

In both Poland and abroad, few companies offering liquid and gaseous helium can be found, which is due to the uniqueness of this industry, and which is rare in comparison to other areas of economic activity. Taking into account the range of services offered, the following companies are among the most important competitors of the surveyed company:

1. Polskie Górnictwo Naftowe i Gazownictwo S.A. (PGNiG) is the largest company in the country that deals with the extraction of crude oil and natural gas. It commenced operations as far back as 1982, and now operates on a large scale in Poland (with seven branches) and abroad. The PGNiG branch in Odolanów is the only place in Europe where helium is separated from natural gas with appropriate properties. For this reason, PGNiG has a very strong position on the European market. Having direct access to the only source of resources on the continent, this company has the ability to create prices on its own (<https://pgnig.pl/>).
2. Linde Gaz Polska is the Polish branch of the German concern Linde Group, established in 1993. The Polish head office is located in Kraków, along with seven plants in other Polish towns. The company's offer includes, among others, compressed medical and technical gases, mixtures of these gases, dry ice and refrigerants. It operates on a large scale in Europe (www.linde-gaz.pl).
3. Air Products is a producer and international supplier of technical gases, based in Pennsylvania in the USA since 1940. It operates in 50 countries, including in Warsaw, the capital city of Poland. In its offer, in addition to the extensive sector of services, inspections and equipment sold, the company distributes a number of gases, from oxygen, argon and helium to welding gases (www.airproducts.com.pl).

4. Air Liquide is a French chemical company founded in 1902. The company's headquarters are located in Paris, and individual branches are located in many countries around the world, including Poland. Its offer includes, among others, technical, food and special gases (www.airliquide.com).

Fig. 6. Logo of PGNiG



Source: <https://pgnig.pl/>

Fig. 7. Logo of the Linde Group



Source: <https://www.linde-gaz.pl>

Fig. 8. Logo of Air Products



Source: www.airproducts.com.pl

Fig. 9. Logo of Air Liquide



Source: <https://www.airliquide.com/>

When analysing the market of the company's largest competitors, it can be noticed that these are mainly large international concerns that have been operating in the industry for decades. The surveyed company, although offering its services in all continents, is relatively small. Such strong competition motivates employees

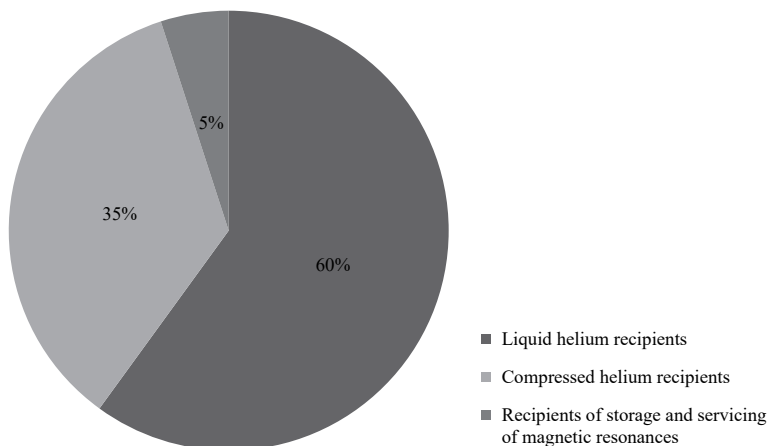
to strive for the continuous development and improvement of the services offered. The company is often chosen by customers who do not need wholesale quantities of products offered by large corporations at one time. It often wins out thanks to the acquired reputation, loyalty and trust of regular customers. By means of a flexible organisation, individualised approach, comprehensiveness and the high quality of services provided, the surveyed company serves clients who appreciate the activities of small and medium-sized enterprises.

Customers

All customers interested in the company's offer of services and products can be divided into three groups, which include: 1) customers buying helium in liquid form – the largest such group (generating 60% of the company's revenues); 2) recipients of compressed gas helium, whose share constitutes approximately 35% of total sales of products and services; and 3) customers interested in MRI storage and service at the company's premises (5% share in sales of goods and services).

In the period of 2003–2018, the number of Polish and foreign customers of the surveyed company grew consistently. From 2003 to 2007, Polish customers constituted the majority, while in the period of 2008–2012, the number of foreign customers interested in buying liquid helium began to rise. Subsequently, over the next two years, the balance again tilted in favour of Polish clients, which resulted from the establishment of greater contacts with Polish companies and hospitals. From 2015 to 2018, the number of foreign customers again exceeded the number of domestic contractors.

Fig. 10. The percentage distribution of sales of goods and services of the company divided according to the share of three groups of customers interested in the company's offer



Source: own study based on the company's commercial books.

The group of recipients of liquid helium is most often associated with the fields of medicine and disciplines involving the exact sciences. The offer of a comprehensive service of supplying and filling liquid helium is most often addressed to private health care facilities and public hospitals, which have magnetic resonances in which the helium level should be systematically refilled. Therefore, the main regular Polish customers purchasing liquid helium include medical and scientific institutions, which: 1) conduct research using magnetic resonance imaging and computed tomography examinations; 2) use helium in thermodynamic, electrical and magnetic laboratories; 3) are involved in chromatographic analysis and cryogenic research at low temperatures.

The most important foreign recipients of liquid helium include distributors of medical equipment in the field of magnetic imaging dedicated to hospitals and private medical clinics located in Central and Eastern Europe.

In terms of compressed gas trading, the main customers include companies operating in the balloon industry in several Western European countries.

The vast majority of customers who store magnetic resonances in the enterprise's facilities are foreign clients (from Germany, Denmark, Austria and France).

In addition to the European range of services offered, deliveries of products to such distant countries as the United States, Israel, Armenia, Kenya, Ethiopia, Nairobi or the Ivory Coast also take place. This is testament to the international renown and business confidence in the industry which the surveyed enterprise has earned.

Business processes

One of the foundations of an effective enterprise management system is the proper management of all processes taking place within the framework of the conducted activity. Thanks to the logical and modern approach to procedure management, it is much easier to carry out specific tasks, monitor their course and adapt the strategies of operation to the changes taking place.

The main and most important processes, the full characteristics of which can be found in the quality manual available to employees, include: 1) the sales and customer service process; 2) the raw material purchasing process; 3) the filling process for liquid helium tanks; 4) the LHe liquid helium delivery process; 5) the process of MRI magnetic resonance storage; 6) the compressed helium GHe production process; 7) the resource management process; 8) the data analysis and improvement process.

Within the framework of the processes taking place in the enterprise, they can be divided into main, management and auxiliary processes. The appropriate categorisation thereof is necessary to achieve the set goals and organise individual activities. The identification of processes enables, first of all, the standardisation of the procedures, the implementation of separate systems for monitoring and

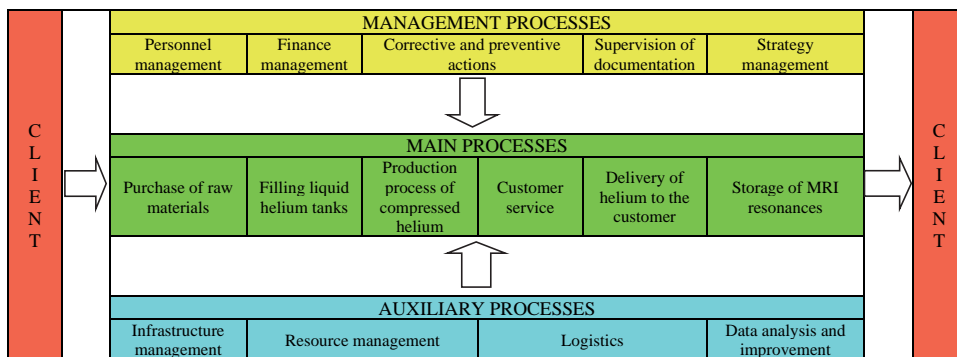
management, as well as the identification of certain areas in which there are discrepancies that require improvement.

In terms of the main processes, the scope covers all activities directly related to the nature and type of business of the company. These are the processes that are mainly the basic activities contributing to the achievement of financial results. They result directly from the purpose of the company's existence and create so-called added value.

Auxiliary processes are all activities intended to support the implementation and functioning of all major processes. Their role is based on the development and achievement of a high level of quality of activities carried out by the enterprise.

The processes classified as belonging to the management group relate mainly to the management of the main and auxiliary processes. They have a one-way effect, and their scope includes control and measurement of the optimisation of individual activities, determination of compliance with specific requirements and goals, as well as detailed verification of the status of implementation of corrective or preventive procedures in the event of non-compliance. These processes are related to the company's goals, its mission and strategy, as well as its position on the market.

Fig. 11. Map of the most important processes of the enterprise



Source: own study.

Taking into account the analysis of the available materials and the observation of the management of the processes taking place in the enterprise, it was found that the surveyed company applies a very good policy towards them. The management team takes care of every detail related to the company's operations; therefore, they meticulously deal with the organisation of all activities carried out at various workplaces. For this purpose, detailed rules of conduct, instructions and all relevant information useful for the implementation of the company's processes have been developed. They were divided into appropriate groups, which made it possible to standardise procedures, implement separate systems for the monitoring thereof, or

extend the branches of specific improvement to individual operations. The company has well-organised process management, which is reflected in the effective functioning of the company at every organisational level.

Sales results

The analysis of the enterprise management system is complemented by the examination of the sales results of the products and services offered by the company. The information obtained on the volume of sales and related income came from public procurement data.

In terms of public procurement processes in which the enterprise participated in the years 2010–2017, the company won seven tenders, which were most often carried out in the Podkarpackie Province. The total number of organisations awarding tenders amounted to five, while the institution that most frequently ordered the products or services of the enterprise was a public university (www.przetargi.egospodarka.pl).

The estimated value of all public contracts awarded by the surveyed company indicates that the advertisers of the highest value contracts are scientific entities conducting research with the use of liquid helium in the field of experimental physics.

The tenders most frequently won by the surveyed company concerned the supply of liquid and compressed helium (i.e. 43.4% of revenues). However, it was services related mainly to filling the research equipment with the appropriate level of helium that contributed most to the total revenues from public procurement (i.e. 56.6% of revenues).

Public procurement carried out by the enterprise in 2010–2017 was only a small fraction of the revenues obtained from the products and services offered. The main segment of the market, generating the highest revenues, is the market for private procurement from companies and state institutions that contact the surveyed organisation in order to commence cooperation. Due to data protection, the results have not been presented in this sales analysis. However, in order to be able to reliably make a final assessment, the information on sales data from private orders obtained during the interviews was taken into account.

The sales analysis carried out regarding the products and services offered by the company as part of tender processes made it possible to obtain a general overview of the revenues achieved in the years subject to analysis. The sales results obtained from the tenders themselves prove the great interest of potential recipients in the products and services offered by the company. Taking into account also the fact that it is a small percentage of other revenues that come from private orders, it can be concluded that, despite the existence of strong competitors in the industrial gases sector, the company operates effectively on the market.

Summary

Effective company management is an extremely complex process. In the case of the liquid and gaseous helium distribution market, this issue results mainly from the fact that in addition to the indispensability of having skills, experience and extensive knowledge in the field of broadly understood company management, excellent knowledge related to helium and the high specificity of the helium distribution market is also a key requirement.

The company which was the subject of the analysis herein, operating on the Polish and foreign market of liquid and gaseous helium distribution, is an example of a company which is strongly focused on the development and needs of both customers and employees. The results of research focusing on market, strategic, personnel, financial and process analysis showed many strengths of the company that determine its dynamic development. Each of the five subsystems achieved a favourable effect, which resulted in a positive final evaluation of the entire management system of the examined enterprise. According to the verified hypothesis, the effectiveness of the company management system on the helium market is influenced by the following factors:

1. the high level of competitiveness of the enterprise, which results from gaining a very good reputation and business trust among market participants (suppliers, recipients, cooperators, etc.),
2. the high level of customer satisfaction, as evidenced by the constantly growing group of both new and returning customers from all over the world,
3. the high level of work efficiency resulting from a properly developed action strategy covering every aspect of the company's operation, including a highly motivating personnel policy,
4. the continuous improvement and development of each activity and process carried out in the company, including the skills and knowledge of all employees,
5. the constant adaptation of the strategy to the changes taking place in the environment.

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The value of innovation compared to other values in enterprises as perceived by the young generation

Introduction to the topic under investigation. The article deals with the issue of how young employees of enterprises assess the areas showing values oriented to the sphere of functioning of enterprises in their various aspects and to relations with the environment, more specifically customers. The article utilises the author's own concept illustrating the constructs of these values and its reference in terms of perception by young workers.

Purpose. The aim of the article is to show how representatives of the young generation perceive the value of innovation as a construct against other values, in relation to their own approach to the values oriented towards the functioning of enterprises/organisations in which they are employed.

Methodology. In addition to the review of the literature on the subject of values and their importance, the article also presents the results of the author's own empirical research, conducted in March and at the beginning of April 2022 on a group of people employed in the Lubuskie voivodeship.

Main results. The article presents how the interviewed representatives of the young generation representing the Lubuskie voivodeship perceive the values in their workplace and how they assess their compliance with the expectations of the management staff.

Theoretical contribution. The article uses the author's own concept illustrating the constructs of these values oriented to the sphere of functioning of enterprises in their various aspects and to relations with the environment, namely customers.

Practical implications (if applicable). The author's construct presented herein may constitute a set of indications for further diagnosis and modification of the development paths of an economic entity, including in the perspective dimension, taking the strategic approach into account.

Keywords: values, enterprise, employees, the young generation

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Introduction

Entrepreneurs operating today should face the fact that “[g]lobalisation is the most often perceived feature of the enterprise environment and will certainly remain a very characteristic feature” (Borowiecki, Dziura, 2016, p. 15). Given the current state of affairs, managers striving to achieve a prestigious position on the market, both locally and nationally, and in relation to entities operating on an even wider international scale, constantly collide with the need to meet the requirements of competitiveness. The driving force behind this is the efforts made by all employees in the company. However, it is worth looking at how young employees entering the labour market perceive the values that describe the potential of enterprises, including the values that determine the internal organisational potential and the power to shape them.

The article deals with the issue of how young employees assess the areas showing values oriented to the sphere of functioning of enterprises in their various aspects and to relations with the environment, namely customers. The article utilises the author’s own concept illustrating the constructs of these values and its reference in terms of perception by young workers.

The aim of the article is to show how representatives of the young generation perceive the value of innovation as a construct against other values, in relation to their own approach to the values oriented towards the functioning of enterprises/organisations in which they are employed.

The results of empirical research conducted in March and at the beginning of April 2022 on a group of respondents from the Lubuskie voivodship, aged no more than 30, have been presented. They were people working in various entities undertaking different areas of economic activity. It is worth looking at how these issues are perceived by the representatives of the young generation who encounter a new reality, which is the beginning of their professional lives and the first years thereof.

Literature review

The multidisciplinary nature of the category of “values” is evidenced by the fact that they are an issue raised in areas such as social sciences, empirical sciences, and humanities. In the psychological dimension, the sense of values is manifested in the form of human behaviour that is oriented towards needs, norms or preferences (Kowalczyk, 2006). The values directing human activity are an indispensable means of self-realisation and self-improvement (Kowalczyk, 2006, p. 163). “The maturity of the [human] person, his perfection, is essentially the fact that he allows himself to be attracted by real values” (Wojtyła, 1994).

According to K. Blanchard, “[v]alues are views with which a person feels emotionally connected, because he chose them from among many others” (K. Blanchard, 2007). Values represent “guiding principles in people’s lives” (Schwartz, Bardi, 2001,

p. 269). For L. Zbiegień-Maciąg, values are “the state of affairs and situations that people value and try to achieve. They are very stable and define what is right and what is desired. They are to perpetuate the actions” (Zbiegień-Maciąg, 2005, p. 48). According to Pratley (2000), “values can be defined as an abstract, collective image of what people consider fair, good and worthwhile. The core values of society are at the core of its culture”. Values are an important element of the company’s organisational culture, as indicated by leading figures from the world of science such as Cameron, Quinn (2006), and Schein (2004).

The behaviour of members of the organisation is determined by a “set of values” shared by the corporate community. They are referred to as “values in use” (Armstrong 2011). From a sociological point of view, values “guide” the behaviour of groups and communities. Their semantic dimension translates into manifestations of the functioning of enterprises such as their intangible dimensions related to their organisational culture. Management through values can be understood as “the process of transferring the main values of the organisation from the generation of managers to the next generation by taking over responsibilities resulting from the main values and protecting them on behalf of and for the benefit of the organisation and its participants through their institutionalisation” (Stachowicz-Stanusch, 2007, p. 38). This is in line with the views of Sikorski, who states that “cultural assumptions dominating in a given environment shape an appropriate set of values for them”, influencing social norms and attitudes (Sikorski, 2009, p. 17). According to A. Stachowicz-Stanusch (2007), the functions of value include the cultural heritage of the enterprise, the catalyst of the atmosphere of organisational stimulation, the element motivating the individual to act and integrating the employee with the enterprise. This “shared value” contributes to the improvement of the competitiveness of a particular economic entity, and the practices implemented in the operational dimension improve its economic and social conditions (Porter and Kramer, 2006).

From this approach, two important aspects emerge: on the one hand, the competitiveness of the enterprise is emphasised; on the other, external orientation, which has a social dimension understood in the context of corporate social responsibility. Achieving mutual benefits, however, has a broader dimension.

According to Borowiecki and Siuta-Tokarska (2015), “(...) the assessment of the competitiveness of Polish enterprises is based on their relatively low innovative activity, there is a lack of essential stimulants of this competitiveness” (p. 64). Creating an organisational climate supporting the innovativeness of enterprises and active participation of employees in this type of activities requires an appropriate information flow system and openness to the process of continuous communication within the organisation (Borowiecki, Dziura, 2016). In order for it to become fully possible, it is necessary to become familiar with the opinions of employees on how

they perceive the importance of innovation, including the context of other values that can build the potential of the company. According to W. Dyduch (2015), the construct of innovation cannot be treated in isolation from others; it is important to relate it to the strategic dimension of the organisation. Innovation should also be treated as a factor that renews the organisation and determines its longevity. In order to maintain it, one should learn how the young generation perceives the values that determine the internal strength of enterprises. It is essential because it is these people – employees of enterprises/organisations – who will influence the directions of development of entities in which they find employment in the future.

Methodology

The aim of the article is to show how representatives of the young generation perceive the value of innovation as a construct against other values, in relation to their own approach to the values oriented towards the functioning of enterprises/organisations in which they are employed.

In addition to the review of the literature on the subject of values and their importance, the article also presents the results of the author's own empirical research. This constitutes a fragment of research carried out in relation to broader, more complex issues in the field of enterprise management.

The research was carried out with the use of a questionnaire-based research tool. Empirical research was conducted in March and at the beginning of April 2022 on a group of people employed in the Lubuskie voivodeship. For the purposes of the article, people who met the age criterion, i.e. belonging to the age group of 30 years and under, were selected from among the respondents. The total number of respondents meeting the given criterion was 95. They included a group of respondents who represented entities diversified in terms of geographic coverage, type of activity, size of the enterprise or capital represented by their employer. A more detailed description of the group of respondents is presented in Table 1.

Table 1. Characteristics of the research population

Description		Number of indications (%)
Gender of respondents	Female	78
	Male	22
Length of tenure in the company/ organisation	Less than 1 year	39
	From 1 to 5 years	55
	From 6 to 10 years	6
Type of workplace	Executive	83
	Managerial	17
Nature of the work performed*	Physical work	33
	Mental work	77

Source: own study based on empirical research.

*Note: Some respondents performed both physical and mental work.

Among the respondents, 78% were women and 22% were men. When it comes to work experience, the majority of people were those who had been employed in a given company/organisation for a period of between one and five years (55% of respondents). 39% had been employed for less than one year, and 6% were people who had worked in a given entity for between six and 10 years. In terms of position, 83% of respondents were employed in executive positions, and 17% in managerial positions. 77% of the respondents performed mental work and 33% physical work – it is important to note that some respondents fell into both categories.

In order to achieve the described goal, the author conducted empirical research using the questionnaire technique. The respondents answered the questions that allowed for the presentation of basic data characterising the enterprises/organisations in which they were employed. The survey did not narrow down the group of respondents in terms of the industry, company size or capital represented by their employer. Table 2 presents the most important elements of the description of enterprises/organisations in which the respondents were employed.

Table 2. Characteristics of enterprises/organisations in which the respondents were employed

Description		Number of indications (%)
The period of operation of the enterprise/organisation on the market	Up to 5 years	22.1
	From 6 to 10 years	11.6
	From 11 to 15 years	17.9
	From 16 to 20 years	11.6
	Over 20 years	36.8
The geographical scope of the enterprise/organisation's activity	Local market	25.8
	Regional market	18.8
	Domestic market	17.8
	International market	37.6
Type of the enterprise/organisation's activity	Production	15.9
	Trade	28.3
	Services	50.5
	Others	5.3
Legal form	State-owned enterprise	11.6
	Private enterprise	82.1
	Other form	6.3
Capital ownership	Polish capital	72.6
	Foreign capital	9.5
	Mixed capital with a predominance of foreign capital	7.4
	Mixed capital with a predominance of Polish capital	8.4
	Equal share of Polish and foreign capital	2.1
Size of the enterprise/organisation	Micro (less than 10 employees)	20.0
	Small (10 to 49 employees)	23.2
	Medium (from 50 to 249 employees)	24.2
	Large (more than 249 employees)	32.6

Source: own study based on the survey research.

The employees surveyed were employed in business entities whose operation on the market varied in terms of duration. The most numerous group were those that worked for companies which had been active on the market for more than 20 years (36.8%). The geographic scope was diverse – some entities were active in more than one market. It was found that the largest group was active on the international market (37.6%). Most of the entities surveyed were private enterprises (82.1%). In

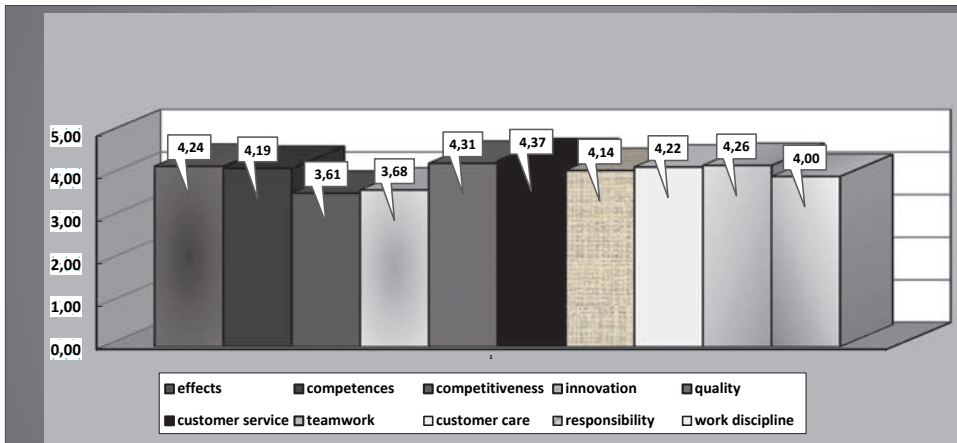
terms of capital ownership, Polish capital was predominant (72.6% of the entities analysed). The largest group of people (32.6% of the respondents) worked in large entities.

Research results

An intelligent organisation builds its potential based on the potential of its employees, which is shaped through the prism of the values they perceive. This also applies to the young generation that is taking their first steps in the area of professional activity. It is necessary to look at how this generation relates to areas that create some reference to the hierarchy of values. It is also important to view this from the perspective of the extent to which the particular values are shared by management and whether there is a convergence of views and opinions in this respect.

The interviewees responded to which of the following areas illustrate the values that are important to them in the company/organisation. A scale of 0 to 5 points was adopted, where 0 meant “not important at all”, 1 point – “not important”, 2 points – “less important”, 3 points – “average”, 4 points – “important”, and 5 points – “very important”. The calculations were obtained using the weighted average and the results obtained are presented in Figure 1.

Figure 1. Perception of areas showing the values which are important to employees of enterprises/organisations



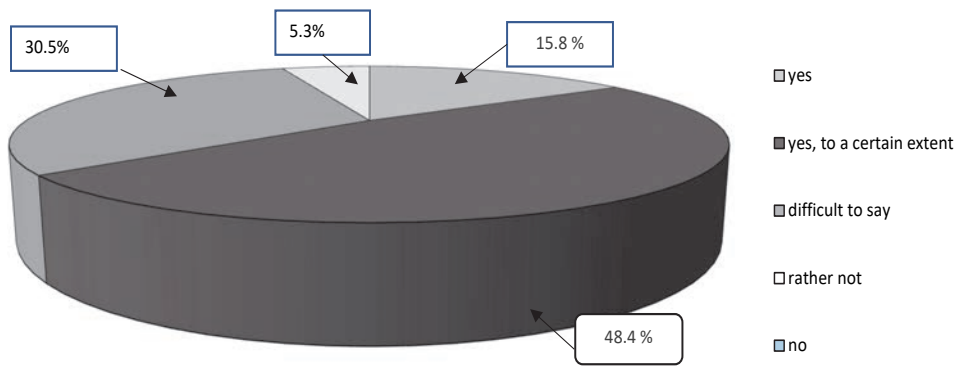
Source: own study based on the results of the survey.

As a result of the research, it was found that all the abovementioned areas are important to the employees surveyed. It bodes well for the future that the younger generation of respondents assigned points (using the weighted average) which in effect gave results in the range from 3.61 to 4.37. It was found that the most

important area illustrating important values is customer service, followed by quality. Other similar positions are occupied by responsibility, customer care, and effects. Innovation was allocated an average score of 3.68 points.

Due to the fact that values act as integrating elements and they are common to all or most of the members of the organisation, it is worth considering whether the values assessed by the respondents are consistent with the expectations of the management staff. In response to this question, the respondents expressed their opinions, which are shown in Figure 2.

Figure 2. Convergence of the areas of significant values given by the respondents with the expectations of the management staff



Source: own study based on the survey research.

Based on the opinions of the respondents representing the young generation, it was found that 64.2% perceived the convergence of their views in terms of values with the expectations of the management staff, as these responded positively, at least to a certain extent. 30.5% of the respondents did not have an opinion in this respect, and only 5.3% somewhat disagreed.

Discussion and Conclusions

On the basis of the research, it seems that management should systematically monitor the perception of key values by employees, including in the context of conditions oriented to the applicable organisational culture. The construct presented herein by the author illustrates the complexity of values which are important to the company and its development as well as with reference to relations with clients, which may constitute a set of indications for further diagnosis and modification of the development paths of an economic entity, including in the perspective dimension, taking the strategic approach into account.

The article demonstrates how the interviewed representatives of the young generation representing the Lubuskie voivodeship perceive values in their workplaces and how they assess their compliance with the expectations of management.

Conscious shaping of an employee-friendly atmosphere in the workplace, and thus also the creation of foundations influencing the success of a company/organisation, requires the ability to look at the work environment through the eyes of employees and make decisions in the context of perceived values. It is worth paying particular attention to newly hired employees who, by getting to know the company and its organisational culture, including the values shared within the company, can significantly contribute to the development of the company thanks to their commitment. Creating the foundations of the “new economy” requires expanding the knowledge potential based on information technologies, “which accelerates the growth of labour efficiency, productivity or the rate of economic growth” (Borowiecki, Dziura, 2016), but also requires acquiring knowledge about how employees of enterprises perceive their workplace, what motivators motivate them to act, and what values are important to them.

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The use of assisted reality to improve processes in accordance with the philosophy of Lean Management in enterprises

Abstract: Industry 4.0 has become a reality. Along with the development of digitalisation, solutions are being implemented to streamline existing processes in companies in order to reduce waste in terms of time, resources and transport. The aim of this article is to present the possibility of using Assisted Reality-type systems in companies as a way of eliminating waste in accordance with the Lean Management philosophy. The first part of the article presents the Lean Management system and its most commonly used tools. The second part presents the concept of Assisted Reality and places it within the available XR bandwidth. In the final stage, a description of how Assisted Reality (aR) can improve processes in companies according to the Lean Management methodology is presented. The discussion section indicates further research steps in this area. The paper has been prepared on the basis of a literature search and the analysis and synthesis of secondary sources.

Keywords: Lean Management, Lean Manufacturing, Kaizen, Assisted Reality, Augmented Reality

Introduction

Industry 4.0 has become a reality. The processes of digitalisation, automation and robotisation in companies are being developed or continued. Another argument confirming the increase in digitalisation in companies is the growing number of digital devices with higher computing capabilities, higher operating speed and miniaturisation levels. The development of wireless technologies providing a connection between devices and networks has resulted in an increase in the number of mobile solutions offered. These devices, which additionally are integrated with

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computing systems or other platforms offered on the market, have significantly expanded functionality and capabilities as a result. This has brought about the dynamic development of the concept known as the Industrial Internet of Things, which is explained, among others, in the lexicon created by Gajdzik and Grabowska [2018]. Along with the development of digitalisation, solutions are implemented to improve the existing processes in companies, which are aimed at reducing waste in terms of time, resources and transport in different areas of the company and the more efficient use of resources in organisations. This article will present the possible impact of modern mobile solutions on changing the operating processes in enterprises.

Lean Management

The word 'lean' literally means slim or thin [www1]; however, as Pawlak and Kudelska [2016] wrote, 'lean' means more than slimming down. In companies operating according to this philosophy, the organisation and the processes therein are built in such a way that the customer ultimately pays for the production of the good rather than for the operation (warehouses, administration, transportation, etc.). Lean Management is a business management philosophy that makes it possible to achieve higher profits by improving processes that are oriented to the needs of customers. It originates directly from the automotive industry, and more specifically from Toyota production facilities. As a result of the processes and tools implemented therein, a system called TPS (Toyota Production System) was created, oriented to minimising all costs that do not affect the quality of the final product. As can be found in the available literature, the term 'lean manufacturing' was first used in 1988 by John Krafcik [Mizga and Bogacz, 2015] and was popularised by researchers from the Massachusetts Institute of Technology in Boston [Womack, Jones and Roos, 2008], who published a paper entitled "The Machine That Changed the World", in which they compared parameters, inputs and outputs from Japanese, American and European companies. The concept of Lean Manufacturing enables the effective implementation of lean production in every area of the enterprise. Companies operating according to the Lean Management philosophy are focused on maximising customer value while using as few resources as possible. As Kisiel [2017] put it, the correct implementation of lean techniques and tools provides the opportunity to produce more using less – human effort, equipment, time and space – while getting closer to achieving the goal of delivering the right goods to customers, at the right time and at the lowest acceptable cost.

The concept of Lean Management is not defined unambiguously [Czerska, 2002], as it is referred to interchangeably in the literature as Lean Manufacturing, Lean Management, Lean Production, Lean Thinking, Lean Enterprise or Lean

Organisation [Antczak and Puchała, 2014]. However, Lean Management is the most widely used term for the concept, especially in light of the numerous successful implementations of this concept in the service sector [Mizga and Bogacz, 2015]. The application of Lean Production tools in an enterprise leads to positive effects. These include, for example, the fact that the various elements of the production process are in the right place at the right time, which is known as Just-in-Time. Following the concept of Lean Management, in particular, one should focus on reducing waste in three areas, known as 3M from the Japanese [Wolniak, 2015]:

- Muda – production waste, downtime, unnecessary movements and any kind of waste of time, resources or activities in general that do not provide value to the customer,
- Muri – excessive workload of employees, machines or processes, leading to fatigue amongst workers, frequent breakdown of equipment and associated downtime, etc.
- Mura – inconsistencies and irregularities of activities – management of the flow of all resources to ensure regularity, lack of downtime, and a constant course of individual operations.

When it comes to the most important Lean tools, the following are mentioned [Bicheno, 2000]:

- 5S – derived from the first letters of the Japanese words: Seiri (selection, order), Seiton (systematics, organisation), Seiso (cleaning, cleanliness), Seiketsu (neatness, keeping clean), and Shitsuke (self-discipline, following all rules) [www2].
- Kaizen – a Japanese method for achieving improvements in efficiency without a large financial outlay. In Japanese, kaizen (kai – change, zen – good) means continuous improvement, involving the implementation of continuous, simple and small changes through small steps [Kryś, 2016].
- Just-in-Time (JIT) is a delivery system, the purpose of which is to eliminate waste by supplying the production process with all the necessary items at the required time and in the required quantity [www3].
- Kanban – a production control system. It is an information system that controls the number of manufactured products at each stage of the manufacturing process. Its primary task is to report the demand for products and parts according to customer demand [Dziekoński and Czapiel, 2014].
- SMED (Single Minute Exchange or Die) – the SMED technique consists in reducing the machine changeover time, which, from the point of view of the Lean concept, is one of the types of wastage. Its primary goal is to increase the flexibility of responses to changing customer demand by

- reducing changeover time and providing a faster response to changing orders [Krucze and Żebrucki, 2012].
- TPM (Total Productive Maintenance) – a method to ensure the maximum efficiency of machinery and equipment. One of the features of TPM is the introduction of autonomous maintenance of equipment and machinery by operators, which means integrating numerous basic maintenance activities into the production process [Legutko, 2009]. The main goal of TPM is to achieve zero failures, zero accidents during work performance and zero shortages [Świątoniowski, Gregorczyk and Rabiasz, 2011]. TPM is about managing machines in a factory in such a way as to minimise the costs resulting from line stoppages caused by failures.
 - VSM (Value Stream Mapping) – A method that allows one to identify sources of wastage and areas for improvement. Value Stream Mapping is performed using three steps: VSA (Value Stream Analysis), VSD (Value Stream Designing) and VSP (Value Stream Work Plan) [Borowiecka, 2020].

In the literature, among the numerous publications on Lean Manufacturing, the tools used in the implementation of this philosophy also include DFMA (Design for Manufacture and Assembly), Heijunka, Poka-Yoke, Standardised Work or the Training With Industry (TWI) programme, which is also identified with the Lean Manufacturing philosophy. This is due to the fact that many tools and methods belonging to this philosophy were developed precisely on the basis of the TWI programme. Therefore, according to Misiurek [2014], Lean Manufacturing and the TWI programme should be treated as a single, fully complementary philosophy focused on improving the efficiency of manufacturing and non-manufacturing processes. The Lean Management concept is successfully applied in the area of services, which also requires the identification of key processes and the diagnosis of emerging sources of wastage, manifested, for example, in downtime, waiting or unnecessary movement. Once the sources of waste are identified, it is possible to eliminate them.

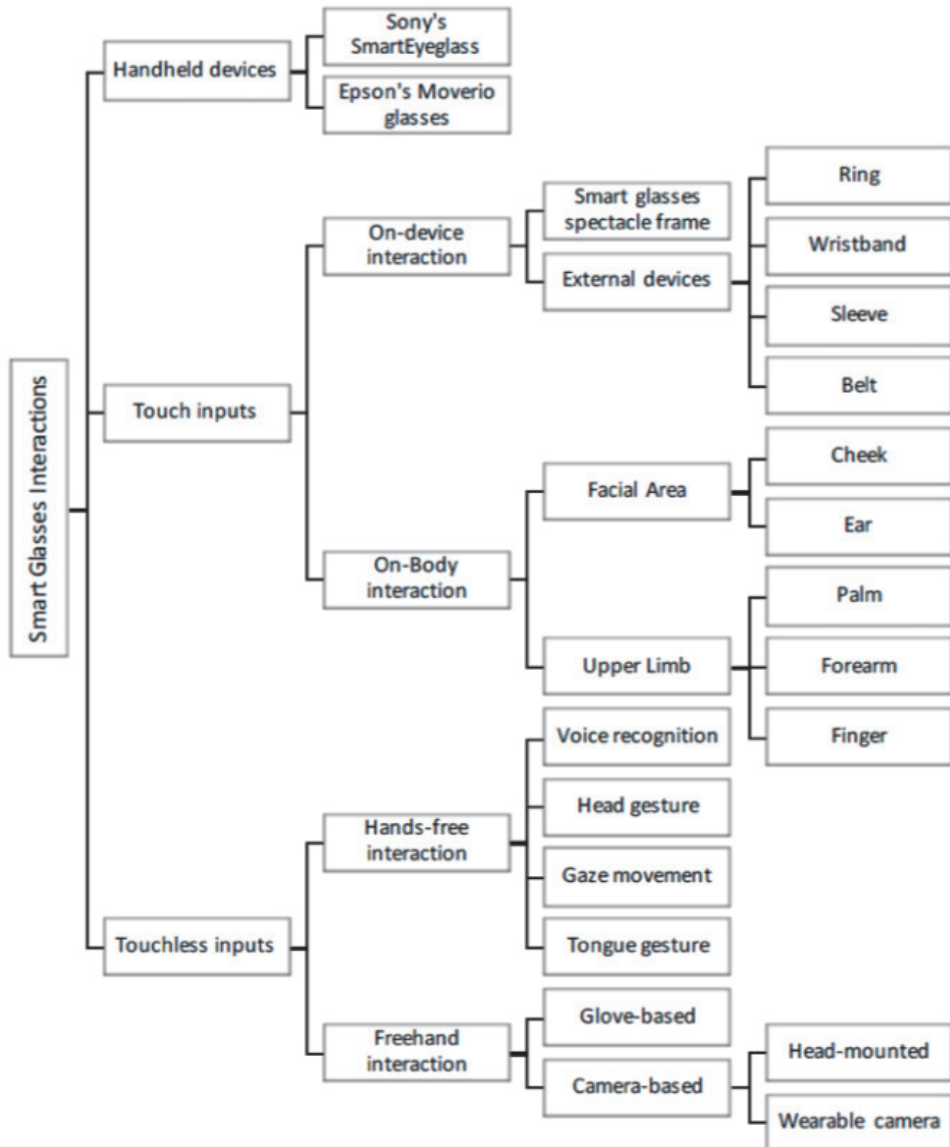
Assisted Reality

In the implementation of the Industry 4.0 concept, augmented reality (AR) and virtual reality (VR) are tools used to support employees and improve their efficiency at work. AR, VR or MR (Mixed Reality) technologies are much more widely known than assisted reality (aR), which is less popular than those previously mentioned. Assisted reality provides access to the right information exactly when the user needs it. It allows the user to maintain full situational awareness. Assisted reality differs from augmented reality in that it does not change the image seen by the user, but only adds an additional layer of information. Thus, the

user does not lose contact with the real world, and the digital image is an add-on. Assisted Reality allows a person to view a screen in their direct field of vision, hands-free. In the literature, however, Assisted Reality (aR), also called Extended Reality, is most often combined together with the concept of Augmented Reality (AR) without an exact distinction. Probably the most common example of the use of assisted reality today is head-up displays in cars, which allow the driver to look through the windshield, but also see a projection of specific information such as current and permitted maximum speed or navigation instructions. Assisted reality technology originated in the aviation industry and was born out of the need to continuously provide pilots with particularly important visual information. In other words, pilots equipped with assisted reality devices were not forced to regularly turn their eyes towards the instrument panel [Kloske and Pêpczynska, 2013].

Although augmented safety systems and devices are gradually being adopted by various industries, their implementation in real-world settings is demanding. During such implementations, system-level interventions (e.g. communication infrastructure, data, management platforms, etc.) are very often required, as well as changed approaches and practices, e.g., new procedures for smart safety devices and the functionality thereof [Podgórski, Majchrzycka, Dąbrowska, Gralewicz, and Okrasa, 2017]. Assisted reality is also used by some types of eyewear, and continuous access to information has led to the label 'smart'. Accordingly, such devices are also called 'Smart Glasses'; the figure below shows the classification by Lee and Hui [2018], who categorised them based on the way they interact with the device.

Figure 1. Classification of smart glasses depending on the means of interaction.



Źródło: Lee, L. & Hui, P. (2018). Interaction methods for smart glasses.

Augmented reality mainly uses displays to visualise content. Ronald Azuma categorised them into three groups: mobile head mounted displays (HMD),

displays that can be held in the hand (e.g., tablet, smartphone), and projector displays. HMD-type displays are most commonly used in aR systems today. They are usually a type of glasses or helmets that generate an image in front of the user's eyes, most commonly using a head-up display or a non-transparent display with a mounted camera that captures the image and then displays it in front of the user's eyes. Advances in technology have facilitated the use of advanced cameras and displays, thus addressing the problem of low resolution and constant depth of the displayed image.

Process improvements resulting from the use of Assisted Reality

As mentioned earlier, a company following the Lean philosophy focuses on eliminating excessive production waste, waste in terms of time and resources (*muda*), employee burden (*muri*), and inconsistency and irregularity of operations (*mura*). An example of combating *muda* can be the application of assisted reality through the use of HMDs, for the implementation of technical support in the form of a remote expert. The use of the remote expert formula allows for more efficient management of human resources. Less skilled employees on site try to solve the issue (e.g. the resulting fault) on their own. If they do not have the necessary competences, they connect with an expert located in another part of the world through assisted reality devices. Using the remote expert work formula allows one to minimise the costs resulting from line stoppages caused by failures (reduction of downtime). By means of a camera placed near the worker's eyes, the image is transmitted to the expert who has all the necessary information and can assist the worker on site. Another argument in favour of using this formula is a reduction in the time needed to transfer information between branches of the company. Information concerning the improvement of processes within the organisation, the means of conducting training and exchange of knowledge combined with job instructions may turn out to be particularly important.

This form of technical support with the use of HMD devices reduces waste in terms of:

- time associated with the movement of experts, who are more experienced company employees or external consultants.
- financial resources associated with the costs of transporting employees,
- downtime of e.g. production lines, through faster repairs carried out by stationary employees with the help of an expert assisting them remotely.
- physical resources, resulting from the operator being able to work with two hands instead of one, as in the case of using a mobile phone or a handheld camera, for example, to transmit video and sound. HMDs are voice-controlled, so the operator has two hands with which to perform the task at all times.

An example of combating the overloading of employees, machines or processes (Muri), may be the implementation of a digital workflow or service control in the company. The completion of paper-based documentation by front-line employees and its subsequent transcription into central systems (digitised form) wastes time. In addition, it is a duplication of work performed by employees which causes fatigue and problems with completing subsequent tasks. The process of downloading data can be replaced by a digital workflow, using voice control, video and audio recording, and then sending the material to a supervisory unit or supervisor. Another example might be the automatic or on-demand loading of data from sensors and transmitting it to the user, who will receive it on a display near the eye. Data from devices is transmitted using wireless technologies, e.g. BLE (Bluetooth Low Energy), GSM or Wi-Fi. This way, the operator does not waste time walking up to more devices and reading the data individually.

An example of process improvement in the area of non-compliance and irregular activities (Mura) could be the use of assisted reality to verify compliance with the control procedures applied within the company (to reduce losses due to defective products) as well as training and auditing. Functioning processes should be checked regularly to see whether there are deviations during the implementation phase. Another example can be an immediate check of the product received after the production process with a reference object. The parameters of the product after production can be immediately evaluated.

Discussion

The availability of information provided to the user (operator) through the use of assisted reality is very helpful and can contribute positively to improving processes within the organisation, implemented in accordance with the concept of Lean Management. The subject of assisted reality, its possibilities, benefits and risks resulting from its use, is an area which remains relatively seldom explored by researchers in Poland, especially in terms of social sciences. The works that have been written so far on this topic mainly cover the issue of assisted reality in the technical sense. Such publications very often concern the use of assisted reality in the context of a particular industry or area of a company, such as warehouse logistics. Research conducted to date has also shown lower error rates of users during ongoing work when they had remote assistance [Wolfartsberger, 2020] and assisted reality providing new business opportunities [Schirgi, 2019]. The economic and non-economic benefits of using such solutions, in a cross-sectional form, remain an interesting research question. Looking at the applications of assisted reality in relation to the Lean concept, it is also worth considering the validity of using HMD solutions in the training process according to the TWI method. Said method, although extremely effective, is difficult to implement due to the organisation of

work in a plant and the way of conducting workplace instructions. This refers to the time of instruction and the method itself, which also includes preparing an employee for instruction. The TWI method requires additional documentation (e.g. a worksheet or training planning matrix), which could function in digital form in a company. Nevertheless, the successful results presented in the literature [Weber and Buchkremer, 2021] concerning training and error reduction with the use of augmented reality indicate the existence of a research gap in this area for assisted reality as well. Based on the available reports [www5, www6, www7], it is estimated that the market for AR solutions will grow rapidly in the coming years. Therefore, it is worth analysing the social and economic conditions associated with the dynamic development of the AR sector, and especially of assisted reality in terms of its use in different areas of consumer and industrial life.

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Digital sustainability – the importance of sustainable and digital transformation in decarbonising enterprises and achieving sustainable development goals

Abstract: Climate and decarbonisation strategies are becoming the cornerstone of corporate sustainability management. While the goal of achieving carbon neutrality by 2050 is a popular market practice, operationalising this goal remains a challenge. Decarbonising businesses requires investment and technological advances. Digital transformation is becoming an increasing ally of sustainable transformation. In this article, I analyse Industry 4.0 digital technologies that support sustainability management and may become a tool by means of which to achieve decarbonisation goals. I also cite the results of a study conducted by Accenture on European companies' investments in new technologies, as well as their potential to be among the Leaders of Tomorrow.

Keywords: digital sustainability, sustainability, digital transformation, decarbonisation, climate change

Introduction

The latest IPCC (Intergovernmental Panel on Climate Change) report, which was published in the middle of 2021, shows unequivocally that mankind is responsible for global warming, and that we must move away from the idea of counteracting climate change towards adapting to the changes, because it is already too late for counteraction. Global warming is occurring faster than scientists previously

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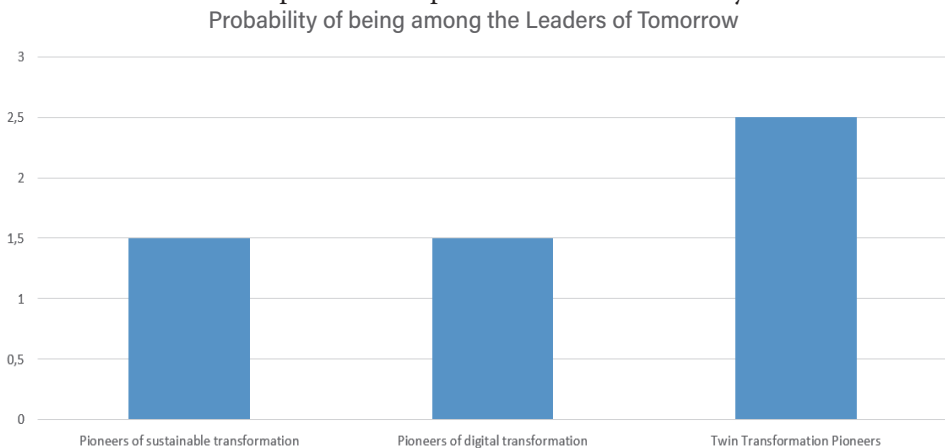
thought, and according to the latest forecasts we will reach or exceed a global temperature of 1.5 degrees above pre-industrial levels within the next decade or two. According to the scientists who wrote the report, avoiding 1.5 degrees of warming is almost impossible, but we can still maintain a level of warming near this critical threshold and mitigate the consequences of global warming that would result from approaching and exceeding an increase of 2 degrees above pre-industrial levels. Scientists point to society's reliance on fossil fuels as the main reason why the planet has already warmed by 1.2 degrees Celsius – as a result of greenhouse gas emissions such as carbon dioxide and methane. The report clearly blames carbon pollution for rising temperatures and makes it clear that the only way to slow and ultimately reverse warming is to reduce greenhouse gas emissions to zero. The IPCC report is also a call for a global energy transition to take place as soon as possible. To avoid the extreme consequences that accompany global temperature, greenhouse gas pollution would have to be reduced by 45% by 2030 and 100% by 2050. The IPCC stresses that these deep cuts in emissions will have to be rapid and far-reaching, and will require unprecedented changes in all aspects of society. Such unprecedented societal changes will need to occur in many dimensions of society, e.g. the largest carbon emissions in the United States come from transportation (29%), followed closely by electricity (28%), industry (22%), commercial and residential buildings (12%) and agriculture.

Climate transformation requires adequate investment, access to technology and support for the most vulnerable sectors that will not be able to adapt quickly. It requires commitment and motivation to change from all market players. Digital sustainability is the use of technology in everyday business applications to improve the environment for sustainable development. The concept is gaining popularity as it provides an opportunity to reduce the impact that technology can have on the environment and climate. To achieve digital sustainability, organisations are embracing digitalisation. Companies adopting sustainable digital transformation as a goal can use digital processes, tools and forecasting models to measure the potential benefits against the impact their success may have on the environment. These same companies can then work to mitigate the potential environmental impact of their operations while connecting consumers with valuable goods and services. There are several determinants behind digital sustainability initiatives, including attention to a growing population and increasing demand for remote IT support software.

The report “No decarbonisation without digitalisation. Sustainable development needs digital technologies”, published by PKN ORLEN in cooperation with Accenture and which was co-authored by the author of this paper, presents analyses which indicate that only 32% of European companies in the economic recovery phase after the COVID-19 pandemic will be able to enter the phase of profitable growth. This group is referred to as the Leaders of Tomorrow. These are companies

that have positive operating profit calculated from the fragile phase of the pandemic (the second half of 2020) to the rebound phase (the first half of 2021), with stable or better operating profit between each phase. At the same time, as many as 19% of the companies surveyed, referred to as Falling Angels, face significant challenges in returning to the growth path which they were on prior to the COVID-19 crisis. Combining digital transformation with transformation based on sustainability goals (Twin Transformation) will enable companies to make efficiency gains while achieving carbon neutrality. According to the analysis and experience of Accenture, companies that are engaged in Twin Transformation are 2.5 times more likely to be among the Leaders of Tomorrow. Most European companies are well prepared to join the Double Transformation. However, they need new business models to prepare for the challenges which await beyond 2030 – such as moving towards carbon neutrality.

The ratio of the likelihood of becoming Leaders of Tomorrow among companies that are pioneers of sustainable transformation, pioneers of digital transformation and twin transformation compared to companies that do not meet any of these criteria.



Source: Accenture

Sustainability is an integral part of economic development in all countries, even when attention is diverted away from it. The balance between humanity’s need to produce and the desire not to destroy the planet in the process is constantly challenged and vacillated. With the disruptive new models that Industry 4.0 has shown the world, and the ever-increasing opportunities in technology, production and improving the way businesses operate, there is the question of sustainability as a driving force by means of which to achieve decarbonisation goals. How will new business models impact sustainability, and will they succeed in putting the future of humanity in the spotlight?

According to the Boston Consulting Group’s 2015 report on Industry 4.0, nine technological advances in particular have created the fourth revolution: autonomous

robots, simulation, horizontal and vertical systems integration, the Industrial Internet of Things, cybersecurity, the cloud, additive manufacturing augmented reality, and Big Data and analytics. In her article “What Industry 4.0 means for sustainable development” in the international journal *Industry 4.0*, Bulgarian researcher R. Tsvetkova identified the opportunities and chances offered by the technologies of the fourth industrial revolution, according to BCG’s classification for achieving sustainable development goals, the same technologies are also pointed out by Accenture:

Artificial intelligence

Artificial intelligence is the ability of machines to exhibit human skills such as reasoning, learning, planning and creativity. It enables the understanding of a wide range of available data (e.g. from sensors in an industrial plant or from a camera). Based on this data, patterns of action are created. AI increases the efficiency and productivity of a company by automating processes or tasks that previously required a great deal of manual work and analysis. AI can also make sense of data, the scale of which is beyond human interpretation. Examples include virtual assistants, image analysis software, search engines, speech and facial recognition systems, systems that support autonomous cars, drones, and the Internet of Things.

AI has the greatest impact on the digital transformation of the economy and the achievement of the goals of Agenda 2030, the Green Deal and the Paris Agreement. It permeates most Industry 5.0 technologies and addresses global climate issues – from monitoring climate trends, to predicting weather events, to specific solutions to reduce or completely eliminate greenhouse gas emissions.

Capgemini Research Institute’s 2020 report “Artificial Intelligence in the Fight against Climate Change” looks at the impact of artificial intelligence in the fight against climate change. As indicated by data from a survey of 800 directors in 400 organisations, this will not be achieved without educational activities, raising awareness and improving competences. Polish companies are not ready for this change either – last year 28 Polish listed companies emitted 28.2 million tonnes of greenhouse gases into the atmosphere, and to date only 1% of the WSE reports data on CO₂ emissions (in 2021 this was made obligatory). Based on its research, CRI estimates that artificial intelligence is expected to help organisations reduce greenhouse gas emissions by 16% over the next three to five years. The use of AI in climate action could help organisations meet up to 45% of their total greenhouse gas reduction targets set by the Paris Agreement by 2030.

Two-thirds (67%) of the organisations surveyed by CRI have set long-term business goals in the fight against climate change. Adaptation is also on the rise, with more than half of organisations (53%) going beyond pilot programmes in implementing AI. As a result of using AI, the companies surveyed have reduced

greenhouse gas emissions by 12.9%, improved energy efficiency by 10.9% and minimised waste by 11.7% over the past three years.

Modelling and simulation technologies

Modelling and simulation technologies are a key factor in the development of Industry 4.0. They are central to the modern design, piloting and operation of new products. New virtual prototyping capabilities, as well as automation in manufacturing industries, increase productivity and improve the quality, design, piloting and support of new products.

Horizontal and vertical system integration

Horizontal and vertical system integration represents integration between different value chains and between layer functionality within an organisation. This integration allows for a greater understanding of all processes, as well as better synergies within and between organisations.

Cloud technologies

Cloud technologies are not just a way to integrate services and cut costs in IT spending – they are a disruptive factor. In manufacturing, but also everywhere else in business, cloud technologies are changing processes and the people who operate them, opening the door to approaches and outcomes that have never been implemented before. It could even be said that cloud technology is ‘democratising communication’.

Cloud computing

Cloud computing is the provision of computing power and related services by an external provider. The data is not stored on one’s own drives, but with the use of external resources. Usually, the customer pays only for the services actually used, which reduces operating costs and allows for more efficient use of the infrastructure. This eliminates the need to manage one’s own servers, install software or deal with administration. This technology enables access to large computing capacities at a fraction of the cost of buying technical infrastructure.

Data migrations from on-premises locations to the public cloud can result in a global reduction in CO₂ emissions of 59 million tonnes per year. This is comprised of activities such as the automation and autonomous adjustment of computing power to current demand, real-time sharing and allocation of computing power, more efficient cooling and heat recovery from cooling equipment in server rooms, and powering data centres with clean energy, for example from large wind farms or high-efficiency solar power plants.

Incremental manufacturing

Incremental manufacturing represents a development in the world of design, testing, manufacturing, etc., such as 3D printing. It is the concept of true and effective, fast connectivity between the customer, data and production; it is changing the way products, and their separate parts, are manufactured. With rapid prototyping, the robust manufacturing of any mould and 3D printing itself, additive manufacturing is changing processes, planning, design ideas, the ability to create and rapidly reducing costs across the production line. The capabilities of additive manufacturing continue to expand.

Augmented Reality

Augmented reality creates a bridge between virtual reality and data that has been collected via methods of physical analysis. It facilitates a new approach to the design and repair of components and entire products. By creating the right digital toolkit, designers, engineers or technicians can improve their problem-solving capabilities and greatly expand their options for optimising products and processes. Augmented reality also helps to connect customers more effectively with their desired products, thanks to the ability to see the possibilities with all the necessary technical specifications.

Big Data and analytics

Media and scientists repeatedly stress that data is the engine of the century, a commodity more valuable than gold. With the increased ability to collect massive amounts of data, and moreover analyse it in a faster and smarter way, Big Data and analytics are paving the way to the transformation of our understanding, production, sales etc. Now, more than just historical data, real-time physical data such as vibration, noise levels and pressure are being used in factories, as well as predictive data for similar processes and various off-site innovations.

Blockchain

Blockchain is a distributed record of data, stored in a way that makes it impossible to manipulate. Blockchain allows for the transmission and storage of information pertaining to online transactions. Importantly, in the context of sustainable development, blockchain makes it possible for a product to be tracked and recorded at all stages, in a transparent and reliable manner.

Blockchain can be used to track the carbon footprint of products, allowing it to be monitored from the manufacturer to the point of sale. It also helps to prevent unethical practices, such as “green washing” (providing incorrect information), making supply chains more transparent. Information on a product’s history is often unavailable and difficult to verify. A product passes through many hands

before it reaches the customer. Blockchain helps to prevent the dissemination of false information about a product – how it is made, what materials and chemicals are used, what item is recycled. Customers gain the ability to make more environmentally friendly choices.

The Internet of Things

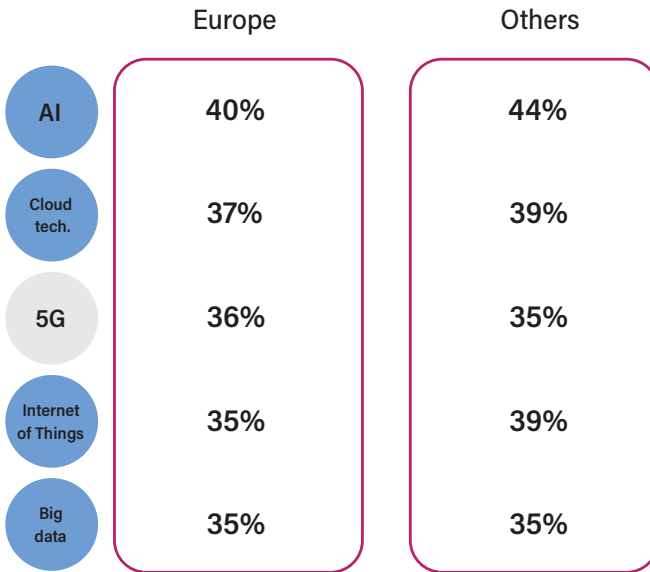
The Internet of Things (IoT) is a system of interconnected devices that are equipped with sensors, which have data processing capabilities and exchange information with other devices, e.g. via the Internet.

5G

5G is the new mobile communications technology standard – the successor to 4G. The parameters it is expected to meet will offer the possibility of data transmission with minimal delay and much higher throughput compared to current mobile technologies.

5G networks can make a real contribution to reducing carbon emissions for operators in several ways. They achieve a high level of energy efficiency as the amount of data that can be transmitted per unit of energy is increased. On average, approximately 90% of the energy spent on sending one bit of data will be able to be saved compared to 4G. With the possibility of future use of millimetre wave transmission (mmWave), this figure could rise to as much as 98%. The use of 5G networks could save up to 0.5 billion tonnes of CO₂ worldwide by 2030, while around 50% of this result can be attributed to effects not directly related to 5G. It should be stressed that the profits from the implementation of 5G technology exceed the outlays many times over, and the sectors that will benefit most will be industry and energy. PKN ORLEN is testing fifth-generation wireless connectivity on the premises of its production plant in Płock and the adjacent service station. The scope of the project includes the launch of a private industrial 5G network, tests and measurements of the 5G network, tests of critical communications, and tests and measurements of the quality of services using 5G technology. Tests include mass transmission of IIoT sensor data, and connectivity parameters for critical applications for real-time video and data transmission. For example, resistance to interference generated by refinery installations, the impact of industrial infrastructure on transmission delays or the level of attenuation by water vapour is analysed.

European companies are planning large investments in new technologies, % of Europe and non-European respondents



Source: Accenture.

There is significant synergy between the principles and objectives of sustainable development and Industry 4.0; perhaps this combination will become the foundation of the fifth industrial revolution. Although today Industry 5.0 is defined as networking between man and machine, sustainability is a broader concept. In addition to the social aspect, the climate and the environment are very important issues. Assuming that the world still has three decades to fight climate change in its quest for carbon neutrality, it is difficult to imagine managing corporate sustainability without Industry 4.0 technologies.

Digital technologies accomplish the task of decarbonisation in three ways:

1. Increased process knowledge through data monitoring and tracking – analysing data on the extent to which raw materials and energy are consumed results in increased awareness of the environmental impact being made. Enables the tracking and reporting of one’s carbon footprint.
2. Optimisation and automation – increasing production efficiency through the more effective use of resources used in production processes. Energy and raw materials are thus saved, which leads to both improved economic performance and reduced greenhouse gas emissions. Better use is made of the resources required for production, which improves energy efficiency.
3. Predicting and preventing adverse events – predicting failures minimises the risk of machine downtime and the waste of raw materials and energy. It

also reduces the risk of leaks and spills, prevents water, air and soil contamination, and improves human safety.

On the other hand, the technology-driven nature combined with the relatively early stages of the 4.0 technology life cycle implies and gives rise to certain risks. In their article “Industry 4.0 and Sustainability”, Krzysztof Ejsmont, Bartłomiej Gładysz and Aldona Kluczek identify three types of risks: economic (especially cost-intensity and difficulty in estimating the full financial benefits and economic efficiency, e.g. computer simulation modelling); environmental (e.g. an increase in electro-waste, an increase in energy consumption and, despite appearances, carbon footprints); and social (e.g. human-robot interaction issues, unemployment risks, privacy issues).

The authors of the report *Digital with Purpose: Delivering a SMARTer2030* highlight the fact that the dynamic development of digital technologies worldwide is associated with a dramatic increase in the widespread use of devices and machines. Consequently, they also foresee three risks: an increase in electricity consumption and more electro-waste; it is estimated that the impact of ICT energy use on greenhouse gas emissions could increase by 11% by 2030; and a third adverse effect could be the polarisation of societies as a result of uneven digital development in different regions of the world.

The development of digital technologies generates greenhouse gas emissions in itself, but their use is an even more effective lever by means of which to counteract negative environmental impacts. For digital tools to serve sustainable goals, they must themselves be used sustainably and the energy they use should come from renewable sources. These are the two most important conditions. Digital solutions responsibly deployed and effectively used are a prerequisite for achieving most of the goals formulated in the 2030 Agenda and the Paris Agreement, and their potential to reduce greenhouse gas emissions could be as high as 35%.

Conclusion

It is clear that Industry 4.0 is not only an opportunity to achieve sustainable development goals, but also requires careful consideration of these risks. From the above analyses, there are undeniable benefits from the synergy of Industry 4.0 and sustainable development, i.e. the combination of artificial intelligence, robotics and other advanced technologies used in many sectors of the economy, e.g. supply chain, distribution channels, and manufacturing – all of which has a significant environmental impact, leading to reduced pollution, lower greenhouse gas emissions, lower energy consumption at the same time and increased profits. Dual Transformation opens up the possibility of combining technology with resources and skills in terms of sustainability benefits. Digitisation can reduce the environmental impact of a product, process or service based on the availability of footprint data and traceable

analysis. Additionally, it helps to achieve more efficient functions, such as reduced resource consumption. Therefore, digital transformation should be seen in the category of sustainability opportunities in developing digital sustainable operations to achieve both the UN 2030 Sustainable Development Goals, the European Green Deal and the Paris Agreement.

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Transport versus Ecology. Consequences for Management

Abstract: The importance of the issue of migration and transport is often underestimated. It has a rich tradition, dating back to the beginnings of the human race. The transport of goods and human beings became one of the foundational pillars of the development of civilisation. For centuries, vehicles have been developed, and so has the infrastructure to help human beings use them. This process accelerated rapidly during the so-called technological revolution and has continued until the present day. Nowadays, it is impossible to imagine economies that do not use mass transport. The car has become a symbol of progress and prosperity. In this context, safety issues have become increasingly important. The social aspects of sustainable development give rise to ever more interest. The COVID-19 pandemic also increased awareness of the vulnerability of means of transport in such situations. At the same time, it brought about an opportunity to analyse the situation and to use the experience that was acquired during this difficult time. Ideas for combining activities for the protection of the environment, transport safety and its automation in terms of care for people seem deserving of implementation.

Keywords: logistics, transport, infrastructure, ship, railway, car, airplane

Introduction

In the course of time, man has settled in almost every corner of the Earth. Gradually, our species has developed trade and methods of manufacturing various goods through the exchange of experiences and civilisational ideas between different groups of human beings (Haviland 1990, pp. 29–57). Owing to technological progress, means of transport have improved, and nowadays may be found in highly sophisticated forms. However, it was soon ascertained that these were connected with numerous dangers, of which environmental damage, high accident rates, and susceptibility to infectious diseases, as in the recent case of the COVID-19 pandemic,

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deserve particular attention. The specificity of this research has resulted in the necessity of using several complementary methods. Apart from 'standard techniques' such as desk research, it also required the use of the comparative historical research method (Weber 2009, pp. 81–167). The aim of the article is to present aspects of sustainable development in relation to the historical transport approach, as well as the changes in this direction which must be pursued by modern transport.

A brief outline of the development of means of transport in modern times

Although the Middle Ages were not supposed to have seen unequivocal achievements in the field of transport development, those who lived in those times showed a great deal of ingenuity in terms of traveling on water, as exemplified by the journeys made by the Vikings. The traditions derived from antiquity and related to the use of certain means of transport enjoying a social statute were also continued in the Middle Ages. Consequently, how people rode their horses and the type of carriage they could afford implied their place in society. In the era of feudalism, a significant marker of freedom in Europe was the right to move around freely; at a time when most members of society were serfs, who had no right to move without the permission of their feudal lord, it was a major issue. The end of the Middle Ages meant an increase in production and transport possibilities (Fisher, 1957, pp. 411–464). The development of navigation and the discovery of new water routes fundamentally transformed the opportunities which Europeans had for mobility. New forms of production were created, and manufacturing in which the division of labour was practiced emerged. Experiments with balloons as a means of transport also began, and many successful attempts were made in this regard. Trade grew in importance, as did fleets. Long distances were no longer insurmountable, although covering them still created serious technical problems. A significant impetus for development was the emergence of the steam engine in contemporary Great Britain. Such engines were applied in all areas of production and transport (Chambers, Grew, Herlihy, Rabb, Woloch I., Janson H.W. (1979), *The Western Experience*, Alfred A. Knopf, New York 1979, pp. 659–664).

Steam energy was perceived as a significant impetus for the development of means of transport as well as the machines needed for industrial production. Due to this, it was possible to greatly improve the mass movement of goods and people. Sailing ships were replaced by metal ones and armed with modern weapons, which made it possible to gain an advantage over other civilisations. Consequently, the colonial European empires provided space and opportunities to develop and use new means of transport, e.g. hot air balloons. Parallel to the technical development

of the means of transport, there were tendencies to synchronise the organisation of the flow of people and goods. In order to do this, as well as for the purpose of using transport in the military field, Antoine-Henri Jomini (1779–1869), a high-ranking officer of Swiss origin, laid the foundations of logistics which, over time, acquired the status of science.

Under the influence exerted by techniques based upon the steam engine, changes occurred in the area of land transport. Railways were created, using “the force of steam to propel vehicles on wheels placed on the tracks”. This concept was also used in France to create a mechanism that in retrospect can be described as the “first car”. This “child of progress”, however, appeared to be not only large, but also extremely slow.

Internal combustion engines were the next step on the path to further progress. As a result, the first version of the modern car was developed in Germany in 1886 by the mechanical engineer Karl Benz.

Soon after, many attempts in the field of aviation were crowned with the first flight by the Wright brothers in the USA in 1903. This opened up new perspectives for mobility and transport. These achievements had an impact on the military sphere; tanks appeared, and balloons and airplanes were used to obtain information, as well as in combat. In 1938, a helicopter constructed by Igor Sikorsky was launched, and it has enjoyed uninterrupted popularity until the present day. At the same time, assembly lines were developed which resulted in an unprecedented number of manufactured items, including means of transport such as cars, motorcycles, airplanes and ships.

This is related to permanently satisfying the needs of affluent societies, which, in turn, is connected with the mechanism of mass consumption. The production of sophisticated means of transport made it possible for trade as well as tourism to develop on an unprecedented scale. At the same time, many machines became increasingly efficient. It should be indicated that not only do they perform various activities, but also operate increasingly often without the active involvement of a human being, as the examples of drones or autonomous cars/vehicles demonstrate. This last field of the economy, previously unknown, has revolutionised the manner in which people spend their free time, laying the foundations for the ‘way of life’ of modern man (Cooley; 72–128). At the same time, social references to the means of transport have changed; the possession and use thereof have become commonplace, just as the right to move is nowadays treated as something natural. Nevertheless, there is a link between the ownership of particularly luxurious means of transport and the high ranking of their owners in the social hierarchy. A similar correlation is noticeable, *inter alia*, when it comes to the manner of spending free time and the place occupied by a given person in the system of social stratification.

Transport and environmental pollution

Means of transport have inherent benefits and drawbacks. The latter include the destruction of the environment, which began on a large scale during the technological revolution, which itself was launched in a symbolic sense by James Watt patenting the steam engine in 1769. Manufactories equipped with a steam drive turned into factories – places of mass production. At that moment in history, mankind took the first step along a dangerous path, being unaware of the seriousness of the situation.

The danger of self-destruction soon became clear and obvious in the military sphere, where ever newer and more effective weapons led to enormous losses in conflicts that are described as “wars waged on an industrial scale” such as the American Civil War (1861–1865) as well as both world wars.

Certain self-destructive tendencies can be noted in cases when a clearly economically negative decision for the environment was taken for the sole purpose of achieving profit. This could also be seen in the case of transport; many types thereof which were nature-friendly were usually abandoned or very limited, while those that were harmful to the environment but generated more profit were supported in business circles. The case of the railroad, brutally superseded by the car industry in the USA, is a good example here; in many areas of the country, entire sections of local railways were bought by car manufacturers only for one purpose, namely to destroy them and thus create demand for their own products. Similar, although less spectacular, actions were taken in relation to balloons, especially to the most developed which fulfilled many of the same functions as airplanes, such as Zeppelins. Also, the fact that electric cars lost the battle against engines which were powered by oil-based derivatives back in the 1920s was due in no small part to Rockefeller, who ensured a steady supply of cheap oil to the market.

The same occurred in terms of ‘economic concepts of transport’ after the Second World War. An example is the entrepreneurship concept based upon an ‘ecological account’, and specifically drawing attention to the need for localisation of the raw material which should be used in the vicinity. This thought was abandoned, and long transport routes for raw material became reality. Only the discussion on the need to protect the environment, which is gaining in strength and importance, allows us to see the essence of this issue in another context.

Apart from the ‘logistics services’ of mass industrial and agricultural production and the mass transport of raw materials and products, there is also mass tourism, which involves carrying large numbers of people. All of this has contributed to the deterioration of the ecological state of the Earth (Berend 2016, pp. 130–134).

The destructive processes on our planet have especially intensified during the advanced phase of globalisation. Transport plays a very important role therein;

without it, it would not have been possible to create a gigantic spiral of supply and demand, which in the 21st century has changed the world into the stage of the activity of consumer societies which, due to the specificity of their behaviour, fully deserve the label of 'ecological pests'. Observing the development of transport in modern times, one may come to the conclusion that it was not planned; development resembled *ad hoc* activities, forced by immediate acted economic reasons. The pursuit of profit was decisive.

The transport industry ranks sixth in the classification of the most polluting industries in the world and generates approximately 24% of global carbon dioxide emissions, of which approximately 40% are caused by commercial transport and the rest by passenger transport.

Apart from the emission of harmful substances and noise, safety is also a serious issue in this sector of the economy. The figure of 1.35 million people killed in road accidents each year, not to mention those who are injured and permanently disabled, speaks for itself.

Transport and pandemic threats

The most important driving force behind the production of goods and the development of the means of transport was, and still is, trade. Since ancient times, merchants, motivated by their willingness to conduct profitable commercial transactions, have travelled enormous distances. Undoubtedly the greatest undertaking of this type in antiquity, which continued in the Middle Ages, was the Silk Road, stretching from China to Europe. Not only did it play a significant role in a commercial sense, but also a civilisational one. It was a kind of 'conveyor belt' by means of which various goods, beliefs, fashions etc. were exchanged.

A significant role in this undertaking was played by so-called infrastructure, namely roads with watchtowers and buildings allowing weary travellers to take a rest after a long and strenuous journey. It was often ascertained, however, that, apart from the positives, this type of 'globalisation in miniature' also had significant drawbacks. These included gangs of robbers waiting for merchants as well as diseases that were spread along the Silk Road. It was widely agreed that they were the greatest threat not only to trade as such, but to the safety of the general population. It should be noted that people who lived at the time did not enjoy good health; indications are that parasitic diseases along the Silk Road were widespread.

Tedious wandering, a lack of adequate food and encounters with dangerous bacteria and viruses, often of animal origin, repeatedly led to the outbreak of plagues, and such pandemics decimated the population. The situation on the waterways was no better in this respect, as repeatedly experienced many times by, for example, Italian cities with fleets such as Venice. Many times, sick people who arrived from distant lands brought waves of infectious disease to the city; for this

very reason, the city introduced the custom of a 40-day period of isolation before entering its gates, which was called quarantine ('40 days'). It should be indicated that the germs of the greatest 'plague' in Europe, which ravaged the continent in 1347–1350, were brought by ships, most probably by infected fleas hosted by rats. They came to Europe from Crimea, where the Tatars used dead bodies as a kind of 'biological weapon', throwing them over the walls into the besieged city (Jones 1979, pp. 193–197).

Another pandemic was caused by the discovery of the 'New World', which occurred after the Turks conquered Constantinople in 1453 and blocked the Silk Road, owing to which goods, especially spices, reached Europe. This motivated travellers, of whom Christopher Columbus is the most famous, to seek a sea route to India. This was of course unsuccessful, but led first the Spaniards, and then other Europeans, to the discovery of America. The consequences of their arrival there were tragic; apart from the brutal violence that the inhabitants of this continent experienced, they were devastated by previously unknown diseases brought by Europeans. This, in turn, led to the beginning of the cultivation of sugarcane, tobacco and cotton plantations established by Europeans, which gave rise to the tragedy of genocide and exploitation facilitated by contemporary means of transport.

The industrial revolution was also perceived to be a dangerous time for the world due to the spread of disease germs around the world, although the development of medicine, including vaccination and hygiene, was undoubtedly helpful in controlling pathological outbreaks. Despite this, there were still pandemics that were beyond control, especially when the global population was weakened and malnourished, often because of armed conflicts, as was the case with the Spanish flu, which claimed a huge number of lives. Here the means of transport played an important role in the spread of disease as well. The development of the road network and the improvement in the means of transport have made globalisation as it is today a reality. The development of previously unknown medicines, especially antibiotics, has also filled mankind with hope for better times. It is clear, however, that diseases have not left us; what is more, they take advantage of the opportunities offered by various means of transport. In addition, one 'panacea' or another is ascertained to be only a temporary preventive measure; an example of this is antibiotics, which, when used too often, have led to many bacteria or fungi developing a resistance to them. This has brought about the recurrence of many largely 'repressed' diseases. The potential threat is significant, although often underestimated. It was only the events related to the COVID-19 pandemic and the 'mutating potential' of the virus that revealed the seriousness of the situation. Given the impact which it has on transport, tourism and many other parts of the economy related to interpersonal contacts, management should seriously re-evaluate their current strategies.

Protection of the environment

The process of the technological revolution which began in the 19th century contributed to industrialisation and lifestyle changes for vast numbers of people in different parts of the world. The concept of the ‘dictating of economic development’, which then developed, meant in practice the subordination of the environment to economic interests. Due to the adoption of this philosophy of action, the state of the Earth’s natural resources worsens as mankind reaches subsequent levels of industrialisation and technical development. The widespread practice of ‘industrialisation’ of agriculture is criticised, together with the associated environmentally harmful crop monocultures and soil contamination. In parallel to the development of negative phenomena, the awareness of the threat to the biological foundations of human existence posed by human economic activity grew among the most enlightened intellectuals. This led, *inter alia*, to the development of ecology (Greek: *οἶκος* – home, environment and *λογία* – science). The list of the founding fathers of this new science is long, including, among others, Aristotle of Stagira (384 BC–322 BC), Theophrastus of Eresos (ca. 371 BC–287 BC), Carl Linnaeus (1707–1778), Friedrich Wilhelm von Humboldt (1769–1859), Charles Robert Darwin (1809–1882), Alfred Russel Wallace (1823–1913), Karl August Möbius (1825–1908), Johannes Eugenius Warming (1841–1924), Vladimir Ivanovich Vernadsky (1863–1945), Arthur George Tansley (1871–1955), Henry Chandler Cowles (1869–1939), and George Evelyn Hutchinson (1903–1991). The term ‘ecology’ was probably coined by Ernst Heinrich Haeckel (1834–1919).

Despite a gradual increase in environmental awareness, industrial production was undoubtedly central to the hierarchy of business circles (Horowitz, Strong 1971, pp. 486–492). The ruthless system of the exploitation of the Earth’s resources, which was present both in capitalism and communism, was beginning to reach the limits of its possibilities. The awareness of the consequences of the policy of nature exploitation and pollution was already high in the 1980s, which prompted circles of intellectuals from various fields to seek a way out of the situation that had arisen.

The discussion on the limits of economic development has become a great step forward. This issue was taken up by the Club of Rome, an international think tank established in 1968 which deals with global problems in the context of the condition of the environment. As a result of the work of this institution, a document entitled ‘Limits to Growth’ was published in 1972 by the Volkswagen Foundation (Volkswagen Stiftung). The published conclusions highlight the fact that development ‘without limits’ is not possible, and overexploitation in the scope of economic activity occurs at the expense of future generations. The thoughts contained in the Club of Rome document generated considerable resonance in various circles. In analysing the causes of the progressive degradation of the environment, the Gro Harlem Brundtland Commission criticised the overexploitation of the Earth’s natural resources by so-called developed Western countries (Janik 2017, pp. 97–102). At the same time, it

indicated the fact that Third World countries were trying to imitate both the Western way of economic activity and the way of life, which leads to an additional burden upon the ecological system of our planet. In order to improve the poor condition of the environment, it would be vital to seek international solutions and develop a general system of economic activity, taking into account the interests of less developed countries and the requirements of 'sustainable development'. As a result of the growing ecological awareness, the subject of recycling has also become an area of interest of various circles, including politicians and businessmen, owing to which various initiatives in this field began to proliferate (Beck 2004, pp. 85–88).

The recovery of valuable materials has a long history. Its origins are not so much related to environmental protection, as this aspect appeared much later, but to economic calculation. This was the case with, for example, precious metals such as jewellery or iron used for the production of weapons and processed in connection with that purpose. At the beginning of the 20th century, attempts were made to achieve 'savings' by reusing used products. This intensified during both world wars when the lack of certain products led to significant savings and to an effort to use whatever was possible. The British press published special advice on how to 'manage' sparingly, including advice on how to recycle actively. In the 1930s, along with the practice of using metal cans, especially for drinks, initiatives to collect and reuse them were observed. During the war, for example in the United States, campaigns for the use of scrap metal ('Get in the Scrap') were initiated and brought positive results. The post-war period, rich in industrial mass production related to so-called 'mass consumption', has created considerable opportunities for the exploitation of the materials used. Their use on a mass scale was associated with the dissemination of ecological ideas and with the concept of sustainable development. Not only were traditional materials such as scrap metal, paper and glass used, but so were many others that had not even been mentioned before. Although not all initiatives that aspire to the title of recycling deserve to be taken seriously, they are of increasing economic importance, and in many countries entire industries have been created to deal with processing recovered materials. As a result of public pressure, entrepreneurs are increasingly reluctant to flaunt ecologically harmful products, transferring 'unclean' forms of production, as part of 'globalisation', to developing countries that do not have legislative safeguards to stop harmful practices (Steger 2009, pp.113–121).

The same occurs in the case of 'industrialised agricultural behemoths', attempting to create their own 'green image' to convince the public of their noble activities, of which Cargill Incorporated would be an example. Of course, not every movement that deserves the 'ecological' predicate has to be synonymous with sustainable development. The fact is, however, that it was this concept that gained the greatest importance and popularity as well as prominent supporters who were able to implement its principles. It is also characterised by a certain simplicity, because it is

relatively easy to compare the steps taken on its behalf with its basic goal, that is, to leave a clean environment for future generations and, in the minimal version, to leave it at least not in a worse condition than it was in. This, of course, applies to the means of transport and their activities as well.

Consequences for management in transport

Economic circles were able to bypass or overlook environmental problems in the past. This was done particularly ‘successfully’ over a lengthy period in the area of transport, despite the fact that it has long been known that certain practices were extremely harmful to nature. The situation in this sector largely reflects the state of affairs prevailing throughout the economy as a whole (Cavanagh, Mander 2004, pp. 179–188). For a significant period of time, there was an unwritten code allowing companies to neglect the natural environment in the name of the development of transport (Singer 2004, pp. 14–50).

This kind of practice was widespread in tourism, among others. Both environmental issues and health and safety have become especially important topics in the context of the COVID-19 pandemic, and have to be properly thought through and re-evaluated at the management level.

It seems that, apart from typical logistics challenges, problems related to the development of natural energy sources for transport as well as the issues of the efficiency and safety of mobility will be predominant in the nearest future. This requires a change in the philosophy of operation of transport managers, which, regardless of ‘green technologies’, should be focused on savings in the field of transporting goods and people. The appropriate choice of factory location can help to avoid unnecessary transport. Contemporary management should not be limited to only one thematic area, but should rather perceive these issues ‘globally’, in the entirety of various aspects related thereto (Löw M. 2018, pp. 82–86). Management should abandon the separatism of individualistic philosophy in favour of cooperation and collective actions.

In many Western countries, for example the European Union member states, the United States, Canada or Australia, the activities of transport managers should be focused on cooperation in larger projects conducted with the aid of government funds or with the help of international organisations. In this way, companies gain the opportunity to access new technologies and gain experience while implementing them. The change to ‘green energy’ is already taking place, which is especially true in the case of urban transport, as evidenced by, *inter alia*, the example of the transport company Hamburg-Holstein (Verkehrsbetriebe Hamburg-Holstein) in Germany. Such steps are met with positive social resonance. At the same time, it forces managers to rethink their existing strategies and introduce new elements therein. This should be done in a reasonable and understandable way for the employees of a given enterprise as well as for public opinion (Hannerz 2010, pp. 88–92).

One can expect that the introduction of electric cars will be associated with other problems. The mere use of electric cars, despite the undoubted benefits to doing so, can also be associated with difficulties. These include the heavy use of metals in the production of batteries that are used to power these vehicles. The methods of charging are also not the simplest. Furthermore, their lack of noise emission, otherwise assessed positively, has already proved to be the cause of accidents in the past, as pedestrians did not hear approaching vehicles soon enough. This requires vigilance and openness, including in relation to technical innovations that are meant to solve existing problems.

It seems highly probable that autonomous vehicles will soon be launched on the market. It is difficult to foresee all the elements of the situation connected with this issue. It is not out of the realms of possibility that transport companies will save on work done by humans through the introduction of autonomous driving systems; this may bring about mass redundancies among transport workers and massive unemployment.

Although initially one can expect a large amount of social resistance during the automation of urban transport, there are indications that this idea will be implemented at least in some situations. At the same time, a not insignificant number of activities, especially technical ones, will continue to be performed by human staff as these cannot be replaced by machines.

One should note the growing importance of information technologies in logistics, which results in the necessity of their increased use in transport management, and which in turn implies the purchase of suitable programmes and training employees in their use (Wren 1994, p. 401). Being open to new emerging management and modern possibilities in this area can contribute to many interesting innovations; among others, the 'intelligent' use of the Internet is becoming increasingly popular when using public transport, owing to which it is possible to order appropriate dimensions of vehicles appropriately sized on seldom-used routes, thus saving on costs and harmful gas emissions. When it comes to sustainable development, attention should not only be focused on the issues of narrowly understood ecology, but also cover the social aspects of this concept. In this spirit, recycling should also be dealt with.

The realisation of sustainable ideas also involves the need to track the preferences of governments and states that have an impact on their policy towards transport. In the case of implementing pro-ecological programmes, transport companies, especially those operating in the field of transporting people, can rely on significant subsidies from the authorities when switching to renewable energy sources; the ability to benefit from such opportunities is one of the most important features of an effective manager (Witzel, 2012, pp. 231–232).

Modern transport management must take into account electricity prices, changing labour costs related to the fact that employees are becoming increasingly highly

qualified, the growing importance of technology, including with high ecological values, and the aspects of focusing on recycling. Issues such as water consumption and the reduction of noise emissions are also important. The challenges related to the development of means of transport relevant to urban traffic will increase and force planners to look for new ways to provide that which is required by different groups of people using different means of transport. This will result in increased interest in service-oriented architecture, which may play an important role in organising transport in the future, including when setting out routes, and using devices that improve mobility, such as electric scooters or skateboards, which can reach fairly high speeds. This is problematic due to the fact that there are no adequately safe paths for them. Environmentally friendly city railways should play a greater role, and rail routes should also be expanded. Ticket prices could play a very important role in the success of a functional rail transport system. The vision of drones circulating in large numbers in cities seems ever more realistic; many companies are already making plans to use them for business purposes, mainly for transporting smaller and lighter packages to their customers. Related to this is the need to create a management system for these drones, which would have to take into account a number of conditions related to the topography of the area and its development. It is also important to increase the level of the safety of such operations (Johnson, Turner 2016, pp. 202–203).

Transport managers should work towards the use of modern vehicle information systems; it is also wise to use semi-autonomous systems to assist drivers where possible. Knowledge occupies an extremely important position in the hierarchy of importance in the current changes in transport. For this reason, it is vital to pay more attention to the scientific ‘support’ for pro-ecological changes in transport in academic circles, both in the form of conducting scientific research and the traditional transfer of knowledge to managers and encouraging them to treat it as part of the implementation of the ‘green transport programme’ at their companies.

The size of modern transport companies should be taken into account when considering the possibility of them adjusting to the needs of sustainable development. Companies which are too large without proper decentralisation, as a rule, would not be effective in terms of the possibility of the implementation of pro-ecological technologies; yet small companies also have problems with this, and not infrequently, because they often lack the adequate resources to implement ‘green technologies’.

An important feature of modern transport managers is sharing acquired knowledge and information (Giddens 1993, p.430). Therefore, appropriate organisations should be established, including think tanks, with both intellectual resources and practical experience as well as material and technical means, facilitating such an exchange of information. The work of managers should also take into account the experiences gained from pandemics, including the most recent one. For example, the

possibility of working from home has consistently proven useful in practice; as a result, many employees are keen to continue to work from their 'home office' even after the pandemic is over. Also, some employers are willing to agree to it because it creates opportunities for savings in the scope of reducing the costs of office space or electricity, and helps to reduce excess road traffic.

At the same time, this pandemic was ascertained to be a great threat to public transport, when commuters were at risk of contracting the virus. This makes the development of action plans for the possible emergence of such threats in the future a crucial element of future planning.

Conclusions

Transport, shaped by civilisation processes, has played an important role in the development of mankind. Without it, important stages of human development would not have been possible. Means of transport significantly contributed to the intensification of the globalisation process, including economic development on a global scale. At the same time, they also play a negative role by polluting the environment either directly or indirectly. The position of transport as an important factor in the destruction of the environment should change in the light of the ongoing transformations and emerging opportunities. For this to occur, the awareness of the need to make changes should increase. An important group in this regard are managers at various levels who, by increasing their knowledge appropriately, should lead the planned changes. This will largely burden them with the need to make employees and the public aware and persuade them of the necessity of the changes taking place.

The modern world, given the advanced process of globalisation, seems to be ever more complicated, and contemporary citizens are confronted with numerous challenges. The transport sector is deemed to be particularly vulnerable to many threats, such as those arising from the pandemic, among others.

The development of technology and the extensive use thereof has led to the degradation of the environment, in which various means of transport have played a significant role. This forces decision-makers operating in the transport sector to rethink the effectiveness of the strategies used to date and to re-evaluate many of the earlier ideas for effective action in this area.

Not only does consideration of the general civilisation aspects of the transport of people and goods allow one to better understand the current condition of transport on a global scale, but also to predict the future changes that may take place therein. It also makes it possible to understand why transport should move towards 'eco-efficiency' without delay and to cease the emission of harmful substances into the atmosphere. This peculiar 'revolution', which is a derivative of the 'ecological revolution' throughout the economy, and which the modern world is facing, means

far-reaching changes in all spheres of human life. This results in a number of challenges for managers, and at the same time is associated with a great opportunity to improve the quality of transport and adapt it to the requirements of sustainable development, especially in terms of safety and 'environmental friendliness'.

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Leaders of the future in turbulent times of change and uncertainty

Abstract: An analysis of the relevant literature reveals that effective leadership is a major challenge for modern leaders. The primary goal of the article was to present the role of leaders of the future in organisations. Also presented were the differences between the development of leaders and the development of leadership in economic entities. Selected leadership systems were also discussed, particularly those which support a new model of leadership. All models presented in this article share certain characteristics, including a lack of hierarchy within the organisation and employees being free to make decisions. Examples of organisations employing the new leadership model were presented. The new models of management offer a range of advantages for the employees, and thus also for the organisation itself. This means that modern management should differ from its previous versions. In light of the above, this is a vital issue which merits further analyses by researchers.

Keywords: Leader, leadership, management, managers, management 3.0

This article is an attempt to analyse the attitudes, behaviours and actions of leaders, as well as factors which significantly impact the performance of organisations. For this purpose, leadership and leading are also given a cursory overview. A great deal of attention is paid to the position, identity – in the general sense – and role of the leader of an organisation. In addition, popular models of leadership are presented, as is the evolution of leadership caused by global transformations. An important part of the paper also focuses on systematising the terminology used to analyse the subject matter. This is of great importance, as it makes it possible to properly understand, and subsequently also to make use of, various terms. Conflicts regarding ambiguous and at times unclear terms frequently lead to their misuse in practice. An added value of this article is the diversity of the examples cited and the references used in the research concerning the subject matter.

The functioning and the continued development of an organisation are largely contingent upon its employees, the leader and their traits. Leading a team of subordinates,

¹ WSB University, Dąbrowa Górnicza.

who should be perceived as important actors within an economic entity, is a very difficult and important challenge. Above all, it requires adequate preparation, the ability to set clear and transparent goals, to motivate employees and being constantly driven to self-develop.² All actions taken by the leader are multi-dimensional and multi-aspectual in nature. If only for the above reasons, it is valid to claim that the role of the leader of an economic entity is a very important one. Leadership is undoubtedly a highly popular subject, as evidenced by the ever-increasing number of papers being published in the field. One of the reasons for this is the belief that all actions taken by leaders impact the functioning of their economic entities, which succeed or suffer failure as a result. The first analyses of this topic were conducted between 1900 and 1945. It should be noted that no single, ironclad rule to which leadership is subject exists; however, it is still possible to identify certain constituent traits of leadership. The relevant literature describes leadership as a relationship based on influence, which characterises the various actions of the leader and his or her supporters.³ The term also refers to the primary aspects of positive leadership.⁴ Leadership is also defined as the power to generate ideas, which are subsequently driven by collective actions. This is most frequently facilitated by a concrete vision. The process of influencing another individual or group of individuals focuses primarily on steering actions which directly contribute to achieving a common goal.⁵ J. Malczyk lists four vital aspects of leadership, namely the person, the process, the position and the achievement of results. Leadership occurs when the influence of the leader has a motivating effect on their subordinates. This type of influence stimulates strategic thinking and actions. It should be kept in mind that nothing motivates subordinates as effectively as a leader with a positive image and charisma. Thus, it is important that they are seen as a role model by their subordinates. The actions and behaviour of a leader should also raise no concerns and be in line with any verbal declarations. It is therefore evident that leaders are perceived primarily through the lens of personal leadership. A leader is only viewed as such if their subordinates acknowledge the leader's relevant traits, including personality traits, skills, experience, knowledge, interests and abilities. In other words, a leader is a person who is able to exert influence on the psychological (including a sense of identity and skills), emotional (including fostering autonomy) and institutional (rewards and penalties, norms, rules and procedures – which comprise

2 M. Geryk, *Rola przywódcy a skuteczne zarządzanie organizacją w zmiennym otoczeniu*, (in:) *Współczesna problematyka wybranych zagadnień prawnych i ekonomicznych*, M. Geryk, A. Pławska (eds.), WSZ, Gdańsk 2016, p. 92.

3 B. Rożnowski, P. Fortuna, *Psychologia biznesu*, 1st edition, Wydawnictwo Naukowe PWN, Warsaw 2020, p. 321.

4 R. Karaszewski, A. Lis, *Czy koncepcja pozytywnego przywództwa może stać się paradygmatem w naukach o zarządzaniu?*, *Nauki o Zarządzaniu* 2(27), Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław 2016, p. 73.

5 R. Kozłowski, *Przedsiębiorcze przywództwo – opis zjawiska i próba oceny*, 'Management Forum', no. 1, vol. 4, Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław 2016, pp. 25–26.

the motivation system) assets of other people.⁶ On the other hand, K. Eikenberry and W. Turmel define the term as willingly following someone whose actions lead to the achievement of a certain result. It can therefore be claimed that leading is undoubtedly a very complex process, one which should be perceived as a specific action, abilities and aptitude, as well as bearing responsibility.⁷

Leadership, as well as its function and role in an organisation, has fascinated humanity since the dawn of time. It should be noted that our changing reality is accompanied by an evolution in the functioning of various economic entities and their organisational cultures. Modern transformations resulting from the internationalisation of the economy, globalisation, the development of computers and other technologies, market competitiveness and instant culture have had a tremendous impact on the life of every human being and their (immediate or more distant) environment. In particular, the rapid progress resulting from these changes has contributed to the emergence of an alternative model of society. This model emphasises agency, treating people as individuals, knowledge, values, experience, abilities and skills. The relevant literature contains numerous publications and research reports, the primary goal of which was to identify the essence of leadership and leadership skills. However, researchers have so far been unsuccessful when it comes to defining a set of attributes which every leader should have. Nevertheless, it has been determined that an immanent trait of every leader is the ability to lead people effectively. Although this may appear obvious, it should be kept in mind that not every leader possesses this ability. Therefore, the concept of leadership and its evolution across various turbulent transformations merits a discussion. All such changes have had an impact on every area of human activity and the reality in which humans operate. D.A. van Seters and R.H.G. Field, in an attempt to trace the evolution of leadership, list the main periods for all existing theories known to them, which they organise into nine eras:

1. The personality era – related to the great man theory and involving analyses and interpretations of the lives of major historical figures, people who performed great deeds and shaped reality in accordance with their visions; such characters include Julius Caesar, Napoleon and Alexander the Great, whose leadership primarily consisted of building strategic plans, courage, eagerness to lead their subordinates and inspiring them to work together, thus allowing them to succeed;⁸

6 J. Majczyk, *Stworzyć lidera. Od wizerunku beniaminka do rozgrywającego w biznesie*, Wydawnictwo Naukowe Wydziału Zarządzania Uniwersytetu Warszawskiego, Warsaw 2019, pp. 13–14.

7 K. Eikenberry, W. Turmel, *Przywództwo na odległość. Jak być skutecznym przywódcą zespołów rozproszonych*, M. Justyna (translator), Dom Wydawniczy Rebis, Poznań 2019, pp. 12–16.

8 M. W. Kopertyńska, *Przywództwo w organizacji czynnikiem sukcesu*, Acta Universitatis Wratislaviensis no. 3695 'Przegląd Prawa i Administracji' CIII, Wrocław 2015, p. 255.

2. The influence era – which focused on sources of power and the application thereof;
3. The behavioural era – which focused on the effective and ineffective actions of leaders respectively;
4. The situation era – where the focus was on leadership being utilised in specific moments;
5. The contingency era – a focus in particular on various factors which resulted in leadership occurring;
6. The transactional era – in addition to incorporating all of the above theories, it is also characterised by the ability to differentiate between roles and social interactions;
7. The anti-leadership era – focused on questioning the essence and meaning of leading. Its proponents promoted various leadership substitutes;
8. The culture era – its main purpose was to stimulate subordinates to lead themselves;
9. The transformational era – which takes into account the actions of leaders in a changing reality.⁹

G.C. Avery, on the other hand, organises existing leadership models using a holistic and multi-aspectual approach which distinguishes between four paradigms:

- classical,
- transactional,
- visionary,
- organic.¹⁰

It is important to note that the first three paradigms mirror the above eras of leadership models. The final one can be seen as the next step, an era which focuses on communication in its broadest sense. From this perspective, leadership is viewed as an interaction and assumes an interdisciplinary character. When discussing the subject at hand, it is important to be cognisant of the modern perception of the development of leaders and the development of leadership. It can often be observed in the literature that these terms are used interchangeably by a certain group of practitioners and theorists. However, a certain group of researchers identifies significant differences between them, and is of the opinion that the two terms are not to be conflated. D.V. Day lists what he considers to be certain major differences between the development of leaders and the development of leadership.¹¹

9 K. Grzesik, *Od rozwoju przywódców do rozwoju przywództwa, czyli od rozwoju kapitału ludzkiego do rozwoju kapitału społecznego organizacji*, (in:) P. Wachowiak, S. Winch (eds.), *Granice w zarządzaniu kapitałem ludzkim*, Oficyna Wydawnicza Szkoła Główna Handlowa w Warszawie, Warsaw 2014, p. 226.

10 K. Grzesik, *Od rozwoju przywódców do rozwoju przywództwa...*, op. cit., pp. 225–227.

11 *Ibidem*, p. 229.

Table 1. Differences between the development of leaders and the development of leadership

Point of comparison	Development of leaders	Development of leadership
Type of capital	People	Society
Fundamental competencies	Intrapersonal	Interpersonal
Leadership model	Individual	Relational
Basic skills	Self-awareness	Social awareness
	Self-regulation	Social skills
	Self-motivation	

Source: based on K. Grzesik, *Od rozwoju przywódców do rozwoju przywództwa, czyli od rozwoju kapitału ludzkiego do rozwoju kapitału społecznego organizacji*, (in:) P. Wachowiak, S. Winch (eds.), *Granice w zarządzaniu kapitałem ludzkim*, Oficyna Wydawnicza Szkoła Główna Handlowa w Warszawie, Warsaw 2014, p. 229

In light of the above, the differences between the development of leaders and the development of leadership are significant. The development of leaders emphasises competencies and skills, which comprise attributes such as knowledge, abilities and credibility. This, in turn, may be interpreted as investing in what is broadly defined as human capital. This type of development fosters fundamental skills, which include self-awareness, self-regulation and self-motivation. Self-awareness comprises traits such as confidence and knowledge of oneself, as well as emotional awareness. Self-regulation, on the other hand, is understood to include traits responsible for adapting to our changing surroundings, taking responsibility for our decisions and self-control. Lastly, self-motivation manifests primarily in the ability to display initiative and become involved in projects.

In contrast, the development of leadership should be viewed through the lens of social capital, major aspects of which include mutual relations, coexistence and working together. The foundations of leadership consist of interpersonal skills, which are based on awareness (empathy, being service-oriented) and social skills (being team-oriented, dispute and conflict management, bonding).¹²

Modern leadership is typically rooted in rational leadership, which only accepts rational sources of power. This point of view assumes that entities entering into a mutual relationship are, first and foremost, mature professional ones.¹³ Thus perceived, leadership serves a very important function in any organisation. It therefore appears that leadership is not to be conflated with the position a person holds or any type of hierarchy. In this context, the leader may be anyone who is able to

¹² *Ibidem*.

¹³ M. Czajkowska, *Sprawiedliwość jako wartość w przywództwie organizacyjnym*, Wydawnictwo Uniwersytetu Łódzkiego, Łódź 2020, p. 79.

assume control of the situation and steer the course of events in the right direction. Therefore, this also covers the case of temporary leadership. In this model, after a task has been completed, the leader may return to their original position, which may or may not have been related to the function they temporarily assumed. This example demonstrates that leadership affects every member of the organisation, who should all feel that they are being treated equally. However, it is important to mention certain exceptions which are directly related to the application of the principle of justice in its broadest sense. While certain people do become effective leaders, for others leadership is a major challenge which causes them to suffer emotional damage. Not every person can adapt to become a leader, make rapid and correct decisions and perform in stressful conditions. This is why, according to Rawls, the correct solution is to deprive such people of the privilege of being able to lead others. Self-directed work teams are currently becoming increasingly popular. The goal in this context is for every employee in an organisation to possess self-control and self-awareness skills. In any event, the primary goal is for every employee to become their own leader. In an organisation, every leader serves a different function. However, by far the most important function of all should be to foster an organisational culture, the primary goal of which is to drive employees to strive towards rational leadership. This goal is pursued by numerous organisations. However, some entities implement the modern leadership model only on certain levels, or apply it to selected elements. In practice, organisations which employ the model only superficially do exist.¹⁴

The most popular theories in support of the new leadership model are remote leadership, self-leadership, authentic leadership and turquoise leadership.¹⁵ The Management 3.0¹⁶ and lean management¹⁷ models also deserve special mention. Remote leadership is related to distributed leadership, both of which have grown in popularity in recent years. It is often the case that employees perform their tasks outside their workplace, which may be a local office, branch or headquarters. Leaders may need to lead their teams while on business trips. At times, they must also lead their teams from another country than where the company is located. In such situations, it is important to realise that, in addition to working from a different location, employees also perform their duties at various hours. As a result, leaders of the future must also effectively manage teams whose members

14 *Ibidem*, pp. 80–95.

15 *Ibidem*, p. 95.

16 J. Appelo, *Zarządzanie 3.0 Kierowanie zespołami z wykorzystaniem metodyk Agile*, I. Jakóbiak, J. Zatorska (translators), Wydawnictwo Helion, 2016, pp. 42–45.

17 A. Byrne, *Jak zrewolucjonizować firmę dzięki Lean Management czyli jak prezesi, dyrektorzy i właściciele wykorzystują zasady Lean Management do transformacji swoich firm i do zwiększenia wartości dostarczanej klientom*, First edition, Wydawnictwo Lean Enterprise Institute Polska, Wrocław 2013, pp. 49–73.

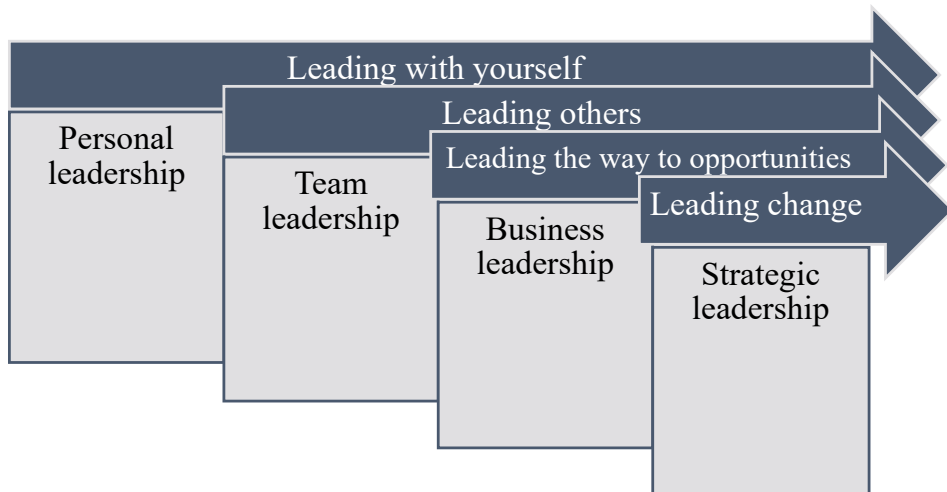
are scattered across the globe, which is undoubtedly a very difficult task, though not an impossible one. This certainly requires dedication, as well as a great deal of time and effort from the leader. In *Remote Leadership*, K. Eikenberry and W. Turmel develop a system which they dub the 'Three-O' model. The authors encourage leaders to combine the foundational elements of leadership, which include the end result, the leader and the employee, with management. This model emphasises the use of modern IT and communication tools. Such a solution not only facilitates the effective management of a distributed team, but also makes it possible for leaders to fulfil a range of other necessary responsibilities. The authors consider leadership and its roles to be of primary importance, while the location of individual employees and managers is secondary. The publication touches upon the important issue of having to lead in various conditions and situations. It also emphasises that technology should be viewed as an asset to be used in modern management, and not as an obstacle. Thus, no effort should be spared to ensure that all tools are used at work in a responsible and reasoned manner, resulting in success. Building trust remotely is a very difficult task, and is certainly not something that happens spontaneously. Thus, a methodical and professional approach to the issue is required. Lastly, the essence of leadership should always consist in the leader being focused not only on the end result, but also on their own needs and the needs of their subordinates. This is why one of the greatest challenges that leaders face is effectively motivating subordinates to engage in various initiatives, and ensuring that this engagement is maximised. The publication also stresses the fact that a leader cannot do everything on their own; delegating responsibilities should be a part of the daily life of the organisation and its management. In light of the above, the primary responsibilities of a leader should be to strive towards a model in which every employee is capable of performing tasks, as well as being responsible for and performing them in an effective manner.¹⁸

The self-leadership model was first introduced in the 1980s. In the literature, it is described as a process in which the leader controls their behaviours, thus exerting influence on themselves via an individual set of competencies. Directing one's actions and influencing oneself are presented as being primarily rooted in what is broadly defined as self-awareness. This, in turn, should have a tremendously positive influence on taking effective actions in real-life scenarios. A self-leader primarily focuses on self-improvement, autonomy, expanding his or her self-awareness, confidence and individual effectiveness. It can thus be said that this type of leadership relies in particular on being aware of one's aims,

18 K. Eikenberry, W. Turmel, *Przywództwo na odległość...*, op. cit., pp. 11–296.

knowledge, experience, skills and values.¹⁹ C. Sikorski believes that self-leadership primarily requires a partnership-based organisation, one in which most relationships are horizontal. Such organisations consider expanding their employees' knowledge far beyond their professional specialisations to be a major goal. The reasoning behind this is that the more educated the employees are, the less direction they require. People who possess diverse knowledge freely and eagerly strive to further expand their skills, and wish to share them with others. Such employees very often generate various ideas and offer creative solutions for which they are capable of assuming full responsibility. According to Sikorski, strong motivation is a necessary requirement for autonomous and responsible decision-making. This motivation serves as an individual stimulus, and may be rooted in ambition, engagement or a degree of interest in one's responsibilities. It also bears noting that motivating oneself can often be significantly more difficult than motivating subordinates.²⁰ The literature thus lists four fundamental levels of self-leadership, which are presented below.²¹

Image 1. Levels of self-leadership.



Source: based on D. Miąsek, B. Bliźniuk, *Samoprzywództwo i Spiral Dynamics – implikacje dla coachingowego stylu zarządzania*, 'Coaching Review' 1/2014, p. 21.

¹⁹ D. Miąsek, B. Bliźniuk, *Samoprzywództwo i Spiral Dynamics – implikacje dla coachingowego stylu zarządzania*, 'Coaching Review' 1/2014, pp. 19–20.

²⁰ Cz. Sikorski, *Autorytaryzm i partnerstwo*, 'Zarządzanie Zasobami Ludzkimi', no. 6/2011, p. 119.

²¹ D. Miąsek, B. Bliźniuk, *Samoprzywództwo i Spiral Dynamics...*, op. cit., pp. 16–18.

Although it is a highly complex management process, self-leadership also offers a wide range of advantages, including independence, responsibility, trust, creativity, positively influencing others, the ability to collaborate and coexist, a sense of satisfaction, increased positive energy driving action and an increased sense of self-worth. Of course, each of the advantages listed above first and foremost constitutes a part of increased engagement. This means that, in turn, they positively impact conscious decision-making and the resulting sense of responsibility. Therefore, it is vital that managers facilitate the development of self-leadership. Of tremendous importance in this context is not only the leader, but also the organisational culture of the company, which is also shaped by the leader and other individuals. It is important to provide working conditions whose primary aim is to motivate, support and inspire leaders. In summary, effective self-management is necessary to be able to serve the extremely important leadership function. Modern leaders are increasingly required to approach work and management in a holistic manner.²²

Authentic leadership can be defined as leadership that is strictly transparent, open and honest. In the 20th century, G. George, a Harvard University professor, took an interest in researching authentic leadership. In his view, this type of leadership encompasses elements such as learning from one's actions, practices and experiences, discovering oneself, as well as one's values and principles, balancing one's sources of motivation (intrinsic and extrinsic), the ability to share responsibilities with subordinates, team building, the ability to collaborate and coexist, as well as integrating individual elements of one's own existence (house, workplace, family, friends). In 2003, F. Luthans and B. Avolio posited that an authentic leader is a person who is self-aware, tenacious and transparent in their leadership.²³ Based on this, one can conclude that this type of leadership comprises primary attributes such as self-awareness, an internalised moral perspective, a degree of relational transparency, being open to feedback and ethical conduct.²⁴

Currently leaders increasingly strive to lead turquoise organisations, which are viewed as the next step in their evolution. In 2014, F. Laloux published his book *Reinventing Organizations*, which is based on a concept originally introduced by Clare Graves and expanded by D.E. Beck and C.C. Cowan in 1996. The publication was widely popular, particularly in management-related circles. Laloux concludes that turquoise organisations are the most developed and effective forms of human collaboration. In this model, every level of human awareness development

22 *Ibidem*, p. 19.

23 P. Korzyński, *Przywództwo w erze cyfrowej. Sposoby pokonywania ograniczeń na platformach społecznościowych*, Wydawnictwo Poltext, Warsaw 2018, p. 35.

24 P. Zbierowski, *Przywództwo w kontekście pozytywnym – autentyczność lidera i kapitał psychologiczny*, 'Organizacja i Kierowanie' no. 2/2017, p. 156.

was assigned a different colour.²⁵ In a turquoise organisation, every employee is of fundamental importance, and should be treated as an individual possessing agency, as well as constituting the main capital of every economic entity. Effective leadership is contingent upon a variety of factors, the most important of which is providing working conditions which motivate and actively involve employees in achieving shared goals.²⁶ The most important competencies of the employees of a turquoise organisation primarily include a well-established value system aligned with the mission and vision of the company. In addition, communication and interpersonal skills are also valued. The leader should foster physical, intellectual, and also emotional engagement. Most importantly, this results in the employees being passionate about their tasks and striving to self-develop, and in turn helping to develop the organisation as well. A major milestone on the path to such success is undoubtedly working on the self-awareness of subordinates, who should profess the same values while also being focused on the mission and vision of the organisation.²⁷

Table 2. The meaning of the colours used in turquoise leadership

Colour	Purpose	Meaning	Example
Red	Short-term	Leadership based on intimidation and fear.	Gangs, mafia
Amber	Recurring	Characterised by a formalised hierarchy and strict rules.	Military, police, government agencies, the Catholic Church
Orange	—	Employee competencies matter. Profit, responsibility and innovation are important.	Corporations, investment banks
Green	Long-term	Customer satisfaction is of tremendous importance, as are shared values based on partner relationships.	A well-functioning family perceived as a social micro-organisation
Turquoise	Long-term	People are the most important actors. No bosses or divisions, equal rights	FAVI, Buurtzorg ²⁸

Source: author's own work based on A. Jeznach, W. Eichelberger (co-author), *Szef, który ma czas. Ewolucja zarządzania – dziennik budowy turkusowej firmy*, Wydawnictwo One Press, Gliwice 2017, p. 19; D. Miąsek, B. Bliźniuk, *Samoprywództwo i Spiral Dynamics – implikacje dla coachingowego stylu zarządzania*, 'Coaching Review' 1/2014, p. 21.

25 A. Jeznach, W. Eichelberger (co-author), *Szef, który ma czas. Ewolucja zarządzania – dziennik budowy turkusowej firmy*, Wydawnictwo One Press, Gliwice 2017, p. 19.

26 A. Poczowski, *Zarządzanie zasobami ludzkimi. Strategie – procesy – metody*, Polskie Wydawnictwo Ekonomiczne, Warsaw 2007, p. 187.

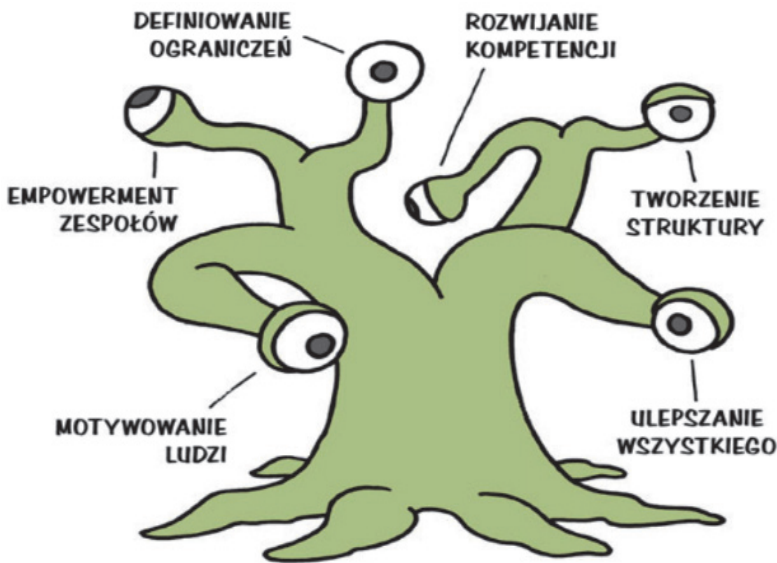
27 A. Kałwa-Rojczyk, *Funkcjonowanie turkusowych organizacji w kontekście kompetencji pracowniczych*, 'Studia i Prace WNEIZ US: Problemy Teoretyczne i Metodyczne' no. 51/2 2018, pp. 49–50.

28 R. Szrajnert, *Turkusowa organizacja (turkusowe zarządzanie), model rozwoju firmy*, <https://www.rafalszrajnert.pl/turkusowa-organizacja-turkusowe-zarzadzanie/>, [accessed on: 15 February 2022].

A turquoise organisation is based on collaboration and communication in the broadest sense of these terms. Its employees perform their duties autonomously, jointly building the mission of the organisation. In addition, the rules which apply to every employee are clear, and every subordinate, no matter what their position, feels that they are an important element of the organisation. Their collaboration is based on mutual trust. It is important to remember that common goals can only be achieved if all parties can trust one another and treat one another fairly. A turquoise organisation supports neoliberalism in its broadest sense, as well as a different type of competition within the company. It bears mentioning that building such an organisation is difficult, and many decision makers are simply afraid of this model. This should come as no surprise, as the lack of a defined hierarchy and employee freedom still make for a relatively controversial and definitely suspicious system of management. However, as demonstrated in Table 2, organisations which have successfully implemented this model do exist, and have been able to succeed in the long term as a result. Managers are often faced with the following question: if the organisation encounters any difficulties, should the previous management model be reimplemented? However, it is precisely in the face of adversity that a turquoise organisation demonstrates its full power. In such situations, the employees “take matters into their own hands” and work even harder. It is often the case that, in difficult situations, employees are capable of generating new ideas and innovative solutions, which certainly does contribute to achieving long-term success.

On the other hand, Management 3.0 grants the leader insight into his or her responsibilities within the organisation and the complexity of managing teams in turbulent times. This model also demonstrates how a leader should strive to adapt to the constantly changing reality, instead of focusing on predictability and at times random actions which are not always effective. The Management 3.0 model is described extensively and transparently in a publication by J. Appelo, who illustrates it using the following figure known as ‘Martie. The Management 3.0 Model’.²⁹

29 J. Appelo, *Zarządzanie 3.0 Kierowanie zespołami z wykorzystaniem...*, op. cit., p. 43.

Figure 1. Martie. The Management 3.0 Model

Source: <https://agilehunters.com/zarzadzanie-3-0-czym-jest-przywodztwo-w-duchu-agile/>, [accessed on: 15 February 2022].

Martie illustrates the six elements of Management 3.0, which include aligning constraints, energising people, empowering teams, developing competence, creating structure and improving everything. From the perspective of Management 3.0, the employee is the most important element of every organisation. A major responsibility of leaders should be to act in a way which ensures that their subordinates are active, creative and motivated to engage in projects. Teams are capable of self-organisation, but this requires the leader to empower them with regard to trust and authorisation in the broadest sense. It is also worth mentioning that only an organisation whose teams are complete and characterised by mutual trust, and whose leader contributes to developing their competencies, can expect to achieve long-lasting success.³⁰

Many modern leaders utilise the lean management model in their work, doing so for a minimum of two reasons. First, lean management can be used as a strategic weapon whose purpose is to improve effectiveness and performance. Second, responsibility towards employees in a broad sense serves an important role. This means that caring about subordinates and facilitating their development are a priority. Therefore, effectively building the organisation's strategy around this model is very important. This task is very difficult yet vital, as it must involve concise and

³⁰ *Ibidem*, pp. 329–330.

simple goals without constraining the development of subordinates. It is important to remember that even the most complex strategy can be executed by employees, as long as it aligns with their personal goals. Another equally important step is to define the core values of the organisation, which should serve as guidelines. Core values should pertain to several key issues, and it is important to avoid lofty dreams or wishful thinking in favour of concrete, simple and lasting values which the organisation can accept and profess.³¹ This management philosophy is also related to the lean manufacturing model, which has been employed by the popular car manufacturer, Toyota, for more than three decades. Every single indicator in businesses utilising this model reaches unparalleled levels, and not only in the manufacturing sector; this model is also growing in popularity in the service sector. It consists in shortening the path between a client submitting an order and their receipt of the goods or service, in a bid to limit waste as much as possible. Waste, in this context, is defined as any human activity requiring a certain amount of effort, but which adds no value. Eliminating waste offers various advantages, including shortened delivery times, freeing trapped funds and decreased manufacturing costs.³²

The above description of leadership models demonstrates that they all share certain characteristics. The first of these is sharing power with subordinates, which should be viewed as a vital skill of any leader. Of course, the feasibility of this depends on the maturity of the subordinates themselves. The situation will undoubtedly differ across various types of businesses. The second shared characteristic is that power is distributed, which occurs in every model described above. This is a long-term process which should encompass the entire organisation, as opposed to a single area.³³ Another shared characteristic is that every employee is viewed primarily as an important actor. This means it is important to take into account the needs of subordinates, as well as to effectively motivate them and foster their engagement. Leaders should also remember that the development of the employees contributes to the development of the organisation. This is why it is vital to effectively organise projects in which employees want to participate in order to improve their skills and expand their knowledge.

It is important to remember that modern leaders operate in an ever-changing environment characterised by either a glut or a dearth of information, acceleration, mobility, unpredictability, network structure, complexity, competitiveness and uncertainty. Nevertheless, the responsibility of the leader often consists in making correct and rapid decisions which will have consequences in the future. It is very

31 A. Byrne, *Jak zrewolucjonizować firmę dzięki Lean Management...*, op. cit., pp. 49–63.

32 A. Łazicki, M. Lewandowski, *System zarządzania przedsiębiorstwem – techniki Lean Management i Kaizen*, Wydawnictwo Wiedza i Praktyka sp. z o. o., Warsaw 2014, pp. 7–9.

33 M. Czajkowska, *Sprawiedliwość jako wartość...*, op. cit., p. 79.

often the case that strategic, innovative and tactical decisions cannot be postponed. Therefore, when making a particular choice, leaders rely not only on rational analyses of extensive data, but also very frequently on their own experience and intuition.³⁴ Every crisis and its resulting changes constitute the natural environment in which leaders must operate. When everything proceeds in accordance with the strategy, the responsibilities of the leader are limited to administration. However, when an unexpected situation, crisis, problem or difficulty arises, such an occurrence is of major importance to the leader. This means that the leaders of the future are those who can transform the majority of threats to their companies into opportunities, and who can significantly facilitate the functioning of their organisations and strengthen their position on the competitive market.³⁵

Summary

The primary goal of the article was to present the role of leaders of the future in organisations. Also presented were the differences between the development of leaders and the development of leadership in economic entities. An analysis of the relevant literature reveals that effective leadership is a major challenge for modern leaders. Their immanent traits are primarily the ability to effectively lead others, treating subordinates as individual actors, as well as properly motivating them to engage in their responsibilities. In addition, it is also vital that the leader provides employees with working conditions which facilitate their holistic development. These responsibilities appear relatively difficult, and must be adapted to a constantly evolving environment. Many of the global transformations occurring today, including technological and communications progress, as well as economic and political development, preclude the application of tried and tested models. As a result, the actions of the leader should align with the needs of the clients and those of the competitive market.

Selected leadership systems were also discussed, particularly those which support a new model of leadership. This comparison led to the formulation of an important conclusion. It was discovered that all models presented in this article share certain characteristics, including a lack of hierarchy within the organisation and employees being free to make decisions. Examples of organisations employing the new leadership model were presented. It should be emphasised that it is thanks to this model that they are able to achieve success in the long term. It is vital that changes are always applied to the entire organisation, as only this approach guarantees lasting benefits. The new model of management offers a range of advantages

34 K. Malewska, *Doskonalenie potencjału intuicyjnego współczesnego menedżera*, 'Nauki o Zarządzaniu' vol. 4(17), Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław 2013, p. 87.

35 B. R. Kuc, *Trudna droga do przywództwa wyższej generacji*, 'Master of Business Administration' 3/2011, Akademia Leona Koźmińskiego, p. 85.

for the employees, and thus also for the organisation itself. Society, which operates in a changing environment, seeks new stimuli, which are primarily provided by self-leading organisations. These are characterised primarily by trust and collaboration based on what is broadly defined as communication. This means that modern management should differ from previous versions. In light of the above, this is a vital issue which merits further analysis.

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The impact of the COVID-19 pandemic on the pass rate for the state driving exam at regional road traffic centers in Słupsk and Zielona Góra

Abstract: The main goal of this article is to present the impact of the pandemic on the pass rate of the state driving exam for the category B driving license at the Regional Road Traffic Centres (WORD Centres) located in Słupsk and Zielona Góra. The specific objective is to compare the pass rate at these centres located in the north and west of Poland during the pandemic compared to the period before.

The article formulates the thesis that the pandemic had a negative impact on the pass rate of the state driving exam for the category B driving license at the Regional Road Traffic Centres (WORD Centres) located in Słupsk and Zielona Góra. This means that the number of people who achieved a positive result in the state driving exam had decreased. One of the reasons for that state of affairs may have been the suspension of classes in driving schools for a two-month period from March 2020 until the beginning of May of that year.

Keywords: driving exam, COVID-19, road traffic centers, pass rate

Introduction

When the new COVID-19 virus appeared, nobody could have expected that it would spread so quickly around the whole world, causing the deaths of millions of people. Since the beginning of the pandemic, 424,277,135 cases of the disease have been recorded worldwide, of whom 5,886,957 people have died². This situation has contributed to the adoption of certain decisions and actions by the governments

1 Private University of Environmental Sciences, Radom.

2 <https://news.google.com/covid19/map?hl=pl&mid=%2Fm%2F02j71&gl=PL&ceid=PL%3Apl> (access: February 21, 2022).

of particular countries, which were primarily aimed at stopping the spread of the virus. Mandatory wearing of face masks was introduced, initially in closed areas (e.g. shops, pharmacies, churches, commercial premises, including hairdressers and beauty salons). The obligation was later extended to open areas. Moreover, restrictions designed to limit interpersonal contacts and socialising were introduced. Additionally, specialist “COVID” hospitals were established. With the increase in the numbers of daily infections, a number of public facilities were closed (e.g. restaurants, gyms, and swimming pools).

In addition, ongoing intensive work to develop a vaccination that would effectively stop the spread of the virus or relieve its symptoms was carried out. However, time pressure and the continued mutations of the coronavirus significantly impacted the timespan of the work. Despite this, vaccinations that at least relieved the symptoms of the infection have been developed. Currently 10,572,623,165 doses of COVID-19 vaccinations have been issued worldwide whereby 4,322,423,769 people have received all the necessary doses (are considered to have been fully vaccinated)³.

All the actions taken affected the functionality of the entire global economy as well as the economy of each country. Business activities were significantly limited, which had a huge impact on income. Service enterprises were the most affected. The affected entities of this type include Regional Road Traffic Centres (PL abbreviation: *WORD – Wojewódzki Ośrodek Ruchu Drogowego*) operating in Poland.

In order to verify the aforementioned thesis, statistical data were provided by the abovementioned driving schools for the following periods:

- 2018–2019 – before the pandemic,
- 2020–2021 – during the pandemic.

The COVID-19 pandemic

In recent times, the COVID-19 pandemic has played a major role in the business environment. The word ‘pandemic’ comes from the Greek ‘pan’ (all) and ‘demos’ (people). It is defined as an epidemic that occurs over large areas of the globe – several continents as well as countries – and is characterised by high incidence⁴. To date, the term ‘pandemic’ has mainly been associated with the spread of plague, cholera or smallpox in previous centuries. However, its most recent popular uses have been in terms of the HIV virus which causes AIDS, or avian flu.

In recent months we have dealt with the COVID-19 pandemic and mutations to the virus, which have affected the whole world. One of the reasons for the rapid

3 <https://news.google.com/covid19/map?hl=pl&mid=%2Fm%2F02j71&gl=PL&ceid=PL%3Apl&state=4> (access: February 21, 2022).

4 <http://www.przegl Epidemiol.pzh.gov.pl/slowniczek-terminow-epidemiologicznych> (accessed: January 20, 2022).

spread of the virus, often mentioned by global health organisations, is migration across different countries and/or continents⁵. Due to the current situation, relevant restrictions have been taken (within particular countries) of which the main purpose is to prevent the spread of the virus. In Poland the entity responsible for monitoring epidemiological threats is the Chief Sanitary Inspector together with the Director of the National Institute of Public Health – National Institute of Hygiene⁶.

However, for some business entities, mainly those operating in the service area, these activities have had a negative impact on their business activities. This also impacted the Regional Road Traffic Centres (WORD Centres) located throughout Poland.

The functioning of regional road traffic centres

in this article two Regional Road Traffic Centres will be the subjects of research, namely those in Słupsk and Zielona Góra.

The Regional Road Traffic Centre in Słupsk was established by the Ordinance of the Voivode No. 26/98 of 20 April 1998, pursuant to art. 116 sec. 1 and art. 120 par. 1 of the Act from 20 June 2020 – Road Traffic Law⁷. In accordance with art. 116 of the above Act, the Regional Road Traffic Centre (WORD) is a local governmental legal entity; however, the legal basis of the activity is the Statute established in accordance with Resolution No. 188/2000 of the Management Board of the Pomeranian Voivodeship of 15 September 2000.

The Regional Road Traffic Centre (WORD) in Słupsk deals with a very wide spectrum of business activities, mainly examination and training sessions aimed at the improvement of road safety, including the following:

- conducting a state driving exam for candidates in order to obtain the right to drive vehicles of all categories of driving licenses,
- conducting a state driving exam for those who wish to broaden their qualifications in terms of driving licenses and checking the qualifications of drivers,
- training sessions for people applying for examiners' qualifications, candidates of all categories (basic and additional ones),
- conducting courses on the transport of dangerous goods,
- organising courses of road safety knowledge,
- conducting courses for people directing the traffic,
- organising training sessions in the field of road traffic control,

5 J.C. Semenza et al., Observed and projected drivers of emerging infectious diseases in Europe, "Annals of the New York Academy of Sciences" 2016, t. 1382, nr 1, s. 73–83, <https://doi.org/10.1111/nyas.13132>.

6 A. Kicman-Gawłowska, *Nadzór nad chorobami zakaźnymi w świetle Międzynarodowych Przepisów Zdrowotnych*, „Przegląd Epidemiologiczny” 2008, t. 62.

7 Journal of Laws, Dz. U. Nr 98, poz. 602, oraz Nr 160, poz. 1086 z póź. zm.

- cooperation with associations dealing with road safety issues.

The Regional Road Traffic Centre (WORD) is managed by a director who is appointed and relieved of his/her duties by the Board of the Pomeranian Voivodeship. The director, in addition to managing the centre, acts as an external representative of the centre and is responsible for the performance of particular tasks.

The Regional Road Traffic Centre in Zielona Góra is a local government legal entity. It was created in February 1998 by the Voivode of Zielona Góra on the basis of the Road Traffic Act⁸. Following the administrative reform, the centre is supervised by the Board of the Lubuskie Voivodeship.

The tasks of the Regional Road Traffic Centre (WORD) in Zielona Góra include:

- cooperation with the regional road safety council,
- cooperation with starosts in the scope of supervising training sessions,
- organisation of state exams to verify the qualifications of those applying for driving licenses and drivers,
- organisation of exams verifying the qualifications of those applying for driving licenses within the scope specified in the international agreement whereto the Republic of Poland is a part,
- conducting qualification courses,
- conducting training courses in the area of road safety,
- conducting re-education courses in road safety,
- organisation of classes for students applying for a bicycle card,
- providing the Marshal of the Voivodeship and starosts with information and statistics pertaining to pass rates for individual training centres and instructors,
- conducting other educational activities within the scope of road traffic and transport.

The Regional Road Traffic Centre (WORD) is managed by a director who is appointed and relieved of his/her duties by the Board of the Lubuskie Voivodeship. The director performs an external representative function and is responsible for the performance of particular tasks set out in the Road Traffic Act and the statute. The director of the centre is authorised to perform legal actions independently on behalf of the centre.

State driving license exam

The main task of each Regional Road Traffic Centre (WORD) is to conduct the state driving test. This exam is divided into two main parts:

8 Journal of Laws Dz. U. Nr 98, poz. 602, oraz Nr 160, poz. 1086 z póź. zm.

- theoretical – the conditions and mode of this part are described in the regulation of the Minister of Infrastructure of 28 June 2019⁹.
- practical – the conditions and mode of this part are described in the regulation of the Minister of Infrastructure of 28 June 2019¹⁰.

Theoretical exam

During this part of the exam, the examinee must demonstrate their theoretical knowledge in the areas of:

- rules and regulations for safe movement of a vehicle on a public road,
- traffic-related hazards,
- obligations of the driver and owner of a vehicle,
- procedures in emergency situations.

The exam is conducted in electronic form on a computerised examination device. The candidate should indicate the correct answer to the questions displayed randomly by the computer system. There is no possibility of returning to an unanswered question. The questions displayed reflect situations that drivers may face in real traffic.

The theoretical part of the state exam includes 20 questions on basic knowledge and 12 questions on specialist knowledge in the area of particular categories of driving licence. Each question has only one correct answer. Different “values” of questions have also been introduced, depending on their importance for road safety:

- 3 points – a question of high importance for road safety,
- 2 points – a question of medium importance for road safety,
- 1 point – a question of low importance for road safety or order of road safety.

Each category of the exam lasts 25 minutes. The maximum possible total of points is 74. Candidates must obtain a score of at least 68 points to pass the exam.

Foreigners have the option of signing up for the theoretical exam in English or German. Deaf people have the opportunity to sign up for a theoretical exam with the presentation of questions and answers in sign language.

The theoretical test may be divided into six stages:

1. checking the identity of the examinee, indicating the computer station, and starting the exam,
2. familiarisation with the instructions pertaining to the examination system,
3. mock exam,
4. state exam,
5. presentation of the result,

9 Dz. U. z 2019 r. poz. 1206.

10 Ibid.

6. checking incorrect answers – this part is available only to people who have completed the exam with a negative result. It allows a candidate to familiarise himself or herself with the questions which were answered incorrectly.

Since 24 August 2014, the regulations governing the validity of the theoretical exam have been removed. Based on the above, all theoretical exams which as of 24 August 2014 resulted positively and were valid on that date are valid for an unlimited period.

Practical exam

This part of the exam is to demonstrate that the person applying for a driving license can apply traffic regulations in practice. Each candidate should:

- have a valid identity document allowing the examiner to verify the identity of the person being examined,
- have glasses, contact lenses, hearing aids, etc. if such indications are included in the medical certificate.

The practical exam may be divided into five stages:

1. confirmation of identity, introduction of the examiner,
2. checking the technical condition of the vehicle and preparing it for driving,
3. performing tasks on the manoeuvring area,
4. performance of tasks in road traffic – this part of the exam is carried out to verify the skills of the candidate in accordance with the road traffic regulations, operating a vehicle in a manner which is safe, energy-saving, efficient and does not hinder other road users; the examiner pays specific attention to:
 - how to perform manoeuvres on the road,
 - behaviour towards the other road traffic participants,
 - the ability to assess potential or actual road hazards,
 - response efficiency in case of danger,
 - usage of the vehicle controls.
5. review of the exam – after the practical part of the state exam is completed, the examiner discusses the result of the practical part with the examinee in detail, and if the result is negative, gives feedback with particular reasons for the final result.

Stages 1–3 and 5 are performed in the manoeuvring area.

The practical part of the category B driving test is recorded. Recording exams other than category B is permitted.

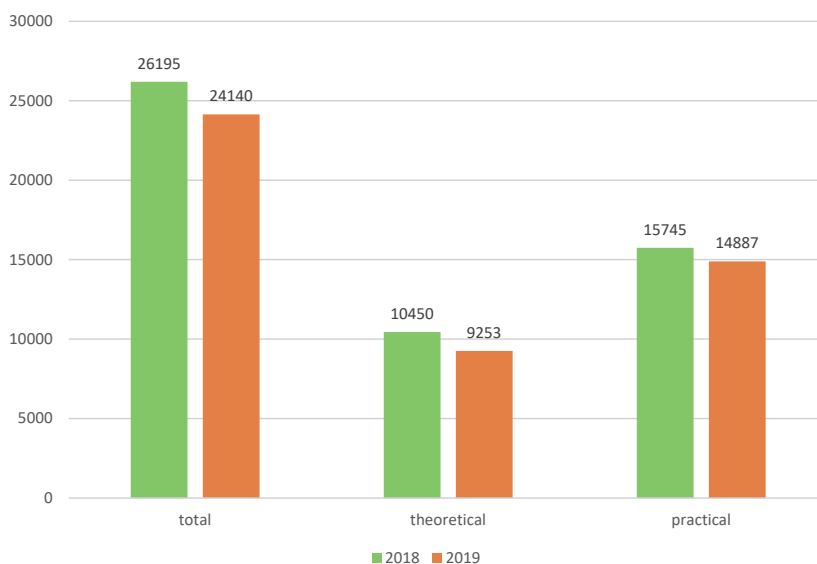
Research methodology - data analysis

The analysis was conducted on the basis of the data provided by the two centres¹¹ which are the subjects of this study. The period of 2018–2019, before the pandemic, was compared with the period of 2020–2021 when COVID-19 spread throughout the world. The study was focused on the state category B driving exam. The total number of exams conducted, both theoretical and practical, was taken into consideration. After that, the results were further subdivided in the context of obtaining a positive result (percentage values) in each of these parts.

Pass rate of the driving licence exam in 2018–2019 - category B

Regional Road Traffic Centre in Słupsk

Chart 1. Total number of exams conducted, with further division into theoretical and practical parts

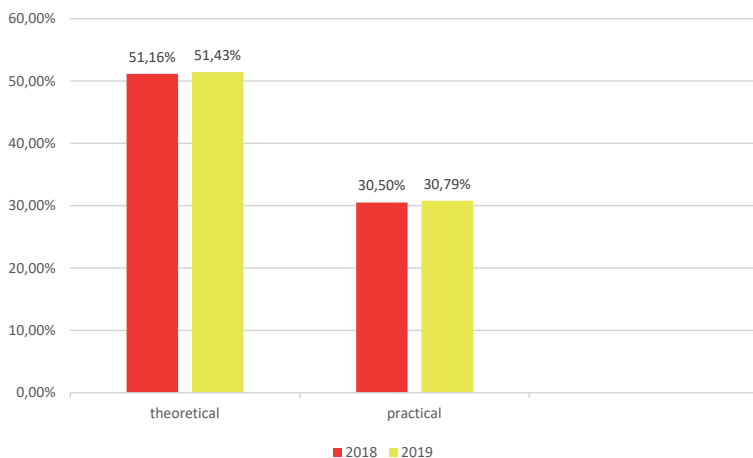


Source: own study based on the shared data.

In the analysed period, the total number of state examinations conducted for category B driving licenses remained at a relatively constant level, as it did following division into theoretical and practical parts. There was no drastic increase or decrease.

11 <http://www.bip.word.slupsk.pl/strona,statystyka-egzaminowania> (accessed: 22 February 2022), <https://wordzg.bip.gov.pl/statystyka-egzaminow/zdawalnosc-w-word-zielona-gora-wszystkie-podejscia.html> (accessed: 22 February 2022).

Chart 2. Pass rate of the state exam for the category B driving license (%)

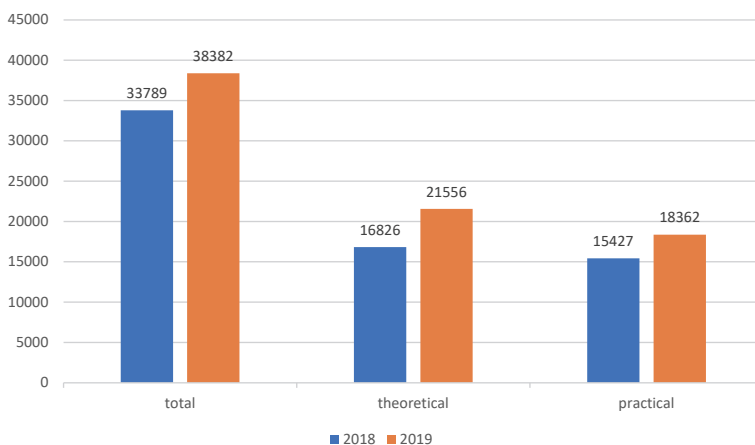


Source: own study based on the shared data.

The pass rate for the theoretical part of the exam was much higher than for the practical part; however, in 2018–2019 it remained at a relatively constant level.

Regional Road Traffic Centre in Zielona Góra

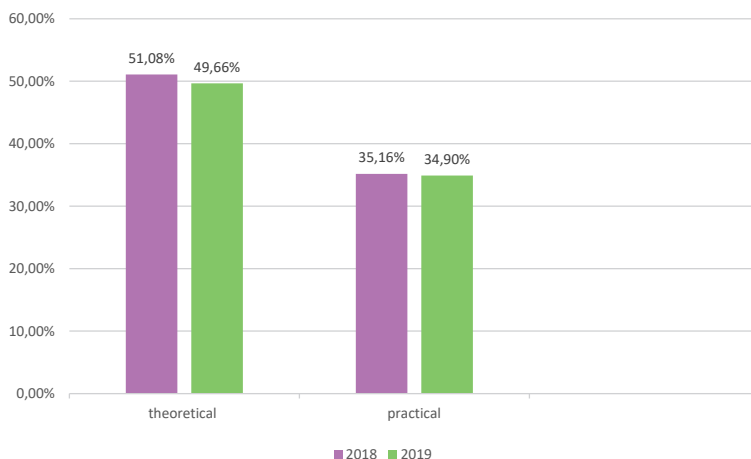
Chart 3. Total number of exams conducted, with further division into theoretical and practical parts



Source: own study based on the shared data.

In 2019 there was a slight increase in the number of state examinations for category B driving licenses, both theoretical and practical, compared to 2018.

Chart 4. Pass rate of the state driving exam for the category B driving license (%)



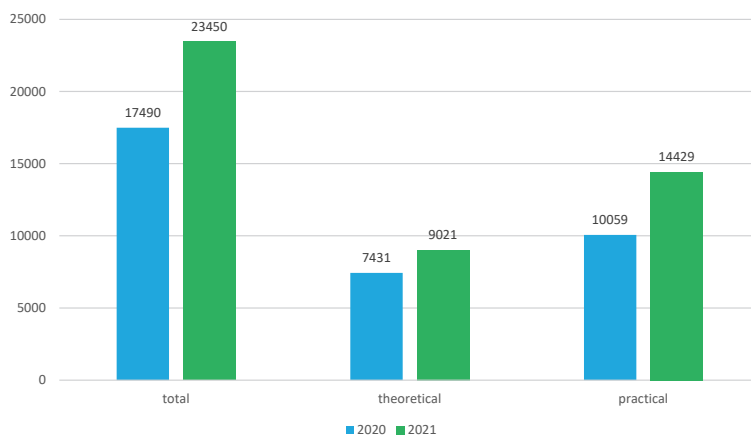
Source: own study based on the shared data.

In the analysed period, there was a slight decrease in the pass rate of the state driving examination for the category B driving license, for both the theoretical and practical parts.

PASS RATE OF THE DRIVING LICENCE EXAM IN 2020-2021 – CATEGORY B

Regional Road Traffic Centre in Słupsk

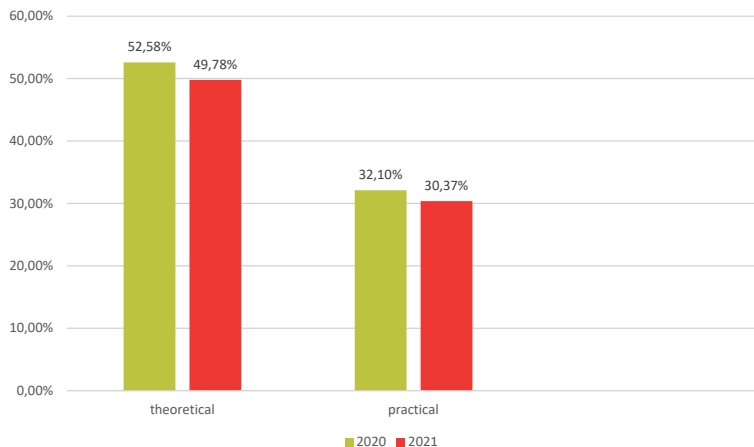
Chart 5. Total number of exams conducted, with further division into theoretical and practical parts



Source: own study based on the shared data.

In the years 2020–2021 at the Regional Road Traffic Centre (WORD) there was an increase in the number of state driving examinations for category B driving licenses conducted in terms of both the theoretical and practical parts.

Chart 6. Pass rate of the state driving exam for the category B driving license (%)

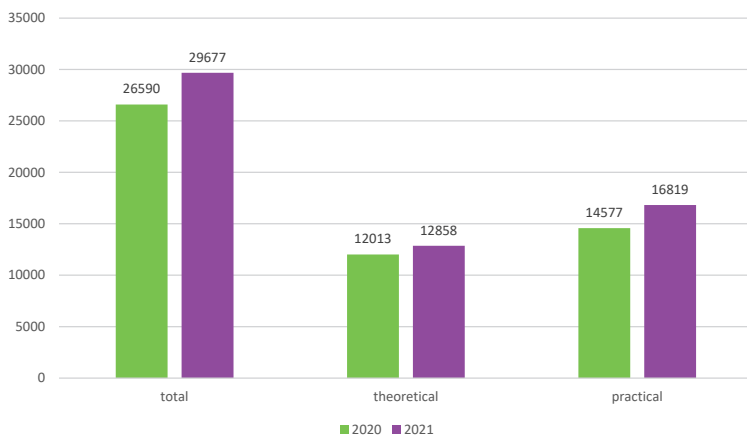


Source: own study based on the shared data.

In the period under consideration there was a slight decrease in the passing percentage rate of the state category B driving license exam, for both the both theoretical and practical parts.

Regional Road Traffic Centre in Zielona Góra

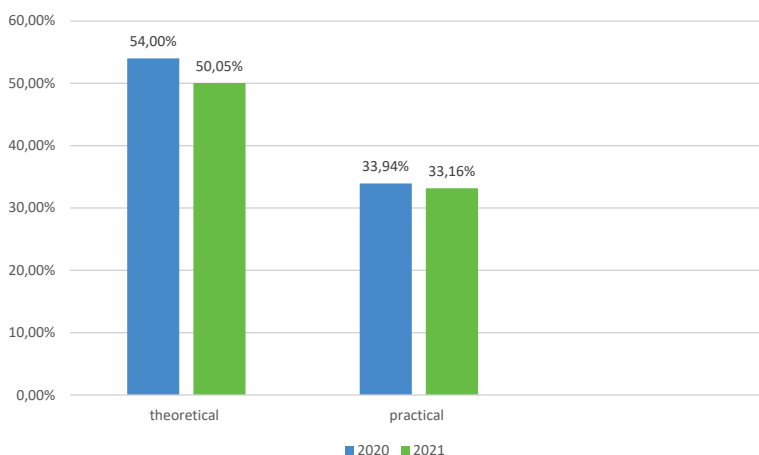
Chart 7. Total number of exams conducted, with further division into theoretical and practical parts



Source: own study based on the shared data.

The Regional Road Traffic Centre (WORD) in Zielona Góra recorded a slight increase in the number of state driving examinations in the year 2021, in terms of both the theoretical and practical parts.

Chart 8. Pass rate of the state driving exam for the category B driving license (%)



Source: own study based on the shared data.

In the years 2020–2021, there was a slight decrease in the pass rate of the theoretical part of the state category B driving test. In terms of the practical part of this exam, a relative balance was maintained.

Summary and conclusions

Table 1. Comparative pass rate of the state driving exam for the category B driving license at WORD Centres in Słupsk and Zielona Góra (%)

Year	WORD Słupsk		WORD Zielona Góra	
	theory	practice	theory	practice
2018	51.16	30.50	51.80	35.16
2019	51.43	30.79	49.66	34.90
2020	52.58	33.10	54.00	33.34
2021	49.78	30.37	50.05	33.16

Source: own study based on the shared data.

Based on the data in the table above, one may confirm the validity of the research hypothesis. Both the theoretical and practical parts of the state category B

driving license exam have not changed significantly in the context of passing rates (in percentage terms) in the period of 2018–2021 which was the subject of analysis. Only the number of exams conducted has changed, which reflects the pandemic situation since 2020. However, there has been no direct impact on the passing rate, either in theoretical or practical terms.

For that reason, the hypothesis was verified negatively. The pandemic did not affect the rate of passing the state category B driving license exam (based on the example of WORD Słupsk and WORD Zielona Góra).

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Protection of genetic data in light of the provisions of law

Abstract: Recently, the continuous and rapid progress of medicine, especially in the fields of genetics and biotechnology can be observed. This is vitally important for our knowledge of various diseases and effective preventive measures. However, in addition to the numerous benefits of this development, some problems arise related to the right to the protection of personal data, including genetic data, which is one of the foundations of the protection of individual privacy and results from the Constitution of the Republic of Poland and acts of international law.

Currently, the level of awareness related to this issue among citizens is still relatively low, which may be due to trust in regulations and the belief that they are protected by law. However, current regulations do not always provide sufficient protection for genetic data, therefore it is important to raise public awareness and draw attention to the risks involved in processing such data. This is essential to ensure a fair approach to the collection and use of genetic data, which in turn is crucial for sustainable development in this area.

Key words: genetic tests, biobanks, genetic data, right to privacy, protection of personal data, genetic information, genetic code, Act on the Protection of Personal Data, GDPR

Introduction

In recent years, the concept of personal data has increasingly emerged when discussing security policy. Here data mean any information about an identified or identifiable living natural person; individual information that, in combination with each other, can lead to the identification of a person's identity is also personal data.

In order to better understand the concept of personal data, recitals 26, 30, 34 and 35 of the General Data Protection Regulation² should be referred to, which emphasise that personal data may also include indirect data, such as electronic

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2 Regulation (EU) 2016/679 of the European Parliament and of the Council (GDPR) of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC.

identifiers stored in cookies, Internet addresses, addresses and device identifiers that can be used to identify individuals. Similarly, fragments of a genetic code combined with other medical data or other information about a person may be similar traces for identification.

Moreover, in order to properly identify a person, objective factors and technological developments must also be taken into account. Verification of whether data can be identified as personal data should take into account not only current identification possibilities, but also future developments in science, technology and social phenomena.

In order to understand the process of identification through a special feature, the manner of how the accused persons are anonymised in the media can be analysed. It consists of disclosing only the first name and first letter of the accused person's surname, for example by using "Jan K." instead of "Jan Kowalski". For most people, this method is effective, but for people with unique names, for example Artemius or Filemon, this method can be useless because the name itself is enough to unambiguously identify a particular person. Similarly, it can be the case for fragmented genetic data, which may be so unique that the identification of a person only on the basis thereof is possible. It should be noted that paternity or kinship with a probability exceeding 99 % can be established based on 34 DNA markers. This shows how unique and sensitive genetic personal data can be.

Protection of genetic data as a special category of personal data

The right to the protection of personal data is one of the foundations of the law protecting the privacy of an individual and has its origin in the provisions of the Constitution of the Republic of Poland.³ It says that every citizen has a right to have their private and family life, honor and good name protected.⁴ In addition, no one may be compelled to disclose information about their person unless provided for by the Basic Law. The Constitution also lays down the rules for collecting and making such information available.⁵

The Act on the Protection of Personal Data⁶ complements the provisions of Article 51 para. 5 of the Constitution and it specifies the principles of handling personal data and the rights of natural persons whose data are or may be processed.⁷ It is an important tool in ensuring state protection in the event of illegal processing

3 The Constitution of the Republic of Poland of 2 April 1997 (Journal of Laws 1997 No 78, item 483).

4 Article 47 of the Constitution of the Republic of Poland.

5 Article 51 para. 5 of the Constitution of the Republic of Poland.

6 Act of 29 August 1997 on the Protection of Personal Data (Journal of Laws 1997 No 133 item. 883). Currently, the Act of 10 May 2018 on the Protection of Personal Data (Journal of Laws 2018, item. 1000).

7 Article 2 para. 1 Act on the Protection of Personal Data

of personal data of citizens. The Personal Data Protection Office⁸ is authorised to sanction detected violations in the processing of personal data.

According to Article 1 of the Act, everyone has the right to the protection of their personal data and the processing of such data is permitted only on the grounds of certain interests, such as the public good, the good of the data subject or the good of a third party. Data processing must take place within the scope and procedure specified in the Act. It is important that the balance between the different interests which underlie the Act on the Protection of Personal Data should be taken into account when applying the provisions thereof.

The function of the Police in the processing of various types of information, including personal data, is specific and subject to a special regime and protection. The Police Act⁹ provides that this authority may collect, verify and process information, including classified information. The police are entitled to obtain information, including personal data¹⁰, subject to restrictions resulting from Article 19 of the Act. The processing of data may concern persons who meet certain categories, such as:

- persons suspected of having committed crimes prosecuted by public prosecution,
- juveniles committing acts prohibited by the law as crimes prosecuted by public prosecution,
- individuals with an unspecified identity or attempting to conceal their identity,
- persons posing a threat,
- wanted persons,
- missing persons,
- persons subject to the measures of protection and assistance provided for in the Act of 28 November 2014 on protection and assistance to the victim and witness (Journal of Laws of 2015 item 21).

It is worth emphasising that the tasks entrusted to the Police, such as protecting people's life and health, property, public order, as well as preventing and prosecuting crimes, are extremely important to ensure the safety of society. In order to perform these tasks effectively, the Police must be able to collect and process personal data, even without the knowledge and consent of the data subject. However, this must be done in accordance with the law, including the Police Act and the Act on Personal Data Protection. It is necessary to strike a balance between the protection

8 The competent authority for the protection of personal data on the territory of Poland, established by the Act of 10 May 2018 on the Protection of Personal Data.

9 Act of 6 April 1990 on the Police (Journal of Laws 1990 No. 30 item. 179).

10 Article 20 para. 1 and para. 2a of the Police Act.

of the rights of the individual, including the right to privacy and the protection of personal data, and ensuring the effectiveness and efficiency of the police, therefore, the law must enable the police to act appropriately and legitimately, which is necessary for the performance of its tasks within the constitutional framework of individual rights.

Detailed rules for the processing of personal data of persons listed in Art. 20 para. 2a of the Police Act are laid down in the Regulation of the Minister of Internal Affairs and Administration of 24 August 2018 on the processing of information by the Police.¹¹

According to §10 of the Regulation, the Police maintains the National Police Information System (KSIP), which is a collection of data within which the information, including personal data, is collected, checked, processed and used. Information may be processed in KSIP, including personal data, to which the Police have rights under other separate acts, if this contributes to more effective coordination, organisation and execution of police tasks. It is worth emphasising that the criterion of the necessity of processing personal data in KSIP must always refer to the statutory tasks of the Police referred to in the provisions of Article 20 para. 1, para. 2a and 2b in conjunction with Article 20 para.17 of the Police Act.

It should also be noted that there are categories of personal data the processing of which has been specifically regulated. These are data revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, trade union membership, genetic data, biometric data, data on health, sexuality or sexual orientation, and data on convictions or infringements of law and related security measures.

The GDPR introduces the definition of genetic data as a special category of personal data. The earlier Directive 95/46/EC¹² did not impose such implementation requirements, which meant that individual EU countries had some legislative leeway to process genetic data. For example, in Poland, Article 27 para. 1 of the Act of 29 August 1997 on the Protection of Personal Data classified information on the genetic code of a natural person as sensitive data. However, the very definition of the term 'genetic code' in this Act is not clear, which creates uncertainty regarding the protection of data concerning the person's genetic characteristics. Therefore, the introduction of a new definition of genetic data is very positively received. Article 4 (13) of the GDPR clearly defines genetic data as personal data relating to the inherited or acquired genetic characteristics of a natural person which give unique information about the physiology or the health of that natural person and which result, in particular, from an analysis

11 Regulation of the Minister of Internal Affairs and Administration of 23 August 2018 on the processing of information by the Police (Journal of Laws 2018, item. 1636).

12 Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data.

of a biological sample from the natural person in question, in particular from the analysis of chromosomes, deoxyribonucleic acid (DNA) or ribonucleic acid (RNA) or from the analysis of other elements enabling equivalent information to be obtained.¹³

The processing of genetic data is in principle prohibited. However, the GDPR introduces exceptions to this rule if:

- the data subject has given his or her explicit consent to their processing for specified purposes,
- processing is necessary for the fulfilment of the obligations and the exercise of specific rights of the controller or the data subject in the fields of employment, social security and social protection,
- processing is necessary to protect the vital interests of the data subject or of another natural person where the data subject is physically or legally incapable of giving consent,
- processing is carried out in the course of legitimate activities with appropriate safeguards by a foundation, association or other not-for-profit-body with political, philosophical, religious or trade union aim and on condition that the processing relates solely to the members or former members of the body or persons who have regular contact with it,
- processing relates to personal data which are manifestly made public by the data subject,
- processing is necessary for the establishment, exercise or defence of legal claims or whenever courts are acting in their judicial capacity;
- processing is necessary for reasons of substantial public interest,
- processing is necessary for the purposes of preventive or occupational medicine,
- processing is necessary for reasons of public interest in the area of public health,
- processing is necessary for archiving purposes in the public interest, scientific or historical research purposes or for statistical purposes.¹⁴

On the other hand, biometric data are defined in Article 4(14) of the GDPR as personal data resulting from specific technical processing relating to the physical, physiological or behavioural characteristics of a natural person, which allow or confirm the unique identification of that natural person, such as facial images or dactyloscopic data. However, photographs fall into the category of biometric data

13 The above definition excludes the interpretation that the processing of prenatal genetic data is related to the pregnant person. The genetic properties of the fetus are not information about the genetic characteristics of the mother, but only the unborn child.

14 Article 6 of the GDPR.

only if they are processed by means of specific technical means allowing the unique identification or authentication of a natural person.¹⁵

On the other hand, data concerning health are described in Article 4(15) of the GDPR as personal data related to the physical or mental health of a natural person, including the provision of health care services. As indicated in recital 35 of the GDPR, personal data concerning health should include information collected in the course of the registration for, or the provision of, health care services, information derived from the testing or examination of a body part or bodily substance, including from genetic data and biological samples; and any information on, for example, a disease, disability, disease risk, medical history, clinical treatment or the physiological or biomedical state of the data subject independent of its source.

The pace of technological progress makes genetic research increasingly available and popular, which brings many benefits, but at the same time poses challenges related to privacy protection and the ethical use of customer data in the public interest. Digital genetic databases and the possibility of comparative analysis allow people to be identified on their basis. With the growing popularity of genetic testing and genetic diagnosis, other threats emerge, such as discrimination based on the characteristics of the genetic code. Such discrimination may lead to the refusal of insurance or work on the basis of the potential risk of certain diseases.

The prohibition of discrimination in the Constitution of the Republic of Poland is laid down in Article 32 (2) and is a consequence of the principle of equality in Article 32 (1). The Constitutional Court, in its jurisprudence, emphasises that this provision is “universal in nature of the principle of rule of law, requiring that it be observed in all spheres of life – precisely in terms of political, social and economic life”.¹⁶ There is no doubt that this principle includes the prohibition of discrimination on the basis of genetic characteristics and the information relating thereto. This is defined as a situation in which an individual is discriminated against on the basis of differences between his or her genetics and the genetics of a “normal” human (whether the disease develops in that person or not). Such discrimination can be expressed primarily in unequal treatment by insurers and employers. The scientific doctrine thus raises the belief that the processing of genetic data in the context of employment and insurance should, in principle, be prohibited and allowed only in exceptional cases. Situations occur where the examination is necessary for the protection of the health of the employee himself or herself, such as the examination of pilot candidates. This position is also maintained by Polish legislation, which prohibits insurers from

15 Recital 51 of the GDPR.

16 L. Bosek, W. Borysiak [w:] M. Safjan, L. Bosek, *Konstytucja RP Tom I Komentarz Art. 1 – 86* [The Constitution of the Republic of Poland Volume I Commentary Art. 1 – 86], pp. 46-49, Warsaw 2016; the judgment of the Constitutional Tribunal of 24.10.2001, SK 22/01, OTK 2001, No 7, item 216, Nb. 107, p. 838.

requesting predictive analytics to assess insurance risks, establish rights to benefits and determine their amount.¹⁷ At the moment in Europe, genetic data in the context of insurance and employment do not provoke significant disputes, but the potential problems that may become a reality as genetics progresses cannot be underestimated.

Another issue is the problem of commercial genetic testing. To date, there is no law that regulates the activities of companies offering such products and services. In American law, genetic tests that can be performed at home are not treated as generating medical data. Unlike genetic tests for medical diagnostics, tests to be performed at home are not tested before being launched on the market. Such a legal approach may pose some risks to users of commercial genetic tests, as their personal data may not be adequately protected by a lack of precise regulation.

Legal experts emphasise that the market for private genetic testing has become a driver of growth for companies which interpret the results of these tests. These companies offer personalised diets, vitamin supplements, exercise plans, and analyse health risks based on genetic data. The products placed on the market allow consumers to get to know their body in the new way, but at the same time pose a risk to the privacy of the most sensitive data. Their transfer to companies which offer DNA analytics services may pose a threat of information theft by cybercriminals in the event of a cyber-attack against these companies.

Another aspect which is worth paying attention to is how genetic data are used for research purposes. Currently, in the context of the development of the field of medicine, in particular genetics and biotechnology, biobanks, as institutions responsible for developing medical knowledge in the field of understanding diseases and effective prevention, play an important role. Supporting their activity is therefore a key step forward. However, it is necessary to maintain appropriate standards that ensure that the rights of donors are respected. Individuals who wish to contribute to the advancement of medicine should not be exposed to the potential adverse effects resulting from the sharing or processing of sensitive genetic data.

Conclusion

Of course, it is of utmost importance that legislation effectively addresses the potential problems that may arise from further genetic progress, including the risk of discrimination against donors, especially by insurers and employers, based on genetic heritage, nevertheless the organisation of biobanks is important, which must ensure the secure storage, availability and appropriate pseudonymisation or anonymisation of data.

17 Art. 37 para. 1 of the Act on Insurance and Reinsurance Activity of 11 September 2015 (Journal of Laws 2015, item 1844).

The need for adequate education and the promotion of scientific activities in society, especially among young people, must not be overlooked. Educational activities should involve media, social networks and representatives related to the institution's topic. Only through these mechanisms can citizens be made aware of the importance of genetic data and their values. The genetic data that identify a person remain unchanged over time, making the protection of the data extremely important not only today, but also in the context of future trends in the development of technology, science and social needs.



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