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ABSTRACT
The research aims at the identification of factors influencing mentoring services with a particular emphasis on the country of origin of the mentor and the mentee. The quantitative research was conducted in four Central and Eastern European countries, i.e., Bulgaria, Poland, Latvia and Lithuania and one Southern European country, Italy. The implemented methodology covered Exploratory Factor Analysis (EFA) and reliability analysis, which were performed to identify factors influencing the process of communication in the mentor–mentee relationship. Moreover, to diagnose statistically significant differences between individual countries in terms of factors influencing the effectiveness of communication, the Kruskal–Wallis H Test and the Mann–Whitney U Test, as well as pair-wise comparisons, were used. Factors influencing communication in the mentor–mentee relationship are mentor traits, mentor's personal background, mentor's professional background, non-verbal communication channels, communication barriers, written communication channels, online communication, quality of content and the ability of content processing by the mentee. There are differences in the perception of individual factors in the analysed countries. So far, no cross-country comparison has been conducted of factors influencing mentoring services. As a direction for future research, more detailed research can be recommended concerning factors of the mentoring process in such countries as Lithuania, Latvia and Italy by developing separate models (or EFA) for mentors and mentees.

KEY WORDS
mentoring services, mentor, mentee, Exploratory Factor Analysis

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Introduction

Mentoring is a critical relationship between a less-experienced mentee and a more-experienced mentor in an area of expertise from which one is seeking guidance on a particular subject (Patel et al., 2022). It is the mentor who plays the central role in the mentoring process. That role is multifaceted as mentoring services include, but are not limited to, advocating, teaching, role modelling and advising (Choi et al., 2019). Mentoring services can be provided not only by individuals but also by organisations (Lis & Lis, 2019). Mentoring services have been

Rollnik-Sadowska, E., Ryciuk, U., Glińska, E., Bartkute-Norkuniene, V., Jodiene, R., Sprudzāne, S., Zvaigzne, A., Marzano, G., & Jecheva, V. (2023). Factors affecting mentoring services — cross-national perspective. *Engineering Management in Production and Services, 15*(2), 1-22. doi: 10.2478/emj-2023-0008

shown to play an important role in the mentee's success in both public and private sectors, aiding in the promotion and decreasing burnout (Boitano et al., 2021). The results of the quantitative meta-analytic review provide some evidence of the effectiveness of mentoring services, with an emphasis on research designs that compared the career outcomes of mentored individuals to non-mentored individuals. The overall mean effect size of mentoring services was significant, indicating that mentoring does improve career outcomes for individuals (Underhill, 2006; Širvaitytė, 2019).

The effectiveness of the mentoring services is very often connected with the mentor's qualities, including being knowledgeable, resourceful, and skilful, as well as mentor communication skills (Eller et al., 2014). However, there are also other aspects of effective mentoring, such as content quality, level of social engagement or selection of communication channels (Rollnik-Sadowska et al., 2022).

Eller et al. (2014) distinguished eight themes describing key components of an effective mentoring relationship: (1) open communication and accessibility; (2) goals and challenges; (3) passion and inspiration; (4) caring personal relationship; (5) mutual respect and trust; (6) exchange of knowledge; (7) independence and collaboration; and (8) role modelling.

Moreover, the effectiveness of mentoring can be connected with cultural context (Peterson, 2007), especially the specificity of the country in which mentoring is provided. The determinants of mentoring effectiveness may also depend on the characteristics of the industry in which mentoring services are provided (Gibson, 2004). The research objective of this paper involves the identification of factors influencing mentoring services with particular emphasis on the country of origin of the mentor and the mentee.

The quantitative research was conducted in four Central and Eastern European (CEE) countries, i.e., Bulgaria, Poland, Latvia and Lithuania and one Southern European country, Italy. The group of CEE countries, similar in cultural background and economic development (Suciu et al. 2018), was contrasted with the case study of Italy.

As part of the selected research process, the following research questions were subject to an in-depth analysis:

RQ1: What factors influence the process of communication of mentoring services?

RQ2: Are there any differences between selected European countries in terms of factors influencing communication in the mentor–mentee relationship?

This paper presents a literature overview defining the participants of the mentoring process, communication in the mentor–mentee relationship using differentchannels, as well as barriers in the mentor–mentee communication. Subsequently, the authors outline the methodology and the outcomes of the primary research conducted in five European countries. The statistical analysis allowed for the identification of factors influencing mentoring effectiveness and peculiarities of countries selected for the analysis in terms of the mentor–mentee relation. The discussion of the results of the quantitative study following the literature investigation allowed for indicating directions for future research.

1. Literature review

1.1. Mentor and mentee definition and relationship

The concepts of mentor, mentee and mentoring have been scientifically researched since the 1960s (Berlew & Hall, 1966; Gould, 1972; Webber, 1976; Schein & Van Maanen, 1977; Levinson et al., 1978; Kram, 1985) and given the widespread practice of mentoring, today there are many different definitions available of mentoring, describing it as a transfer of knowledge from experienced mentors to mentees.

The idea of mentoring traces back to Homer's Odyssey, which includes a character named Mentor (goddess Athena in disguise), who helps Odysseus's son Telemachus find the strength (menos) and connections (napios) necessary to overcome the challenges (Rosselot-Merritt & Bloch, 2020).

Mentoring relationships (mentorships) are dynamic, reciprocal, personal relationships in which a more experienced person (mentor) acts as a guide, role model, teacher, and sponsor of a less experienced person (protégé). Mentors provide protégés with knowledge, advice, counsel, support, and opportunity in the protégé's pursuit of full membership in a particular profession (Baltov et al., 2020).

A mentoring relationship is based on the mentor's knowledge and experience, which allows the mentee to consider the opportunities and resources at his/her disposal and use them to solve a particular problem or achieve a particular goal (Konstantinova, 2008). Sullivan (2000) stresses a strong relationship

between the mentor and the mentee that creates a safe environment for the growth and development of the mentee.

Business mentoring refers to a systematic relationship based on long-term and voluntary support between a successful and experienced businessperson, a mentor who shares his/her knowledge, experience and beliefs with another businessperson, a mentee who is ready and willing to gain experience from the relationship and develop his/her competence. Some researchers point out that mentoring does not represent a counsellor's job but dialogue and idea sharing. The mentor helps the mentee gain a broader and more comprehensive understanding of the way a business operates and opportunities for its growth and encourages him/her to take action (Latvian Rural Advisory and Training Centre).

In recent years, in view of changes in the geopolitical situation, including the COVID-19 pandemic impacts and technological progress, some researchers (Haeger & Fresquez, 2016; Hernandez et al., 2018; Kunaka & Moss, 2019; Hilali et al., 2020; Marzano, Pellegrino & Zorzi, 2020; Hussey & Campbell-Meier, 2020; Ngongalah et al., 2021; Marshall et al., 2021; Doyle & Ossorno De, 2021; Sera & Johnson, 2021; Laster et al., 2021; Lin, Cai & Yin, 2021) have undertaken to update and supplement concepts and processes in line with scientific novelty, e.g., by stating that mentoring represents the quality of a relationship in comparison with a different category of relationship and that mentoring should be based on compassion, friendship and mutual vulnerability, thereby showing genuine care for the mentee. Recent research studies (Marshall et al., 2021) have found that the success of mentoring results from active and respectful listening and a willingness to learn and use opportunities for personal growth.

Intellectual openness, distance and conflict are enumerated as important elements in mentoring. It shows that mentoring dynamic comes with challenges. Mentors should encourage mentees to feel free to express new ideas. For mentors, mentoring can offer a fresh perspective, new avenues of knowledge to pursue, or different approaches to try. Distance may shed light on how the two can play a significant role in a mentoring relationship, but conflicts may truly involve conflicts of interest in which the goals of one person in the mentoring relationship are inherently out of sync with the goals of the other, or when there is an ethical consideration that requires a more critical look at the mentoring relationship itself (Rosselot-Merritt & Bloch, 2020).

1.2. Communication in the mentor–mentee relationship

Communication can be understood as a mechanism of mutual relations, which establishes contacts as well as a set of all means and methods for transferring information to influence the behaviour of people. A key element in this definition is the meaning. Communication has the transfer of meaning as the main objective (Naumovski et al., 2017).

Communication is crucial in the mentor–mentee relationship, and effective communication is a condition of the effective mentoring process (Farmer, 2005). It is crucial to ensure that communication between the mentor and the mentee is effective (Rollnik-Sadowska et al., 2021). Effective communication can be defined as a process for a message to be received and understood directly as the sender intended. However, this situation is not always achieved due to various reasons, including incorrect encoding and decoding of the message, interfering messages and an incorrect choice of communication channel (Guffey et al., 2009; Scheming, Mason, 2013; Gulc, 2021; Ibidunni et al., 2018). The most important thing to remember is that communication is a two-way process. Both sides must be involved in this process. There must be a giver and a receiver, a speaker and a listener. If one of the two sides is not functioning properly, business communication will break down.

Effective communication combines verbal and non-verbal forms (Scheming & Mason, 2013). Verbal and non-verbal communication is equally important in mentoring. It is crucial to have a good understanding of the information transmitted and received during communication. According to Kaul (2015), verbal and non-verbal information must be adequate to each other because if the verbal information provided is "denied" by the body or eye movements, it can impair successful communication. Verbal communication uses words in conversation or speech to provoke mentors' and mentees' feelings, specific emotions and distinct functions in their comments to penetrate mentors and mentees instead of non-verbal communication, which is wordless communication (Lustig & Koester, 2010).

Verbal communication requires asking questions, listening carefully, trying to understand the mentee's concerns or needs, demonstrating a caring attitude, remaining open-minded, and helping to solve problems. There are many communication skills that mentors can utilise to effectively communicate

with mentees, including (I-TECH Clinical Mentoring Toolkit, etc.): active listening, emotional perception and stress/conflict management, asking questions and formulating sentences and giving and receiving feedback.

Mentors are more able to use self-awareness, connect with mentees, handle the intensity of the relationship, accurately assess the feelings of mentees, encourage mentee reflections on actions, utilise personal emotions and draw on them to be effective mentors, challenge mentees to deal with negative emotions, help mentees with character development, express empathy for mentees, exhibit good role modelling, urge mentees to reflect on learning and manage emotions. Mentees are more able to use self-awareness and understand emotions, be open and honest, listen and reflect, respect the advice of mentors and ask for help and manage emotions and stress. Mentees know that mentors understand how they feel and that their feelings are respected and valued (Opengart & Bierema, 2015).

Skills to give and receive feedback provide a systematic approach to developing better relationships, learning and improving performance and staying on track and achieving goals (Hattie & Timperley, 2005).

Non-verbal communication in mentoring helps to create a better image of oneself; understanding the non-verbal cues of the mentee will help the mentor communicate more effectively; helps to discover the mentee's true feelings towards their mentor and the mentor's words (Pfund et al., 2013). The mentee uses positive body language and non-verbal signals to demonstrate openness and undivided attention. In a great variety of situations, mentors and mentees can achieve their purpose more easily by improving the accuracy and effectiveness of their non-verbal communication (Leathers & Eaves, 2016).

A communication channel is the technical (or formal) side of the communication process that allows people to transfer information from the sender to the receiver and vice versa. A communication channel includes all the means for the creation and acceptance of a message, i.e., signs, language (including body language), codes, technical devices etc. (Sanina et al., 2017).

Communication channels and tools play a key role in the communication process while mentoring. The channel is the formal means of communication through which the sender's message travels, whether oral, written, electronic or otherwise. Choosing the right means or channels for the delivery of the message is essential for meaningful communication. Fiske (2002) defined a channel as a physical means by which a signal (i.e., information) is transmitted and suggested dividing tools into three main categories, i.e., presentation tools — voice (intonation, pauses and logical accents), face and body; representative tools — books, pictures, photos, writing, architecture, interior etc.; mechanical tools — phone, radio, television and the Internet. The principle characteristics for understanding various communication channels are as follows (Sanina et al., 2017): reliability — a measure of certainty that the channel will function, meaning the likelihood that the communicative content (i.e., feedback or information) will be delivered; speed — how fast it is possible to obtain a result from communication, meaning either that information is delivered or a response is received; effectiveness — choosing the right channel or a combination of channels to solve a particular problem and to increase organisational development.

The communication effectiveness depends on the choice of the information channel. A particular channel could be a preferred option in certain situations or totally ignored in other circumstances. Channels can be used separately or combined with each other (Sanina et al., 2017). The most effective communication is face-to-face contact. The effectiveness of such communication is enhanced for two reasons: first, both verbal and non-verbal information is exchanged, and second, there is feedback. A less efficient channel is described by George and Jones (2012) as "verbal communication transmitted electronically". The authors refer to this channel as the telephone and videoconferencing, where communicators can transmit verbal information, some non-verbal information (tone of voice, intonation) and feedback. These authors consider e-mail to be an even more ineffective communication channel, depending on whether the e-mail message has a precise destination or not. The least reliable communication channel is written communication: newsletters, standard messages etc.

Communication is the primary relationship tool in organising the relationship between the mentor and the mentee. Effective communication is critical to different levels of employees and representatives in various fields. Failure to communicate effectively may cause miscommunication, distrust, anger, inefficiency and other negative outcomes. Effective communication promotes motivation and builds staff culture, while poor communication creates dissatisfaction (Tyler, 2016). Effective communication, by minimising strikes and lockouts, enhances intra-organisational relationships (Kelvin-Iloafu, 2016). Effective

communication and stakeholder engagement requires recognition that the subject of all the processes and lists are people and they cannot be categorised in the same way as inanimate objects (Bourne, 2016).

Three critical components of effective and qualitative communication — trust, transparency and active listening — build the relationship necessary to engage in challenging conversations (Salamondra, 2021).

Research on interpersonal communication has changed the communication perspective. It does not refer to people as senders and receivers but as communicators (Lane, 2016). Accordingly, people involved in the communication process both send and receive messages. The Transactional Model of Communication (TMC) forms the basis for many interpersonal communication theories (Barnlund, 2017; Stuart, Sarow & Stuart, 2007). It assumes that communication between two or more entities is dynamic, process-oriented and adapted or appropriated according to the context of the transaction. Communication involves the channel of communication (e.g., telephone, e-mail or letter), the source of communicators (e.g., interpersonal or impersonal), language (e.g., native or second) and the message type (e.g., mode of transmission and image, video, text or other). Social, relational, and cultural contexts also drive the transactional process of communication.

Furthermore, from a social psychology perspective, communication encompasses several extra-linguistic functions aimed at achieving such goals as persuasion, bargaining, dating, instruction, deliberation and flattery (Fig. 1).

The ultimate goal of communicator C's communicative actions is not just to enable receiver R to decode the symbolic message S as accurately and faithfully as possible, as in Shannon and Weaver's (1949) classical theoretical framework. Nor is the goal to conserve the logical truth value of the propositions inherent in S, as in propositional logic. Rather, the actual goal is for C to move R somewhere relative to a communication goal or reference topic T (e.g., to move R to do someone a favour, to buy a product, or to come to a party or a date, to share an idea or emotion etc.).

The development of a mentoring relationship depends on the perceptions and activities of both the mentor and mentee. If one or the other does not choose to engage actively, then the relationship will unlikely be as effective (Rosselot-Merritt & Bloch, 2020). Theoretical literature stresses the importance of two-way communication to make mentoring relationships work. For mentoring to be effective, mentees must be confident enough to manage the relationship and communicate openly with the mentor so that the relationship can be mutually beneficial. Two-way communication aims at information exchange by means of dialogue between the mentor and the mentee. It requires the sender of the information to listen to the experience of the mentee. It is called symmetrical communication and implies that the organisation (here, the mentor or the sender of information) reflects on its own policies and behaviour after considering the public's views (Wonneberger & Jacobs, 2016).

Mentoring service could be characterised as bilateral "communicative relations" that consist of verbal and non-verbal behaviour and whose goal is to

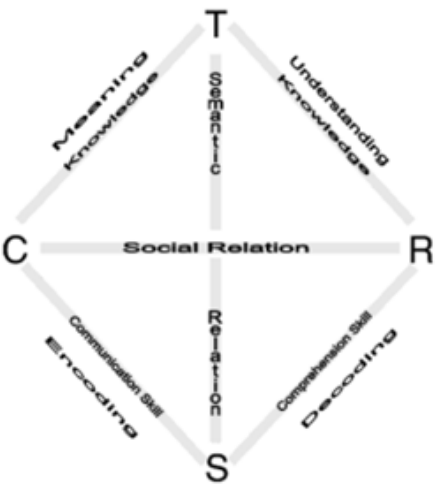


Fig. 1. General framework for the analysis of social communication processes
Source: (Fiedler, 2011, p. 4).

offer or request assistance. Performing this dialogue communication, mentors develop and give relevant messages that are referred to as specific communicative behaviour or one party's action aimed at benefitting someone or helping others (Burleson et al., 2002). If mentors encourage mentees to feel comfortable communicating with them, especially at the beginning of the mentoring relationship, this can set a positive tone for future communication (Rosselot-Merritt & Bloch, 2020).

1.3. Barriers to mentor–mentee communication

Communication barriers are defined as obstacles and factors disturbing the communication process and, therefore, making communication incomplete and ineffective (Scheming & Mason, 2013). Communication barriers lead to miscommunication and cause problems in the course of this process, such as causing defensive reactions, cutting off further communication, diminishing chances to identify options, and resulting in confusion or misunderstanding (Scheming & Mason, 2013).

Communication barriers can be external to participants, intrapersonal and interpersonal (Moore, 2013). External barriers can include organisational structure and available technology. Intrapersonal barriers involve such issues as personality, level of knowledge and emotional state. Interpersonal obstacles include the credibility of the sender as perceived by the receiver.

Communication between mentees and mentors must be based on honesty and professionalism to maintain an excellent inner climate. With a good relationship, communication with mentees is more sincere. Verbal barriers to communication that should be avoided include (Pfund et al., 2013) moralising, arguing, preaching, storytelling, blocking communication and talking too much.

Examples of non-verbal barriers to communication include shuffling papers, not looking directly at the mentee when they are speaking, and allowing interruptions or distractions. These barriers may lead to poor sharing of information, fewer questions being asked by the mentee, difficulty in understanding problems, uncomfortable situations and a lack of motivation on the part of the mentee.

Personal communication barriers relate to the human aspects of communication: the climate of relationships, values and attitudes. The following main personal barriers can be identified (Eisenberg, 2010; Jucevičienė, 1996):

- Different perceptions. If people have different value systems, they are likely to receive and interpret the same information differently. Some typical differences can be identified, such as different areas of expertise, different interests, needs, emotional state, different experiences and different social attitudes.
- Semantic barriers. Information is encoded using words. However, individual words can have different meanings for different people. Therefore, information can be interpreted differently.
- Non-verbal barriers. Verbal transmission of information is often accompanied by non-verbal interference, which can reinforce the impression or completely change the meaning of spoken words. Different cultural traditions play a very important role here. Different interpretations of certain gestures or actions can completely distort the meaning of the message.
- Poor feedback. This can arise for several reasons. It can range from a failure to listen, a fear of appearing incompetent, to a poor relationship, etc.

Hence, to overcome communication difficulties, it is advisable to present information in a way that is easy for the recipient to understand and use clear and understandable words. Also, it is important to anticipate the reaction of the recipient, get familiarised with the recipient of the communication, research his/her needs and avoid intermediaries. The sender of the information must choose the most appropriate transmission channel to minimise the distortion possibility. To avoid distortion, it is advisable to have a feedback loop with the information recipient.

2. Research methodology

The research objective was implemented by means of conducting quantitative research. The research was conducted under the project Development and Introduction of a Communication Competencies Model for Enhancing and Maintaining a Business Mentor Network (DICCMEM), financed by the program Erasmus+, KA203 — Strategic Partnerships for Higher Education. The research was conducted among all project partners.

The research process consisted of three stages, involving answering the research questions (Fig. 2). The first stage involved quantitative research con-

ducted in four Central and Eastern European countries (Bulgaria, Poland, Latvia and Lithuania) and Italy using the CAWI (Computer Assisted Web Interviews) technique. The research tool was based on the theoretical model of communication in mentoring developed by Rollnik-Sadowska, Glińska and Ryciuk (2022), which consists of three basic components, i.e., channels and tools of communication (oral, written and non-verbal), content creation (information veracity, information clarity, provision of solicited information only, information completeness and regular updating, and speed of response) and levels of social engagement in the mentoring process (information, consultation, involvement and co-decision).

The research constructs comprised a total of 38 items (observable variables) and were divided into six groups related to oral channels and tools of communication, written channels and tools of communication, non-verbal channels and tools of communication, content creation, social engagement in the mentoring process, the effectiveness of communication (Table 1). To evaluate each item in the questionnaire, a five-level scale was used from "very unimportant" (1) to "very important" (5).

The structured questionnaire was sent to mentors who were qualified for the study in accordance with the adopted definition, in which the mentor is an experienced entrepreneur or manager with accumulated knowledge in entrepreneurship and who, without consideration and willingly, devotes their time, experience and suggestions to help the new entrepreneur, who is oriented in the business environment. The mentor listens, asks questions, challenges the mentee's goals, studies, gives advice and shares their experience and contacts (Rollnik-Sadowska et al., 2021). The mentees were identified for the study by the mentors participating in CAWI, who had handed the questionnaires to the cooperating mentees.

The sample was selected in a quota-random way, and its structure (after removing the records with missing data) is presented in Table 2. The research was conducted among 638 respondents from Poland (213 respondents), Bulgaria (115 respondents), Latvia (102 respondents), Lithuania (106 respondents) and Italy (102 respondents). The structure of the respondents in terms of their status in the mentoring process is balanced since about 52 % of the sample represents mentors, and 48 % are mentees. 33 % of the respondents were from Poland, 18 % from Bulgaria, and 16 % each from Lithuania, Latvia and Italy. The age structure indicates that almost 33 % of the respondents were below 30 years of age, 26 % were 30–40, 25 % were 41–50, and 16 % were over 50. The educational background of the majority of the respondents (66 %) is non-technical.

In the second stage of the research process, the Exploratory Factor Analysis (EFA) and reliability analysis were performed. The aim of EFA was to obtain a minimum number of factors that include the

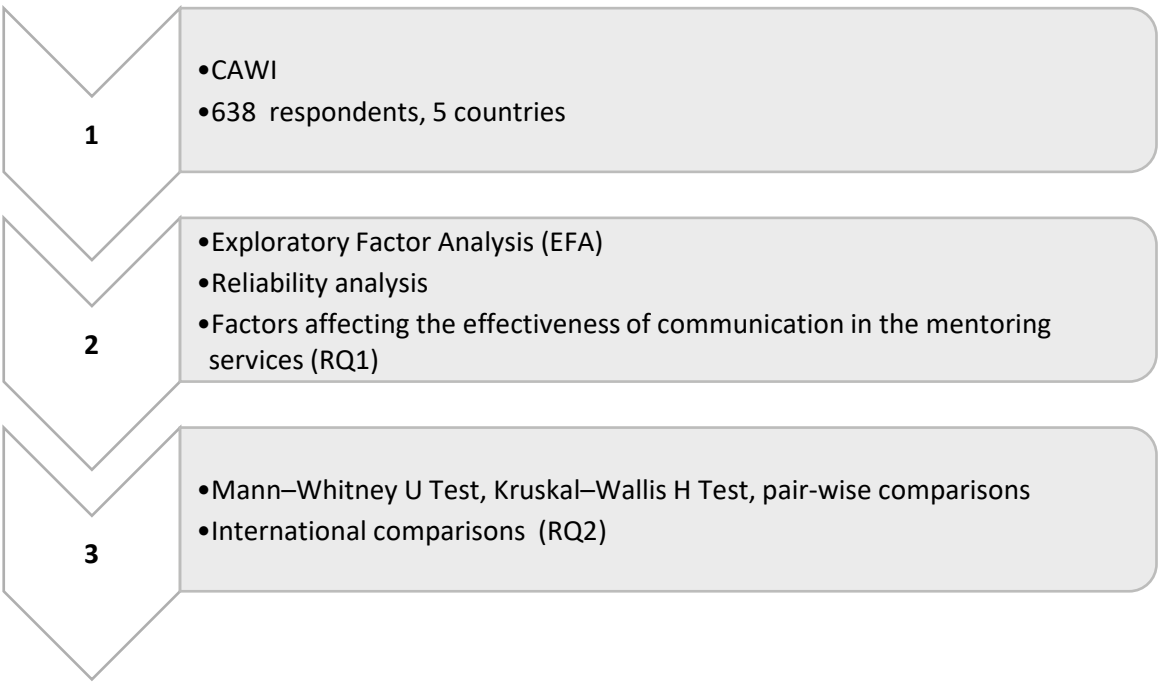


Fig. 2. Stages of the research process

Tab. 1. Communication model observable variables

Oral channels and tools of communication
Face-to-face conversation
Face-to-face group meeting
Phone call
Video or audioconference
Written channels and tools of communication
Written letters and memos
Reports
Presentations
Manuals
Notices and announcements
E-mail
Newsletter
Internal communication platforms
Document sharing software
Internal podcasts
Internal social media
Blog
Non-verbal
Facial expressions
Look and eye contact
Gestures
Posture and body orientation
Voice intonation
Physical distance
Content creation
Information veracity
Information clarity
Provision of solicited information only
Information completeness
Information regular updating
Speed of response
Social engagement
Information
Consulting
Engagement
Co-decision
Effectiveness of communication
Content is understood
The message leads to a specific action
Decisions made about the issue
The goal of the meeting has been reached
The goal of the mentoring process has been reached
Emotional support gained

Tab. 2. Structure of respondents [%]

Status	Mentor	52.4
	Mentee	47.6
Country	Bulgaria	18.0
	Poland	33.4
	Latvia	16.0
	Italy	16.0
	Lithuania	16.6
Age	Below 30 years old	32.6
	30 – 40 years old	25.9
	41 – 50 years old	25.5
	51 and more years old	16.0
Educational background	Technical	34.5
	Non-technical	65.5

maximum possible amount of information contained in the original variables used in the model and with the greatest possible reliability (Rossoni et al., 2016). The reliability analysis for each extracted factor was made using Cronbach's alpha.

In the third stage, an analysis was carried out to identify statistically significant differences between individual countries in terms of factors influencing the effectiveness of communication. The Kruskal–Wallis H Test and the Mann–Whitney U Test, as well as pair-wise comparisons, were used to answer the second research question.

3. Research results

3.1. Factors affecting communication in the mentor–mentee relationship

Six items were excluded out of a total of 38 observable variables due to factor loadings below 0.5. As a result, 32 aspects describing the communication process became the basis for further analysis. To identify the structure of data and reduce the number of variables and observable variables, the Exploratory Factor Analysis (EFA) was performed.

The final rotated factor matrix for EFA is presented in Table 3. The use of EFA enabled identifying nine factors related to the specificity of communication in the mentoring process, namely:

1. Factor 1 (F1): Mentor traits.
2. Factor 2 (F2): Non-verbal communication.
3. Factor 3 (F3): Barriers to communication.
4. Factor 4 (F4): Written communication.
5. Factor 5 (F5): Online communication.
6. Factor 6 (F6): Quality of content.

Tab. 3. Factor loadings — EFA results

Factor name	Variable	Factor								
		1	2	3	4	5	6	7	8	9
1. Mentor traits α=0.90	Mentor age	0.872								
	Mentor sex	0.866								
	Mentor nationality	0.851								
	Mentor ideological views	0.738								
	Mentor social status	0.720								
2. Non-verbal communication α=0.83	Gestures		0.807							
	Posture and body orientation		0.795							
	Look and eye contact		0.704							
	Facial expressions		0.646							
	Voice intonation		0.512							
3. Barriers to communication α=0.79	Semantic barriers and obstacles			0.679						
	Stylistic barriers and obstacles			0.654						
	Phonematic barriers and obstacles			0.614						
	Psychophysiological barriers			0.603						
	Social barriers and obstacles			0.574						
	Logical barriers and obstacles			0.573						
4. Written communication α=0.72	Reports				0.671					
	Presentations				0.623					
	Written letters and memos				0.593					
	Manuals				0.515					
5. Online communication α=0.70	E-mail					0.686				
	Internal social media					0.671				
	Document sharing software					0.618				
6. Quality of content α=0.73	Information veracity						0.674			
	Information clarity						0.609			
	Information completeness						0.569			
	Information regular updating						0.554			
7. Content processing α=0.69	Filtration							0.614		
	Attitude to the communicator							0.610		
	Source reliability							0.602		
	Selective listening							0.573		
8. Mentor's personal background α=0.66	Openness								0.769	
	Honesty								0.546	
1. Mentor professional background α=0.64	Experience									0.750
	Education									0.554

Extraction Method: Principal Axis Factoring.

Rotation Method: Promax with Kaiser Normalisation.

a. Rotation converged in 7 iterations.

Tab. 4. Reliability analysis

Factor	Mean	Standard Deviation	Minimum	Maximum	Number of Items	Cronbach's Alpha (a)
1. Mentor traits	2.25	0.92	1.00	5.00	5	0.90
2. Non-verbal communication	4.22	0.58	2.20	5.00	5	0.83
3. Barriers to communication	3.45	0.71	1.00	5.00	6	0.79
4. Written communication	3.67	0.69	1.00	5.00	4	0.72
5. Online communication	3.47	0.81	1.00	5.00	3	0.70
6. Quality of content	4.46	0.51	2.75	5.00	4	0.73
7. Content processing	3.96	0.65	1.00	5.00	4	0.69
8. Mentor's personal background	4.33	0.62	1.50	5.00	2	0.66
9. Mentor's professional background	3.70	0.89	1.00	5.00	2	0.64

7. Factor 7 (F7): Content processing.
8. Factor 8 (F8): Mentor's personal background.
9. Factor 9 (F9): Mentor professional background.

In the next step, the reliability analysis for each extracted factor was conducted using Cronbach's alpha coefficient (Table 4). In all cases, the result is higher than the desired value of 0.60–0.70 (Nunnally, Bernstein, 1994), and it is particularly acceptable for social science research (Greene, 2008).

3.2. Comparison between countries

With regard to RQ2, it is particularly important to capture the differences between the countries participating in the survey. Table 5 summarises the descriptive statistics of each extracted factor. The results show differences in the perception of individual factors in the analysed countries, indicating the need for an in-depth analysis of differences between countries.

The first test used for intergroup comparisons was Kruskal–Wallis H Test (Table 6). It is a non-parametric test verifying if one of the samples is different from the other. For this research, the country was selected as a grouping variable. The results of the Kruskal–Wallis test prove significant country differences for all nine factors.

The Kruskal–Wallis Test does not identify where or how many differences actually occur. Therefore, a test procedure for making pair-wise comparisons is needed (Ostertagova et al., 2014). Pair-wise comparisons between countries ensure answering the question as to which of the analysed groups differ from each other (Appendix 1). The perception of the significance of F1 (mentor traits) differed in such pairs of countries as Lithuania and Bulgaria, Lithuania and Italy, Poland and Latvia, Poland and Bulgaria and Poland and Italy. F2 (non-verbal communication) was perceived differently in the following pairs of countries: Italy and Latvia, Italy and Poland, Italy and Lithuania, Italy and Bulgaria, as well as Latvia and Bulgaria. Factor F3 (barriers of communication) aroused different approaches in Bulgaria and Italy, Bulgaria and Poland, Bulgaria and Latvia, Bulgaria and Lithuania, Italy and Poland, Italy and Latvia, Italy and Lithuania, Poland and Latvia, and Poland and Lithuania. In terms of F4 (written communication), the differences in perception of significance were identified for Italy and Latvia, Italy and Lithuania, Italy and Poland, Italy and Bulgaria, Latvia and Bulgaria, and Latvia and Poland. In terms of F5 (online communication), the differences were noticed in pairs Poland and Italy, Poland and Latvia, Poland and Bulgaria, Poland and Lithuania, as well as Italy and Bulgaria, Italy and Lithuania, Latvia and Bulgaria, Latvia and Lithuania. F6 (quality of content) aroused differences in the perception of significance in the following pairs of countries: Italy and Poland, Italy and Latvia, Italy and Lithuania, and Italy and Bulgaria. F7 (content processing) differed in terms of factor significance in Latvia and Bulgaria, Latvia and Lithuania, Latvia and Poland, Italy and Lithuania, and Italy and Poland. F8, which concerned the mentor's personal background, produced different opinions in Italy and Bulgaria, Italy and Latvia, Italy and Poland, Lithuania and Latvia, Lithuania and Poland. F9 (mentor professional background) differed only in one pair, i.e., Poland and Italy.

A box and whisker plot can also help in interpreting the data (Appendix 2). The box and whisker plot displaying the distribution of the data shows the val-

Tab. 5. Descriptive statistics of extracted factors — differences among countries

Country		F1	F2	F3	F4	F5	F6	F7	F8	F9
Bulgaria	Mean	2.38	4.42	2.81	3.84	3.95	4.62	3.88	4.38	3.69
	Standard deviation	0.90	0.56	0.67	0.57	0.55	0.49	0.90	0.59	0.94
	Minimum	1.00	3.00	1.00	2.25	2.33	3.00	2.00	3.00	1.00
	Maximum	4.20	5.00	4.50	5.00	5.00	5.00	5.00	5.00	5.00
Poland	Mean	2.08	4.26	3.56	3.93	2.92	4.52	4.14	4.47	3.62
	Standard deviation	0.95	0.53	0.64	0.63	0.82	0.43	0.53	0.62	0.87
	Minimum	1.00	3.00	2.00	1.00	1.00	3.00	1.00	2.00	1.00
	Maximum	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Latvia	Mean	2.43	4.15	3.78	3.50	3.57	4.49	3.66	4.45	3.75
	Standard deviation	1.11	0.70	0.63	0.65	0.72	0.49	0.60	0.57	0.95
	Minimum	1.00	2.20	2.00	1.00	1.00	2.75	1.50	1.50	1.00
	Maximum	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Italy	Mean	2.53	3.92	3.16	3.09	3.40	3.95	3.83	4.05	3.93
	Standard deviation	0.44	0.49	0.38	0.49	0.52	0.50	0.52	0.45	0.78
	Minimum	1.00	2.80	2.00	2.00	2.00	2.75	2.75	3.00	1.50
	Maximum	3.80	5.00	4.17	4.50	4.67	5.00	5.00	5.00	5.00
Lithuania	Mean	2.03	4.29	3.86	3.71	4.04	4.63	4.11	4.16	3.59
	Standard deviation	0.91	0.56	0.61	0.73	0.61	0.39	0.58	0.71	0.91
	Minimum	1.00	3.00	2.33	1.00	2.00	3.50	2.75	2.00	1.00
	Maximum	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00

ues of the 25th percentile, median (50th percentile), and 75th percentile, minimum and maximum for all factors in all the analysed countries. The length of the box presents an interquartile range — the difference between the 25th percentile and the 75th percentile (the range of central 50 % of the data), with a square marking the median value. The length of the whiskers depends on the minimum and maximum data values.

The box plot shows that the median value for F1 is the lowest in Poland and Lithuania and the highest for Bulgaria and Italy and that in Italy, values are more concentrated around the median (taller boxes imply more variable data). Especially in the case of Poland, the maximum value is far away from the median, showing less consistency in results. For F2, F4, F6 and F8, the median values are the lowest in Italy.

However, the values for Italy are usually more consistent around the centre values and more symmetrical. For F3, the median value is the lowest in Bulgaria; for F5, it is the lowest in Poland; for F7, it is the lowest in Italy and Latvia; and for F9, the median has equal value in all the analysed countries. The respondents have the lowest opinion dispersion in the case of F3 in all countries. In the case of F8, the opinions concentrate around maximum values, with some different opinions, especially in the case of Latvia.

In Bulgaria, Poland and Latvia, the most important factors in mentor–mentee communication are F6 (quality of content), F2 (non-verbal communication) and F8 (mentor's personal background). An identical situation is in Lithuania; however, for this country, F7 (content processing) is also of the same importance as F2 and F6. In Italy, all factors were evaluated by the respondents lower than in Central and Eastern European countries, and the differences between the assessment of factors are smaller — F8, F6 and F2, as well as F7 and F9, were assessed comparably.

As two different groups of participants of the mentoring services were among respondents, the analysis of differences between mentors and mentees was conducted, and it was based on the non-parametric Mann–Whitney U Test. The results of the test confirmed statistically significant differences between mentors and mentees for the entire sample in the case of factors describing the channels of communication such as Factor 2 (non-verbal communication) and Factor 4 (written communication) — it was $U=45669.500$, $p<0.05$ and $U=45669.500$, $p<0.05$, respectively (Appendix 3). In all other factors, statistical differences between mentors and mentees were insignificant.

Tab. 6. Results of Kruskal–Wallis H Test (country as a grouping variable)

Factor	Country	N	Mean Rank	Sum Rang	Kruskal–Wallis Test Statistics	
F1	Bulgaria	115	349.83	40230.50		
	Poland	213	282.77	60229.00	Chi-Square	30.13
	Latvia	102	346.96	35389.50	df	4
	Italy	102	378.39	38595.50	Asymp. Sig.	0.00
	Lithuania	106	277.33	29396.50		
F2	Bulgaria	115	383.09	44055.50		
	Poland	213	328.97	70071.50	Chi-Square	46.31
	Latvia	102	305.85	31196.50	df	4
	Italy	102	220.68	22509.00	Asymp. Sig.	0.00
	Lithuania	106	339.70	36008.50		
F3	Bulgaria	115	161.81	18608.00		
	Poland	213	348.41	74211.00	Chi-Square	173.86
	Latvia	102	410.82	41904.00	df	4
	Italy	102	233.65	23832.50	Asymp. Sig.	0.00
	Lithuania	106	427.22	45285.50		
F4	Bulgaria	115	364.71	41942.00		
	Poland	213	391.06	83295.50	Chi-Square	133.97
	Latvia	102	271.55	27698.00	df	4
	Italy	102	150.76	15378.00	Asymp. Sig.	0.00
	Lithuania	106	335.17	35527.50		
F5	Bulgaria	115	432.99	49794.00		
	Poland	213	197.38	42041.00	Chi-Square	200.21
	Latvia	102	341.43	34826.00	df	4
	Italy	102	286.87	29261.00	Asymp. Sig.	0.00
	Lithuania	106	452.07	47919.00		
F6	Bulgaria	115	386.47	44444.50		
	Poland	213	330.00	70291.00	Chi-Square	116.47
	Latvia	102	330.17	33677.00	df	4
	Italy	102	151.03	15405.50	Asymp. Sig.	0.00
	Lithuania	106	377.58	40023.00		
F7	Bulgaria	115	315.15	44444.50		
	Poland	213	372.02	70291.00	Chi-Square	55.56
	Latvia	102	230.07	33677.00	df	4
	Italy	102	265.09	15405.50	Asymp. Sig.	0.00
	Lithuania	106	357.09	40023.00		
F8	Bulgaria	115	330.75	38036.50		
	Poland	213	367.22	78217.00	Chi-Square	57.26
	Latvia	102	350.00	35700.50	df	4
	Italy	102	219.07	22345.50	Asymp. Sig.	0.00
	Lithuania	106	278.69	29541.50		
F9	Bulgaria	115	319.03	36688.50		
	Poland	213	300.98	64109.50	Chi-Square	10.02
	Latvia	102	336.34	34307.00	df	4
	Italy	102	362.10	36934.50	Asymp. Sig.	0.04
	Lithuania	106	300.01	31801.50		

Tab. 7. Differences between mentors and mentees in individual countries. Results of the Mann–Whitney U Test

	Status	Bulgaria				Poland				Latvia				Italy				Lithuania			
		N	Mean Rank	Sum Rang	U Mann-Whitney Test Statistics	N	Mean Rank	Sum Rang	U Mann-Whitney Test Statistics	N	Mean Rank	Sum Rang	U Mann-Whitney Test Statistics	N	Mean Rank	Sum Rang	U Mann-Whitney Test Statistics	N	Mean Rank	Sum Rang	U Mann-Whitney Test Statistics
F1	Mentor	59	54.82	3234.50	U=1464.50, p=0.29	97	109.44	10616.00	U=5389.00, p=0.59	65	54.59	3548.50	U=1001.50, p=0.16	57	62.24	3547.50	**U=670.50, p=0.00**	56	51.86	2904.00	U=1308.00, p=0.56
	Mentee	56	61.35	3435.50		116	104.96	12175.00		37	46.07	1704.50		45	37.90	1705.50		50	55.34	2767.00	
F2	Mentor	59	58.88	3474.00	U=1600.00, p=0.77	97	115.66	11219.00	U=4786.00, p=0.06	65	59.65	3877.00	**U=673.00, p=0.00**	57	49.31	2810.50	U=1157.50, p=0.39	56	54.25	3038.00	U=1358.00, p=0.78
	Mentee	56	57.07	3196.00		116	99.76	11572.00		37	37.19	1376.00		45	54.28	2442.50		50	52.66	2633.00	
F3	Mentor	59	58.51	3452.00	U=1622.00, p=0.87	97	107.37	10414.50	U=5590.50, p=0.94	65	53.86	3501.00	U=1049.00, p=0.28	57	60.32	3438.00	**U=780.00, p=0.00**	56	47.29	2648.00	**U=1052.00, p=0.03**
	Mentee	56	57.46	3218.00		116	106.69	12376.50		37	47.35	1752.00		45	40.33	1815.00		50	60.46	3023.00	
F4	Mentor	59	59.40	3504.50	U=1569.50, p=0.64	97	101.71	9866.00	U=5113.00, p=0.25	65	51.52	3348.50	U=1201.50, p=0.99	57	51.64	2943.50	U=1274.50, p=0.96	56	46.79	2620.50	**U=1024.50, p=0.02**
	Mentee	56	56.53	3165.50		116	111.42	12925.00		37	51.47	1904.50		45	51.32	2309.50		50	61.01	3050.50	
F5	Mentor	59	63.68	3757.00	U=1317.00, p=0.06	97	107.66	10443.00	U=5562.00, p=0.88	65	49.55	3220.50	U=1075.50, p=0.37	57	50.70	2890.00	U=1237.00, p=0.75	56	53.37	2988.50	U=1392.50, p=0.96
	Mentee	56	52.02	2913.00		116	106.45	12348.00		37	54.93	2032.50		45	52.51	2363.00		50	53.65	2682.50	
F6	Mentor	59	57.07	3367.00	U=1597.00, p=0.74	97	102.01	9894.50	U=5141.50, p=0.27	65	50.92	3310.00	U=1165.00, p=0.79	57	57.02	3250.00	**U=968.00, p=0.03**	56	52.14	2920.00	U=1324.00, p=0.62
	Mentee	56	58.98	3303.00		116	111.18	12896.50		37	52.51	1943.00		45	44.51	2003.00		50	55.02	2751.00	
F7	Mentor	59	60.48	3568.50	U=1505.50, p=0.41	97	111.94	10858.50	U=5146.50, p=0.28	65	55.91	3634.00	**U=916.00, p=0.04**	57	51.75	2949.50	U=1268.50, p=0.92	56	51.95	2909.00	U=1313.00, p=0.58
	Mentee	56	55.38	3101.50		116	102.87	11932.50		37	43.76	1619.00		45	51.19	2303.50		50	55.24	2762.00	
F8	Mentor	59	54.81	3234.00	U=1464.00, p=0.26	97	100.99	9796.00	U=5043.00, p=0.17	65	51.81	3367.50	U=1182.50, p=0.88	57	50.93	2903.00	U=1250.00, p=0.81	56	54.93	3076.00	U=1320.00, p=0.60
	Mentee	56	61.36	3436.00		116	112.03	12995.00		37	50.96	1885.50		45	52.22	2350.00		50	51.90	2595.00	
F9	Mentor	59	55.94	3300.50	U=1530.50, p=0.49	97	106.46	10327.00	U=5574.00, p=0.91	65	53.92	3504.50	U=1045.50, p=0.26	57	62.43	3558.50	**U=659.50, p=0.00**	56	50.77	2843.00	U=1247.00, p=0.32
	Mentee	56	60.17	3369.50		116	107.45	12464.00		37	47.26	1748.50		45	37.66	1694.50		50	56.56	2828.00	

In the next step, the differences between mentors and mentees in individual countries were analysed. Significant differences are noticed for Latvia — F2 (non-verbal communication) and F7 (content processing), Italy — F1 (mentor traits), F3 (barriers of communication), F6 (quality of content) and F9 (mentor's personal background), and Lithuania — F3 (barriers of communication) and F4 (written communication) (Table 7).

4. Discussion of the results

Mentorship is considered an integral part of fostering entrepreneurship and innovations. It supports the learning and development process in various domains. Therefore, the quality of mentor–mentee communication can affect learning, particularly any disparity in their expectations. The factors affecting this relationship have been the subject of research for many years. Hodges (Hodges, 2009) recognised the following factors that can have a negative influence on mentoring: poor communication, differing expectations between the mentor and the mentee, a lack of trust and a lack of appreciation of everyday life circumstances that affect each person. On the contrary, as factors that can help to prevent or counteract problems in the relationship, the author recognised the use of learning contracts, formulation of ground rules, tracking mentees' progress and a discussion of the expectations of the mentor and the mentee.

A study conducted in 2000 (Stanulis et al., 2000) found that an effective mentoring relationship, where both participants feel comfortable, could be achieved by using such strategies as reciprocal activities, reflections and being versatile, among others, that works effectively for both the mentor and the mentee.

Qureshi (2018) conducted a semi-structured survey regarding mentor–mentee relationship details. The research concluded that the most important strengthening concepts in this communication are creating a positive environment, taking initiative, giving customised support, in-depth answers, positive encouragement, being accessible, etc.

A detailed interview with university lecturers from the USA was conducted in 2013 (Straus et al., 2013). It reports the following characteristics of effective mentors: altruism, active listening, honesty, trustworthiness, having substantial professional and mentorship experience, as well as being accessible and able to identify and support the development of potential strengths and skills in their mentees. In addition, the characteristics of effective mentees were also identified. They should be open to feedback and be active listeners, be respectful of their mentor's input and time, be responsible, pay attention to timelines, and take responsibility for "driving the relationship".

A recent study (Parija, 2021) examined factors for effective mentor–mentee communication. The following factors were enumerated as the most important: active listening, either verbal or non-verbal, which includes a focused conversation on the set goals, paraphrasing and summarising the salient points shared by the mentee, asking open-ended questions to obtain additional information, disclosing relevant self-experiences, etc., as well as feedback and reflection. The following negative factors that hinder communication were identified: unnecessary arguments, talking about irrelevant things or the mentor dominating the interaction, passive listening, and being judgmental of the mentee's behaviour.

Another study (Afolabi, 2021) that surveyed mentor–mentee relationships revealed that the main characteristics identified as qualities of a good mentor are teaching, listening attentively and communicating effectively. The following characteristics of a good mentor were reported as crucial: the ability to teach, attentive listening and effective communication, flexibility and openness to suggestions, supportiveness, excellent leadership qualities, supportiveness, etc. Among the negative factors affecting communication, the following were considered: a clash of personalities, unrealistic expectations, arguments and conflicts, too much workload on one party, bringing personal problems into the relationship, etc.

All these previous surveys conducted in various countries to a great extent comply with the majority of findings of this research. In all five analysed countries, both verbal and non-verbal communication methods are considered important in most of the variants. However, in some countries, significant differences in the perceived importance of the factors between mentors and mentees were found. This is also confirmed, e.g., by a comparative analysis of Latvia and Lithuania (Bartuševičienė et al., 2021), which showed that the assessment of communication elements (communication channels, content creation through communication, various communication skills and communication barriers) usually differed significantly between Lithuanian and Latvian mentors and mentees, and this may have been influenced by a different number of respondents by age, Latvian

respondents being more concentrated in one field of activity (agriculture) while Lithuanian respondents representing more different fields. All the conducted studies confirm that the mentor's personality and capabilities are also critical factors for successful mentorship, along with professional skills and knowledge. This research confirms the results of the previous examinations, showing that emotional intelligence is critical for successful mentorship activities. Both mentors and mentees should be able to manage their feelings and have proper expectations for mentorship results. In addition, they both should be motivated to a sufficient degree to maintain such a long-run relationship, the results of which would be seen in the future.

Conclusions

The conducted research shows that the mentoring service is determined by various factors, where their perception depends on the specificity of the country in which mentoring is conducted. Factors influencing communication in the mentor–mentee relationship are mentor traits, mentor's personal background, mentor's professional background, nonverbal communication channels, barriers to communication, written communication channels, online communication, quality of content, and the ability of content processing by the mentee.

Research results prove significant differences among countries for all nine factors. F2 (non-verbal communication), F4 (written communication) and F6 (quality of content) were perceived differently in Italy and all the analysed CEE countries. F3 (barriers to communication) differed in Bulgaria and the remaining four countries. F5 (online communication) was perceived differently in Poland and the rest of the countries. The most similar opinions in all the analysed countries about factor importance were represented for F9 (mentor's professional background).

Not only the country in which mentoring is conducted determines the different perceptions of the importance of factors influencing the mentoring process, but also the role played by the participant in the mentoring relationship. Some statistically significant differences were noticed between mentors and mentees for the entire sample in the case of factors describing such channels of communication as F2 (non-verbal communication) and F4 (written communication).

As a direction for future research, it can be recommended to conduct more detailed studies concerning factors of the communication process among mentors and mentees in such countries as Lithuania, Latvia or Italy by developing separate models (or EFA) for mentors and mentees. Significant differences were identified for those countries in the perception of the importance of factors by mentors and mentees. In addition, research on the determinants of the mentoring process should also include other elements that may differentiate the approach to identified factors, such as age or the type of education of mentors and mentees.

Literature

Afolabi, A. O., & Akinola, A. (2021). An empirical investigation of the mentor-mentee relationship among female architects and female architectural students. *International Journal of Emerging Technologies in Learning*, *16*(13), 168-185. doi: 10.3991/ijet.v16i13.21971

Anderson, D. (2022). Tools and best practices for effective verbal and nonverbal communication. Retrieved from https://www.nrpa.org/parks-recreation-magazine/2022/february/message-received.

Baltov, M., Bartkutė-Norkūnienė, V., Bartuševičienė, V., Glińska, E., Jecheva, V., Jodienė, R., Kotāne, I., Marzano, G., Mietule, I., Mineva, K., Murinska, S., Pellegrino, A., Rollnik-Sadowska, E., Ryciuk, U., Zorzi, S., & Zvaigzne, A. (2020). *Communications Skills for Mentors and Mentees in Entrepreneurship: Theory and Practice*. Białystok – Rezekne: Oficyna Wydawnicza Politechniki Białostockiej.

Baltov, M., Glińska, E., Jecheva, V., Jodienė, R., Kavoliūnienė, R., Pelenienė, A., Kotāne, I., Marzano, G., Mietule, I., Mineva, K., Murinska, S., Pellegrino, A., Rollnik-Sadowska, E., Ryciuk, U., Zorzi, S., Zvaigzne, A., & Riekstiņa, T. (2021). *Mentoring Handbook*. Rēzekne: Rēzeknes Tehnoloģiju akadēmija. Retrieved from http://new.llkc.lv/sites/default/files/baskik_p/pielikumi/mentorings-vadlinijas.pdf

Barnlund, D. C. (2017). A transactional model of communication, In C. D. Mortensen (Ed.), *Communication theory* (pp. 47–57). Routledge.

Bartuševičienė, V., Bartkute-Norkuniene, V., Jodienė, R., Zvaigzne, A., Kotāne, I., Mietule, I., & Murinska, S. (2021*). Expression of communication skills and benefits for creating an effective mentoring environment. Comparative analysis of the case of Lithuania and Latvia*. Environment. Technology. Resources. Latvia Proceedings of the 13th International Scientific and Practical Conference, Rezekne University of Technology, Rezekne, 1, 23-29.

Bloom, G. A., Schinke, R., Durand-Bush, N., & Salmela, J. (1998). The importance of mentoring in the development of coaches and athletes. *International Journal of Sport Psychology*, *29*, 267-281.

Boitano, T. K., Chi, D. S., Copeland, L. J., & Straughn, J. M. (2021). Standing on the shoulders of giants: mentorship advice from leaders in the field. *Gynecol Oncol*, *161*(2), 339-341. doi: 10.1016/j.ygyno.2021.01.017

Bordens, K. S., & Abbott, B. B. (2008). *Research Design and Methods. A Process Approach*. New York: McGraw-Hill.

Bourne, L. (2016). Targeted communication: The key to effective stakeholder engagement. *Procedia – Social and Behavioral Sciences*, *226*(14), 431-438. doi: 10.1016/j.sbspro.2016.06.208

Burleson, B., MacGeorge, E., Knapp, M., & Daly, J. (2002). *Supportive Communication. Handbook of Interpersonal Communication*. London: Sage.

Choi, A. M. K., Moon, J. E., Steinecke, A., & Prescott, J. E. (2019). Developing a culture of mentorship to strengthen academic medical centers. *Academic Medicine*, *94*(5). doi: 10.1097/ACM.0000000000002498

Clutterbuck, D. A., Kochan, F. K., Lunsford, L., Domínguez, N., & Haddock-Millar, J. (Eds.) (2017). *The SAGE Handbook of Mentoring*. London: Sage.

Ehrich, L. C., & Kimber, M. (2016). The purpose and place of mentoring for women managers in organisations: an Australian perspective. In M. L. Connerleym & J. Wu. (Eds.), *Handbook on well-being of working women. International Handbooks of Quality-of-Life* (pp. 225–241). Dordrecht: Springer. doi: 10.1007/978-94-017-9897-6_14

Eisenberg, E. M. (2010). *Organizational communication: balancing creativity and constraint*. New York: Saint Martin's.

Eller, L. S., Lev E. L., & Feurer A. (2014). Key components of an effective mentoring relationship: A qualitative study. *Nurse Education Today*, *34*(5). doi: 10.1016/j.nedt.2013.07.020

Farmer, B. (2005). Mentoring communication. *Review of communication*, *5*(2-3), 138-144. doi: 10.1080/15358590500297003

Fiedler, K. (2011). Voodoo correlations are everywhere – not only in neuroscience. *Perspectives on Psychological Science*, *6*(2), 163-171. doi: 10.1177/174569161140023

Fiske, J. (2010). *Introduction to communication studies*. London: Routledge.

Garcia S. D. O., & Doyle, L. (2021). The mentoring relation as an interpersonal process in EDUCATE: A qualitative case study of mentor-mentee perspectives. *Research for All*, *5*(1), 19-35. doi: 10.14324/RFA.05.1.04

George J. M., & Jones G. R. (2012). *Understanding and managing organizational behavior*. New Jersey: Pearson Education.

Gibson, S. K. (2004). Mentoring in business and industry: the need for a phenomenological perspective. *Mentoring & Tutoring: Partnership in Learning*, *12*(2), 259-275. doi: 10.1080/1361126042000239974

Greene, W. H. (2008). *Econometric analysis*. New York: Pearson Prentice Hall.

Guffey, M. E., Rogin, P., & Rhodes, K. (2009). *Business communication: process and product*. Toronto: Nelson Education.

Gulc, A. (2001). *Multi-stakeholder perspective of courier service quality in B2C e-commerce*. PLoS ONE, *16*(5), 1-18. doi: 10.1371/journal.pone.0251728

Haggard, D. L., Dougherty, T. W., Turban, D. B., & Wilbanks, J. E. (2011). Who is a mentor? A review of evolving definitions and implications for research. *Journal of Management*, *37*(1), 280-304. doi: 10.1177/0149206310386227

Hattie, J., & Timperley, H. (2007). The Power of Feedback. *Review of educational research*, *77*(1), 81-112. doi: 10.3102/00346543029848

Heager, H., & Fresquez, C. (2016). Mentoring for Inclusion: The Impact of Mentoring on Undergraduate Researchers in the Sciences. *CBE Life Science Education*, *15*(3), 1-9. doi: 10.1187/cbe.16-01-0016

Hernandez P., Estrada M., & Schultz P. W. (2018). A longitudinal study of how quality mentorship and research experience integrate underrepresented minorities into STEM careers. *CBE Life sciences education*, *17*(1), 1-13. doi: 10.1187/cbe.17-04-0066

Hilali, K. S., Kian, M. W., Mughairi, B. M., & Karim, A. M. (2020). Coaching and mentoring. Concepts and practices in development of competencies: A theoretical perspective, *International Journal of Academic Research in Accounting, Finance and Management Sciences*, *10*(1), 41-54. doi: 10.6007/IJARAFMS/v10-i1/6991

Hodges, B. (2009). Factors that can influence mentorship relationships. *Pediatric Nursing*, *21*(6), 32-35. doi: 10.7748/PAED2009.07.21.6.32.C7149

Hussey, L., & Campbell-Meier, J. (2020). Are you mentoring or coaching? definitions matter. *Journal of Librarianship and Information Science*, *53*(3), 510-521. doi: 10.1177/0961000620966651

Ibidunni, A. S., Olokundun, M. A., Motilewa, D. B., Atolagbe, T. M., & Osibanjo, O. A. (2018). Group-tacit knowledge and organisational effectiveness: analysis of effects using a mixed method approach. *Business: Theory and Practice*, *19*, 135-145. doi: 10.3846/btp.2018.14

I-TECH Clinical Mentoring Toolkit. Retrieved from: https://www.go2itech.org/resources/clinical-mentoring-toolkit/

Jucevičienė, P. (1996). *Organizacijos elgsena*. Kaunas: Technologija (in Lithuanian).

Kaul, A. (2015). *Effective Business Communication*. Delhi: PHI Learning Private Limited.

Kelvin-Iloafu, L. E. (2016). The role of effective communication in strategic management of organizations. *International Journal of Humanities and Social Science*, *16*(12), 93-99.

Konstantinova, E. (2008). *Mentoring as a knowledge transfer process promoting entrepreneurship in rural areas of Latvia*. Doctoral thesis, Latvia University of Agriculture. Retrieved from https://llufb.llu.lv/dissertation-summary/management/Elina_Konstantinova_prom_d_kopsavilkums_2009_LLU_EF.pdf

Kram, K. (1985). *Mentoring at Work: Developmental Relationships in Organisational Life*, Scott. Glenview: Foresman and Company.

Kram, K. E. (1983). Phases of the mentor relationship. *The Academy of Management Journal*, *26*(4), 608-625. doi: 10.2307/255910

Kumar, P. (Ed.) (2018). *Exploring Dynamic Mentoring Models in India*. Switzerland, Cham: Springer International Publishing.

Kunaka, C., & Moos, M. N. (2019). Evaluating mentoring outcomes from the perspective of entrepreneurs and small business owners. *The Southern African Journal of Entrepreneurship and Small Business Management*, *11*(1). doi: 10.4102/sajesbm.v11i1.214

Lane, S. D. (2016). *Interpersonal Communication: Competence and Contexts*. New York: Routledge.

Lasater, K., Smith, C., Pijanowski, J. & Brady, K. P. (2021). Redefining mentorship in an era of crisis: responding to COVID-19 through compassionate relationships. *International Journal of Mentoring and Coaching in Education*, *10*(2), 158-172. doi: 10.1108/IJMCE-11-2020-0078

Leathers, D., & Eaves, M. H. (2016). *Successful Nonverbal Communication. Principle and Applications*. London: Routledge.

Lin, L., Cai, X., & Yin, J. (2021). Effects of mentoring on work engagement: Work meaningfulness as a mediator. *International Journal of Training and Development*, *25*(2), 183-199. doi: 10.1111/ijtd.12210

Lis, A. M., & Lis, A. (2019). To meet or to connect? Face-to-face contacts vs ICT in cluster organisations. *Engineering Management in Production and Services*, *11*(4), 103-117. doi: 10.2478/emj-2019-0037

Lustig, M. W., & Koester, J. (2010). *Intercultural Competence: Interpersonal Communication Across Cultures*. Boston: Pearson Education Inc.

Marshall, A. G., Vue, Z., Palavicino, Maggio, C. B., & Spencer, E.C. (2022). The role of mentoring in promoting diversity, equity, and inclusion in STEM education and research. *Pathogens and Disease*, *80*(1). doi: 10.1101/2021.12.08.471502

Merriam S. (1983). Mentors and protégés: a critical review of the literature. *Adult Education Quarterly*, *33*(3), 161-173.

Moore, L. H. (2013). *Business Communication: Achieving results*. Bookboon.com.

Naumovski, V., Dana, L. P., Pesakovic, G., & Fidanoski, F. (2017). Why interpersonal communication is important in public administration? *Współczesne Problemy Ekonomiczne*, *1*(14), 55-77. doi: 10.18276/wpe.2017.14-04

Ngongalah, L, Rawlings, M. M., Musisi J., Rawlings, N. N., & Awanchiri, K. (2021). *Mentorship as a strategy to improve research ability of students and young researchers in Africa: an exploratory study and initial findings on the CORE Africa Research Mentorship Scheme*, bioRxiv. doi: 10.1101/2021.01.29.428492

Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric Theory*. New York: McGraw-Hill.

Omonijo, D. O., Adetola, O. B., Lawal, A. S., Anyaegbunam, M. C., Odukoya, J. A., & Olowookere, E. I. (2019). An exploratory study of Igbo business mentoring (nwa boy) for establishing small-scale enterprise: Panacea to youth unemployment in South-East geo-political zone of Nigeria. *The Journal of Social Sciences Research*, *5*(4), 1103-1115.

Opengart, R., & Bierema, L. (2015). Emotionally intelligent mentoring: Reconceptualizing effective mentoring relationships. *Human Resource Development Review*, *14*(3), 234-258. doi: 10.1177/153448431559

Ostertagova, E., Ostertag, O., & Kováč, J. (2014). Methodology and Application of the Kruskal-Wallis Test. *Applied Mechanics and Materials*, *611*, 115-120. doi: 10.4028/www.scientific.net/AMM.611.115

Parija, S. C., & Shanmuganathan, P. (2021). Efficient interpersonal communication is a prime factor for the success of a mentoring program. *Annals of SBV*, *10*(1). doi: 10.5005/jp-journals-10085-8137

Patel, K., Gupta, Y., & Patel, A. (2022). Key communication skills for mentors. *Journal of the American College of Radiology*, *19*(7), 903-904. doi: 10.1016/j.jacr.2022.03.001

Peterson, D. B. (2007). Executive coaching in a cross-cultural context. *Consulting Psychology Journal: Practice and Research*, *59*(4), 261-271. doi: 10.1037/1065-9293.59.4.261

Pfund, C., House, S., Asquith, P., Spencer, K., Silet, K. & Sorkness, C. (2013). *Mentor Training for Clinical and Translational Researchers*. New York: W.H. Freeman and Company.

Qureshi, H. A. (2018). *Communication in mentoring: A grounded theory approach.* PhD Dissertation, Friedrich Schiller University Jena.

Ragins, B. R., & Kram, K. (2007). The Roots and Meaning of Mentoring. In E. Roosevelt, J. S. Day O'Connor, B. R. Ragins, & K. E. Kram (Eds.), *The Handbook of Mentoring at Work: Theory, Research, and Practice* (pp. 3–15). Thousand Oaks: Sage.

Rollnik-Sadowska, E., Glińska, E., & Ryciuk, U. (2022). Model of communication effectiveness in the mentoring process. *WSEAS Transactions on Business and Economics*, *19*, 1-12. doi: 10.37394/23207.2022.19.1

Rosselot-Merritt, J., & Bloch, J. (2020). Mentoring in business and professional communication: Case study of a multiyear dynamic. *Business and Professional Communication Quarterly*, *83*(1), 5-33. doi: 10.1177/232949061988589

Rossoni, L., Engelbert, R., & Bellegard, N. L. (2016). Normal science and its tools: Reviewing the effects of factor analysis in management. *Revista de Administração (RAUSP)*, *51*(2), 198-211. doi: 10.5700/rausp1234

Salamondra, T. (2021). Effective communication in schools. *BU Journal of Graduate Studies in Education*, *13*(1), 22-27.

Sanina, A., Balashovb, A., Rubtcova, M., & Satinsky, D. M. (2017). The effectiveness of communication channels in government and business communication. *Information Polity*, *22*(4), 251-266. doi: 10.3233/IP-170415

Scheming, O., & Mason, R. B. (2013). Communication channels and interpersonal communication between South African and German business partners. *Cor-*

porate Ownership and Control, *10*(4), 409-419. doi: 10.22495/cocv10i4c4art4

Sera, H., & Johnson, W. B. (2022). Mentoring. *Comprehensive Clinical Psychology*, *2*, 150-159.

Širvaitytė, A. (2019). *The impact of mentoring on the career construction of future professionals* (in Lithuanian). Master's Thesis. Kaunas University of Technology. Retrieved from http://new.llkc.lv/sites/default/files/baskik_p/pielikumi/mentorings-vadlinijas.pdf

Stanulis, R. N., & Russell, D. (2000). Jumping in: trust and communication in mentoring student teachers. *Teaching and Teacher Education*, *16*(1), 65-80. doi: 10.1016/S0742-051X(99)00041-4

Straus, S. E., Johnson, M. O., Marquez, C., & Feldman, M. D. (2013). Characteristics of successful and failed mentoring relationships: A qualitative study across two academic health centers. *Academic Medicine*, *88*(1), 82-89. doi: 10.1097/ACM.0b013e31827647a0

Stuart, B. E., Sarow, M. S., & Stuart, L. (2007). *Integrated Business Communication: In a Global Marketplace*. John Wiley & Sons.

Suciu, M.-Ch., Năsulea, Ch., & Nasulea, D. (2018). Developing cultural industries in Central and Eastern European countries. *Management of Sustainable Development Sibiu*, *10*(2), 51-56. doi: 10.2478/msd-2019-0008

Sullivan, R. (2000). Entrepreneurial learning and mentoring. *International Journal of Entrepreneurial Behavior & Research*, *6*(3), 160-175. doi: 10.1108/13552550010346587

Underhill, Ch. M. (2006). The effectiveness of mentoring programs in corporate settings: A meta-analytical review of the literature. *Journal of Vocational Behavior*, *68*(2), 292-307. doi: 10.1016/j.jvb.2005.05.003

Wonneberger, A., & Jacobs, S. (2016). Mass media orientation and external communication strategies: Exploring organisational differences. *International Journal of Strategic Communication*, *10*(5), 368-386. doi: 10.1080/1553118X.2016.1204613

Appendix 1

Results of pair-wise comparisons: differences between mentors and mentees in the analysed countries

F1

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Lithuania-Poland	5,440	21,788	,250	,803	1,000
Lithuania-Latvia	69,630	25,424	2,739	,006	,062
Lithuania-Bulgaria	72,505	24,681	2,938	,003	,033
Lithuania-Italy	101,062	25,424	3,975	,000	,001
Poland-Latvia	-64,191	22,072	-2,908	,004	,036
Poland-Bulgaria	67,065	21,211	3,162	,002	,016
Poland-Italy	-95,622	22,072	-4,332	,000	,000
Latvia-Bulgaria	2,875	24,932	,115	,908	1,000
Latvia-Italy	-31,431	25,668	-1,225	,221	1,000
Bulgaria-Italy	-28,557	24,932	-1,145	,252	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is ,05.

F2

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Italy-Latvia	85,172	25,557	3,333	,001	,009
Italy-Poland	108,298	21,976	4,928	,000	,000
Italy-Lithuania	-119,026	25,314	-4,702	,000	,000
Italy-Bulgaria	162,415	24,824	6,543	,000	,000
Latvia-Poland	23,126	21,976	1,052	,293	1,000
Latvia-Lithuania	-33,855	25,314	-1,337	,181	1,000
Latvia-Bulgaria	77,243	24,824	3,112	,002	,019
Poland-Lithuania	-10,729	21,694	-,495	,621	1,000
Poland-Bulgaria	54,117	21,120	2,562	,010	,104
Lithuania-Bulgaria	43,388	24,574	1,766	,077	,775

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is ,05.

F3

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Bulgaria-Italy	-71,843	24,992	-2,875	,004	,040
Bulgaria-Poland	-186,600	21,263	-8,776	,000	,000
Bulgaria-Latvia	-249,015	24,992	-9,964	,000	,000
Bulgaria-Lithuania	-265,413	24,741	-10,728	,000	,000
Italy-Poland	114,756	22,125	5,187	,000	,000
Italy-Latvia	177,172	25,730	6,886	,000	,000
Italy-Lithuania	-193,570	25,486	-7,595	,000	,000
Poland-Latvia	-62,415	22,125	-2,821	,005	,048
Poland-Lithuania	-78,813	21,841	-3,608	,000	,003
Latvia-Lithuania	-16,398	25,486	-,643	,520	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is ,05.

F4

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Italy-Latvia	120,784	25,636	4,712	,000	,000
Italy-Lithuania	-184,400	25,393	-7,262	,000	,000
Italy-Bulgaria	213,948	24,901	8,592	,000	,000
Italy-Poland	240,294	22,045	10,900	,000	,000
Latvia-Lithuania	-63,616	25,393	-2,505	,012	,122
Latvia-Bulgaria	93,164	24,901	3,741	,000	,002
Latvia-Poland	119,510	22,045	5,421	,000	,000
Lithuania-Bulgaria	29,548	24,651	1,199	,231	1,000
Lithuania-Poland	55,894	21,761	2,568	,010	,102
Bulgaria-Poland	-26,346	21,185	-1,244	,214	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is ,05.

F5

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Poland-Italy	-89,497	21,992	-4,070	,000	,000
Poland-Latvia	-144,056	21,992	-6,550	,000	,000
Poland-Bulgaria	235,616	21,135	11,148	,000	,000
Poland-Lithuania	-254,690	21,709	-11,732	,000	,000
Italy-Latvia	54,559	25,575	2,133	,033	,329
Italy-Bulgaria	146,119	24,841	5,882	,000	,000
Italy-Lithuania	-165,193	25,332	-6,521	,000	,000
Latvia-Bulgaria	91,560	24,841	3,686	,000	,002
Latvia-Lithuania	-110,635	25,332	-4,367	,000	,000
Bulgaria-Lithuania	-19,075	24,592	-,776	,438	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is ,05.

F6

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Italy-Poland	178,970	21,759	8,225	,000	,000
Italy-Latvia	179,132	25,304	7,079	,000	,000
Italy-Lithuania	-226,541	25,064	-9,039	,000	,000
Italy-Bulgaria	235,440	24,578	9,579	,000	,000
Poland-Latvia	-,162	21,759	-,007	,994	1,000
Poland-Lithuania	-47,571	21,479	-2,215	,027	,268
Poland-Bulgaria	56,469	20,911	2,700	,007	,069
Latvia-Lithuania	-47,409	25,064	-1,892	,059	,586
Latvia-Bulgaria	56,307	24,578	2,291	,022	,220
Lithuania-Bulgaria	8,898	24,331	,366	,715	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is ,05.

F7

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Latvia-Italy	-35,015	25,601	-1,368	,171	1,000
Latvia-Bulgaria	85,079	24,867	3,421	,001	,006
Latvia-Lithuania	-127,021	25,358	-5,009	,000	,000
Latvia-Poland	141,945	22,014	6,448	,000	,000
Italy-Bulgaria	50,064	24,867	2,013	,044	,441
Italy-Lithuania	-92,006	25,358	-3,628	,000	,003
Italy-Poland	106,931	22,014	4,857	,000	,000
Bulgaria-Lithuania	-41,942	24,617	-1,704	,088	,884
Bulgaria-Poland	-56,867	21,156	-2,688	,007	,072
Lithuania-Poland	14,924	21,731	,687	,492	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is ,05.

F8

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Italy-Lithuania	-59,620	24,588	-2,425	,015	,153
Italy-Bulgaria	111,679	24,112	4,632	,000	,000
Italy-Latvia	130,931	24,824	5,274	,000	,000
Italy-Poland	148,142	21,346	6,940	,000	,000
Lithuania-Bulgaria	52,059	23,870	2,181	,029	,292
Lithuania-Latvia	71,312	24,588	2,900	,004	,037
Lithuania-Poland	88,523	21,072	4,201	,000	,000
Bulgaria-Latvia	-19,253	24,112	-,798	,425	1,000
Bulgaria-Poland	-36,464	20,514	-1,778	,075	,755
Latvia-Poland	17,211	21,346	,806	,420	1,000

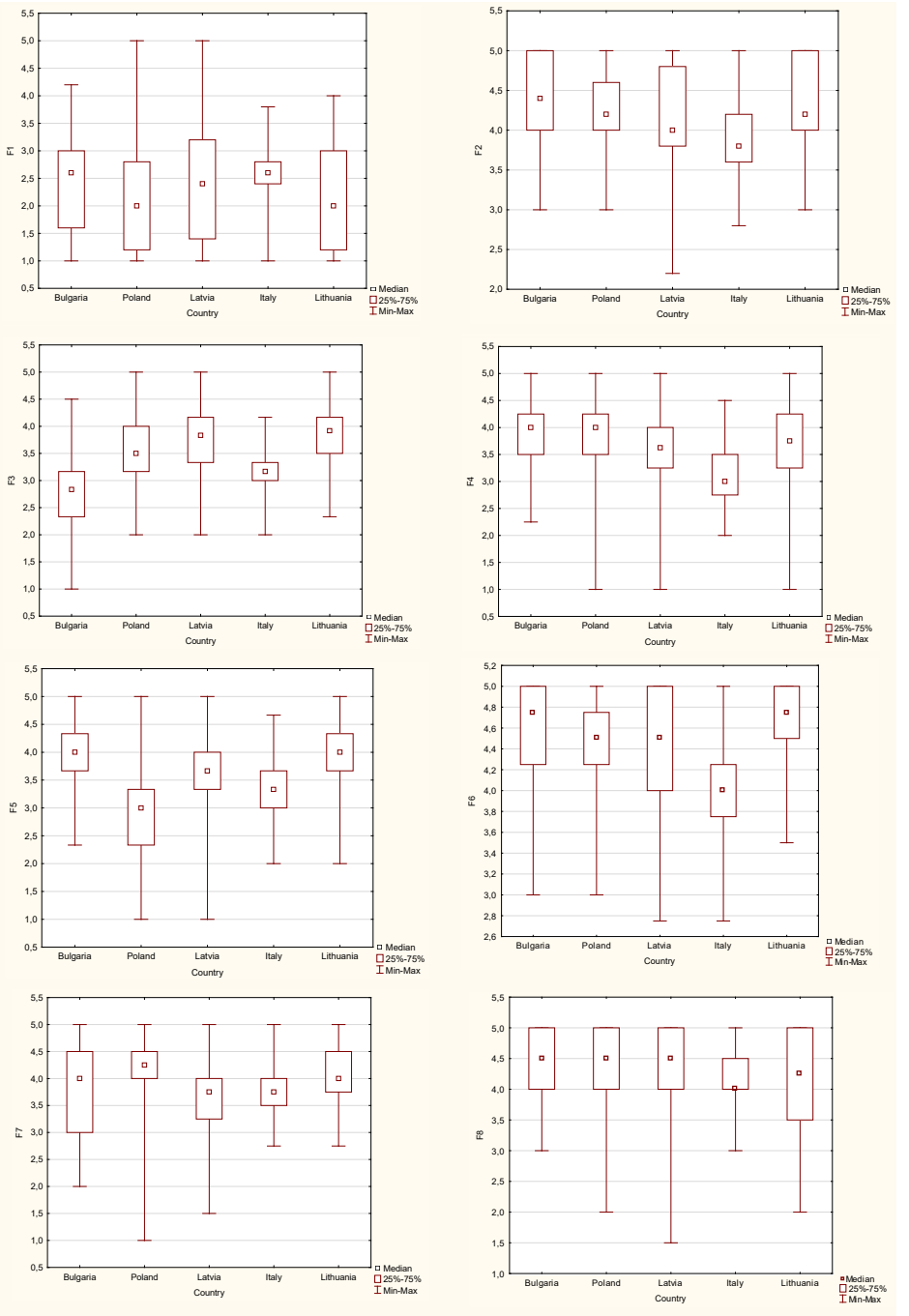
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is ,05.

F9

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Poland-Italy	-61,119	21,761	-2,809	,005	,050
Lithuania-Italy	62,089	25,067	2,477	,013	,133
Bulgaria-Italy	-43,073	24,581	-1,752	,080	,797
Poland-Latvia	-35,360	21,761	-1,625	,104	1,000
Lithuania-Latvia	36,329	25,067	1,449	,147	1,000
Latvia-Italy	-25,760	25,307	-1,018	,309	1,000
Poland-Bulgaria	18,047	20,913	,863	,388	1,000
Lithuania-Bulgaria	19,016	24,334	,781	,435	1,000
Bulgaria-Latvia	-17,313	24,581	-,704	,481	1,000
Lithuania-Poland	,969	21,482	,045	,964	1,000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is ,05.

Appendix 2
Box and whisker plots for comparisons among countries



Appendix 3

Mann–Whitney U Test results — differences between mentors and mentees in the analysed countries, the entire research sample

Factor	Status	N	Mean Rank	Sum of Ranks	Test Statistics	
F1	Mentor	334	328.64	109765.00	Mann-Whitney U	47716,000
	Mentee	304	309.46	94076.00	Asymp. Sig. (2-tailed)	0.187
F2	Mentor	334	334.76	111811.50	Mann-Whitney U	**45669.500**
	Mentee	304	302.73	92029.50	Asymp. Sig. (2-tailed)	**0.027**
F3	Mentor	334	325.68	108778.50	Mann-Whitney U	48702.500
	Mentee	304	312.71	95062.50	Asymp. Sig. (2-tailed)	0.373
F4	Mentor	334	302.30	100968.50	Mann-Whitney U	**45023.500**
	Mentee	304	338.40	102872.50	Asymp. Sig. (2-tailed)	**0.013**
F5	Mentor	334	327.02	109225.50	Mann-Whitney U	48255.500
	Mentee	304	311.24	94615.50	Asymp. Sig. (2-tailed)	0.276
F6	Mentor	334	313.27	104631.00	Mann-Whitney U	48686.000
	Mentee	304	326.35	99210.00	Asymp. Sig. (2-tailed)	0.361
F7	Mentor	334	323.50	108050.50	Mann-Whitney U	49430.500
	Mentee	304	315.10	95790.50	Asymp. Sig. (2-tailed)	0.562
F8	Mentor	334	309.72	103445.00	Mann-Whitney U	47500.000
	Mentee	304	330.25	100396.00	Asymp. Sig. (2-tailed)	0.144
F9	Mentor	334	330.69	110450.50	Mann-Whitney U	47030.500
	Mentee	304	307.21	93390.50	Asymp. Sig. (2-tailed)	0.101

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Lecturers' attitude towards the use of e-learning tools in higher education: a case of Portugal

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ABSTRACT

This study aims to assess the lecturers' opinions about the use of e-learning tools to support distance and blended learning in higher education in Portugal, evidently reinforced by the COVID-19 pandemic. This research was based on a qualitative methodology, specifically, a focus group with professors from five higher education institutions from different geographical areas in Portugal. The obtained results were analysed along four main dimensions: (1) the level of knowledge of e-learning tools, (2) the reasons for using or (3) not using them, and, finally, (4) the opinion of lecturers on the student assessment process using these tools. The results showed that in addition to the concerns with smooth running classes and the appropriate delivery of the syllabus, the lecturers considered the transition to the e-learning context to have been easy. They noted a high level of literacy in the used tools, believed in the continued use of e-learning in the post-pandemic context, indicated several advantages for those involved in the e-learning context and a majority of limitations related to the time required for the adoption of more tools; and, finally, underlined the student assessment issue, which was pointed out as the most sensitive topic in the whole e-learning context. The study informed on the lecturers' perspective on e-learning and the used tools and provided insight into their perceived usefulness and benefits for lecturers and students. An especially strong concern was verified on the part of lecturers to optimise e-learning tools to provide better knowledge delivery to students.

KEY WORDS

education, communication, educational technologies, e-learning tools

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Introduction

Although some studies are available on the adoption of e-learning tools in higher education, all of them are focused on a specific institution and different limitations and perspectives (Regueras et al., 2009; King & Boyatt, 2015; Valencia-Arias et al., 2019; Alkhawaja & Abd, 2019; Eze, 2020; Yamoah & ul Haque, 2022). Moreover, most of them investigate the students' but not the lecturers' perspectives on using the tools (Phutela & Dwivedi, 2020; Ho et al., 2020, Rehman et al., 2022; Al Rawashdeh et al., 2021; Almajali et al., 2021; Ejdys & Szpilko, 2021).

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Therefore, this study explored the lecturers' points of view.

Considering the research objectives, the study used the most relevant qualitative methodology, a focus group. From the initial stage, it was based on four specific investigated objectives: the level of lecturers' knowledge about existing e-learning tools; the perceived advantages and reasons for using them; the advantages and disadvantages of using e-learning tools; and, finally, the perspective of participating lecturers on the student assessment process and tools in e-learning.

The research objectives aligned with some unexplored points within studies on the same topic. Also, they were used for the focus group debate to learn the lecturer's opinions on the use of e-learning tools in the context of distance learning in Portugal, necessitated by the pandemic.

Throughout the research, the lecturers' opinions on the topic were facilitated and encouraged in the definition and application phases of the methodology, i.e., in the focus group. This research format was chosen to ensure as substantiated analysis of the results as possible and to draw lessons effectively in line with the statements given by the participating lecturers.

The article is divided into the following parts: first, a literature review focuses on various e-learning topics to be analysed; then, a detailed explanation and justification are given for the chosen research methodology; next, for the analysis and conclusions, research results are divided into four broad objectives and presented in writing and visually; and, finally, the conclusions are summarised and discussed, indicating perspectives for future studies on this research topic.

1. Literature review

Before analysing the application of e-learning tools in higher education in Portugal, it is important to understand them and their advantages for teaching, as well as the main concerns in their development and application.

Nowadays, it is increasingly important to develop tools that keep up with digital transformations and user requirements, which are changing faster and more drastically (Costa et al., 2021; Rodrigues et al., 2021). Besides usability as a primary objective, software developers have offered e-learning tools with well-defined pedagogical strategies (Garcia et al., 2022) and integrated training for students and lecturers, state-of-the-art technologies aligned with user expectations, continuous performance evaluation for students and the learning platform, various support to students and, finally, the pleasant design and appearance of the tools (Eneterio et al., 2020; Ayu, 2020).

Based on Aljawarneh et al. (2010), e-learning tools have taken a leading role in teaching delivery in the 21st century as it significantly reduces education costs and is much more efficient and effective than traditional teaching at its genesis. The authors listed five advantages of adopting e-learning tools: more proactive teaching; more diversified forms of teaching; greater attention and achievement of students; less time for lectures, and visual stimulation of classes and content. Also, they listed four disadvantages of the use of e-learning tools: equipment and hardware failures; the greater need for training and recovery plans in case of problems; anxiety caused by over-expository lectures; and the time spent learning new technologies and the skills needed to use them (Aljawarneh et al., 2010). According to another study on e-learning effectiveness conducted among higher education students, e-learning has such advantages as speediness, the economy in terms of time and financial costs, suitability for independent work, added value to teaching from the learner's perspective, usability for more proactive teaching; responsiveness to different needs, applicability outside the classroom, and the overall satisfactory quality of e-learning, indicating its effectiveness (Ali et al., 2018). This study aimed to verify if the same conclusions were true in Portugal from the lecturers' perspective.

The identification of these advantages and disadvantages by other authors is extremely relevant for this study on the Portuguese reality, allowing to verify if the problems vary from country to country (Sebele-Mpofu, 2020). According to Reddy (2015), the opportunities for developed and developing countries are somewhat similar, yet difficulties may vary a lot since, in developing countries, the constraints go far beyond the lack of motivation and proactivity of the involved actors, also noting the difficulties added by lacking technological infrastructure and incentives from governments to introduce such solutions in education. This important issue should also be investigated for a possibility to later verify if the advantages and difficulties in Portugal align with other countries implementing policies on e-learning tools in higher education. Higher education has been going through a gradual transition towards e-learning over the years.

According to Magano et al. (2008) in 2008, Portuguese higher education had overcome the initial traditionalist fears and mistrust of this distance learning method. Then, the authors considered that e-learning had already been seen as a valid means to overcome existing problems and enhance the teaching and learning quality in Portugal (Magano et al., 2008). This reality has become more evident in Portuguese higher education, especially during the COVID-19 pandemic, which required the adoption of strategies and responses to ensure the best possible transmission of knowledge (Pokhrel & Chhetri, 2021). This study also focused on this dimension to verify whether the e-learning context has evolved, considering, e.g., the preconceptions of 2008 about the e-learning framework.

The research environment in the studied area is still undeveloped, which explains why this article not only presents the lecturers' perspective but also elucidates on the Portuguese teaching context through qualitative analysis. These two factors are the main distinctive elements of the study. Until now, some studies have been conducted from the perspective of students regarding e-learning in Portuguese higher education. Remote and online e-learning is considered a more personalised and appropriate knowledge transmission format tailored to the needs of each student (Mamede, 2014). E-learning can also be defined as the use of technologies providing a wider range of solutions to problems associated with knowledge transmission. E-learning also supports the rising idea of flexible learning, which allows lecturers and students to personalise teaching and knowledge transmission and/or reception depending on the case (Kumar Basak et al., 2018). Besides these types of studies, many more specific case studies have been performed, several of which are related to Universidade Aberta in Portugal, an institution which mostly operates using an e-learning format. Based on some of the studies, the institution faced several problems regarding the lecturers' attitudes. According to Pereira et al. (2012), adequate training and necessary support were provided to all lecturers so that this type of teaching could be developed in the entire institution. Such cases are interesting due to the possibility of comparing whether the difficulties encountered by Universidade Aberta lecturers are similar to those currently felt. In preparation for this study, lecturers from several institutions in the country were interviewed, so it is pertinent to compare the difficulties faced by them and their institutions and the problems that existed at Universidade Aberta during its transition since 2006 (Pereira et al., 2012) to verify if there is any difference related to the time gap.

In addition, other studies focused on specific geographical areas and teaching sectors. Baber (2021) presented a case study of South Korea defining the acceptance of e-learning during the COVID-19 pandemic. Based on the conclusion, the interaction was the main critical success factor in this teaching context, and the main initiator's role in such interaction must be taken by the teacher in charge and not the students (Baber, 2021). Irfan et al. (2020) studied a specific case of difficulties experienced in the transition from classroom teaching to e-learning in Indonesia. The study was focused on the teaching of mathematics and various associated sub-areas. The author indicated several constraints experienced by teachers in this transition, such as the lack of interaction with students, the barriers in the computerised use of mathematical symbols, and limited computer knowledge and content presentation skills as the teachers continued applying the models used in face-to-face settings which, evidently, were not suitable in an e-learning context (Irfan et al., 2020). Although such studies address areas different to those presented in this study, they allow for a comparison with other realities to understand if e-learning brought globalisation or polarity in the transmission of knowledge in the pandemic context.

The analysis of other literature reviews on the research subject allowed identifying some of the main study areas in the context of e-learning enhanced by the COVID-19 pandemic, i.e., the difficulties in adjusting the needs and desires of teachers to those of students, difficulties in connecting to devices and communication networks, less control over issues related to mental health, and the lack of necessary resources associated with the transmission and acquisition of academic knowledge (Zethembe, 2020). The author also indicated insufficient scientific research on these issues and their respective short and long-term consequences for e-learning in higher education (Zethembe, 2020). The study described in this article aims to fulfil these research needs and to deepen the understanding of how the situation in Portuguese higher education compares to other countries.

Although most students preferred teaching in an e-learning context, it is important to look at the teachers' perspectives and the difficulties they experienced in this context. According to Kulikowski et al. (2022), the teachers' motivation and performance suffered because of job characteristics, which conse-

quently may have implications for the overall teaching performance. This "forced" e-learning adoption may have caused practically incorrigible impacts on the teachers' opinions about this teaching context since many insufficient preparation cases could have jeopardised the adoption or the continuity of the use of the e-learning tools. Kulikowski et al. further suggested dividing the consequences of forced e-learning into two major tracks, one that understands the consequences derived from COVID-19 and the other that understands the major consequences that were motivated by the implementation and execution of e-learning (Kulikowski et al., 2022).

This division of consequences is essential for the analysis as it may demonstrate the paradigm verified by teachers in each of these two strands instead of just understanding the general opinion of teachers without any breakdown of the obtained results.

2. Research methods

The methodology used was a focus group with a sample of lecturers working in public higher education (universities or polytechnic schools) and representing different teaching and geographical areas to achieve a more holistic perspective on lecturers' attitudes towards using e-learning tools. Participants were selected and invited based on the network of contacts of different researchers engaged in this study.

No exhaustive list of tools was created to ensure that lecturers mention the most-used e-learning tools and to encourage the discussion. Instead, all participants were asked to openly state the e-learning tools used during teaching by distance or face-to-face modes. A more open study of knowledge and familiarity with new tools created a climate of knowledge transmission between participants of the focus group.

Since this study involved the personal perspectives of each teacher, no pre-established metrics were used to avoid limiting the opinions. However, perspectives given in the focus group and the analysis were always directed towards studied objectives to refrain from digressing too far into other topics.

Table 1 contains the list of participants providing their names, scientific area, educational institution, and a code assigned by the research team. In the following sections, whenever participants are mentioned in the conclusions drawn, they will be referred to by these codes.

Considering the nature of the studied subject, a qualitative approach was chosen to achieve a more comprehensive response and enhance the sharing of ideas. Following this methodological approach justification, a focus group was selected because it best meets the two premises.

Since the focus group can be used in various contexts, such as exploring new and examining existing areas of research or even exploring new areas that may arise from the methodology application (Wilkinson, 1998), the flow of information analysis is highly relevant.

The focus group was held on 10 March 2022 for approximately 1 hour and 30 minutes. The moderator asked the participants for permission to record the session to follow the sequence presented in Fig. 1. The results analysis and the focus group followed a spe-

Tab. 1. Focus group participants (n = 5)

Name of Lecturer	Scientific Area	Higher Education Institution	Code
Ângela Silva	Logistics	Polytechnic Institute of Viana do Castelo	P1IPVC
Célio Marques	Information and Communication Technologies	Polytechnic Institute of Tomar	P2IPT
Samuel Mateus	Communication Sciences	University of Madeira	P3UMa
André Souto	Mathematics	University of Lisbon	P4UL
Tiago Pinho	Industrial Engineering and Management	Setúbal Polytechnic Institute	P5IPS

Fig. 1. Focus group analysis process

cific approach aimed at receiving and understanding the lecturers' perspectives. The topics analysed and the ideas derived from them, in terms of content, were used in the research as qualitative methods open to discussion. Direct participants' quotes stated during the focus group were used to support different objectives of the analysis (Jones et al., 2005).

The four major objectives outlined to respond to the methodology's application were: (1) the participant's level of knowledge of different e-learning tools and the freedom given by the institutions to choose them, which aimed to understand the reality felt in different scientific and geographical areas when inserted in the same teaching context; (2) the main advantages and (3) the main disadvantages associated with the use of these tools, aiming to understand the participants' opinions (positive or negative) the regarding their use to aid in the knowledge transmission; and (4) the lecturers' opinions on the assessment in the context of e-learning, previously identified as a critical factor and to be confirmed or rejected in this study and, most importantly, in the application of this methodology.

3. Research results

The focus group began with an introductory discussion to assess how the transition from traditional face-to-face teaching to distance learning occurred starting in March 2020 during the spread of the SARS-CoV-2 virus.

The introductory discussion revealed that many represented institutions were prepared for the change. They provided training, equipment, constant monitoring and psychological support for students and lecturers. Despite all the efforts, the participants also emphasised some difficulties in this transition, mainly due to the lack of interactivity and the refusal of many lecturers to work remotely due to the belief that this method did not guarantee the required equity. In conclusion, despite some restrictions particular to this format of classes/assessments, positive results were achieved because higher education institutions were prepared, which made the transition quick, easy, and quite enjoyable. This reality highlighted the great responsiveness of higher education institutions in Portugal throughout this process.

The participants also showed great responsiveness to this context and were satisfied with the use of distance learning support tools, even stating that they continue to use them daily.

P5IPS — "I think it went well; now it's our daily life, so to speak!"

3.1. Level of knowledge of e-learning tools

After addressing the introductory topic, the research moved on to its first major dimension, aimed at measuring the degree of participants' knowledge of e-learning tools and the freedom given by their educational institutions to choose the tools. It was found that the focus group participants had complete freedom to choose the tools; however, the institutions made recommendations, i.e., mainly Zoom[1], Moodle[2], traditional e-mail[3] and Microsoft Teams[4] and in some instances, Fenix[5], BigBlueButton[6] and Exame.net[7]. The training was provided for lecturers on certain previously used tools, namely Moodle. It provided knowledge for more optimised assessments and introduced lecturers to earlier undiscovered and unexplored features. In addition to the tools licensed by educational institutions, other tools were used to streamline the course of the classes, such as Kahoot[8]. After measuring the participants' level of knowledge about these types of tools, the discussion delved into functionalities considered having an added value during lessons and necessary for their use within different teaching areas. Two participants defended the non-use of many tools; however, the remaining participants considered the use of more tools and methodologies as a way to increase the interaction lost in this remote teaching regime. Therefore, it was considered that such tools as Mentimeter[9], Zoom simultaneous rooms, ScreenCasts[10], Quizizz[11], Sway[12], Podcast[13], Google Forms[14], Microsoft Forms[15], URKUND[16], etc., could promote interaction with

1 Zoom — videoconferencing tool.
2 Moodle — sharing documentation.
3 E-mail — interpersonal communication.
4 Microsoft Teams — videoconferencing and documen tation sharing tool.
5 Fenix — internal information system.
6 BigBlueButton — video conferencing tool.
7 Exame.net — assessment control.
8 Kahoot — interaction through questionnaires.
9 Mentimeter — interaction through questionnaires.
10 ScreenCasts — asynchronous teaching by sharing content via a screen.
11 Quizizz — interaction through questionnaires.
12 Sway — content presentation tool.
13 Podcast — asynchronous teaching by sharing content through audio recordings.
14 Google Forms — interaction through questionnaires.
15 Microsoft Forms — interaction through question naires.
16 URKUND — plagiarism detection tool.

students making them more comfortable with the means used.

The participants advocating for the use of these tools proved to be quite versatile and adaptable to the environment. They even admitted that in a different environment, the methodologies should also be different and more diversified, as they believed this was the only way to achieve a better result regarding the cognitive optimisation of students.

P2IPT — "Means are different; therefore, we also have to have different methodologies."

Although most participants advocated for diverse e-learning tools, two reasons were stated by the participants who did not. First, they argued that it was due to institutional rules and legislation that lecturers could not force students to use tools for which the institutions had no legal protocols and thus could not guarantee the security of data, so students could refuse to use them.

Second, the tools did not have functionalities considered especially important to participants, such as making text transcription of verbal conversations on videoconferencing platforms. One participant stated that their institution decided to keep all the workload and conduct as was done face-to-face, i.e., the tools could not replace synchronous human interaction, even if at a distance.

Fig. 2. Word cloud of the first dimension
Source: elaborated by the authors using the MAXQDA 2022 software.

P3UMa — "Even the best technologies can never simulate human interaction. We do a simulation, but limitations will always exist."

Within the first dimension on the level of knowledge of e-learning tools, a new discussion topic was launched to try and understand if participants who extensively used the tools remotely continued doing so in face-to-face classroom settings once the pandemic in Portugal subsided and to learn the reasons behind this choice. The discussion revealed that almost all participants continued using the tools, particularly for exercises using a tablet and providing documents with corrections made during a class so that students felt more familiar with the topics. Also, one participant attested to a strong investment by their higher education institution in high-resolution cameras that continue to be used frequently, particularly in the case of students in prophylactic isolation.

Despite these topics being more specific to certain realities, the participants agreed more on the continued use of Teams as the main form of communication, the greater potential of Moodle as a whole, Kahoot and Zoom in a professional context and/or as an addition for extra-class students. In addition to tools officially adopted by institutions, some participants continue to use tools discovered and explored during the time of remote teaching.

P2IPT — "I was already using these tools. What happened was more massive and more intensive use of them."

P5IPS — "I say that now, I will hardly ever stop using any of these tools because they have become a part of our everyday life."

In conclusion of the first dimension's analysis, Fig. 2 shows a word cloud composed of the most used and relevant words that reflect the main addressed concepts. Some ideas support previous analyses, e.g., the focus on students through the adequacy of tools, concerns with the needs of colleagues, lecturers, some technologies and different ways to share content, and some fears regarding the excess of diversification.

3.2. Main advantages and reasons for using e-learning tools

The second dimension aimed to assess the advantages perceived by participants in the use of

Fig. 3. Word cloud of the second dimension
Source: elaborated by the authors using the MAXQDA 2022 software.

e-learning tools. This topic revealed more divergence among the participants.

One participant believed that the tools brought practically no added value to students, as they remained quite discouraged due to the remote format of classes, even with various tools at their disposal. The institution of this particular participant prioritised face-to-face teaching, making no massive investment in technological tools and equipment to support e-learning.

P3UMa — "There is a limitation of the technologies to be used, whether it is at the hardware level in the rooms (...), whether it is at the level of imitation software, there is no interactivity on the boards or anything that allows it."

Other participants mentioned several yet very different advantages of the use of e-learning tools in this same context.

While some participants saw advantages for students, who seemed more motivated and energised in this context, others indicated benefits related to the ease of working with students, meeting them after work and scheduling individual tutoring sessions and even arranging meetings with companies connected to the educational institutions. The participants indicated that the tools allowed for a simplified and more practical day-to-day running of the classes and interaction with stakeholders involved in higher education.

The second view was based on the premise that higher education students are digital natives, perceiving e-learning tools as extremely beneficial in general and to lessons in particular. The supporters of this view also argued they were using the tools because they were considered the best by students. They saw effective advantages in the use of the tools, and if students wanted other types of methodologies, they would have also been used to ensure student satisfaction with the e-learning process.

P2IPT — "I've been using a lot of digital tools because I think that's what the students want, but if the students wanted something else, I would use it because I have to achieve my goal."

The word cloud model allowed for the verification of lecturers' concern regarding the focus on students and the smooth running of classes, as can be seen from the terminology most used by the participants in this category (Fig. 3). Also, some most frequently used terminology evaluated the use of distance learning support tools as good and creating "added value" in meeting the objectives and adapting methodologies.

3.3. Main disadvantages and reasons for not using e-learning tools

While it makes sense to study the advantages of using e-learning tools, it also makes sense to study the main disadvantages and/or reasons for not using some of the available solutions.

Some factors causing the non-use of tools were perceived; however, the participants mostly mentioned the lack of time to master them, the practicality and ease in finding the contents by students, insufficient adequate training regarding the existing technologies and choosing the best in each situation/context of the classes taught by the participants' strong financial constraints throughout higher education for the acquisition of licenses, cameras, interactive whiteboards and computers, the need to adapt the material to be taught remotely, and the lack of time to autonomously learn about tools and their use.

Participants gave a range of reasons for not using certain tools in the e-learning context. One indicated not using more tools because it was impossible to use them all, and trying to do so would run the risk of losing focus on teaching and knowl-

Fig. 4. Word cloud of the third dimension
Source: elaborated by the authors using the MAXQDA 2022 software.

edge transmission. Therefore, the participant felt forced to analyse and choose the tools best suited for the lecturer's and syllabus' objectives.

Although different reasons were given, all participants strongly advocated for the lack of available time to master the tools perfectly and to increase the practicality of students' cognitive process through simplicity.

P5IPS — "I would maintain here, as a fundamental point, the objective need to achieve certain goals in various contexts. The amount of time that lecturers have to spend to be able to master the tool is also relevant."

As the cloud of words for the third dimension verifies, the term "tools" clearly stands out, once again showing a great interest in mastering the platforms to contribute to the smooth running of classes and transmission of the greatest degree of knowledge and information to students in this remote teaching context (Fig. 4).

3.4. General opinion about assessment in the e-learning context

After studying different perspectives on dimensions concerning the environment and the context of used e-learning tools, the study moved to address the lecturers' views on student assessment since this was one of the most sensitive and least successful issues in the context of remote classes.

In this dimension, the answers were very similar, indicating the aspect as the least successful area due to numerous fraud cases and the unreliability of students' academic results. Some situations were defended by the participants as more sensible for remote rather than face-to-face assessments; however, they underlined the necessity to guarantee some equity in the results, i.e., performing oral tests and using other methods of substantiating the performance obtained in the different moments of assessment.

In addition to this practically unanimous perception of the assessment in remote learning contexts, one participant was an exception. As a lecturer in the archipelago of Madeira, he could always perform assessments in a face-to-face setting due to different regulations compared to mainland Portugal. The participant also pointed out the possibility of continuing assessments face-to-face, even in the context of remotely taught classes. Practically all lecturers in this educational institution chose to use this assessment method already implemented in a face-to-face setting because they considered it filled the gaps previously exposed in the study of this dimension.

Although the participants believed that assessment was the least successful accomplishment of e-learning tools, a concern was raised that no assessment method is 100 % reliable and that all means must be validated to achieve greater equity in results.

P2IPT — "I'll start by saying that there is no 100 % reliable instrument, whether it's online or face-to-face."

As this last dimension delved into student assessment in remote teaching, the most frequently used terms were related to students, the assessment and the maintenance of equity among them, also reflecting the need to adapt the strategies to ensure greater accuracy of remote testing (Fig. 5).

Conclusions

To draw more centralised and schematic conclusions about the studied topic, the research team considered it important to present the dimensions and different perspectives provided by the focus group participants in their different responses (Table 2).

Fig. 5. Word cloud of the fourth dimension
Source: elaborated by the authors using the MAXQDA 2022 software.

The summary of data and the analysis of the lecturers' perspectives on the use of e-learning tools allowed for a conclusion that the main objective of the remote teaching process was to ensure the transmission of knowledge in line with the expectations and needs of students.

Several different views were offered regarding the greater or smaller number of tools to be used during classes, considering the demands and limitations of each teaching area and/or represented higher education institution.

Besides a very comprehensive set of answers, the focus group as a research methodology allowed for a continuous sharing of knowledge and for obtaining broad results for each of the pre-established dimensions, which was extremely necessary for the analysis of the topic with such an intrinsic component for each participant.

The main considerations, besides the concern with the smooth and appropriate delivery of the syllabus, were very much focused on an easy transition to the remote learning context, the literacy of a fairly broad level of e-learning tools and the continuity of their use in a post-pandemic context, several advantages for specific cases and those involved in the remote learning context, limited time for the adoption of more e-learning tools; and the assessment as the most sensitive point in the whole remote learning process.

Despite fairly divided opinions on some of the studied dimensions, it was possible to verify high technological literacy and extensive preparation by participants and represented higher education institutions. It was possible to verify the enormous capacity demonstrated by the lecturers throughout this process to adapt and work towards the success of students.

P5IPS — "This context somehow also forced us to do some technological updates in certain solutions that were a little older."

P3UMa — "I believe that with technologies, we are the ones who adapt to them and not the other way around."

Nearly all the participants were concerned with adapting methodologies to the context in which they were required to teach and used several digital e-learning tools as a current form of work, both in teaching and professional terms.

As verified, higher education institutions also had a preponderant role in the success as they had to provide training, licenses, and the best possibilities for remote classes from the perspective of the lecturers in this case.

This case study in Portugal verified some of the earlier pointed-out difficulties (Kulikowski et al., 2022) faced by teachers. It was possible to verify the consequences of this forced adoption of e-learning in Portugal, motivated by the COVID-19 pandemic. In most cases, teachers continue to use tools even though they are no longer mandatory but are effectively seen as having added value. Therefore, in this case study, the consequences for teachers in Portugal were not as much derived from the sudden and forced implementation of e-learning but rather from the pandemic context that was experienced and the implication this had on the physical and mental health of teachers.

P2IPT — "It seems to me that students, as digital natives, are more linked to technologies than to other types of methodologies, such as chalk and blackboard."

P2IPT — "It was far from what distance learning is, but for remote learning, it was amazing!"

The limitations of this paper are based on two major points. The first limitation is the sample used since not all higher education institutions in Portugal were represented, and each of them had only one representative. The second major limitation is the

Tab. 2. Synthesising the answers by dimension

Point under study	First Perspective	Supporters of the first perspective	Second perspective	Supporters of the second-perspective
How was the transition to remote teaching	Simple, fast, and prepared transfer	P2IPT P3UMa P4UL P5IPS	Fast change, but not very easy	P1IPVC
Level of knowledge of remote teaching tools	Freedom of choice; great knowledge of tools; use of a wide range of tools; many of them continue to be used in the post-pandemic context	P1IPVC P2IPT P5IPS	Not using many tools; discontinuity of the use in the post-pandemic context	P3UMa P4UL
Reasons why lecturers use this type of tools	Advantages for students and others; scheduling of tutoring sessions; added value for students by meeting their needs and wants	P1IPVC P2IPT P4UL P5IPS	No added value for the students and a lot of demotivation	P3UMa
Reasons why lecturers do not use some tools	Lack of time and availability; optimise convenience for students; the lack of proper training in some cases; the lack of funding to purchase hardware and software	P1IPVC P2IPT P3UMa P4UL P5IPS	-	-
General opinion about assessment in the remote teaching context	Most problematic point in this context; the lack of equity in results; the need to complement them with other forms of assessment	P1IPVC P2IPT P4UL P5IPS	Always performed face-to-face assessments because it was possible in the archipelago	P3UMa

focus on one country only, which represents the specific reality of lecturers in a specific country. This may prevent generalising the results to some other countries with a greater or lesser impact of the COVID-19 pandemic on the national education system. Therefore, there should be adapted and in-depth studies of the realities of other countries.

Future studies on this research topic should include two major subjects. The first should seek to understand the students' attitudes towards the use of e-learning tools in the context of higher education in Portugal. This study would disclose student opinions, showing both sides of the same coin. Also, this would show the connection between the arguments used and verified by teachers, students and educational institutions regarding the tools that greatly impacted Portuguese higher education.

The second topic should be devoted to studying the reality of other countries. Although the study focused on the opinions of Portuguese teachers regarding the use of e-learning tools, it would be important and interesting to adapt and perform the study in other countries to compare different higher education institutions and experiences of teachers in using these tools, aiming to ascertain the existence of a pattern for the adoption and acceptance in different countries.

Literature

Al Rawashdeh, A. Z., Mohammed, E. Y., Al Arab, A. R., Alara, M., & Al-Rawashdeh, B. (2021). Advantages and disadvantages of using e-learning in university education: Analyzing students' perspectives. *Electronic Journal of e-Learning*, *19*(3), 107-117.

Ali, M., Hossain, S. K., & Ahmed, T. (2018). Effectiveness of E-Learning for University Students: Evidence from Bangladesh. *Asian Journal of Empirical Research*, *8*(10), 352-360. doi: 10.18488/journal.1007/2018.8.10/1007.10.352.360

Aljawarneh, S., Muhsin, Z., Nsour, A., Alkhateeb, F., & AlMaghayreh, E. (2010). *e-Learning Tools and Technologies in Education*. A Perspective. LINC Proceedings.

Alkhawaja, M. I., & Abd Halim, M. S. B. (2019). Challenges of e-learning system adoption in Jordan higher edu-

cation. *International Journal of Academic Research in Business and Social Sciences*, *9*(9), 487-494.

Almajali, D., Al-Okaily, M., Barakat, S., Al-Zegaier, H., & Dahalin, Z. M. (2022). Students' perceptions of the sustainability of distance learning systems in the post-COVID-19: a qualitative perspective. *Sustainability*, *14*(12), 7353.

Ayu, M. (2020). Online Learning: Leading e-Learning at Higher Education. *The Journal of English Literacy Education: The Teaching and Learning of English as a Foreign Language*, *7*(1), 47-54. doi: 10.36706/jele.v7i1.11515

Baber, H. (2021). Modelling the acceptance of e-learning during the pandemic of COVID-19-A study of South Korea. *International Journal of Management Education*, *19*(2), 100503. doi: 10.1016/j.ijme.2021.100503

Costa, C. R., Garcia, J. E., Serra da Fonseca, M. J., & Teixeira, A. (2021). Data Analysis in Content Marketing Strategies. *16th Iberian Conference on Information Systems and Technologies (CISTI)*, Chaves, Portugal, 1-6. doi: 10.23919/cisti52073.2021.9476377

Ejdys, J., & Szpilko, D. (2021). Teachers' Perception of e-learning on the Example of Bialystok University of Technology. *Przegląd Organizacji*, *9*(980), 27-39. 10.33141/po.2021.9.04

Eneterio, N. da P., Major, C. R., Oliveira, E., Rolindo, J., Freitas, M., Ferreira, M., Abreu, S., & Morais, T. (2020). O E-Learning Como Ferramenta Estratégica Na Pandemia Covid-19. *Anais do Seminário de Atualização de Práticas Docentes*, 163-167. Retrieved from http://45.4.96.34/index.php/praticasdocentes/article/view/5742

Eze, S. C., Chinedu-Eze, V. C., Okike, C. K., & Bello, A. O. (2020). Factors influencing the use of e-learning facilities by students in a private Higher Education Institution (HEI) in a developing economy. Humanities and social sciences communications, 7(1), 133.

Garcia, J. E., Rodrigues, P., Simões, J., & Serra da Fonseca, M. J. (2022). Gamification Strategies for Social Media. In J. Remondes, & S. Teixeira (Eds.), *Implementing Automation Initiatives in Companies to Create Better-Connected Experiences* (pp. 137–159). IGI Global. doi: 10.4018/978-1-6684-5538-8.ch007

Ho, N. T. T., Sivapalan, S., Pham, H. H., Nguyen, L. T. M., Pham, A. T. V., & Dinh, H. V. (2021). Students' adoption of e-learning in emergency situation: the case of a Vietnamese university during COVID-19. *Interactive Technology and Smart Education,18*(2), 246-269. doi: 10.1108/ITSE-08-2020-0164

Irfan, M., Kusumaningrum, B., Yulia, Y., & Widodo, S. A. (2020). Challenges During the Pandemic: Use of E. Learning in Mathematics Learning in Higher Education. *Infinity Journal*, *9*(2), 147. doi: 10.22460/infinity.v9i2.p147-158

Jones, A. Q., Dewey, C. E., Doré, K., Majowicz, S. E., McEwen, S. A., Waltner-Toews, D., Henson, S. J., & Mathews, E. (2005). Public perception of drinking water from private water supplies: Focus group analyses. *BMC Public Health*, *5*, 1-12. doi: 10.1186/1471-2458-5-129

King, E., & Boyatt, R. (2015). Exploring factors that influence adoption of e-learning within higher education. *British Journal of Educational Technology*, *46*(6), 1272-1280.

Kulikowski, K., Przytuła, S., & Sułkowski, Ł. (2022). E-learning? Never again! On the unintended consequences of COVID-19 forced e-learning on academic teacher motivational job characteristics. *Higher Education Quarterly*, *76*(1), 174-189.

Kumar Basak, S., Wotto, M., & Bélanger, P. (2018). E-learning, M-learning and D-learning: Conceptual definition and comparative analysis. *E-Learning and Digital Media*, *15*(4), 191-216. doi: 10.1177/2042753018785180

Magano, J., Castro, A. V., & Carvalho, C. V. (2008). O e-Learning no Ensino Superior: um caso de estudo. *Educação, Formação & Tecnologia*, *1*(1), 79-92.

Mamede, S. M. P. (2014). Comportamento do consumidor digital: o caso do e-learning nas licenciaturas do ensino superior português. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&site=eds- live&db=edsrca&AN=rcaap.openAccess.10400.22.5454

Pereira, A., Quintas-Mendes, A., & Morgado, L. (2012). Educação on-line no Ensino Superior: um programa de doutoramento em educação a distância e e-learning na Universidade Aberta (Portugal). *Revista Teias*, *13*, 313-333.

Phutela, N., & Dwivedi, S. (2020). A qualitative study of students› perspective on e-learning adoption in India. *Journal of Applied Research in Higher Education*, *12*(4), 545-559. doi: 10.1108/JARHE-02-2019-0041

Pokhrel, S., & Chhetri, R. (2021). A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning. *Higher Education for the Future*, *8*(1), 133-141. doi: 10.1177/2347631120983481

Regueras, L. M., Verdu, E., Munoz, M. F., Perez, M. A., De Castro, J. P., & Verdu, M. J. (2009). Effects of competitive e-learning tools on higher education students: A case study. *IEEE Transactions on Education*, *52*(2), 279-285.

Rehman, M. A., Soroya, S. H., Abbas, Z., Mirza, F., & Mahmood, K. (2021). Understanding the challenges of e-learning during the global pandemic emergency: the students' perspective. *Quality Assurance in Education*, *29*(2/3), 259-276. doi: 10.1108/QAE-02-2021-0025

Rodrigues, M. I., Fonseca, M. J., & Garcia, J. E. (2022). The Use of CRM in Marketing and Communication Strategies in Portuguese Non-Profit Organizations. In J. Andrade, & T. Ruão (Eds.), *Navigating Digital Communication and Challenges for Organizations* (pp. 223-244). IGI Global. doi: 10.4018/978-1-7998-9790-3.ch013

Sebele-Mpofu, F. Y. (2020). Saturation controversy in qualitative research: Complexities and underlying assumptions. A literature review. *Congent Social Sciences*, *6*(1). doi: 10.1080/23311886.2020.1838706

Sree Reddy, B. (2015). Challenges and Opportunity of E-Learning in Developed and Developing Countries-A Review. *International Journal of Emerging Research in Management & Technology*, *46*, 2278-9359.

Valencia-Arias, A., Chalela-Naffah, S., & Bermúdez-Hernández, J. (2019). A proposed model of e-learning tools acceptance among university students in developing countries. *Education and Information Technologies*, *24*(2), 1057-1071.

Wilkinson, S. (1998). Focus group methodology: A review. *International Journal of Social Research Methodology*, *1*(3), 181-203. doi: 10.1080/13645579.1998.10846874

Yamoah, F. A. ., & ul Haque, A. . (2022). Strategic Management Through Digital Platforms for Remote Working in the Higher Education Industry During and After the COVID-19 Pandemic. *Forum Scientiae Oeconomia*, *10*(2), 111-128. doi: 10.23762/FSO_VOL10_NO2_6

Zethembe, M. (2020). A Literature Review of E-Learning and E-Teaching in the Era of Covid-19 Pandemic. *International Journal of Innovative Science and Research Technology*, *5*(10), 588-597.

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Social media platforms in sustainability communication of Polish social enterprises from the IT industry and beyond

Michał Baran

ABSTRACT

The article aims to identify and compare behaviour patterns of Polish social enterprises, especially those operating in the IT branch and using social media to communicate with their clients. The research consisted of a multidimensional qualitative and quantitative content analysis, including Cramér's V correlation coefficient based on chi-squared statistic, also suitable for nominal data types. The article focused on client communication content created and placed on social media by Polish social enterprises from the IT and other branches. The research sample comprised 301 entities. According to the adopted assumption, the statistical research (correlation analysis) results showed certain behaviour patterns within the scope of the analysed area and revealed significant circumstances that affect communication. Due to the profile of professional competencies, the IT industry prefers communicating via social media, which aims to formulate a concise and precise message. Social enterprises in the group of the most economically effective entities have a unique way of using social media. They choose the most popular social media and, at the same time, to some extent, expand their communication to more specialised platforms. The applied approach is a new way to analyse social enterprise activities in social media. The analysis findings contribute to a greater understanding of connections between the discussed phenomena. The presented research procedure can be applied to determine the impact of other competencies of the analysed entities on sustainability communication in social media. According to research, IT entities enrich the current trends in social media use by social enterprises. The research results may be useful for banks, investors and public institutions forecasting the success of social enterprises and making support-related decisions. The scale and scope of the use of social media platforms for communication with the market may be a criterion in measuring the chances to commercialise goods and services offered by social enterprises.

KEY WORDS

social entrepreneurship, sustainability, communication

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Introduction

Social enterprises are entities with unique characteristics which operate effectively in an environment adapted to commercial activities. Although social goals are the primary pursuit of these organisations, they may remain unnoticed in the general environment and result in treating social entities equally to their profit-driven competitors. In such situations, effective communication is a crucial competence for a social enterprise connected to the use of modern tools offered by the Internet (Choi & Scott, 2013). Such communication allows to effectively pre-

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sent the essential values and mission of the organisation to the environment and offers an opportunity to change the competitive position of a social enterprise in relation to its commercial competitors (Budzanowska-Drzewiecka, Jedynak & Lipińska, 2016). Thus, the communication method becomes a catalyst for gaining allies for the organisation and facilitates its sustainable development (Stańczyk, Stuss & Wziątek-Staśko, 2020). Therefore, sustainability-conforming marketing communication means communication aligned with the sustainable development strategy created by the entity's management. This type of communication can completely change the environment's assessment of the organisation and their relationship. In the modern world, social media is one of the most popular solutions for disseminating a message that allows for building a community around common values (Gupta et al., 2021). It can be expected that social enterprises operating in the IT industry are best at using social media to run sustainability communication as they provide information management services. Social enterprises from the IT industry are characterised by digital competencies and the synergy of technical and social skills. However, the question arises whether this potential is actually fully utilised in their day-to-day operations. This issue has not yet been investigated by the scientific community. Therefore, the article aims to identify the behaviour patterns of Polish social enterprises, especially those operating in the IT branch and using social media to communicate with their clients. The first part of the article discusses considerations and the use of social media in the context related to sustainability communication. Next is explained the method for data collection and search for correlations in the context of the adopted research hypotheses. The following part presents the analysis results. Finally, the conclusions, study limitations and future research directions are described.

1. Literature review

Sustainability communication is an idea derived from the concept of sustainability. To understand it properly, the more basic term must first be explained. The term "sustainability" is extremely popular in the modern world and is strongly dependent on technological development (Lorenz, 2008). As many perspectives on the topic can be adopted and descriptions can be quite distant from each other, the topic is associated with some interpretation difficulties (Zink, 2008). However, in the organisational context, the most popular approach refers to the relationship of an organisation with other entities in its environment (Landrum & Ohsowski, 2017). Today's world has shifted towards the paradigm of sustainable development (D'Humieres, 2018), and this idea covers practically every aspect of an organisation's operations (Schaltegger, Lüdeke-Freund & Hansen, 2016). So, how can the sustainability idea be explained?

In the context of challenges faced while creating a sustainable organisation, the following six challenges can be underlined (Evans et al., 2017): (1) the triple bottom line, which relates to the balance between profits, social benefits and environmental benefits; (2) mindset, referring to the need to eliminate mental restrictions imposed by rules, guidelines, behavioural norms and performance metrics; (3) resources, focusing on elimination inertia and internal resistance to innovative organisational changes; (4) technology innovation, referring to a challenge underlining the need for multidimensional integration of complex technological innovations to achieve a synergic effect; (5) external relationships, focusing on creative engagement with stakeholders and the environment; and (6) business modelling methods and tools, promoting the creative use and development of existing business modelling methods and tools.

Sustainability communication is aligned with the sustainable goals of the organisation and is used to achieve them. In the case of the six challenges described above, sustainability communication is charged with the task of making the environment understand and accept the actions taken by the social enterprise. Furthermore, the aim is to actively involve the environment in supporting socially important undertakings around which the organisation's activities are focused. It is, therefore, about convincing and creatively engaging the environment to make at least a small effort for the idea that inspires the organisation. There is a fundamental difference in the interpretation of sustainable challenges made by a commercial or social enterprise (Igwe, Icha-Ituma & Madichie, 2018). Society is the main beneficiary of a social enterprise's activities; therefore, it should be involved in supporting the organisation, which can be achieved using sustainability communication. Such engagement positively changes financial indicator values describing the company's situation, although the effects of sustainability communication depend on many factors, such as industry, size, etc. (Baran et al., 2022).

The Natural Step is another conceptual approach to the term sustainability, which is holistic and long-term oriented (Karl-Henrik, 2000). It contains the postulate referring to the role of the organisation in society, indicating that to be sustainable, a social enterprise should contribute to maintaining a sustainable society while eliminating structural obstacles to its health, influence, competence, impartiality and importance. Effective communication is crucial for achieving such a goal. One of the archetypes of a sustainable organisation shows it as an entity existing primarily for society and the environment (Bocken et al., 2014). Such an entity is primarily intended to benefit society and the environment rather than to gain economic profits. An organisation's sustainability could also be understood as moral leadership (Bergman, Bergman & Berger, 2017), which undoubtedly requires appropriate communication with the environment.

The adopted sustainability idea helps a social enterprise define its activity priorities (Jenner, 2016). Research shows that a social enterprise aiming for social activity success should engage beneficiaries in active cooperation (Lorenzo-Afable, Lips-Wiersma & Singh, 2020). The sustainable development of an organisation is conditioned by its use of innovative communication tools, such as social media (Punia, 2016). Appropriately used social media allows a social enterprise to communicate with its environment and build a community of naturally existing organisation partners with different motivations and sensitivities around common ideas supported by everyone and potentially employ their competencies (Toscher, Dahle & Steinert, 2020). In light of the above remarks, social media-based sustainability communication occurs when a social enterprise uses platforms to publish non-commercial content closely related to its mission, and each such event triggers a positive reaction (e.g., likes, comments and sharing) to the message.

In general, social media literacy is the ability of social media users to access, analyse and evaluate the content and communicate effectively (Rahman et al., 2021; Bulger, 2012; Boyd & Ellison, 2007). No accurate procedure has yet been developed to measure social media literacy. Such measurements are usually made depending on the study context (James & Chan, 2016). Social media is a tool that can be used to conduct sustainability communication practically in every ecosystem of social entrepreneurship because such ecosystems favour the network of cooperating entities forming a team with a changing composition (Hazenberg et al., 2016). By its very nature, the social media business model is conducive to supporting the activities of social enterprises (Scillitoe, Poonamallee & Joy, 2018). Commercial projects limit the space for the activity of social enterprises, making them operate within a certain niche (Kachlami, 2016). Sustainability communication using social media certainly helps to overcome this limitation. The commercial sector successfully uses social media to effectively convince the environment of its own goals adopted as part of the corporate sustainable development strategy (El Alfy, Darwish & Weber, 2020). A social enterprise can achieve significant benefits by professionally using social media for sustainability communication (Abedin, Maloney & Watson, 2019). Sustainability communication maintained using various means is a precondition for an organisation's success in the world of intense marketing of competing ideas (Jian, Ţurlea & Guşatu, 2016). Earlier research has shown that social enterprises, usually classified as small and medium, do not have large funds for marketing; therefore, they should actively use the social media potential to build an image of a credible, socially sensitive organisation that conducts activities useful for the environment (Kang, & Park, 2018). Undeniably, this is not sufficient for such entities to achieve global success (Ćwiklicki, 2018); however, the skilful use of social media can certainly facilitate the implementation of the adopted development strategy.

Social media is a communication tool creating a new quality in the implementation of individual or group goals. However, it can also be abused and manipulated, which raises credibility-related questions while communicating important matters of social concern unrelated to commercial offers (Meikle, 2016). Communication — including the use of social networks — should be implemented following the sustainability idea to ensure the achievement of socially equitable goals (Servaes, 2016). Social media is a very effective tool for sustainable social change; therefore, such platforms cannot be ignored by a social enterprise communicating with its environment (Wilkins, Tufte & Obregon, 2014). Social media is a platform connecting partners interested in cooperation; thus, it allows for the creation of innovative organisational solutions and the implementation of projects aimed at niche sustainable social goals. Without it, the partners would have very limited possibilities to communicate. Social enterprises operating in the IT branch have a potentially crucial role in bridging public–private partnerships and setting an

inspiring example for other social enterprises (Battisti, 2019).

Contemporary business models are derived from the "new cooperativism" trend and lead to bottom-up solutions to important social problems at the local level, stimulating sustainable development (Zawiślak, 2016). A key success factor in this process appears to be value creation using digital technologies and social media platforms, where customer actions play a key role in organisational performance, and value has a much broader definition (Mazurek, 2014). In this context, multimedia technological entrepreneurship can become a catalyst for the implementation of the organisation's sustainable development goals (Badzińska, 2016). Such a strategy may become a tool for effective leadership on the path of sustainable development and the achievement of important social goals (Szczepańska-Woszczyna & Kurowska-Pysz, 2016). The specificity of a social enterprise and the variety of its forms result in the necessity to build its competitiveness differently than commercial entities (Żur, 2014). The important factor is the context where such an entity functions, especially in relation to bigger or smaller local communities, and the applied formal and organisational solutions (Starnawska, 2016). Social legitimacy, acceptance and legal validation of activities performed by individual entities comprise the entire social economy system (Marzec, 2021). The adoption of correct solutions in this regard ensures the financial foundations of a functioning social enterprise (Otaru, Adeyeye & Sajuyigbe, 2021).

When it comes to Polish social enterprises, a higher level of economic efficiency is achieved by entities operating in the form of foundations or, possibly, cooperatives and limited liability companies, which are located in larger urban centres (Główny…, 2021a). This refers to situations when these entities undertake an economic activity. Then, economic efficiency is understood as higher average values of their profitability ratios achieved in comparison with other types of social enterprises. This phenomenon results from the fact that foundations and, to some extent, limited liability companies and cooperatives aim to protect capital. Meanwhile, associations take a different approach, as their primary role is to protect the interests of their members. Additionally, in large urban centres, which are usually wealthier than small towns or rural areas, it is easier to access capital resources that can be spent for social purposes. However, to gain capital and attract customers, a social enterprise must effectively communicate with society (Bogacz-Wojtanowska & Wrona, 2015). In this context, it is necessary to mention the constantly growing importance of the Internet (including social media) from the perspective of the activities of social enterprises (Główny…, 2021b). The research has not yet allowed for determining whether the more economically effective social enterprises show any specificity when it comes to actions taken on social media. If such differences exist, they may concern the frequency of platform selection, i.e., general mass platforms as opposed to less popular ones with specialised functionality. A more frequent selection of one or a set of niche platforms could indicate the strength of the formulated message if it successfully attracts the community. The economies of scale in the use of a mass platform or the segmentation approach (using a set of niche platforms) may be factors that should be considered. The use of social media can also be influenced by techno-competence in ICT. The community of IT specialists is a group of people who prefer remote communication to social contacts. They are among the pioneers of using innovations in this area (Bauer, 2022). Usually, they are also the first to fully appreciate and use the full functionality of such solutions (Astakhov, 2021). As they do not experience mental resistance to exploring the possibilities offered by the latest software, they play an educational role in the market (Singh & Hess, 2020).

The main goal of sustainability communication is to popularise the socially valuable idea among potential stakeholders, directly justifying the offering of goods and services by a social enterprise. Publication of non-commercial content closely related to the enterprise's mission is expected to trigger a positive reaction (e.g., likes, comments or sharing) among message recipients. It seems that among the most popular communication models (i.e., linear, interactive and transactional (Curtis, Neate & Vazquez Gonzalez, 2022), the interactive model and, especially, the Westley and MacLean model (Luttrell & Wallace, 2021, p. 40), is the closest to sustainability communication through social media platforms. However, as shown above, such communication is affected by certain conditions, i.e., such factors as the need to protect capital, location and type of activity (industry) can potentially modify the scope of emphasis placed on certain message content. Therefore, the publication of non-commercial content by social enterprises on social platforms aimed at a community's reaction could be considered in the context of identified conditions, potentially modifying the message content.

In the context of the main topic and based on the theoretical analysis, the following research questions were asked:

Q1: Is the ability to use social media for sustainability communication considered important among the most basic features of a social enterprise?

Q2: Do social enterprises operating in the IT industry have a unique behaviour pattern compared to others in the surveyed community in terms of using social media for sustainability communication?

Based on the above research questions, the following research hypotheses were adopted:

H1: The location of the social enterprise's headquarters affects the use of social media for sustainability communication.

H2: The legal form of a social enterprise affects the use of social media for sustainability communication.

H3: Social enterprises operating in the IT industry have a unique behaviour pattern of using social media for sustainability communication.

2. Research methods

Sustainability communication is designed to support the organisation's sustainable development. Therefore, such communication should be directed to a wide range of social partners who can get to know the organisation better and provide it with support. Such a dialogue, which is a two-way communication, should be included in the social enterprise's strategy. For such action to be effective and build a faithful community around the organisation, communication must cover a wider range of topics than just promoting the social enterprise's offer. Pilot studies allowed for establishing that social enterprises use four social networks statistically significantly: Facebook, Twitter, Instagram and YouTube. The assessment of a single social enterprise's activity on each of the four platforms included in the study was performed based on the following set of permissible values (data were registered separately for each of the platforms):

0 — no activity on the social media platform,

1 — limited, sporadic use of the social media platform, only basic (commercial) presentation of the enterprise,

2 — active use of the social media platform to conduct sustainability communication and build a community focused on common values.

On the scale, two points were awarded to entities that have placed at least one non-commercial post related to their social mission on the platform during the last year and received a reaction (likes or responses) from the platform community.

Additionally, three indicators were calculated, the value of which expressed the following observations:

Mix 1 — the total number of different social media platforms used by the social enterprise (a value between 0 and 4, depending on the number of used platforms),

Mix 2 — the number of social media platforms actively used by the social enterprise for sustainability communication and building a community around common values (a value between 0 to 4, depending on the number of used platforms),

Mix 3 — the sum of points obtained by a social enterprise in the assessment of using each of the four social media platforms included in the survey (a value between 0 and 8).

The research was planned considering the data available in the official register of social enterprises. Therefore, the second variable to be used in the developed analysis was the legal form of the social enterprise. This variable took values from the following set:

1 — association,

2 — foundation,

3 — social cooperative,

4 — non-profit limited liability company.

The third variable informed about the location of the social enterprise's headquarters and took values from the following set:

1 — a large city, which is the capital of the region,

2 — a medium-sized city, which is a local administrative centre,

3 — other locality.

The fourth variable described at least partial activity in the IT sector as social enterprises can declare activity in a maximum of three sectors simultaneously. This was expressed as an alternative:

0 — the company does not declare any activity in the IT industry,

1 — the enterprise declares at least partial activity in the IT industry.

The following section of the article uses empirical data expressing the values of the nominal variables described above to calculate the correlation coefficients, i.e., Cramér's V correlation coefficient based on chi-squared statistic, also suitable in reference to nominal data types.

According to Polish law, a social enterprise is a legal entity that conducts officially registered economic, educational or cultural activity for public

benefit and employs at least 30 % of staff requiring special support (Godlewska-Bujok, 2018). The study covered only those enterprises that had passed the official verification of their status to use the privileges provided by the law. Such a procedure also requires specifying the industry of operation with the IT sector as one of the nineteen options, keeping in mind that more than one option could be selected. The official register of social enterprises (ekonomiaspoleczna.gov.pl) is maintained by the central administration in Poland and contains 1391 entries. The analysis adopted a confidence level of 0.95 with a maximum estimation error of 5 %. With such assumptions, the minimum size of the research sample (random sample) was 301 entities.

3. Research results

The analysis of the collected data revealed Facebook as the most popular social networking site used by social enterprises. In the case of this platform, two points were obtained by 143 entities and one point was obtained by 36 companies, while 122 organisations received 0 points. Twitter's popularity was much lower compared with Facebook, i.e., ten entities received one point, and only six scored two, while all other organisations showed no evidence of activity on this platform. Instagram was used by five entities at a basic level (one point), and 18 companies were active users (two points). In the case of YouTube, the results were similar: one point was given nine times, and two points were registered 17 times. The group of 301 surveyed social enterprises included 32 associations, 68 foundations, 126 social cooperatives and 75 non-profit limited liability companies. The examined sample included eleven social enterprises declaring their activity in the IT industry. Regarding the location of the headquarters, 67 entities were situated in a large city, the capital of the region; another 124 enterprises were located in cities that were local administrative centres, and 110 entities came from smaller towns. The results of the research, in the form of a correlation matrix, are presented in Tables 2 and 4, and the results of the chi-square statistics calculations are presented in Tables 1 and 3.

The analysis of the correlation matrices using Guilford's scale allows for identifying statistically significant relationships. Table 2 has 14 such results, nine of which are in the range of weak correlations (between 0.11 and 0.30), two are moderate (between 0.31 and 0.50), and the remaining three are in the range of strong correlations (between 0.51 and 0.70). The strongest relationship exists between the use of YouTube and Instagram, so in the rare cases when an enterprise uses an account on one of these platforms, a significant probability exists that it will also have an account on another. Even more significant is the relationship between the legal form of a social enterprise and the way it uses each of the four social net-

Tab. 1. Results of the chi-squared statistic calculation between the variables included in the research (excluding results for Mix 1, Mix 2 and Mix 3 indicators presented in Table 3)

	FB	Twitter	Instagram	YouTube	Form	Locality
Twitter	11.6547*					
Instagram	20.8153***	22.9553***				
YouTube	23.7295***	24.9986***	62.2770***			
Form	167.4189***	152.0357***	154.7631***	154.9062***		
Locality	2.4755	2.4474	13.7779**	2.9375	17.5935**	
Branch	0.2465	15.5892***	0.3770	1.7747	3.3532	2.1241

Source: elaborated by the author [* result is significant at the 0.05 level; ** result is significant at the 0.01 level; *** result is significant at the 0.001 level].

Tab. 2. Correlations (Cramér's V correlation coefficient based on chi-squared statistic) between the variables included in the research (excluding the correlations for Mix 1, Mix 2 and Mix 3 indicators, presented in Table 4)

	FB	Twitter	Instagram	YouTube	Form	Locality
Twitter	0.14*					
Instagram	0.19***	0.20***				
YouTube	0.20***	0.20***	0.32***			
Form	0.53***	0.50***	0.51***	0.51***		
Locality	0.06	0.06	0.15**	0.07	0.17**	
Branch	0.03	0.23***	0.04	0.08	0.11	0.08

Source: elaborated by the author [* result is significant at the 0.05 level; ** result is significant at the 0.01 level; *** result is significant at the 0.001 level].

Tab. 3. Results of the chi-squared statistic calculation between the values of Mix1, Mix2 and Mix3 indicators and other variables

	Mix 1	Mix 2	Mix 3
Facebook	301.4499***	289.3428***	558.5355***
Twitter	131.9351***	90.3517***	198.5340***
Instagram	212.9135***	159.5381***	255.3053***
YouTube	260.3373***	223.4586***	348.5657***
Form	61.2337***	63.7669***	87.9190***
Locality	11.8381	9.5587	15.2995
Branch	7.4376	12.3111*	11.7768

Source: elaborated by the author [* result is significant at the 0.05 level; ** result is significant at the 0.01 level; *** result is significant at the 0.001 level].

Tab. 4. Correlations (Cramér's V correlation coefficient based on chi-squared statistic) between the values of Mix1, Mix2 and Mix3 indicators and other variables

	Mix 1	Mix 2	Mix 3
Facebook	0.71***	0.69***	0.96***
Twitter	0.47***	0.39***	0.57***
Instagram	0.59***	0.51***	0.65***
YouTube	0.66***	0.61***	0.76***
Form	0.32***	0.33***	0.31***
Locality	0.14	0.13	0.16
Branch	0.16	0.20*	0.20

Source: elaborated by the author [* result is significant at the 0.05 level; ** result is significant at the 0.01 level; *** result is significant at the 0.001 level].

works. A detailed analysis of the collected data allows for concluding that foundations and, to some extent, social cooperatives are responsible for this effect. Enterprises organised in such forms mostly have social media accounts, while they are less frequent among associations and limited liability companies. When it comes to the location of the business, the only weak correlation occurs in the context of Instagram. Careful data analysis shows that the few entities using this social network are usually organisations either from large or medium-sized cities, i.e., social enterprises that belong to the first group usually only register a simple account on this platform, while entities from the second group most often use it actively. Finally, when it comes to social enterprises from the IT industry, they stand out only by the more frequent use of Twitter. This behaviour indicates a certain specificity of the IT industry and results in the widening of the set of social networks popular among social enterprises.

The structure of the Mix type indicators (Mix 1, Mix 2 and Mix 3) naturally means they are strongly related. However, these indicators have a cognitive value when their correlation with other variables is examined. As regards social networks, when assessing the scale of the relationship with each of the three indicators, the order is the same each time: Facebook, YouTube, Instagram and Twitter. It can, therefore, be concluded that passive and active use of social media is based on the same assessment of the usefulness of individual platforms. Also, the way a social enterprise uses individual platforms is related to its legal form, i.e., moderate correlations in the case of each indicator. Foundations are primarily responsible for this effect. In the group of 301 surveyed enterprises, 46 cases were identified, constituting 15.3 % of the entire sample, of an organisation using more than one social networking site. This behaviour was observed in 21 foundations, nine social cooperatives, eight associations and eight limited companies. Also, a weak correlation exists between the size of the town where a social enterprise is located and the way it uses social networks. Finally, when it comes to the relationship with the Mix group of indicators, the importance of belonging to the IT branch is even slightly higher, although still a weak correlation, compared to the importance of the location.

4. Discussion and conclusions

The research results allowed for verifying the formulated hypotheses. First, the social enterprise's business location has a certain effect on using social

media for sustainability communication. Larger cities are conducive to the active use of social networks. Such a relationship is weak yet statistically significant. Mix indicators were particularly helpful in detecting this weak relationship. In the context of localisation, the results also showed practically no preferences for using some platforms over others, and only Instagram had a weak correlation with this variable. The detected correlations may be the result of generational differences in attitudes to social media because the inhabitants of large cities are usually younger, better educated and more active in using portals, considering them a natural part of everyday life (Hysa, Karasek & Zdonek, 2021). It may also be the result of greater openness to new solutions, which is facilitated by functioning in a more complex urban environment (Grajeda & Sheldon, 2015). Thus, the first hypothesis (H1) can be considered confirmed, although to a very limited extent. The second hypothesis (H2) should also be considered true, especially due to moderate correlations, which are the basis of such a judgment. Foundations represent the legal form that is the friendliest to sustainability communication through social media. This is in line with previous research, which has shown that more formally organised social enterprises (requiring professional management) are more successful due to their complex, extensive communication with stakeholders (Wang, 2022). The third hypothesis (H3) was confirmed only to a limited extent. Social enterprises in the IT industry generally behave like all other entities. The only peculiarity is that they are more likely to use Twitter. Apparently, due to the profile of professional competencies and activities in the IT industry, companies prefer social media aimed at formulating a concise and precise message. The dominant personality profile among IT specialists may be a decisive factor (Potter, 2008). This is also in line with previous research into how tech companies communicate (Dziekoński, 2017).

The literature on the subject describes numerous examples of relationship marketing strategies that are based on social media and the affecting conditions (Delu, 2019). The limitations related to the conducted research resulted mainly from the number of included variables. There are several additional features that could help in assessing the behaviour of social enterprises in terms of how they use social media for sustainability communication. For example, the research did not consider the turnover, number of employees, start date of the activity, number of customers served etc. Possibly, widening the set of variables would reveal a greater variety of determinants influencing the behaviour of social enterprises on social media (Pandey & Kumari, 2019). On theoretical grounds, the conducted analysis contributes to a scientific discussion as it shows the determinants important for predicting the use of social media by social enterprises for sustainability communication (Wong & Lam, 2015). As regards the management practice, social enterprises unaware of the social media usefulness can use the analysis to understand how other similar entities use this tool for sustainability communication. This can be the basis for comparisons and determining the direction of developing useful communication skills (Enke & Borchers, 2019). The principle is that the lack of participation in market competition pushes the enterprise to peripheral positions (Lee, 2017). It can be assumed that social enterprises effectively communicating with the environment via social media gain an additional tool for building social capital (Busch, 2014). This allows them to use the potential represented by the community focused on common ideas, e.g., using "word of mouth" marketing (Wagner, Baccarella & Voigt, 2017). The conducted analysis can be treated as an initial stage in identifying good practices applied by social enterprises in sustainability communication through social media. Moreover, the results of the conducted research may be of particular practical use to banks, investors and public institutions forecasting the success of social enterprises and making support-related decisions (Lambert et al., 2019; Roy et al., 2015). In this context, it should be emphasised that social enterprises that use social media similarly to foundations and especially those located in large cities, imitate the behaviour of the most economically effective entities. Applying such good practices should help them achieve economic success.

Social enterprises belong to the group of organisations that pursue goals important to society (Ottlewski, 2021). Their existence depends on the ability to properly perceive societal needs and inform the environment about their activities (Kim & Lim, 2017). In the modern world, the importance of sustainability communication is growing with the use of social media (Baghdadi, 2013). In the face of the dynamic social media development, promoting cooperation, collectivism and egalitarianism, and limited influence of cultural conditions on the development of social enterprises (Canestrinoa et al., 2020), the path to success for such entities is the development of sustainability communication. The most economically efficient social enterprises appreciate the economies of scale in sustainability com-

munication and choose mass platforms. The analysis of the research results showed that social enterprises operating in the IT industry, which are entities with potentially the most joint social and technical competencies compared to organisations from other industries, there is still much room for improvement when it comes to using social media in sustainability communication. Entities from the IT sector could act as leaders in using social media for sustainability communication; however, it seems that such enterprises do not use their potential of combined technical and social competencies. As demonstrated, regardless of the sector, the most favourable characteristics related to the active use of social media were found among enterprises registered as foundations and entities located in the largest cities, which are regional administrative centres. This is probably due to the scale of activity and the developed social network that can be built in a big city in the real and not only in the virtual world. Additionally, an important factor may be observing the behaviour of other entities, including commercial, operating in the immediate environment of the organisation (Liu & Ko, 2012). When an enterprise decides to use a social networking site, it first chooses a platform that allows for the most partner-like, extensive dialogue with the environment. Maintaining sustainability communication through social media is, to a large extent, the result of the awareness that such an option is valuable (Oncioiu et al., 2021; Gupta et al., 2021). However, it is important to have knowledge of how to do this effectively.

Literature

Abedin, B., Maloney, B., & Watson, J. (2019). Benefits and Challenges Associated with Using Online Communities by Social Enterprises: A Thematic Analysis of Qualitative Interviews. *Journal of Social Entrepreneurship*, *11*, 1-22. doi: 10.1080/19420676.2019.1683879

Astakhov, D. V. (2021). *Professional competence characteristics of information and communication technology specialists*. Publishing House "Baltija Publishing". doi: 10.30525/978-9934-26-114-5-13

Badzińska, E. (2016). Innovative multimedia project – the exemplification of the concept of technological entrepreneurship. *Engineering Management in Production and Services*, *8*(2), 38-46. doi: 10.1515/emj-2016-0015

Baghdadi, Y. (2013). From E-commerce to Social Commerce: A Framework to Guide Enabling Cloud Computing. *Journal of Theoretical Applied Electronic Commerce Research*, *8*(3), 12-38. doi: 10.4067/S0718-18762013000300003

Baran, M., Kuźniarska, A., Makieła, Z., Sławik, A., & Stuss, M. (2022). Does ESG Reporting Relate to Corporate Financial Performance in the Context of the Energy Sector Transformation? Evidence from Poland. *Energies*, *15*(2), 477. doi: 10.3390/en15020477

Battisti, S. (2019). Digital Social Entrepreneurs as Bridges in Public–Private Partnerships. *Journal of Social Entrepreneurship*, *10*(2), 135-158. doi: 10.1080/19420676.2018.1541006

Bauer, J. A. (2022). *The onboarding process of highly-skilled self-initiated expatriates: an exploratory study in the Austrian information technology sector*. Linz: Johannes Kepler University.

Bergman, M. M., Bergman, Z., & Berger, L. (2017). An Empirical Exploration, Typology, and Definition of Corporate Sustainability. *Sustainability*, *9*(5), 753. doi: 10.3390/su9050753

Bocken, N. M. P., Short, S. W., Rana, P., & Evans, S. (2014). A literature and practice review to develop sustainable business model archetypes. *Journal of Cleaner Production*, *65*, 42-56. doi: 10.1016/J.JCLEPRO.2013.11.039

Bogacz-Wojtanowska, E., & Wrona, S. (2015). Sposoby i narzędzia komunikacji wybranych przedsiębiorstw społecznych w Polsce [Ways and tools of communication of selected social enterprises in Poland]. *Ekonomia społeczna*, *1*, 38-53. doi: 10.15678/ES.2015.1.03

Boyd, D. M., & Ellison, N. B. (2007). Social network sites: Definition, history, and scholarship. *Journal of Computer-Mediated Communication*, *13*, 210-230. doi: 10.1111/j.1083-6101.2007.00393.x

Budzanowska-Drzewiecka, M., Jedynak, P., & Lipińska, A. (2016). *Challenges related to new segments and market trends*. Kraków: Jagiellonian University Press.

Bulger, M. (2012). Measuring media literacy in a national context: Challenges of definition, method and implementation. *Media Studies*, *3*, 83-104.

Busch, C. (2014). Substantiating social entrepreneurship research: Exploring the potential of integrating social capital and networks approaches. *International Journal of Entrepreneurial Venturing*, *6*(1), 69-84.

Canestrinoa, R., Ćwiklicki, M., Magliocca, P., & Pawełek, B. (2020). Understanding social entrepreneurship: A cultural perspective in business research, *Journal of Business Research*, *110*, 132-143. doi: 10.1016/j.jbusres.2020.01.006

Choi, J. H., & Scott, J. E. (2013). Electronic Word of Mouth and Knowledge Sharing on Social Network Sites: A Social Capital Perspective. *Journal of Theoretical Applied Electronic Commerce Research*, *8*(1), 69-82. doi: 10.4067/S0718-18762013000100006

Curtis, H., Neate, T., & Vazquez Gonzalez, C. (2022). State of the Art in AAC: A Systematic Review and Taxonomy. *Proceedings of the 24th International ACM SIGACCESS Conference on Computers and Accessibility*. doi: 10.1145/3517428.3544810

Ćwiklicki, M. (2018). Requirements of Scaling International Social Enterprises. *Entrepreneurial Business and Economics Review*, *7*(1), 45-60. doi: 10.15678/EBER.2019.070103

Delu, W. (2019). Enterprise network marketing strategy based on SNS social network. *12th International Conference on Intelligent Computation Technology and Automation (ICICTA)*, 295-299. doi: 10.1109/ICICTA49267.2019.00069

D'Humieres, P. (2018). Towards a sustainable European business model? Foundation Robert Schuman. *European Issues*, *460*.

Dziekoński, K. (2017). Factors affecting communication quality in project teams. *Przegląd Organizacji*, *3*, 60-66.

El Alfy, A., Darwish, K. M., & Weber, O. (2020). Corporations and sustainable development goals communication on social media: Corporate social responsibility or just another buzzword? *Sustainable Development*, *28*(5), 1418-1430. doi: 10.1002/sd.2095

Enke, N., & Borchers, N. S. (2019). Social Media Influencers in Strategic Communication: A Conceptual Frame-work for Strategic Social Media Influencer Communication. *International Journal of Strategic Communication*, *13*(4), 261-277. doi: 10.1080/1553118X.2019.1620234

Evans, S., Vladimirova, D., Holgado, M., Van Fossen, K., Yang, M., Silva, E., & Barlow, C. Y. (2017). Business model innovation for sustainability: Towards a unified perspective for creation of sustainable business models. *Business Strategy Environment*, *26*, 597-608. doi: 10.1002/bse.1939

Główny Urząd Statystyczny [Central Statistical Office]. (2021a). *Organizacje non-profit jako podmioty ekonomii społecznej w 2019 roku* [*Non-profit organizations as entities of the social economy in 2019*]. Warszawa, Poland.

Główny Urząd Statystyczny [Central Statistical Office]. (2021b). *Zarządzanie w organizacjach non-profit w 2019 r.* [*Management in non-profit organizations in 2019*]. Warszawa, Poland.

Godlewska-Bujok, B. (2018). Przedsiębiorstwo społeczne w polskim systemie prawnym [Social enterprise in the Polish legal system]. In M. Paluszkiewicz & M. Włodarczyk (Eds.), *Polityka społeczna a prawo pracy: Wybrane problemy* [*Social policy and labor law: Selected problems*], (pp. 75–84). Łódź, Poland: Wydawnictwo Uniwersytetu Łódzkiego.

Grajeda, M. R., & Sheldon, I. M. (2015). Trade Openness and City Interaction. In A.A. Batabyal, P. Nijkamp (Eds.), *The Region and Trade: New Analytical Directions*, (pp. 267–318). Singapore: World Scientific.

Gupta, S., Nawaz, N., Alfalah, A.A., Naveed, R.T., Muneer, S., & Ahmad, N. (2021). The Relationship of CSR Communication on Social Media with Consumer Purchase Intention and Brand Admiration. *Journal of Theoretical Applied Electronic Commerce Research*, *16*(5), 1217-1230. doi: 10.3390/jtaer16050068

Hazenberg, R., Bajwa-Patel, M., Mazzei, M., Roy, M.J., & Baglioni, S. (2016). The role of institutional and stakeholder networks in shaping social enterprise ecosystems in Europe. *Social Enterprise Journal*, *12*(3), 302-321. doi: 10.1108/SEJ-10-2016-0044

Hysa, B., Karasek, A., & Zdonek, I. (2021). Social media usage by different generations as a tool for sustainable tourism marketing in society 5.0 idea. *Sustainability*, *13*(3), 1018. doi: 10.3390/su13031018

Igwe, P., Icha-Ituma, A., & Madichie, N. (2018). The Evaluation of CSR and Social Value Practices Among UK Commercial and Social Enterprises. *Entrepreneurial Business and Economics Review*, *6*(1), 37-52. doi: 10.15678/EBER.2018.060102

James, P. W., & Chan, T. (2016). Conceptual challenges in designing measures for media literacy studies. *International Journal of Media and Information Literacy*, *1*, 1-16. doi: 10.13187/ijmil.2016.1.27

Jenner, P. (2016). Social enterprise sustainability revisited: an international perspective. *Social Enterprise Journal*, *12*(1), 42-60. doi: 10.1108/SEJ-12-2014-0042

Jian, I., Țurlea, C., & Guşatu, I. (2016). The Reporting and Sustainable Business Marketing. *Sustainability*, *8*(1), 23. doi: 10.3390/su8010023

Kachlami, H. (2016). Social venture creation and the influence of commercial ventures. *Social Enterprise Journal*, *12*(3), 347-367. doi: 10.1108/SEJ-02-2016-0006

Kang, M.Y., & Park, B. (2018). Sustainable Corporate Social Media Marketing Based on Message Structural Features: Firm Size Plays a Significant Role as a Moderator. *Sustainability*, *10*(4), 1167. doi: 10.3390/su10041167

Karl-Henrik, R. (2000). Tools and concepts for sustainable development, how do they relate to a general framework for sustainable development, and to each other? *Journal of Cleaner Production*, *8*(3), 243-254. doi: 10.1016/S0959-6526(00)00011-1

Kim, D., & Lim, U. (2017). Social enterprise as a catalyst for sustainable local and regional development. *Sustainability*, *9*(8), 1427. doi: 10.3390/su9081427

Lambert, L., Dedeurwaerdere, T., Nyssens, M., Severi, E., & Brolis, O. (2019). Unpacking the organisational diversity within the collaborative economy: The contribution of an analytical framework from social enterprise theory. *Ecological Economics*, *164*, 106343. doi: 10.1016/j.ecolecon.2019.05.023

Landrum, N. E., & Ohsowski, B. (2017). Identifying Worldviews on Corporate Sustainability: A Content Analysis of Corporate Sustainability Reports. *Business Strategy and the Environment*, *27*(1), 128-151. doi: 10.1002/bse.1989

Lee, Y. Ch. (2017). Corporate Sustainable Development and Marketing Communications on Social Media: Fortune 500 Enterprises. *Business Strategy and the Environment*, *26*(5), 569-583. doi: 10.1002/bse.1936

Liu, G., & Ko, W. W. (2012). Organizational learning and marketing capability development: A study of the charity retailing operations of British social enterprise. *Nonprofit and Voluntary Sector Quarterly*, *41*(4), 580-608. doi: 10.1177/0899764011411722

Lorenz, M. H. (2008). *Information Technology and Sustainability: Essays on the Relationship Between ICT and Sustainable Development*. Norderstedt, Germany: BoD – Books on Demand.

Lorenzo-Afable, D., Lips-Wiersma, M., & Singh, S. (2020). 'Social' value creation as care: the perspective of beneficiaries in social entrepreneurship. *Social Enterprise Journal*, *16*(3), 339-360. doi: 10.1108/SEJ-11-2019-0082

Luttrell, R., & Wallace, A. A. (2021). *Social media and society: An introduction to the mass media landscape*. Lanham, USA: Rowman & Littlefield.

Marzec, M. (2021). Legitimisation of Social Economy Entities: Theoretical Framework for Analysis in Polish Conditions. *International Journal of Contemporary Management*, *57*(1), 29-42. doi: 10.2478/ijcm-2021-0003

Mazurek, G. (2014). Network Value Creation through Marketing. *Central European Management Journal*, *22*(4), 70-77. doi: 10.7206/mba.ce.2084-3356.120

Meikle, G. (2016). *Social Media: Communication, Sharing and Visibility*, London, UK: Routledge. doi: 10.4324/9781315884172

Oncioiu, I., Căpuşneanu, S., Topor, D. I., Tamaş, A. S., Solomon, A. G., & Dănescu, T. (2021). Fundamental Power of Social Media Interactions for Building a Brand and Customer Relations. *Journal of Theoretical Applied Electronic Commerce Research*, *16*(5), 1702-1717. doi: 10.3390/jtaer16050096

Otaru, S., Adeyeye, M., & Sajuyigbe, A. (2021). Financial Resource Mobilization Strategies and Sustainability of Non-Governmental Organizations (NGOs): Evidence from Nigeria. *International Journal of Contemporary Management*, *57*(2), 1-8. doi: 10.2478/ijcm-2021-0004

Ottlewski, L. (2021). Building and Strengthening Community at the Margins of Society through Social Enterprise. *Sustainability*, *13*(21), 12046. doi: 10.3390/su132112046

Pandey, R., & Kumari, P. (2019). Information Portals and Their Use in Village Development. *Indian Journal of Extension Education*, *55*, 242-245.

Potter, L. E. (2008). *The Information Technology Gap: exploring the factors that potentially separate and differentiate IT professionals and users*. Nathan, Australia: Griffith University.

Punia, Y. (2016). Information and communication technology for sustainable development. *Voice of Research*, *5*(1), 40-41. doi: 10.1201/9781351045230

Rahman, A. H. A., Abdullah, A., Selvadurai, S., Zakaria, S. Z. S., Lyndon, N., & Abidin, K. (2021). Social Media Literacy among Oil Palm Smallholders in East Malaysia and Association with Oil Palm Integration Practices. *Sustainability*, *13*(24), 13802. doi: 10.3390/su132413802

Roy, M. J., McHugh, N., Huckfield, L., Kay, A., & Donaldson, C. (2015). "The most supportive environment in the world"? Tracing the development of an institutional 'ecosystem'for social enterprise. *Voluntas: International Journal of Voluntary and Nonprofit Organizations*, *26*(3), 777-800. doi: 10.1007/s11266-014-9459-9

Schaltegger, S., Lüdeke-Freund, F., & Hansen, E. G. (2016). Business Models for Sustainability – A Co-Evolutionary Analysis of Sustainable Entrepreneurship, Innovation, and Transformation. *Organization & Environment*, *29*(3), 264-289. doi: 10.1177/1086026616633272

Scillitoe, J. L., Poonamallee, L., & Joy, S. (2018). Balancing Market Versus Social Strategic Orientations in Socio-tech Ventures as Part of the Technology Innovation Adoption Process – Examples from the Global Healthcare Sector. *Journal of Social Entrepreneurship*, *9*(3), 257-287. doi: 10.1080/19420676.2018.1498378

Servaes, J. (2016). How 'sustainable' is development communication research?. *International Communication Gazette*, *78*(7), 701-710. doi: 10.1177/1748048516655732

Singh, A., & Hess, T. (2020). How chief digital officers promote the digital transformation of their companies. In R. D. Galliers, D. E. Leidner & B. Simeonova (Eds.), *Strategic Information Management*, (pp. 202-220). London, UK: Routledge. doi: 10.4324/9780429286797-9

Stańczyk, I., Stuss, M., & Wziątek-Staśko, A. (2020). The role of communication in the organizational support of managers in efficient management. *Proceedings of the 11th Business & Management Conference: Dubai, 16-18 January, International Institute of Social and Economic Sciences in Prague*, 184-196. doi: 10.20472/BMC.2020.011.012

Starnawska, M. (2016). Social Entrepreneurship Research – Challenges, Explanations and Suggestions for the Field Development. *Management Issues*, *14*(3), 13-31. doi: 10.7172/1644-9584.61.1

Szczepańska-Woszczyna, K., & Kurowska-Pysz, J. (2016). Sustainable Business Development Through Leadership in SMEs. *Engineering Management in Production and Services*, *8*(3), 57-69. doi: 10.1515/emj-2016-0024

Toscher, B., Dahle, Y., & Steinert, M. (2020). Get Give Make Live: An empirical comparative study of motivations for technology, youth and arts entrepreneurship. *Social Enterprise Journal*, *16*(2), 179-202. doi: 10.1108/SEJ-03-2019-0016

Wagner, T. F., Baccarella, Ch. V., & Voigt, K. I. (2017). Framing social media communication: Investigating the effects of brand post appeals on user interaction. *European Management Journal*, *35*(5), 606-616. doi: 10.1016/j.emj.2017.05.002

Wang, R. (2022). Organizational commitment in the nonprofit sector and the underlying impact of stakeholders and organizational support. *Voluntas: International Journal of Voluntary and Nonprofit Organizations*, *33*(3), 538-549. doi: 10.1007/s11266-021-00336-8

Wilkins, K. G., Tufte, T., & Obregon, R. (2014). *The Handbook of Development Communication and Social Change*. Hoboken, USA: John Wiley & Sons. doi: 10.1002/9781118505328

Wong, A. H. K., & Lam, F. W. T. (2015). An investigation of how networking improves social enterprise performance. *International Journal of Advanced Research in Management and Social Sciences*, *4*(11), 25-35.

Zawiślak, P. (2016). Innovative multimedia project – the exemplification of the concept of technological entrepreneurship. *Central European Management Journal*, *28*(3), 168-195. doi: 10.7206/cemj.2658-0845.31

Zink, K.J. (2008). *Corporate Sustainability as a Challenge for Comprehensive Management*. Berlin, Germany: Springer Science & Business Media.

Żur, A. (2014). Building competitive advantage through social value creation – a comparative case study approach to social entrepreneurship. *Management Issues*, *12*(4), 56-71. doi: 10.7172/1644-9584.49.4

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Improving the assessment of the diversification of construction companies

Romualdas Ginevičius

ABSTRACT
Various indicators are used to determine the level of company diversification. Their adequacy largely depends on the structure of the production programme. Its essential feature is the comparative weight of the main product in the total scope of the company's work. In this situation, the intensity of the diversification process is reflected by the decrease in the volume of this product due to the inclusion of new products in the production programme. In this case, the adequacy of the diversification indicator can be reflected by comparing the scale of the main product with changes in the value of these indicators. The adequacy will be higher with more changes in the values of diversification indicators corresponding to changes in the volumes of the main product. Four indicators of corporate diversification are the most well-known and widely used: the Berry index, the entropy measure, Utton's measure and the DG index. All of them have both strong and weak sides, so it is important to determine situations of the company's production programme in which diversification indicators are appropriate to use, i.e., in which situations their adequacy is the greatest. The research has established that if the comparative weight of the main product of the production programme in the total scope of work is greater than 0.5, then the adequacy of the entropy measure and index DG is higher compared to the Berry index and Utton's measure. If it is lower than 0.5, the other two diversification indicators should be used. The obtained results will help to more efficiently manage the process of diversification as a company's development strategy.

KEY WORDS
strategic management, diversification indicators, their adequacy

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Introduction

In the course of market globalisation, companies' competitiveness becomes a condition for their successful commercial activity. In theory and practice, it is understood as the occupied part of both domestic and foreign markets. The company will be competitive if it is able to adapt to constantly changing external conditions. However, in this case, it will be able not only to maintain but also to improve its position. This can only be achieved by continuous development. The continuous development of the company is encouraged by the overall economic result and the

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Tab. 1. Possible transformations of product development strategies into other development strategies

Objects	Products	
	modification of existing products	new products
Clients	Same	New
Markets	Same	New or same
Transformation to other development strategies	Penetration	Diversification

country's position in international markets. As an economic entity of the country, this encourages the company to increase the scale of its activities; otherwise, it will lose its position and decay. Thus, the pursuit of an ever-increasing market share becomes the condition for the company's competitiveness. They can increase this share and, at the same time, maintain and expand their positions only by maintaining development rates not lower than the overall growth of the market.

In this situation, companies apply various growth strategies, i.e., penetration, product improvement, market development and diversification (Ansoff, 1965; Ansoff, 1957). The simplest and least risky is the strategy of penetration or penetrating the market. In this case, the company only seeks to maintain its position in the markets where it has operated so far. To not lose customers, the quality of existing products is improved, better service is offered, the price is reduced etc. (Pierscionek, 1966).

Although involving more risk, better commercial performance results can be expected by applying a market development strategy. In this case, new products are offered to existing markets, or attempts are made to enter new markets with existing products. The greatest risk in this strategy comes from these market barriers, which protect markets from competitors (Sontheimer, 1989).

A product development strategy aims to increase sales volume by offering new products to existing markets. In this situation, the fundamental problem is the concept of a new product. This reflects the possible transformation of the product improvement strategy into other strategies presented in Table 1.

The most well-rounded is the company's growth diversification strategy. It refers to the release and sale of new products in new markets that differ from those produced so far. It is characterised by high complexity, which is why it is risky. On the other hand, it acquires a special significance under economic recession conditions faced by countries today. It is risky because it requires fundamental changes in the company's entire activity, i.e., technology, management etc. Technological changes are related to the adaptation of the production structure to the release of new products, and managerial changes are related to the reorganisation of the organisational management structure. In addition, implementing this strategy requires new knowledge and specialists who can work effectively with new technologies.

Quantitative assessment of its condition plays a special role in implementing diversification as a development strategy. In addition, effective management of this process is impossible. Several methods have been proposed for measuring unrelated diversification. All of them have strengths and weaknesses. Their scale largely depends on how the structure of the company's production programme is evaluated. Today no answer to this question exists. Therefore, assessing the adequacy of diversification indicators has both scientific and practical significance. The solution to this problem is relevant for engineering technology management because diversification is a new organisational management structure of the company, new technologies etc.

The article aims to propose ways to assess the suitability of one or another diversification indicator depending on the structure of the construction company's production programme.

1. Literature review

The diversification of companies, as one of their main growth strategies, is characterised by high complexity and is, therefore, quite controversial (Ansof, 1965; 1957). Attempts were often made to reduce or even deny this possibility of increasing production efficiency. It is based on the fact that a significant number of diversification projects have failed. The reason for this approach to this corporate growth strategy is insufficient knowledge of this phenomenon. It prevented a timely and sufficient assessment of the complex of conditions necessary for success. For example, existing organisational management structures that did not meet the operating conditions

of diversified companies were not changed and continued to rely on the existing qualifications of employees etc. The value of diversifying and the changed external situation, the business internationalisation has increased, economic crises have become more frequent etc. All this has made diversification one of the most important business management strategies. Today, it is applied by increasingly more international companies (Li, 2014).

The application of the diversification strategy in companies enables them to use capital flows more rationally to increase the efficiency and competitiveness of commercial and economic activities (Li, 2014; Atanasova & Li, 2019), which provides the opportunity to enter new markets, industry sectors or introduce new products to both existing and new markets (Errasti et al., 2014).

Many studies have focused on the impact of diversification and various aspects of corporate performance: reinvestment strategy (Mackey & Barney, 2013), capital costs and structure (Hann et al., 2013), corporate value (Kuppuswamy et al., 2014; Jara-Bertin et al., 2015; Nazarova, 2015; Hyland, 2003), profitability (Santarelli & Tran, 2016; Zahavi & Lavie, 2013; Becerra & Santaló, 2006; Dosi et al., 2020), production export (Gnangnon, 2021), land efficiency of business enterprises (Nurimbetov, 2017), corporate social responsibility (Patricia & Dastgir, 2017; Zandi et al., 2022) and dynamics of production sector diversification (Shikata et al., 2021).

Analyses have also been performed on the impact of banking diversification on the government securities market (Sawada, 2013) and the impact of technology on the diversification process (Wang et al., 2014; Li et al., 2014). Several studies have been devoted to examining the influence of the ownership form of business enterprises (Chung, 2013; Hernández-Trasobares & Galve-Górriz, 2016; Schmid et al., 2015; Sanchez-Bueno & Usero, 2014).

A separate line of research is geographical diversification (Qian et al., 2013; Yahaya et al., 2009; Chonghui et al., 2013; Thoumrungroje & Tansuhaj, 2005; Mauer et al., 2015; Gaur & Delios, 2015; Boehe & Jimenez, 2019).

An important research subject is the risk of diversification projects (Yücel & Önal, 2015; Busse et al., 2014; Jafarinejad et al., 2018). Diversification processes in corporate networks are also analysed (Chen & Jaw, 2014; Kim et al., 2014; Aivazian et al., 2019).

The literature analysis shows a lack of studies aimed at measuring the level of diversification of companies over several years.

Diversification measures of companies' activities should follow from their nature and forms of manifestation. However, two essential ones are unrelated and related diversification. Assignment to one or another form is determined by the "core" of the company's capabilities. It refers to the cumulative ability to accurately and efficiently combine the knowledge of markets with technology for the purpose of adapting to the external environment and, thus, making a profit (Wrigley, 1970). Related diversification reflects the qualitative side of this process and means the company's expansion into the release of new products, the production and sale of which are located in the "core" area of its capabilities. Unrelated diversification reflects the quantitative side of this process and refers to the inclusion in the production programme of such products, the release of which requires capabilities located outside the mentioned zone. As the globalisation of markets grows and competition intensifies, companies aiming to increase profits and ensure long-term financial stability try to minimise the impact of fluctuations in the volumes of one developed business on others. This can be achieved by entering unrelated markets that are far apart. In connection with this, the evaluation of the

Tab. 2. Measures of corporate diversification

The name of the diversification indicator	Source
Berry index	Berry, Ch. (1971). Corporate Growth and Industrial Diversification. Journal of Law and Economics, 14, 371-383
A measure of entropy	Jaquemin, A. P., & Berry, Ch. (1979). Entropy Measure of Diversification and Corporate Growth. Journal of Industrial Economics, 27, 46-57
Index D_G	Ginevičius, R. (2009). Quantitative evaluation of unrelated diversification of enterprise activities. Journal of Civil Engineering and Management, 15(1), 105-111
Utton's measure	Utton, M. A. (1977). Large Firm Diversification in British Manufacturing Industry, Economic Journal, 87, 96-113

achieved level of diversification of an unrelated company becomes important since this process can be managed if there is an opportunity to measure it.

This literature analysis showed that the same measures of diversification had been used for many years (Table 2).

All reviewed and other literature sources refer to the indicators listed in Table 2. For example, when analysing the diversification of construction companies, the indicator of the number of activities is applied (Šaparauskas & Vilutienė, 2005) and for oil and gas diversification processes — the entropy measure (Kirichenko et al., 2020), for the impact of diversification as a company development strategy on the commercial activity results of manufacturing companies — entropy measure and Berry index (Wang et al., 2018), and for diversification of agricultural systems — Berry index and entropy measure (Phuge et al., 2020) etc.

Most of the diversification measures originate in the US because, at that time, Europe had not yet had research efforts on how to manage this process. All proposals for measuring diversification can be divided into two groups. The first group includes indicators based on the number of activity areas, which are determined by various types of classifications. The indicators of the second group are based on the number of activity areas and the variation of work volumes between them. The indicators of the first group have significant shortcomings. The main ones are:

- difficulty in unequivocally distinguishing one area of the company's activity from another;
- the number of activities does not estimate their significance for production turnover and profit;
- the number of activities does not tell whether there is a relationship between the products produced by the firm (Wolf, 1995a; Wolf, 1995b).

The indicators of the second group are more accurate. The most famous and widely used Berry index (Berry, 1971):

$$D_B = 1 - D_H = 1 - \sum_{i=1}^{n} P_i^2; \quad (1)$$

here, D_B is the Berry diversification index; P_i — the relative volume of the i-th activity of the company; D_H — Herfindahl concentration index; n — number of activities ($i = \overline{1,n}$).

The Berry index was obtained by transforming Herfindahl's concentration index (Herfindahl, 1950):

$$D_H = \sum_{i=1}^{n} P_i P_i = \sum_{i=1}^{n} P_i^2. \quad (2)$$

The Berry index is equal to 0 if the company is specialised, i.e., develops its activities in only one direction. The more diversified it is, the closer D_B gets to 1.0. When there is no variation between the volumes of work, the D_B index is equal to:

$$D_B = 1 - \frac{1}{n}. \quad (3)$$

Based on Berry's index, an indicator was proposed, which is called the entropy measure of diversification (Jacquemin & Berry, 1979):

$$E_D = \sum_{i=1}^{n} P_i \, ln \frac{1}{P_i}, \quad (4)$$

here, E_D is a measure of the entropy of diversification.

Berry's diversification index has certain weaknesses. To avoid them, the proposed index D_G (Ginevičius, 2009)

$$D_G = 1 - \frac{1}{1 + \sum_{i=1}^{n-1} \frac{1 - P_{\max}}{1 - P}}. \quad (5)$$

here, $P_{\max}$ is the volume of the company's largest (main) activity.

In England, Utton's measure is widespread (Utton, 1997):

$$D_U = 2 \sum_{i=1}^{n} i P_i - 1. \quad (6)$$

here, D_U is Utton's measure of diversification.

From the fact that the diversification of the company's activities is proposed to be measured in various ways, it can be concluded that none of them is perfect. To exploit their strengths, it is necessary to determine cases in which it is appropriate to apply one or another method. In other words, their adequacy should be determined according to the current situation.

2. Research methodology

The possibilities and ways of assessing the adequacy of the company's diversification indicators emerge from its definition (Arbeitskreis, 1973). So, it follows the essential feature of diversification, i.e., the ratio of existing products to new ones. The more distant the latter, the more diversified the company's products. The extreme cases of a company's production programme are a specialised one-product company and a company that keeps adding new, unrelated products to its production programme. In this situation, the intensity of the diversification

process is reflected by the decrease in the relative weight of the main product due to the fragmentation of the production programme among a larger number of products. The legitimacy of such an approach is confirmed by indicators that were not so precise but reflected the essence of diversification (Kieser & Kubicek, 1992):

$$D = 100 - D^{\max}, \quad (7)$$

$$D = 100 - \sum_{i=1}^{n-1} \tilde{P}_i, \quad (8)$$

here, D is the diversification rate; $D^{\max}$ — the volume of the largest production programme product, per cent; $\tilde{P}$ — the volume of the i-th product (except for the largest product, %).

It follows from these formulas that the greater the comparative weight of the main product in the total volume of the company's production programme, the lower the value of the diversification indicator will be, and vice versa, as the comparative volume of the largest product decreases, the value of the diversification indicator will increase. Therefore, the adequacy of diversification indicators can be reflected by comparing the extent of changes in the main product with changes in these indicators. The adequacy of one or another indicator will be reflected by the size that shows the extent changes in the volumes of the main product correspond to changes in the values of the relevant diversification indicator:

$$K_{Dj} = 1 - \frac{\Delta P_k^{\max}}{\Delta D_{kj}}, \quad (9)$$

here, K_{Dj} is the adequacy indicator of the j-th diversification index; $\Delta P_k^{\max}$ — the ratio of the main product of the k-th production programme option to the volume of the main product of the next production programme option; D_{kj} — the same, for the j-th diversification indicator.

It follows from formula (9) that the closer in size the changes in the main product and the diversification indicator, the greater its adequacy. Ideally, when these changes coincide, $K_{Dj} = 0$.

Size ΔP_k is determined as follows:

$$\Delta P_{kj} = \frac{P_k^{\max}}{P_{k+1}^{\max}}; \quad (10)$$

here, $P_k^{\max}$ is the comparative weight of the k-th main product of the j-th company in the general production programme of the j-th company.

Size ΔD_{kj} is determined as follows:

$$\Delta D_{kj} = \frac{D_{kj}}{D_{kj+1}}; \quad (11)$$

here, D_{kj} is the value of the j-th diversification indicator of the k-th company.

Based on formula (9), it is possible to determine the case in which the indicator is appropriate to use when calculating the degree of diversification of the company's production programme.

3. Empirical study

To illustrate the application of the proposed methodology for determining the adequacy of diversification indicators, five construction companies with significantly different production programme structures were selected (Table 3).

Table 4 shows what products are offered by companies to the market.

To determine the adequacy of diversification indicators, it is first necessary to know their values. The results of the calculations are given in Table 5.

Table 5 was used to determine the relationships between the values of the main product volumes among the considered companies, i.e., size $\Delta P_k^{\max}$ (Table 6).

Table 6 and formula (11) were used to determine the ratio of values of diversification indicators among considered companies, i.e., size ΔD_{kj} (Table 7).

Knowing this quantity, formula (9) was used to determine the adequacy indicator of the diversification indicator of the considered construction companies K_{Dj} (Table 8).

To obtain a generalised picture of the adequacy of diversification indicators, the results of Table 8 should be converted into ranks (Table 9).

Table 9 shows that the situation of the first, second, third and fourth construction companies is best reflected by indices D_G and E_D and fifth — indices D_B and U_D. Based on this, it is possible to present a generalised model of the adequacy of diversification indicators of the considered construction companies (Fig. 1).

Fig. 1 shows that when the size of the construction company's production programme compared to the rest of it is greater than 50 per cent, it is appropriate to use indicators D_G and E_D for diversification assessment; if less than 50 per cent — indicators D_B and U_D.

Tab. 3. Structure of the production programme of the construction companies

Construction companies	Products						
	first (main)	second	third	fourth	fifth	sixth	seventh
First	0.85	0.05	0.04	0.04	0.02	–	–
Second	0.71	0.14	0.09	0.04	0.02	–	–
Third	0.54	0.39	0.03	0.02	0.02	–	–
Fourth	0.49	0.16	0.13	0.07	0.06	0.06	0.03
Fifth	0.28	0.25	0.20	0.15	0.12	–	–

Tab. 4. Content of the production programme of the construction companies

Construction company	Nature of activity									
	residential, commercial construction	Plumbing works	welfare works	building materials and products	field engineering networks	hydro-technical structures	roads, bridges, overpasses	rental of equipment, mechanisms	railway construction	other activities
First	+	+	–	–	+*	–	+	–	–	+
Second	+ *	–	–	–	–	+	+	+	+	–
Third	+ *	–	+	+	–	–	+	+	–	–
Fourth	–	–	+	+	+ *	–	–	+	–	+
Fifth	+ *	+	+	+	–	–	–	–	–	+

* main product.

Tab. 5. Meanings of the diversification indicators of the construction companies

Construction company	Diversification indicators			
	Berry index	D_G index	A measure of entropy	Utton's measure
First	0.271	0.384	0.619	0.660
Second	0.465	0.556	0.866	2.040
Third	0.501	0.684	0.965	2.180
Fourth	0.679	0.717	1.307	2.800
Fifth	0.780	0.799	1.566	0.920

Tab. 6. Ratios of main product volumes among the companies under consideration

first		Firm				
		second	third	fourth	fifth	
Firm	first		1.198	1.574	1.735	3.036
	second	1.198		1.315	1.449	2.536
	third	1.574	1.315		1.102	1.929
	fourth	1.735	1.449	1.102		1.750
	fifth	3.036	2.536	1.929	1.750	

Tab. 7. Calculation results of the diversification indicator adequacy of considered construction companies

		Construction company																			
		first				second				third				fourth				fifth			
		D_G	E_D	D_B	U_D	D_G	E_D	D_B	U_D	D_G	E_D	D_B	U_D	D_G	E_D	D_B	U_D	D_G	E_D	D_B	U_D
Firm	first					0.172	0.143	0.301	0.025	0.116	0.010	0.148	0.198	0.071	0.178	0.397	0.591	0.494	0.200	0.055	0.212
	second	0.172	0.143	0.301	0.025					0.069	0.180	0.220	0.231	0.124	0.96	0.008	0.150	0.164	0.402	0.512	0.244
	the third	0.116	0.010	0.148	0.198	0.069	0.180	0.220	0.231					0.051	0.174	0.187	0.142	0.691	0.189	0.239	0.011
	fourth	0.012	0.105	0.307	0.120	0.124	0.045	0.008	0.150	0.051	0.174	0.187	0.142					0.609	0.460	0.523	0.425
	the fifth	0.494	0.200	0.055	0.212	0.164	0.402	0.512	0.244	0.478	0.342	0.400	0.082	0.609	0.342	0.523	0.082				

Tab. 8. Ratios of diversification indicator values among the examined companies

Construction company	Construction company																			
	first				second				third				fourth				fifth			
	D_G	E_D	D_B	U_D	D_G	E_D	D_B	U_D	D_G	E_D	D_B	U_D	D_G	E_D	D_B	U_D	D_G	E_D	D_B	U_D
first					1.448	1.339	1.716	3.091	1.782	1.559	1.849	3.303	1.868	2.112	2.506	4.243	2.032	2.530	2.879	1.394
second	1.448	1.339	1.716	3.091					1.231	1.115	1.078	1.069	1.290	1.510	1.461	1.373	1.403	1.809	1.678	2.218
third	1.782	1.559	1.849	3.303	1.231	1.115	1.078	1.069					1.049	1.355	1.356	1.285	1.141	1.623	1.557	2.370
fourth	1.868	2.112	2.506	4.243	1.290	1.510	1.461	1.373	1.049	1.355	1.356	1.285					1.088	1.199	1.149	3.044
fifth	2.032	2.530	2.879	1.394	1.403	1.809	1.678	1.394	1.141	1.623	1.557	2.370	3.044	1.198	1.199	0.329				

Tab. 9. Ranks reflecting the adequacy of the diversification indicators of the considered construction companies

Firm	Construction company																			
	first				second				third				fourth				fifth			
	D_G	E_D	D_B	U_D	D_G	E_D	D_B	U_D	D_G	E_D	D_B	U_D	D_G	E_D	D_B	U_D	D_G	E_D	D_B	U_D
first					3	2	4	1	2	1	3	4	1	2	3	4	4	2	1	3
second	3	2	4	1					1	2	3	4	3	2	1	4	1	3	4	2
third	2	1	3	4	1	2	4	3					1	3	4	2	4	2	3	1
fourth	1	2	3	4	3	2	1	4	1	3	4	2					4	2	3	1
fifth	2	4	1	3	2	3	4	1	4	2	3	1	1	2	4	4				
Total	8	10	11	12	9	9	13	9	8	8	13	11	6	10	12	12	13	9	1	7
Sum of ranks	8		21		18		22		16		24		15		26		22		8	

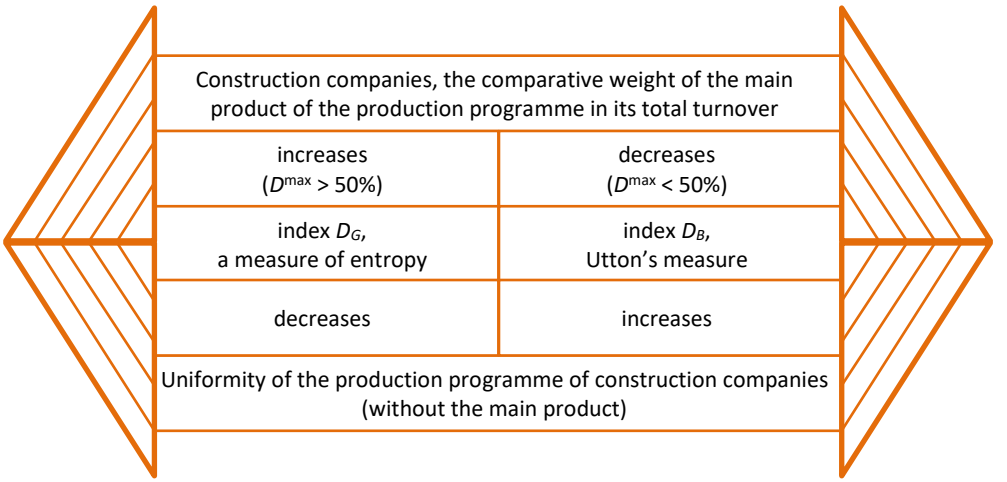

Fig. 1. Adequacy of diversification indicators depending on the structure of the construction company's production programme

Conclusions

With market globalisation and intensifying competition, the strategy of business diversification is becoming increasingly important for companies. It provides opportunities to adapt to constantly changing external conditions and, thus, maintain and improve the position. The success of a diversification strategy depends, to a large extent, on the ability to measure its achieved level at a desired point in time. Today, four indicators for measuring unrelated diversification are the most well-known and widely used: Berry index D_B, the entropy measure E_D, Utton measure D_U and the index D_G. On the other hand, the question remains which indicator to apply in a specific case and, at the same time, increase the adequacy of the assessment. The conducted research found that it largely depends on the structure of the company's production programme, which is sufficiently accurately reflected by the comparative weight of the main product in the total volume of work. As the degree of diversification increases, this share decreases. In this case, the adequacy of the company's activity diversification indicator can be reflected by changes in the scale of the main product compared to changes in the value of this indicator.

It has been established that if the relative size of the main product of the construction company's production programme compared to the rest of its scope is greater than 50%, then it is appropriate to use the Berry index and the entropy measure to assess the

level of diversification if it is less than 50% — Utton measure and index D_G.

The limitations of the proposed methodology can be attributed to the fact that it is more suitable for the evaluation of the structure of the production programme of a construction company with a clear main product. The weakness of the methodology can be attributed to its remaining unclear sensitivity, i.e., to the extent changes in the main product correspond to changes in the adequacy of the considered diversification indicators; on the strong side, compared to the changes in the main product of the production programme, the adequacy indicator changes more.

Literature

Aivazian, V. A., Rahaman, M. M., & Zhou, S. (2019). Does corporate diversification provide insurance against economic disruptions? *Journal of Business Research, 100*(C), 218-233. doi: 10.1016/j.jbusres.2019.03.044

Ansoff, H. (1957). Strategies for Diversification. *Harvard Business Review, 35*(5), 111-125.

Ansoff, H. (1965). *Corporate Strategy.* New York: McGraw-Hill Book Comp.

Arbeitskreis. (1973). Diversifizierung. *Zeitschrift für betriebswirtschaftliche Forschung, 25*, 294-335.

Atanasova, Ch., & Li, M. (2019). Do all diversified firms hold less cash? The role of product market competition. *Journal of International Financial Markets, 59*(C), 134-152. doi:10.1016/j.intfin.2018.11.005

Becerra, M., & Santaló, J. (2006). The Effect of Diversification on Performance Revisited: How the Dominance of Diversifiers Versus Specialists Drives the Diversification-Performance Relationship. *Management Research, 4*(1), 23-34. doi: 10.2753/JMR1536-5433040102

Berry, C. (1971). Corporate Growth and Industrial Diversification. *Journal of Law and Economics, 14*, 371-383.

Boehe, D., & Jimenez, A. (2019). Does the sequencing of related and unrelated export diversification matter? Evidence from Colombian exporters. *International Business Review, 27*(6), 1141-1149.

Busse, M., Dacorogna, M., & Kratz, M. (2014). The Impact of Systemic Risk on the Diversification Benefits of a Risk Portfolio. *Risks, 2*(3), 260-276. doi: 10.3390/risks2030260

Chen, Y.-Y., & Jaw, Y. L. (2014). How do business groups' small world networks affect diversification, innovation, and internationalization? *Asia Pacific Journal of Management, 31*(4), 1019-1044. doi: 10.1007/s10490-014-9385-9

Chonghui, J., Yongkai, M., & Yunbi, A. (2013). International diversification benefits: an investigation from the perspective of Chinese investors. *China Finance Review International, 3*(3), 225-249.

Chung, H.-M. (2013). The role of family management and family ownership in diversification: The case of family business groups. *Asia Pacific Journal of Management, 30*(3), 871-891. doi: 10.1007/s10490-012-9284-x

Dosi, G., Mathew, N., & Pugliese, E. (2020). What a firm produces matters: processes of diversification, coherence and performances of Indian manufacturing firms. *Research Policy*, 104152.

Errasti, N., Zabaleta, N., & Ruiz, M. (2014). Competitive intelligence as a key tool for SMEs' diversification process. *7th International Conference of Education, Research and Innovation (ICERI),* (pp. 1062–1068). Seville.

Gaur, A., & Delios, A. (2015). International Diversification of Emerging Market Firms: The Role of Ownership Structure and Group Affiliation. *Management International Review, 55*, 235-253. doi: 10.1007/s11575-015-0240-0

Ginevičius, R. (2009). Quantitative evaluation of unrelated diversification of enterprise activities. *Journal of Civil Engineering and Management, 15*(1), 105-111. doi: 10.3846/1392-3730.2009.15.105-111

Gnangnon, S. (2021). Manufacturing exports and services export diversification. *The International Trade Journal, 35*(3), 221-242.

Hann, R., Ogneva, M., & Ozbas, O. (2013). Corporate Diversification and the Cost of Capital. *Journal of Finance, 68*(5), 1961-1999. doi: 10.1111/jofi.12067

Herfindahl, O. (1950). *Concentration in the US Steel Industry. Dissertation.* New York: Columbia University.

Hernández-Trasobares, A., & Galve-Górriz, C. (2016). The influence of family control on decisions regarding the specialization and diversification of business groups. *BRQ Business Research Quarterly, 19*(2), 73-89. doi: 10.1016/j.brq.2015.09.001

Hyland, D. C. (2003). The Effect of Diversification on Firm Value: a Pre- and Post- Diversification Analysis. *Studies in Economics and Finance, 21*(2), 22-39. doi: 10.1108/eb028773

Jackuemin, A. P., & Berry, C. H. (1979). Entropy Measure of Diversification and Corporate Growth. *Journal of Industrial Economics, 27*, 46-57.

Jafarinejad, M., Ngo, T., & Escobari, D. (2018). Disentangling the impacts of industrial and global diversification on firm risk. *Global Finance Journal, 37*(C), 39-56.

Jara-Bertin, M., López-Iturriaga, F. J., & Espinosa, Ch. (2015). Diversification and control in emerging markets: The case of Chilean firms. *BRQ Business Research Quarterly, 18*(4), 259-274. doi: 10.1016/j.brq.2015.01.002

Kieser, A., & Kubicek, H. (1992). *Organization. 3. Völling neu Bearb. Aufl.* Berlin, New York: de Gruyter.

Kim, S. W., Kim, T., Choi, K.-H., & Yang, J. A. (2014). Comparative Analysis on the Diversification Effects between Firm Performance and Whole Supply Chain Performance in Korea and Japan. *Journal of Korea Trade, 18*(1), 1-27.

Kirichenko, O. S., Komzolov, A. A., Nazarova, Y. A., Shcherbakova, N. S., & Kirichenko, T. V. (2020). Diversification of Russian Oil and Gas Upstream Companies. *International Journal of Energy Economics and Policy, 10*(3), 112-118. Retrieved from https://econjournals.com/index.php/ijeep/article/view/9194

Kuppuswamy, V., Serafeim, G., & Villalonga, B. (2014). The Effect of Institutional Factors on the Value of Corporate Diversification. *Finance and Strategy, 31*, 37-68. doi: 10.1108/S0742-332220140000031000

Li, D., Li, L., & Huang, Y. (2014). Technological Diversification Effect on Business Performance: a Probing into Intermediaries Role of Product Innovation Strategy. *8th International Conference on Intelligent Systems and Knowledge Engineering (ISKE)* (pp. 181–190). Shenzhen.

Li, L. (2014). The Research on Management of Private Enterprise in Diversification Strategy Environment.

Mackey, T. B., & Barney, J. B. (2013). Incorporating opportunity costs in strategic management research: The value of diversification and pay-out as opportunities forgone when reinvesting in the firm. *Strategic Organization, 11*(4), 347-363.

Mauer, D. C., Wang, S., Wang, X., & Zhang, Y. (2015). Global diversification and IPO returns. *Journal of Banking & Finance, 58*, 436-456. doi: 10.1016/j.jbankfin.2015.05.015

Nazarova, V. (2015). Corporate Diversification Effect on Firm Value (Unilever Group Case Study). *Annals of Economics and Finance, 16*(1), 173-198.

Nurimbetov, T. (2017). Diversification of the manufacturing activity in the agricultural sector and methodological approaches to evaluate its level. *ISJ Theoretical & Applied Science, 10*(54), 77-82.

Patrisia, D., & Dastgir, S. (2017). Diversification and corporate social performance in manufacturing companies. *Eurasian Business Review, 7*(1), 121-139.

Phuge, S. C., Deorukhakar, A. C., Meshram, A. V., Thorat, V. A., & Kshirsagar, P. J. (2020). Evaluation of Farming Systems for Diversification and Sustainability in North Konkan Coastal Zone of Maharashtra. *International Journal of Current Microbiology and Applied Sciences, 11*, 121-127.

Pierscionek, Z. (1966). *Strategie rozwoju firmy.* Warszawa: Wydawnictwo Naukowe PWN.

Qian, G., Li, L., & Rugman, A. M. (2013). Liability of country foreignness and liability of regional foreignness: Their effects on geographic diversification and firm performance. *Journal of International Business Studies, 44*(6), 635-647.

Sanchez-Bueno, M., & Usero, B. (2014). How may the nature of family firms explain the decisions concerning international diversification? *Journal of Business Research, 67*(7), 1311-1320. doi: 10.1016/j.jbusres.2013.09.003

Santarelli, E., & Tran, H. T. (2016). Diversification strategies and firm performance in Vietnam Evidence from parametric and semi-parametric approaches. *Economics of Transition and Institutional Change, 24*(1), 31-68. doi: 10.1111/ecot.12082

Šaparauskas, J., & Vilutienė, T. (2005). Statybos įmonių veiklos diversifikacijos alternatyvų analizė (Analysis of construction companies diversification alternatives]. *Ūkio technologinis ir ekonominis vystymas (Technological and Economic Development of Economy), 11*(4), 310-318.

Sawada, M. (2013). How does the stock market value bank diversification? Empirical evidence from Japanese banks. *Pacific-Basin Finance Journal*, 40-61. doi: 10.1016/j.pacfin.2013.08.001

Schmid, T., Ampenberger, M., Kaserer, Ch., & Achleitner, A.-K. (2015). Family Firm Heterogeneity and Corporate Policy: Evidence from Diversification Decisions. *Corporate Governance: An International Review, 23*(3), 285-302. doi: 10.1111/corg.12091

Shikata, N., Imahashi, H., & Gemba, K. (2021). An analysis of diversification dynamics of R&D activities and external collaboration in major manufacturing industries in Japan. *Forum Scientiae Oeconomia, 9*(4), 79-97.

Sontheimer, D. (1989). Visual information processing in infancy. *Developmental Medicine & Child Neurology (DMCN), 31*(6), 787-796. doi: 10.1111/j.1469-8749.1989.tb04075.x

Thoumrungroje, A., & Tansuhaj, P. (2005). Entrepreneurial Strategic Posture, International Diversification, and Firm Performance. *Multinational Business Review, 3*(1), 55-73.

Utton, M. (1977). Large Firm Diversification in British Manufacturing Industry. *Economic Journal, 87*, 96-113.

Wang, W. K., Ting, W. K., Kuo, K. C., Kweh, Q. L., & Lin, Y. H. (2018). Corporate diversification and efficiency: evidence from Taiwanese top 100 manufacturing firms. *Operational Research, 18*(1), 187-203.

Wolf, J. (1995). Die Messung des Diversifikationsgrads von Unternehmen (I). *Wirtschaftsstudium, 5*, 439-445.

Wolf, J. (1995). Die Messung des Diversifikationsgrads von Unternehmen (II). *Wirtschaftsstudium, 6*, 519-523.

Wrigley, L. (1970). *Divisional Autonomy and Diversification.* Boston: Harvard Business School.

Yahaya, M. I., Aliyu, M. I., & Kabir, B. (2009). Geographic diversification, performance, and the risk profile of UK construction firms. *Journal of Engineering, Design and Technology, 7*(2), 171-185.

Yücel, E., & Önal, Y. B. (2015). Industrial Diversification and Risk in an Emerging Market: Evidence from Turkey. *Emerging Markets Finance and Trade, 51*(6), 1292-1306. doi: 10.1080/1540496X.2015.1011544

Zahavi, T., & Lavie, D. (2013). Intra-industry diversification and firm performance. *Strategic Management Journal, 34*(8), 978-998. doi: 10.1002/smj.2057

Zandi, G., Shahzad, I. A.,Bajaber, N., Nowodziński, P., & Shahid M. S. (2022). Relationship between corporate governance and cost of equity capital. *Polish Journal of Management Studies*, *26*(1), 386-406. doi: 10.17512/pjms.2022.26.1.24

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Trip planning mobile application: a perspective case study of user experience

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ABSTRACT
Mobile trip planning applications may contribute to popularising public transport, provided they work efficiently and gain high user acceptance. This article aims to take a closer look at the functioning of the JakDojade application, which has been the most popular platform in Poland for several years, supporting travel planning by public transport. In the presented case study, the authors tried to diagnose problems and indicate the directions of application development. At the same time, through this analysis, the authors aimed to demonstrate the usefulness of researching user comments from the viewpoint of managing the development of mobile applications and related services. A case study methodology was used to perform a descriptive study. Data on user feedback on JakDojade mobile application in Poland comes from Google Play Store. Semantic categorisation of user comments and sentiment analysis allowed for identifying user problems and diagnosing emotions related to its use. The presented methodology allowed for diagnosing typical user problems for the JakDojade application, which may help indicate further development directions. The authors attempted to demonstrate the usefulness of researching user comments from the point of view of managing the development of mobile applications and related services. The semi-automatic approach to text analysis presented in the article highlights the problems related to the study of user reviews. The limitations of the proposed methodology and the possibilities for its improvement were indicated.

KEY WORDS
public transport, mobile application, user experience, UX, sentiment analysis, semantic analysis, software engineering

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Introduction

According to the World Bank Today, 56 % of the world's population lives in cities. This number is expected to grow. By 2050, nearly seven out of ten people will live in cities (World Bank, 2022). The population growth in urban areas will pressure public transport management and infrastructure. The increase in fuel and car prices in the primary and secondary markets causes an increased demand for shared transport models. In the era of universal mobile access to the Internet, mobile applications have become indispensable for younger people as

Pawełoszek, I., & Wieczorkowski, J. (2023). Trip planning mobile application: a perspective case study of user experience. *Engineering Management in Production and Services, 15*(2), 55-71. doi: 10.2478/emj-2023-0012

they support all spheres of personal and professional activity. By offering mobile applications for planning trips, the city can achieve a higher use and economic effectiveness of public transport. Promoting shared transport has many such benefits as (AlKheder, 2021) decreasing the number of private vehicles to ease traffic congestion, resulting in a positive impact on the environment and enhancing the cost-effectiveness, reliability, and accessibility of the road network. The main factors that may discourage passengers from using public transport are:

- Schedule sliding, i.e., the case where vehicles cannot be dispatched according to the planned timetable due to accumulated delays when performing previous trips (Gkiotsalitis & Cats, 2021).
- Problems with purchasing tickets from the electronic ticket machine. In some vehicles, the machines are not present or not functioning correctly. It is not always possible to buy a ticket from the driver, for example, during the restrictions related to the COVID-19 pandemic.
- The difficulty of planning a transfer from one bus or tram to another in the shortest possible time.
- The lack of knowledge about the bus facilities (such as the low floor) essential for people with mobility impairments.
- Uncertainty about the time of arrival and reaching the bus stop.
- Different timetables during the weekends and holidays.

Providing accurate and timely information about public transportation is necessary to increase its dependability. Commuters should know when their trains and buses will arrive so that they can plan their trip accordingly (Rawal, 2018).

The answer to these problems may be a mobile application with real-time access to vehicle information, route plans, and timetables. The authors believe that functional mobile applications meeting user needs are an important factor contributing to the promotion of public transport.

One of the critical success factors of an application is its proper design considering user experience (UX). User expectations are tested during the initial application design process and later, during its production use to apply appropriate corrections and design subsequent versions. User experience research in software engineering usually uses questionnaires, surveys, observations, and psychophysical measurements, often involving users in design work. However, in the operational phase of the application lifecycle, UX research can also be performed by analysing user comments on social networks or in application stores. This, in turn, requires appropriate text mining methods and solving semantic problems, often specific to the analysed language.

This article takes a closer look at the functioning of the JakDojade (How do I arrive?) application, which has been the most popular platform in Poland for several years, supporting travel planning by public transport. By analysing user comments, the authors aimed to diagnose problems and indicate the directions of application development. At the same time, the authors used this analysis to demonstrate the usefulness of researching user comments from the viewpoint of managing the development of mobile applications and related services.

1. Literature review

The debate on the importance of efficient urban transport is not new and has been highlighted in many publications. According to Banister (1995), the attractiveness of particular locations depends on the transport infrastructure's relative accessibility, quality, and quantity. The main problems of efficient transport systems development are (Zavitsas et al., 2010):

- Land use. Well-designed transport networks improve people's accessibility to existing services and amenities. Transport performance is the ratio between the accessibility to certain amenities (including the number of people) by a mode of transport (i.e., how many amenities can be accessed by a specific transport mode in 30 minutes) and the proximity of these amenities (i.e., how many are located in a radius of 8 km) (OECD, 2022).
- Congestion and parking places. Cities are faced with a growing number of cars and limited parking spaces, making people park their vehicles haphazardly on roads and congesting streets.
- Car dependence is among the leading causes of congestion and air pollution. Other consequences are social isolation, discrimination, high expenses, and declining small businesses (Price, 2017).
- Achieving a modal shift from private to public transport, walking, and cycling. In the last few years, the COVID-19 pandemic has caused

a significant impact on public transportation services, travel behaviour, and mode choice preferences (Das et al., 2021).

- Pollution and noise. The EU plans to ban sales of fossil fuel-powered vehicles from 2035 (Abnett, 2022). Many public transport companies in Poland are switching their fleet to electric vehicles. Easily obtained external funds for the purchase of electric buses encourage even the smallest towns to use this solution (Połom & Wiśniewski, 2021).
- Other factors, e.g., political issues and economic prosperity. Urban transport problems can increase travel times and affect the efficiency of commerce, counterbalancing the economic advantages of urban proximity (Zavitsas et al., 2010).

Inner city areas with high building and population densities are problematic in providing efficient transport links and infrastructure while ensuring safety and environmental sustainability. Many cities are thus considering reallocating road space giving more space to public transport and pedestrians (Zavitsas et al., 2010). Due to the spatial and economic problems, local governments have a limited possibility of constant investment in new transport infrastructure. Reducing the share of individual transport will improve the air in the city and the overall quality of life of the population (Bubelíny & Kubina, 2021).

Thus, strategies based on managing existing resources and encouraging the use of public transport seem to be the most appropriate development path. In the information and communication technologies era, solutions and models drawing on the smart city concept have become a hot topic. Great hopes are placed on using various Internet of Things solutions (Shahrour & Xie, 2021). Noteworthy is the selection and integration of IoT tools within smart cities to support decision-making processes in determining investment needs in the public transport lines. It is essential to analyse which IoT tools are available in the city (Stępniak et al., 2021). Implementing real-time locating systems (RTLS) offers the possibility of tracking public transport vehicles.

The basis for creating innovative solutions supporting public services valid for residents is ensuring the openness of source data. Open government data (OGD) is used to develop innovative products, including services and software (Wieczorkowski, 2019). Ensuring the data openness on timetables and information on the current vehicle location enables mobile applications for trip planning.

Mobile applications for paid public services, which usually include public transport, often have to resolve the intermediation problem in the payment-for-service system. The application's popularity may be influenced by implementing appropriate payment solutions with a high level of user trust (Szumski, 2020).

The need to reduce individual transport promotes journey planning platforms involving different public transport means to ease the inhabitant's daily commute. Travel planning applications benefit not only passengers but also the urban transport system and economy. Software companies and startups design and implement these applications, creating new jobs. In addition, Big Data Sources created by these applications may be used for marketing.

However, measuring the benefit of an application for users, i.e., passengers, is problematic. Thus, it is vital to study user experience, particularly the understanding of subjective feelings while using the product (Rota et al., 2009), in this case, a mobile application.

User experience is defined as a person's perceptions and responses that result from the use and/or anticipated use of a product, system, or service (ISO 9241-210, 2010). This formal definition is supplemented by other interpretations: user experience explores how a person feels about using a product, i.e., the experiential, affective, meaningful, and valuable aspects of product use (Vermeeren et al., 2010). Hassenzahl and Tractinsky (2006) distinguished a few prominent perspectives of UX. None of these perspectives fully capture UX, which is about technology that fulfils more than just instrumental needs in a way that acknowledges its use as a subjective. UX is a consequence of a user's internal state, the characteristics of the system (e.g., complexity, purpose, usability, functionality, etc.), and the context within which the interaction occurs.

There are two disparate stances on how UX should be studied, i.e., qualitative versus quantitative, that are not necessarily compatible or can even be antagonistic (Law et al., 2014). UX literature focuses on the previously mentioned methods, such as questionnaires, surveys, and user observation. Such methods often require a manual approach to collecting the necessary data and their subsequent evaluation. As reported (Maia & Furtado, 2016) in a systematic review of UX literature regarding the

automation of such data collection, most studies collected data manually (80 %), 12 % used a mixed form (manual and automated), and 8 % did it automatically. After collecting user experience data, 84 % of the studies performed the user experience evaluation manually, 8 % did it automatically, 4 % used a mixed form, and 4 % did not report the user experience evaluation techniques. Automated UX evaluation is regarded as an unexplored field, especially when adopted for widely used mobile applications (Saleh et al., 2020). However, the authors make such attempts based on user observations. The problem is, therefore, the low level of possible automation of UX research.

The authors of this article focused on the automatic analysis of collected comments. This approach is sporadically mentioned in the literature. Stuart et al. (2015) also examined the reviews of 20 mobile applications from the Google Play Store and the Apple App Store. It was underlined that the unstructured and informal nature of the reviews complicated the analysis. Additional barriers arise from the emotional language enriched with slang, peculiar spelling, and the use of emojis and other symbols (Gimadi, 2021). Many comments address various problems in one review, making it difficult to classify them.

The analysis of user comments (including sentiment analysis) is used when evaluating products, particularly mobile applications. On the other hand, it can also be useful at the city management level to build city development strategies, implement related projects (Jelonek et al., 2020) and evaluate the public transport system (Buran, 2023). The authors of this article focused on the first option.

Semantic analysis is language specific. The abovementioned study concerned comments in English, and the conclusions reached do not need to be valid for other languages. Hence, there is a need for further research on the use of comments for UX assessment, and a research gap here is the use of the Polish language as part of a completely different language group.

The Polish language semantic analysis is a challenging task because of the relatively free word order (Savary & Waszczuk, 2020), which stresses the importance of information rather than following the rules of grammar. Several written corpora of contemporary Polish have been created, which could be used for automatic topic detection. Still, due to copyright issues, they are not freely available for download (Ogrodniczuk et al., 2022).

2. Purpose and characteristics of the JakDojade application

JakDojade application is a public transport planner. Its basic functionality includes searching for the fastest and alternative transport connections and selling tickets online. The application uses city maps, timetables, and user geolocation data. The website is currently available in a mobile version for Android and iOS, as well as in an older Web version.

In 2021, JakDojade was the most popular application for planning trips by public transport in Poland, according to research carried out on behalf of the application developer. Monthly active users (MAU) average about four million. Searching for connections serves over 30 Polish cities or agglomeration areas, and purchasing tickets is possible in about ten cities or regions (Fig. 1). The real-time function is gradually introduced in the application, which consists of using data on vehicles' exact position parallel to the schedule data. So far, it has been implemented in Wrocław, Warsaw, Poznań, Tricity and Kraków. Real-time data improves the quality of finding optimal connections. A passenger can also have a high probability that the selected bus or tram will arrive at the stop at the scheduled time. In addition, the planning considers vehicles' constantly updated speed and travel time on individual sections, not only the timetable values.

However, real-time information requires real-time access to data about the current position of each vehicle. Location data is determined using GPS devices. It is transferred to the transportation company and public transport supervisors and is made available using API programming interfaces. This is still not being done correctly in many cities, resulting in the slow pace of real-time feature deployment. In addition, some vehicles do not report their location accurately due to GPS device failures, problems in data transmission, or driver errors. The quality of the service is also influenced by the frequency of updating the location of vehicles.

The basic version of the mobile application is free, but it provides users with profiled ads. A paid premium version without ads is also available. These advertisements and the sale of user-sourced data are the backbones of the producer's revenue. An increasingly important part of the company's revenues is the intermediation in the sale of online tickets. The

Fig. 1. Geographical coverage of JakDojade application

adopted business model means that the activity is profitable only in larger cities with good advertising and the ticket sales market. Including other centres in the service generates high fixed costs. An alternative is the participation of smaller-town authorities in the costs of including them in the service. The above-described characteristics of the application's operation suggest potential problems affecting user opinions negatively. Therefore, initially, it can be assumed that the criticism and poor opinions may concern:

- speed and reliability of the application operation,
- usability of the application interface,
- the quality of optimisation algorithms,
- news of timetables,
- gaps and errors in real-time information,
- a limited number of cities where the service is provided,
- online ticket sales methods in individual cities,
- problems with paying for tickets,
- the nuisance of displayed advertisements,
- privacy policy,
- prices for the premium version and the profitability of its purchase.

The application evaluation should also be expected to be influenced by the quality of external data downloaded, such as timetables, GPS data of vehicles, and maps. At the same time, the assessment may also be influenced by factors utterly independent of the application, such as the quality of public transport in individual cities and even traffic jams causing delays to timetables. The JakDojade application and business model are described in detail by Wieczorkowski, Chomiak and Pawełoszek (2021). The JakDojade application covers most of the large agglomerations in Poland.

3. Research methods

The great advantage of mobile application stores, such as Google Play, is their star-rating and comments system, allowing users to evaluate the apps and leave feedback. User reviews contain valuable information, such as bug reports, feature requests, and user experiences (Noei & Lynos, 2019). The analysis of user comments is a research method that, in recent years, formed a popular and influential field of

research (Schindler & Domahidi, 2021). This method effectively identifies existing technical problems and other sources of customer dissatisfaction. According to Carter (2022), around 81 % of consumers say they have left a business review around four times a year or less. Therefore, it can be assumed that the analysis of user comments can provide a statistically representative result (Reimer et al., 2021). Although it is increasingly common for customers to leave negative reviews about a product, the most common reason to leave a review is that the service or product was excellent (56 %). The second most common reason to leave a review is that the product was unsatisfactory (41 %) (Carter, 2022). Dissatisfied customers are likely to describe their opinions and experiences in more detail. Sentiment analysis and categorising user comments can indicate the directions for improving the services. Data on user feedback on JakDojade mobile application in Poland was obtained from Google Play Store.

The research procedure consisted of the following steps:

- Gathering comments on the application JakDojade. Comments were extracted from the Google Play store using a Python script and a dedicated library (Mingyou, 2022).
- Preparation of data for analysis in an Excel spreadsheet. The obtained data structure and the description of the variables are presented in Table 1.
- Feature creation, i.e., deriving new features from existing ones. This step involved establishing the gender of commenting users. The gender of users was determined (1) based on their first and last names, using a dictionary method, and (2) based on the words contained in the comment that may indicate gender. In Polish, it is possible to extract past and future verbs and some adjectives indicative of gender. The text analysis was carried out using a VBA script developed by the project authors.
- Calculating descriptive statistics of the data set for individual numerical and categorical variables.
- Application of the CLARIN-PL (Janz et al., 2017) sentiment analysis tool for evaluating the polarity of the comments as positive or negative and also to detect particular emotions accompanying the users of the JakDojade service.
- Separation of thematic categories by using simple text-processing techniques. Here, the first step was to identify the most frequent phrases in the text that could indicate the subject of the comment.
- Tagging the comments and counting the number of comments in each category. Each review could have more than one category.

4. Research results

The first step of the analysis was to identify basic statistics on user ratings and comments. The number of comments and the average assessment from 2011 to the third quarter of 2022 are presented in Fig. 2.

Tab. 1. Variables used in the study

Variable name	Description
Variables in the data set	
reviewId	Unique identifier of the review, string of characters
userName	The user's name and surname or nickname
userImage	User image icon
content	Review text
score	5-point rating scale, where 1 means "Unacceptable" and 5 is "Excellent"
thumbsUpCount	Number of users who found the comment useful
reviewCreatedVersion	Version of app reviewed
at	Date and time of the review
replyContent	Reply text
repliedAt	Date and time of the reply
Derived variables	
gender	User's gender (female, male or unknown)
wordCount	Wordcount in comments
delay	Delay in response to the comment in days
Year	year of adding the comment

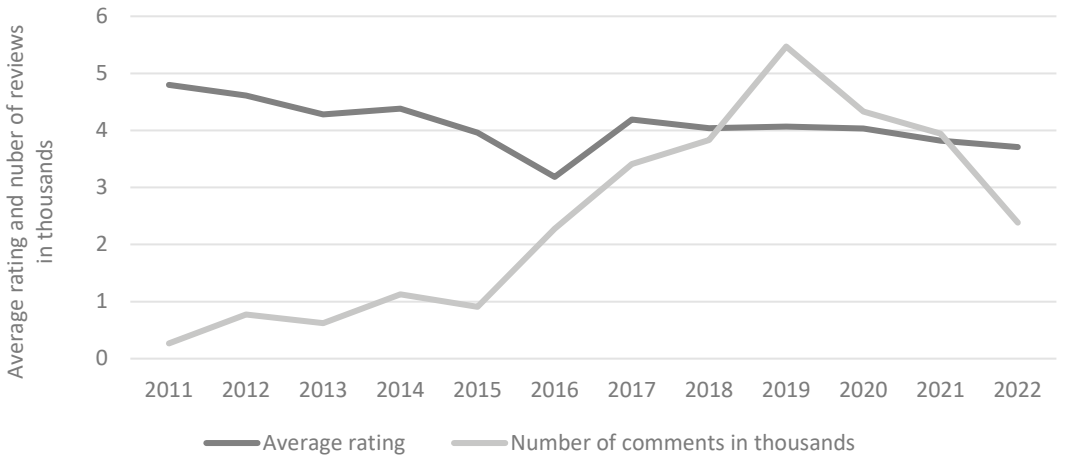

Fig. 2. Number of comments and the average assessment of the JakDojade application

Tab. 2. Descriptive statistics cross-section table

Gender	N	Mean	Std.Dev	Q25	Median	Q75
Female	3584	3.86	1.55	3	5	5
Male	6380	3.66	1.65	2	5	5

Source: elaborated by the author.

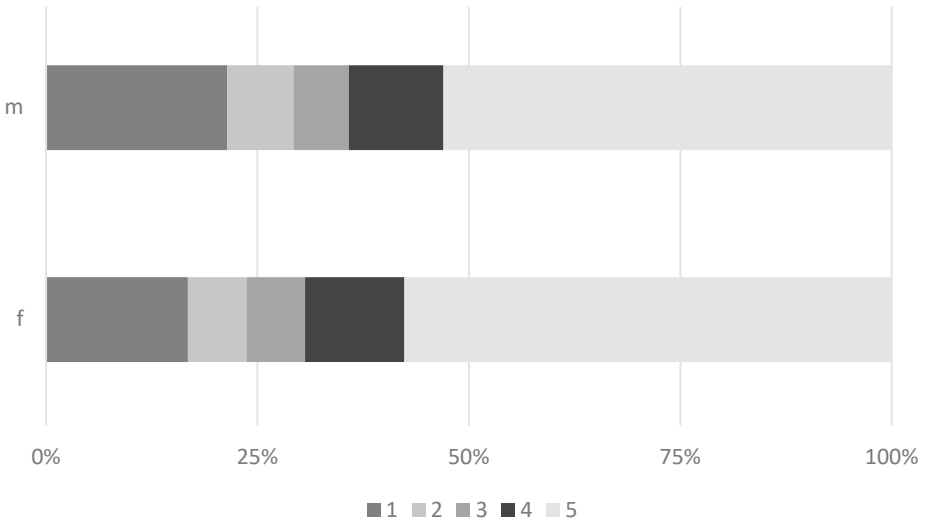

Fig. 3. Share of ratings 1–5 by gender

The average user ratings over the years ranged from 3.18 to 4.8. Notably, the median in each year of the analysis was five, meaning that over half of the users rated the application very well. The lowest average rating was recorded in 2016 (3.18). Then, the ratings of the JakDojade application broken down by gender were analysed. By analysing the names and surnames of commentators and the grammatical analysis of statements, the authors were able to determine the gender of 33 % of commentators.

The authors decided to check whether men and women differed in the assessment of the application. The obtained results are presented in Table 2. The chart in Fig. 3 presents the visualisation of the number of grades on a scale of 1–5, broken down by gender.

The statistics analysis on the length of comments (the variable wordCount) showed that women write longer reviews. However, the difference is not significant and likely has arisen by chance. For men, the

Tab. 3. Descriptive statistics on comment length

Gender	N	Mean	Std.Dev	Q25	Median	Q75
Female	3584	16.14	17.73	3	10	22
Male	6380	15.82	18.75	3	9	21

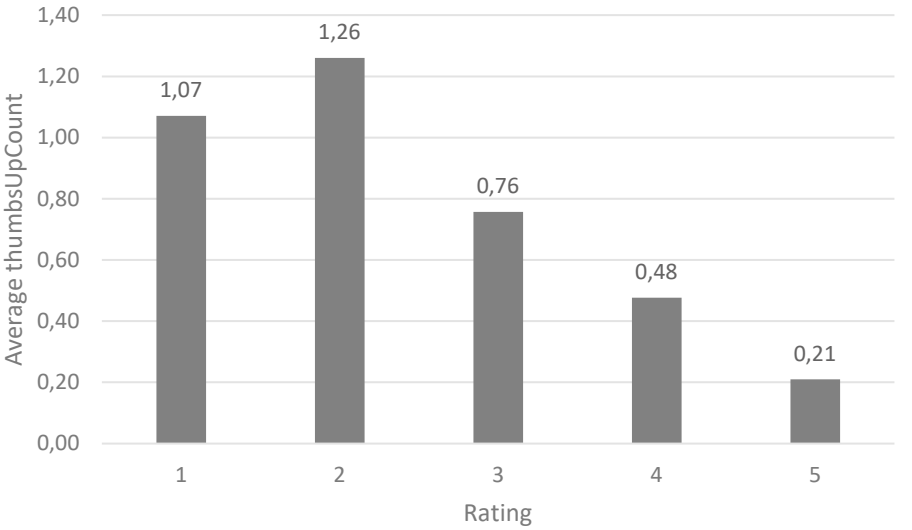

Fig. 4. Average variable thumbsUpCount by application rating

median and average are 15.81 and nine words, and for women, it is 16.14 and ten, respectively. Detailed statistics on comment length by gender are presented in Table 3.

The Google Store comment system allows users to evaluate the usefulness of a review. Users can click the thumb icon if they find a comment valuable. In the analysed dataset, the usefulness of the comment is measured by the variable thumbsUpCount. To take a closer look at the usefulness of the comments, the authors examined the following relationships:

- The usefulness of comments, depending on their length.
- In this study, the authors assumed that the most valuable comments were those with the most text and detailing why users were satisfied or dissatisfied. However, this assumption was rejected due to the correlation coefficient between wordcount and thumbsUpCount amounting to 0.19.
- The usefulness of comments, depending on their rating.

The correlation coefficient between these two variables was -0.01, showing no linear relationship. Fig. 4 presents the average number of thumbs by rating.

On average, the comments that rated the app low (one and two stars) proved to be the most helpful.

The analysis of the length of comments broken down by star rating showed that these comments contained the most text (Fig. 5).

Considering the usefulness and length, comments evaluating the application with one, two, and three stars were selected for further analysis. These comments detailed the reasons for user dissatisfaction and the application use barrier.

Responding to comments is crucial to building a customer-oriented marketing strategy. By timely response, the company will improve customer retention rates and loyalty. Answering the comments also increases the chances of acquiring new customers by showing the company's commitment. The authors decided to check the response time and the share of answered comments according to ratings. In the research sample, the company responded to 64 % of the comments. The share of replied comments broken down by rating is presented in the chart in Fig. 6. Detailed statistics on the reply time are presented in Table 4.

In most cases outside the 4-star rating, the median response time to comments was one day. On average, the company responds to 1-star comments the fastest. When examining the dependence of the response delay on the comment length, the authors used the correlation coefficient. Its value was -0.00128,

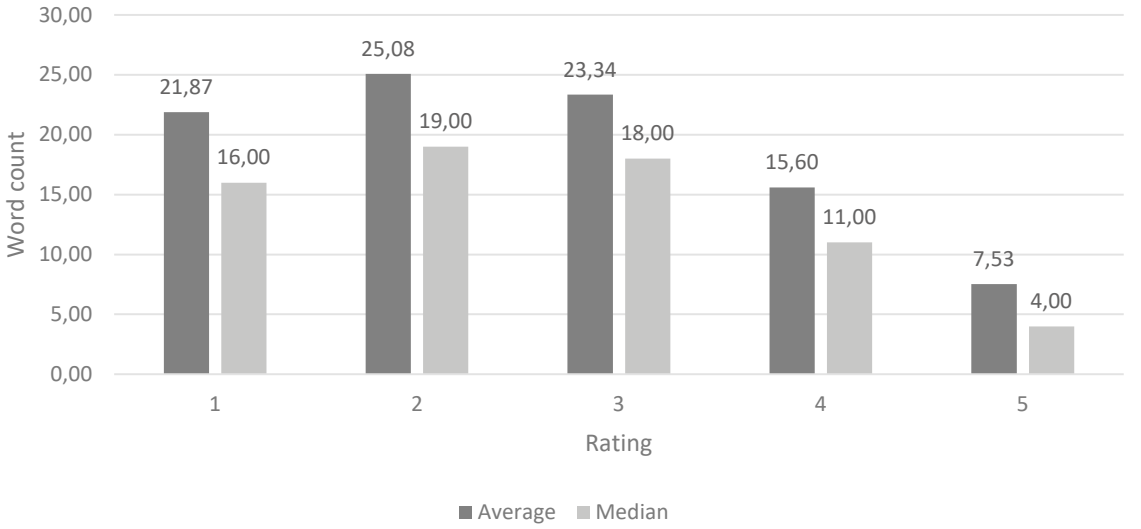

Fig. 5. Average and median word count by application rating

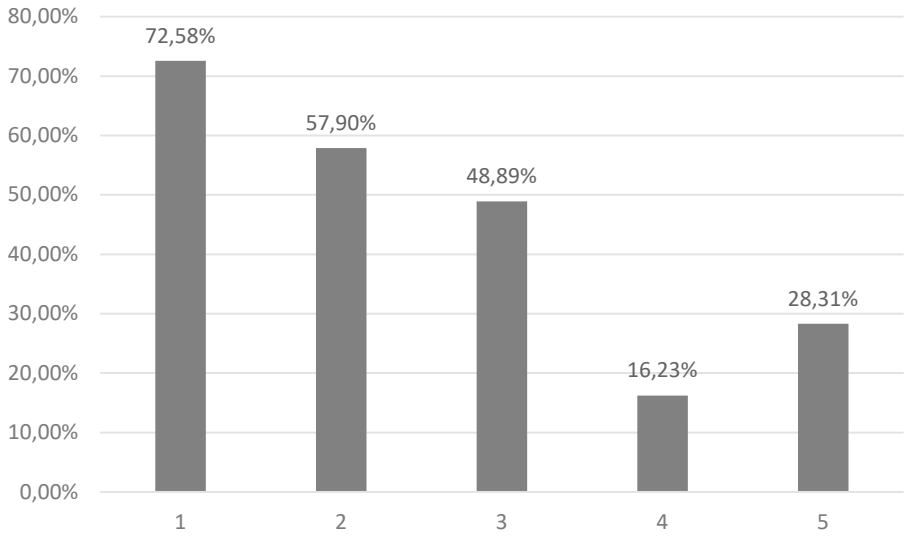

Fig. 6. Percentage of replied comments by rating

Tab. 4. Descriptive statistics of application ratings

Rating	N	Average	Median	Min	Max	Q1	Q3	Std. dev.
1	3041	4.68	1.00	0.00	122.00	0.00	5.00	9.17
2	1088	5.07	1.00	0.00	116.00	0.00	5.00	10.46
3	1088	5.07	1.00	0.00	116.00	0.00	5.00	10.46
4	614	8.57	2.00	0.00	182.00	0.00	8.00	18.07
5	4970	5.49	1.00	0.00	165.00	0.00	4.00	16.16

which indicates no relationship between the two variables.

To diagnose the problems and barriers faced by users of the JakDojade mobile application, sentiment analysis and semantic analysis were used to distinguish the categories of emerging issues. The sentiment analysis using the CLARIN-PL tool was applied to identify the users' emotions. Due to a large number of comments (29.343) and limited computing power, the sentiment analysis was performed on a sample of 400 comments. Therefore, the sample contained 80 reviews from each rating 1–5, respectively. The graph

presented in Fig. 7 clearly shows the advantage of positive emotions.

A more detailed analysis with the CLARIN-PL tool allows for extracting phrases related to various emotions, both positive (such as joy, trust, and looking forward to something unexpected) and negative (sadness, anger, fear, disgust, and negative surprise). The results of the analysis are presented in Fig. 8.

Among the identified positive emotions, joy and trust prevailed. The content analysis of positive comments showed that users were happy to plan their trip well with the help of the application. They trusted the application, as evidenced by numerous phrases proving no experienced disappointment. Sadness and anger predominated among negative emotions. These emotions were related to many shortcomings of the application's functioning. To find out the causes, a semantic analysis of the text was made and is described in the further part of the article.

A more in-depth analysis with the CLARIN tool extracts the emotional tinge of the application characteristics mentioned by users in the comments. The summary of the analysis results is shown in Fig. 9.

The results are largely in line with the emotions identified earlier. The most frequently indicated feature is the usability of the application. Users often described cases of successfully reaching destinations or not getting lost in an unfamiliar city. Among the negative traits, the most frequently mentioned were uselessness, harm and misfortune.

It is possible to identify problems by analysing comments with low ratings, i.e., one, two or three stars. The first step was identifying recurrent topics. For this purpose, the 100 most extended negative

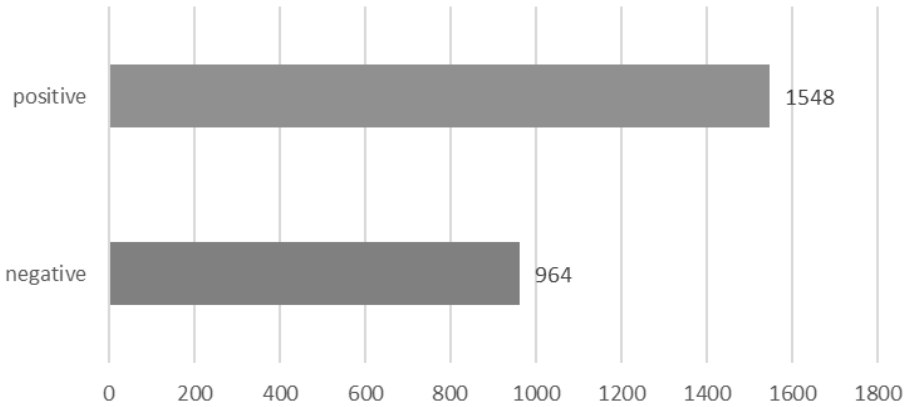

Fig. 7. Polarity of comments

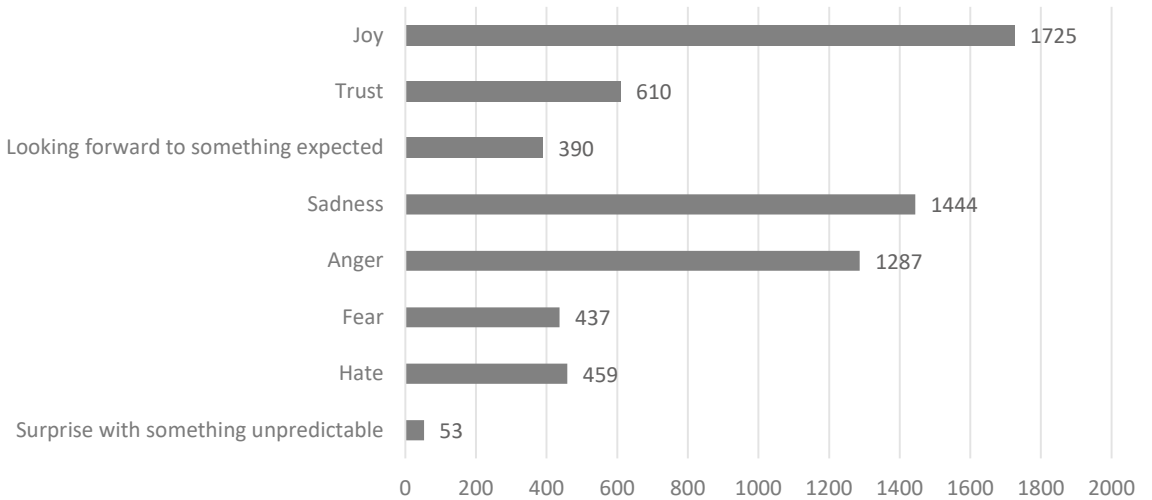

Fig. 8. User emotions detected by sentiment analysis

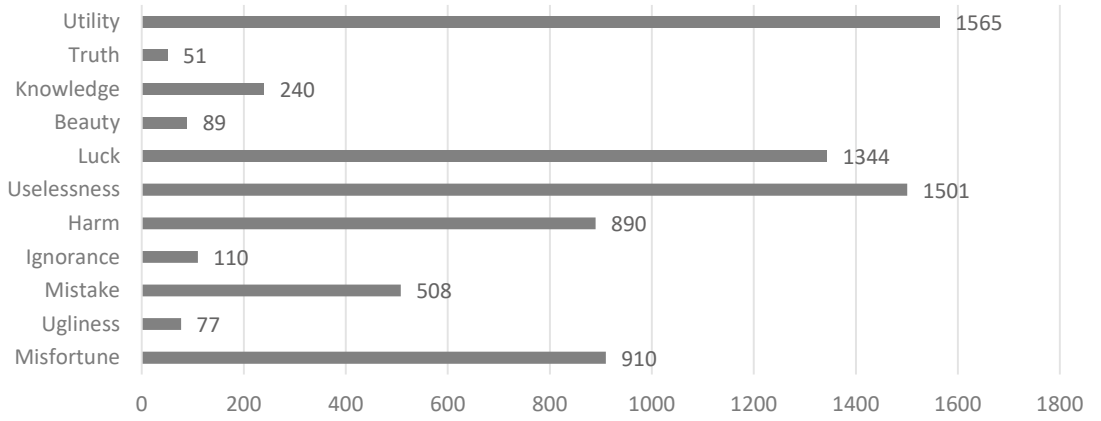

Fig. 9. Emotional colouring of the features of the JakDojade mobile application detected by the sentiment analysis

Tab. 5. Categories and key phrases used for tagging user comments

Category	Description	Key phrases
TimetableS	Problems with the timeliness of the timetable, updating, and searching for optimal connections	Timetable, showing delay, showing connections, change of means of transport, hours, searching, delay, route, train, timetable update
Sharing personal data	The application collects the personal data of users, for which they must consent to use the application	Statute, policy, personal data, agreement, private, protection, consent
Energy consumption	Energy consumption by the application, cases of power drain	Battery, energy consumption, power drain
Finance	Payments for tickets, payment methods, complaints about transactions, payments for the premium application	Paid, payment, return, money, scam, wallet, complaint, ticket
Navigation	Problems with in-app navigation, road showing on map and GPS location	Navigate, navigation, GPS, location, map update
Interface	Application interface, ease of use, interface changes, suggestions for changes	Appearance, interface, font, button, readable
Premium app	Comments related to the app's premium version and displaying advertisements in the non-premium version. Comparison of free and premium applications	Ads, premium
Application	Problems with using the mobile application and updating.	Efficient, stable, suspending, mule, silt, slime, jam, update
Cities	Reporting problems related to specific places, service in cities	City, town, names of the cities
Holiday	Problems encountered with revised timetables	Holiday, weekend, Saturday, Sunday

comments sample was selected and analysed to find the most frequent issues reported by users. Next, the authors extracted the concepts that indicated problems and their synonyms; this way, 54 keywords were identified and categorised. Table 5 shows the categories of topics. Due to the declension rules in the Polish language (inflexion of a word by cases and numbers), a simple searching method did not give accurate results. To avoid this problem, the morphemes of the words (a part of the word with a recognisable meaning) were used. The corpus of all the comments was searched to find the morphemes and count their occurrences in the text.

In the case of key phrases consisting of two words, an original VBA function was used to examine the close coexistence of morphemes in the text. Topic extraction from the text was made by automatically tagging the reviews according to predefined categories.

The frequency of words in particular categories is presented in the diagram in Fig. 10. The overwhelming number of negative comments criticise the time-

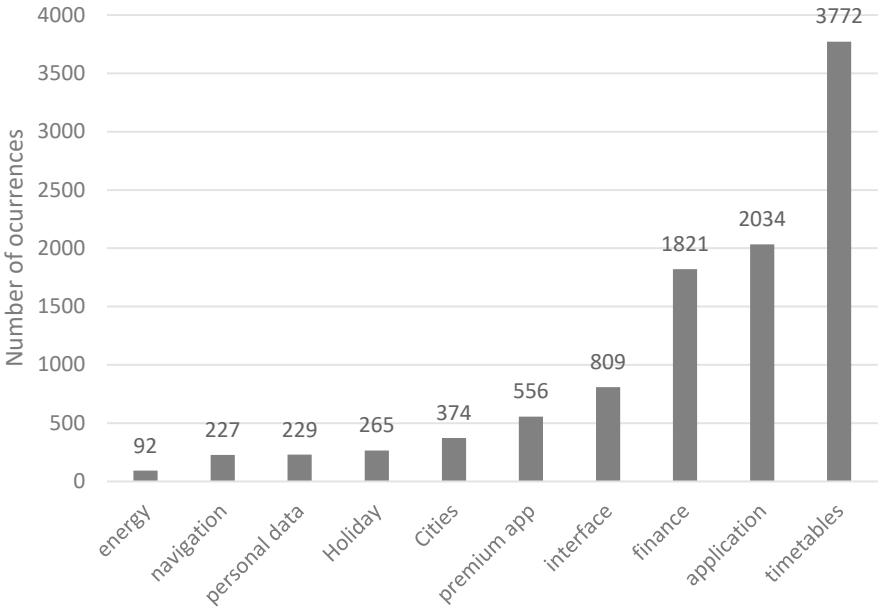

Fig. 10. Number of problem occurrences in user comments by category

	Energy consumption	Holiday	Sharing personal data	Cities	Premium version	Navigation	Interface	Finance	Application	Timetables
Energy consumption		0,00%	0,03%	0,01%	0,04%	0,08%	0,08%	0,03%	0,19%	0,08%
Holiday			0,01%	0,04%	0,00%	0,04%	0,03%	0,10%	0,20%	1,27%
Sharing personal data				0,06%	0,15%	0,34%	0,19%	0,45%	0,45%	0,94%
Cities					0,11%	0,44%	0,29%	0,50%	0,46%	1,22%
Premium version						0,76%	0,75%	0,61%	0,93%	1,37%
Navigation							1,39%	0,39%	1,74%	2,48%
Interface								0,54%	2,23%	2,92%
Finance									2,88%	2,83%
Application										7,59%
Timetables										

Fig. 11. Co-occurrence of the topics matrix — support coefficients

table. This is a particularly important problem when planning a journey with transfers. In large cities, the application supports various means of transport, such as buses, trams, metro and light rail. Updating these timetables may vary by carrier.

Another frequently mentioned problem is the functioning of the application. In particular, software stability and crashes, which, in turn, are related to the inability to make payments. This situation may create a legal problem and expose the passenger to travel without a purchased ticket.

The coexistence of topics was determined using the association rules method known from the market basket analysis in the marketing field. It analyses co-occurrence patterns and determines the strength of the link between two items in the dataset (Szymkowiak et al., 2018).

Every comment rated from one to three was tagged with topic categories. The analysis consisted of identifying the frequency of coexisting categories in user reviews. This approach allowed for extracting support and confidence coefficients for the recognised rules. Support emphasises how popular an item set is, and confidence denotes the likelihood of certain items occurring together. The matrix in Fig. 11 shows support coefficients for the identified two-item rules.

If x and y are the categories listed in the first row and column of the table, respectively, the support

y/x	Energy consumption	Holiday	Sharing personal data	Cities	Premium version	Navigation	Interface	Finance	Application	Timetables
Energy consumption		0,00%	2,17%	1,09%	3,26%	6,52%	6,52%	2,17%	16,30%	6,52%
Holiday	0,00%		0,38%	1,13%	0,00%	1,13%	0,75%	3,02%	6,04%	38,11%
Sharing personal data	0,87%	0,44%		2,18%	5,24%	11,79%	6,55%	15,72%	15,72%	32,75%
Cities	0,27%	0,80%	1,34%		2,41%	9,36%	6,15%	10,70%	9,89%	25,94%
Premium version	0,54%	0,00%	2,16%	1,62%		10,97%	10,79%	8,81%	13,31%	19,60%
Navigation	2,64%	1,32%	11,89%	15,42%	26,87%		48,90%	13,66%	61,23%	87,22%
Interface	0,74%	0,25%	1,85%	2,84%	7,42%	13,72%		5,32%	22,00%	28,80%
Finance	0,11%	0,44%	1,98%	2,20%	2,69%	1,70%	2,36%		12,63%	12,41%
Application	0,74%	0,79%	1,77%	1,82%	3,64%	6,83%	8,75%	11,31%		29,74%
Timetables	0,16%	2,68%	1,99%	2,57%	2,89%	5,25%	6,18%	5,99%	16,04%	

Fig. 12. Confidence matrix of co-occurring topics
Source: elaborated by the author.

factor S x, y located in the cell at the intersection of the row and column can be written as follows:

S(x,y) = number of comments containing both x and y / total number of comments

The confidence coefficients (Fig. 12) at the top right of the matrix were calculated using the following formula:

Confidence (X→Y) = (Support (X,Y)) / (Support (X))

Accordingly, the confidence coefficients at the left bottom part used the formula:

Confidence (Y→X) = (Support (Y,X)) / (Support (Y))

The higher the confidence, the greater the likelihood that the comment that includes topic X will also include topic Y.

Knowledge of support and confidence in the rules may indicate a semantic connection between the considered problem categories (Zhuge et al., 2004). The three and more-component rules were also distinguished; however, their supports were very low, less than 1 %; therefore, they were considered insignificant and omitted in the inferential analysis.

5. Discussion of the results

The presented analysis shows that the number of comments grew dynamically from 2015 to 2019 when the application began to gain recognition from increasingly more users. This fact can be explained by expanding the action zone with new cities and adding new functions. At the beginning of 2015, 20 new cities, suburban zones and railway lines were added to the application. However, major cities were already served much earlier. Gradually, in the year 2008, Poznań was introduced to the service. In the following years, the area of operation was extended to the next seven large urban areas: Wrocław, Warsaw, Szczecin, Kraków, Łódź, Bydgoszcz and Toruń. For about ten years, the offer was extended to significantly smaller cities. Thus, the number of comments was more related to the popularisation of the service and not its availability in other cities.

The decrease in the number of users in 2020 was caused by restrictions related to the COVID-19 pandemic. During the pandemic, public transport was considered a contamination hazard, and the number of passengers decreased significantly. Additionally, timetables were limited to the necessary minimum. The scope of the analysed data does not allow conclusions about the application's popularity during the period of easing the restrictions after the pandemic.

In addition to the development of the application by adding new cities, the range of offered services increased (including the possibility to purchase tickets and track the location of vehicles in real-time). Their evaluation may be of particular interest to the application provider. The clear increase in the number of comments in 2015–2019 can be associated with extending the application's functionality.

The average app ratings in the analysed period slightly decreased. However, as already noted, the median in each analysed year was five, and more than half of the users assessed the app very well. The lowest average rating value recorded in 2016 was likely related to the increasing complexity of the application and growing user expectations. It should be noted that other platforms with similar functions were also developing in parallel, the most competitive of which

was Google Maps. In 2015, Google Maps introduced the possibility of using offline maps and many new functions.

It is more difficult to interpret the differentiation in the number and value of rates by gender. Especially for more than half of the comments, it was impossible to assign a gender, so there are no grounds to conclude that one gender does not dominate in this group. Undoubtedly, however, in the case of comments with the identified gender of the commentator, women rated the application higher than men by giving excellent ratings (5) and fewer poor ratings (1). The authors observed a similar relationship in another study, i.e., the analysis of comments from car-sharing applications (Pawełoszek, 2022). Therefore, it can be suspected that this is a general rule resulting from the psychological characteristics of gender, although it would require further research. Similarly, it is difficult to explain some differences in the length of written comments.

The analysis of the usefulness (thumbs up) of comments depending on the number of stars given to the comment indicated that the most useful comments were negative (one or two stars), indirect neutral comments (three stars), and the least useful were positive comments (four or five stars). This is understandable as the content analysis of the comments showed that these worse comments were more likely to indicate specific bugs and deficiencies of the application. Positive comments, in turn, generally praised the application only by confirming the correct operation, i.e., by confirming what should be the norm. Consequently, a detailed analysis of negative comments may be of significant value to the application developer. The creator of the JakDojade application responds to negative comments most often and quickly. In addition, other users can see the answer from the point of view of the application's developer. Such a strategy also aims at building the image of a company that cares about good contact with users and their loyalty.

From the company's viewpoint, the comment sentiment analysis at the most general level of identification of positive and negative emotions may have a complementary role to the analysis of the system's comments rating based on the number of stars. The sentiment analysis, like the number of stars, allows for observing trends in product evaluation. In the case of the tested application, the predominance of positive over negative emotions confirmed the observed high mean and median rating in the star system. Further, it is possible to isolate positive and negative emotions. In practice, however, it is difficult to identify the cause of a given feeling without analysing the content of the entire specific comment.

More practical information can be obtained from the semantic features' analysis of the tested application. However, it should be considered that for mobile applications, analogous but opposite features will appear both positive and negative, as in the case of "utility" and "uselessness". In this case, usability was assessed highly differently. In the case of the JakDojade application, the frequent occurrence of the "mistake" feature was also disturbing, which is probably related to the inconsistency of the provided timetables and proposed routes with the actual functioning of transport. It should be noted that sentiment analysis can be carried out (as in his study) to a large extent with the help of ready-made tools. On the one hand, this significantly simplifies the analysis, but on the other hand, the tool is then universal and not adapted to solving a specific problem. Consequently, the usefulness of such an analysis is often limited.

The procedure is different in the case of identifying typical problems appearing in the comments. The used approach required expert identification of the anticipated problem categories and assigning them to keywords. Such a procedure is often iterative, based on repeated attempts in the event of imminent failure. Keyword selection with this approach is partially subjective. The approach requires knowledge of the tested product or service and is associated with a greater amount of work, but the analysis is tailored to the solution of a specific problem. Ultimately, the authors distinguished ten categories for the tested application, assigning them several keywords. Some of the categories were universal for the evaluation of various mobile applications. Such an important category of problems typical of all mobile applications are those related to the stability, performance, and updates of the application (the "application" category). In the example used by the authors, as expected, many negative comments contained keywords assigned to this category. There were often other comments related to the application's features belonging to another distinguished category of "interface" and much less frequently to the category of "energy consumption".

The categories typical of most mobile applications also include "sharing personal data". In the discussed case, the keywords related to this category did not often appear in negative comments. Nevertheless, the business model of many mobile application providers, including JakDojade, is based on personal

data processing, which may raise user objection, and the level of such objection should be monitored.

A similar situation occurs when offering different versions of an application, usually the basic free version and the advanced paid premium version. This is also the case with JakDojade. The negative comments included several keywords assigned to the "premium version" category, which may indicate the dissatisfaction of users with such a pricing policy or a malfunction of the paid version. On the other hand, such comments may indicate the limitations and shortcomings of the basic product version, including the nuisance of displayed ads.

Another group of categories is related to the specificity of the application or related services. In this case, such a category is primarily "timetables". In negative studied comments, it was by far the most important category, which is in line with previous assumptions. The comments relate to incorrect and outdated timetables, inconvenient proposed routes, and incomplete real-time information. This category is related to another distinguished category concerning holiday schedules (the "holiday" category). Another important category was related to the application's basic functionality, i.e., the purchase of tickets (the "finance" category). The comments analysis shows that errors resulting from unsuccessful ticket purchase transactions using the application are extremely bothersome.

A characteristic feature of the JakDojade application is its diversified usability in individual cities due to the specificity of local public transport. Hence, the comments had keywords assigned to the "cities" category. This is mainly due to the location of the existing problems in the geographic comments (usually related to timetables or the purchase of tickets). However, contrary to the authors' expectations, the number of such keywords was not significant. The application usually does not receive comments from people from cities where the service has not been implemented. Hence, there are few entries for the limited number of cities where the service is provided.

Some keywords may be difficult to interpret due to their ambiguity. For example, "navigation" can, on the one hand, be understood in the context of geographical navigation related to the user's location and the location of individual public transport vehicles. On the other hand, it can also be understood in the context of navigation within the user interface. Here, the analysis of the coexistence of keyword pairs or their categories, as well as the confidence analysis, can be useful. The co-occurrence results (Fig. 11) showed a strong relationship between the "navigation" category with both the "interface" category and the "timetables" category. At the same time, the confidence analysis (Fig. 12) showed that a significant part of the comments relating to the category "navigation" referred simultaneously to at least one of the categories: "interface", "application", or "timetable". Such links help to understand the context of the keywords' occurrence.

However, some of the strong co-occurrences between the most popular categories (e.g., the most popular "application" and "timetable" categories) are trivial, generally related to the intended use of the application, and, in practice, not interpretable. It is also possible to analyse the coexistence of three or more categories, i.e., either those with the strongest support or expertly selected combinations of several categories. This is justified when it is difficult to interpret the presence of individual categories or their pairs.

The above analyses can at least partially be automated thanks to the semantic analysis of the text. Unfortunately, in practice, it is necessary to examine the content of individual comments in parallel to understand their meaning more precisely. The authors had almost 8 000 comments at their disposal. The random selection showed that they often described specific situations in which the application did not work properly (e.g., timetables, purchase of tickets, updates of the application or timetables, operation of the application on specific devices, the complaint handling process, etc.). It is an important source of knowledge for application developers, but this type of comment analysis is very laborious. In addition, many comments contain numerous typos, incorrect abbreviations, and other linguistic errors, making it a challenge for automated analysis.

Conclusions

The research confirmed the usefulness of analysing comments on mobile applications posted in application stores. Such analysis helps application developers identify and understand user problems. However, the possibilities of automating this type of analysis are very limited. Simple tools that do not require a significant amount of work, such as the analysis of the ratings given to the application by its users or automated sentiment analysis, do not sufficiently explain the motivations of the evaluators. The semantic analysis of the content of comments gives

much greater possibilities. Still, it is associated with a more significant workload resulting from the need to select the appropriate keywords and their proper categorisation, which is related to the amount of work but also requires a good knowledge of the tested application at the beginning. In practice, if an application developer expects detailed information about user feedback, they usually have to refer to the content of specific opinions. Their analysis can, to some extent, be automated thanks to text mining tools, but it already requires much work.

The authors' initial intent was to question the extent to which the analysed comments would concern the application and the entire service. In the case of JakDojade, comments could relate to the quality of public transport in general, timetables, punctuality, and other factors independent of the application. However, the analysis of the comments showed that the vast majority of entries concerned the application and not its broader context. This is an important conclusion from the viewpoint of the usefulness of the proposed method for managing the software development and maintenance process.

Therefore, it was possible to diagnose typical user problems for the selected JakDojade application, which may help indicate further development directions. However, most of all, it was possible to demonstrate some, though partially limited, usefulness of the proposed methods of researching user comments from the point of view of managing the development of mobile applications. It should be assumed that similar methods can also be used in the case of other products and services, although it should be noted that access to comments related to mobile applications is extremely convenient due to their distribution through online stores with extensive comment systems.

Literature

Abnett, K. (2022). EU lawmakers back ban on new fossil-fuel cars from 2035, *Reuters*. Retrieved from https://www.reuters.com/business/autos-transportation/eu-lawmakers-support-effective-ban-new-fossil-fuel-cars-2035-2022-06-08/

AlKheder, S. (2021). Promoting Public Transport as a Strategy to Reduce GHG Emissions from Private Vehicles in Kuwait. *Environmental Challenges*, *3*, 100075. doi: 10.1016/j.envc.2021.100075

Banister D. (1995). *Transport and Urban Development*, London, UK: E & FN Spon.

Bubelíny, O., & Kubina, M. (2021). Impact of the concept smart city on public transport. *Transportation Research Procedia*, *55*, 1361-1367. doi: 10.1016/j.trpro.2021.07.120

Buran, B. (2023). Sentiment Analysis on Public Transportation During Covid-19: An Exploratory Study. In F. Calisir (Ed.), *Industrial Engineering in the Age of Business Intelligence. GJCIE 2021. Lecture Notes in Management and Industrial Engineering* (pp. 119–132). Cham: Springer. doi: 10.1007/978-3-031-08782-0_10

Carter, R. (2022). *The Ultimate List of Online Review Statistics for 2022*, B2B Insights. Retrieved from https://findstack.com/online-review-statistics/

Das, S., Boruah, A., Banerjee, A., Raoniar, R., Nama, S., & Maurya, A. K. (2021). Impact of COVID-19: A radical modal shift from public to private transport mode. *Transport Policy*, *109*, 1-13. doi: 10.1016/j.tranpol.2021.05.005

Gimadi, D. (2021). Web-sentiment analysis of public comments (public reviews) for languages with limited resources such as the Kazakh language. In *Proceedings of the Student Research Workshop Associated with RANLP 2021* (pp. 65–68). INCOMA Ltd.

Gkiotsalitis, K., & Cats, O. (2021). At-stop control measures in public transport: Literature review and research agenda. *Transportation Research Part E: Logistics and Transportation Review*, *145*, 102176. doi:10.1016/j.tre.2020.102176

Hassenzahl, M., & Tractinsky, N. (2006). User experience - a research agenda. *Behaviour & Information Technology, 25*(2), 91-97. doi: 10.1080/01449290500330331

ISO 9241-210:2010. Ergonomics of human system interaction -Part 210: Human-centred design for interactive systems.

Janz, A., Kocoń, J., Piasecki, M., & Zaśko-Zielińska, M. (2017). *plWordNet as a Basis for Large Emotive Lexicons of Polish*. LTC'17 8th Language & Technology Conference. Poznań, Poland. Retrieved from https://www.researchgate.net/publication/322684200_plWordNet_as_a_Basis_for_Large_Emotive_Lexicons_of_Polish

Jelonek, D., Stępniak, C., Turek, T. & Ziora, L. (2020). Planning Cities Development Directions with the Application of Sentiment Analysis. *Prague Economic Papers*, *3*, 274-290. doi: 10.18267/j.pep.740

Law, E., van Schaik P., & Roto V. (2014). Attitudes towards user experience (UX) measurement. *International Journal of Human-Computer Studies*, *72*(6), 526-541. doi: 10.1016/j.ijhcs.2013.09.006

Maia, C.L.B., & Furtado, E.S. (2016). A Systematic Review About User Experience Evaluation. In A. Marcus (Ed.) *Design, User Experience, and Usability: Design Thinking and Methods*. DUXU 2016. *Lecture Notes in Computer Science*, 9746. Cham: Springer. doi: 10.1007/978-3-319-40409-7_42

McIlroy, S., Ali, N., Khalid, H., & Hassan A. E. (2016). Analyzing and automatically labeling the types of user issues that are raised in mobile app reviews. *Empirical Software Engineering*, *21*, 1067-1106. doi: 10.1007/s10664-015-9375-7

Mingyou, J. (2022). *Google-Play-Scraper*. Retrieved from https://pypi.org/project/google-play-scraper/

Noei, E., & Lyons, K. A. (2019). A survey of utilizing user-reviews posted on Google play store. In *Proceedings*

of the 29th annual international conference on computer science and software engineering 2019, (pp. 54–63). IBM Corp., USA, CASCON '19.

OECD (2022). *Efficient land use and public transport systems for sustainable cities (SDG 11)*. Retrieved from https://www.oecd-ilibrary.org/sites/79c1e03d-en/index.html?itemId=/content/component/79c1e03d-en

Ogrodniczuk, M., Pęzik, P., Łaziński, M., & Miłkowski M. (2022). *European Language Equality. D1.27 Report on the Polish Language*. Retrieved from https://european-language-equality.eu/wp-content/uploads/2022/03/ELE___Deliverable_D1_27__Language_Report_Polish_-1.pdf

Pawełoszek, I. (2022). Towards a Smart City—The Study of Car-Sharing Services in Poland. *Energies*, *15*, 8459. doi: 10.3390/en15228459

Połom, M., & Wiśniewski, P. (2021). Implementing Electromobility in Public Transport in Poland in 1990–2020. A Review of Experiences and Evaluation of the Current Development Directions. *Sustainability*, *7*, 4009. doi:10.3390/su13074009

Price, A. (2017). *The Negative Consequences of Car Dependency, Strong Town*s. Retrieved from https://www.strongtowns.org/journal/2017/11/2/the-negative-consequences-of-car-dependency

Rawal, P. (2018). *Public transport – A key element of smart cities*, Observator Research Foundation. Retrieved from https://www.orfonline.org/expert-speak/43591-public-transport-a-key-element-of-smart-cities/

Reimer, J., Häring M., Loosen W., Maalej W., & Merten L. (2021). Content Analyses of User Comments in Journalism: A Systematic Literature Review Spanning Communication Studies and Computer Science. *Digital Journalism*. doi: 10.1080/21670811.2021.1882868

Roto, V., Obrist, M., & Vaananen-Vainio-Mattila, K. (2009). *User experience evaluation methods in academic and industrial contexts*. In *Proceedings of the Workshop UXEM* 9 (pp. 1–5). International Conference on Human-Computer Interaction.

Saleh, A. M., Al-Badareen, A. B., & Enaizan, O. (2020). Automated user experience tool development for mobile application. *International Journal of Advanced Science and Technology*, *29*(6), 4929-4940.

Savary A., & Waszczuk J. (2020). Polish corpus of verbal multiword expressions. In *Proceedings of the Joint Workshop on Multiword Expressions and Electronic Lexicons*, (pp. 32–43). Barcelona, Spain: Association for Computational Linguistics.

Schindler, M., & Domahidi, E. (2021). The growing field of interdisciplinary research on user comments: A computational scoping review. *New Media & Society, 23*(8). doi: 10.1177/1461444821994491

Shahrour, I., & Xie X. (2021). Role of Internet of Things (IoT) and Crowdsourcing in Smart City Projects. *Smart Cities*, *4*(4), 1276-1292. doi: 10.3390/smartcities4040068

Stępniak, C., Jelonek, D., Wyrwicka, M., & Chomiak-Orsa, I. (2021). Integration of the Infrastructure of Systems Used in Smart Cities for the Planning of Transport and Communication Systems in Cities. *Energies*, *14*(11), 3069. doi: 10.3390/en14113069

Szumski, O. (2020). Technological trust from the perspective of digital payment. *Procedia Computer Science, 176*, 3545-3554. doi: 0.1016/j.procs.2020.09.032

Szymkowiak, M., Klimanek, T., & Józefowski, T. (2018). Applying Market Basket Analysis to Official Statistical Data. *Econometrics*, *22*(1), 39-57. doi: 10.1261/rna.7252205

Vermeeren, A., Law E., Roto, V., Obrist, M., Hoonhout, J., & Väänänen, K. (2010). User experience evaluation methods: current state and development needs. In *Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries (NordiCHI '10)* (pp. 521–530). New York, USA: Association for Computing Machinery.

Wieczorkowski, J. (2019). Open Data as a Source of Product and Organizational Innovations, In *Proceedings of the 14th European Conference on Innovation and Entrepreneurship ECIE 2019*, *2* (pp. 1118–1127).

Wieczorkowski, J., Chomiak-Orsa, I., & Pawełoszek, I. (2021). *Big data w zarządzaniu* [*Big Data in Management*], Warszawa, Poland: Polskie Wydawnictwo Ekonomiczne.

World Bank (2022). *Urban Development.* Retrieved from https://www.worldbank.org/en/topic/urbandevelopment/overview

Zavitsas, K., Kaparias, I., Bell, M., & Tomassini, M. (2010). Transport problems in cities. *ISIS*, *1*. Retrieved from https://trimis.ec.europa.eu/sites/default/files/project/documents/20120402_173932_45110_D%201.1%20-%20Transport%20problems%20in%20cities%20-%20v3.pdf

Zhuge, H., Zheng, L., Zhang, N., & Li, X. (2004). An automatic semantic relationships discovery approach. In *Proceedings of the 2004 International Conference on the World Wide Web* (pp. 278-279). doi: 10.1145/1013367.1013434

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Industry and innovation in the Alto Minho region: assessing regional performance

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ABSTRACT

As a tool, the Sustainable Development Goals (SDG) guide local and regional leaders in developing policy approaches for better social development. SDGs are 17 ambitious objectives towards a greener, healthier, more peaceful and equal planet, promoted by the United Nations to achieve by 2030. Having this performance in mind, countries and regions can measure their level of SDG implementation and rethink how they could promote prosperity, cooperation among regions and progress. This study focuses on SDG-9: Industry, innovation and infrastructure in ten municipalities of the Alto Minho region, Portugal. The main idea is to assess the level of each municipality in the achievement of the indicators related to this SDG. The similarities and differences between the municipalities can underline areas for joint efforts or investments in the development policy. This paper selected a performance analysis as a tool for informing on the amount of effort required to achieve SDG-9 at a local level, i.e., the Alto Minho region in the north of Portugal. If the trend of evolution is maintained, only Viana do Castelo will reach the full range of indicators for SDG-9, and Caminha will have 50 % of the indicators achieved. The remaining municipalities will reach at least half of the indicators, thus achieving a value lower than half of the target value. This approach could be replicated in other SDGs and other regions. This assessment allows the region's stakeholders to indicate areas of required action to achieve the SDG.

KEY WORDS

Sustainable Development Goals, innovation, regional performance, mapping

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Introduction

With the global population increasing at a faster rate, it is predicted that it will reach 8.5 billion by 2030 and 11.2 billion by 2100. For the planet to remain sustainable, innovation and creativity will be increasingly important and decisive to allow more efficient and better use of resources worldwide.

The Sustainable Development Goals (SDG) of the United Nations' 2030 Agenda is intended to be a global task of society to ensure a development that satisfies the needs of the present, at the same time safeguarding or supporting ecosystems of the Earth,

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on which the present and future generations depend (United Nations, 2015).

Such development has a necessary dimension of entrepreneurial innovation and private sector intellectual property that seem to be absent in the literature on data sustainability.

In the era of digitalisation, the main factors for sustainable development are the construction and maintenance of adequate economic and social infrastructures, namely, energy, transportation, information technology, telecommunications, and education.

A more robust ecological innovation system is intended to be built, suitable for achieving sustainable development objectives, more specifically, SDG-9. With the existence of these facilities, the innovation systems can incorporate, adapt and produce new technologies suitable for sustainable development. The infrastructures, innovation, or business environment and the qualifications of the workforce are also the focal points of economic policies and planning. Information and Communication Technologies (ICT) are the infrastructures on which all countries should focus.

Likewise, the realisation of SDG-9 to build resilient infrastructures, promote inclusive and sustainable industrialisation and encourage innovation must be incorporated into the strategy to restore economic growth with social inclusion.

Regional development policies were initiated in Portugal a few decades ago due to the notorious asymmetry of the coastal and interior regions of the country. Although this asymmetry continues, the focus has shifted to the regions that display low demographic density and weak economic density. In Alto Minho, a region in the north of Portugal, more than 50 per cent of municipalities are classified as low-density regions. Nevertheless, in a technological and environmental era, as more people decide to live and work outside the crowded cities, there is a lack of the critical thinking needed to study low-density populated areas and identify different drivers to promote sustainable growth.

The municipal level is not always an optimal scale for promoting business investments or even the local supply of public goods and services. Therefore, it is necessary to make an inter-municipal analysis to understand the best features already offered or to be developed for better connections with neighbouring regions. In this context, an analysis of the ten municipalities of Alto Minho is performed, considering the Sustainable Development Goals (SDGs). SDGs are 17 ambitious objectives for a greener, healthier, more peaceful and equal planet, promoted by the United Nations to achieve by 2030. Using the SDGs, it is possible to create a framework for improving the quality of human life while respecting the surrounding environment on the governmental and urban levels or even in private companies or universities.

The data from the National Institute of Statistics from Portugal (INE) was used to select the SDG-9 indicators scrutinised at the municipal level; a statistical analysis was made.

This paper aims to analyse the differences between the ten municipalities of the Alto Minho region, in the north of Portugal, related to four SDG-9 indicators, which intend to build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation (United Nations, 2015). The objective is to verify if there is homogeneity throughout the different municipalities and, if not, identify in which area each municipality needs to invest in getting the established targets for each analysed indicator. The identified research question, RQ, is formulated as follows: "Are there similarities in the performance of several municipalities of the Alto Minho region on achieving the targets established by Agenda 2030 for SDG-9?" Two sub-questions are formulated as follows: SRQ1, "Which municipality of the Alto Minho region is closer to achieving the targets established by Agenda 2030 for SDG-9?" and SRQ2, "How much effort is needed to achieve SDG-9 at a local level in the Alto Minho region?"

The similarities and differences between the municipalities indicate areas for joint efforts with neighbouring municipalities or even investments in the development policy.

This paper is divided as follows. Section 2 presents a literature review of the concepts covered in the paper. Section 3 introduces the methodological approach used in this research. Section 4 demonstrates the main results and discussion related to SDG-9, discretised until the municipality context in the Alto Minho region. Finally, the last section presents the conclusions and suggestions for future lines of research.

2. Literature review

The Sustainable Development Goals (SDGs) and the 2030 Agenda, adopted by almost all the countries of the world in the context of the United Nations, define the priorities and aspirations of global sustain-

able development for 2030 and seek to activate global efforts around a set of common goals and targets (United Nations, 2015).

There are 17 SDGs in areas that affect the quality of life of all the world's citizens and those yet to come. Five general areas could be identified: people — focusing on the eradication of poverty and hunger, the promotion of dignity and equality; planet — focusing on sustainable consumption and production, the fight against climate change and the management of natural resources; prosperity — referring to personal fulfilment, economic and social progress; peace — cantered on peaceful, just and inclusive societies, free from fear and violence; and partnerships — referring to cross-cutting integration, interconnectedness and joint mobilisation on behalf of the most vulnerable (BSCD, 2022).

Actions in all dimension levels, i.e., national, regional, and local, are needed to achieve a sustainable future for the world (D'Adamo et al., 2021). The global goals aim to be relevant to all community levels, from global to local.

Localisation of global goals and sustainability efforts have played an important role in the advancement of sustainable development around the world because it aims to engage local stakeholders in the processes that affect local, national, and global development (ElMassah & Mohieldin, 2020; Szpilko & Ejdys, 2022).

Therefore, recent works have emerged related to the analysis of SGDs measures and evolution at different levels (Ibrahim, 2022; Berisha et al., 2022; Haas & Ivanovskis, 2022; Smith et al., 2022; D'Adamo et al., 2021; Gustafsson & Ivner, 2018; Allen et al., 2018). For example, D'Adamo et al. (2021) focused on a national perspective (Italy) where multi-criteria decision analysis (MCDA) is used to measure current sustainability performance. Ibrahim (2022) investigates utilised digital governance platforms using a case study of a Norwegian municipality to achieve the UN SDGs towards a smart and sustainable city, whereas Han et al. (2021), Vommaro et al. (2020) and Gustafsson & Ivner (2018) studied the implementation of sustainable policies at the municipal level in terms of strategic planning and management.

The business sector has a critical role to play and a conferred interest in contributing to achieving the SDGs as a driver for economic growth and employment and as a source of technology and innovation.

The SDGs are an opportunity for businesses to improve existing and implement new strategic actions and projects to contribute to regional, national, and global goals (Smith et al., 2022; United Nations, 2015).

Among the 17 SDGs, Goal 9 explicitly contributes to economic development based on industry, innovation and infrastructures that play an important role at all levels.

This implies that countries should focus on affordable and equitable access for all, such as transborder infrastructure, which will support economic development and human well-being, retrofitting industries to make them sustainable, efficient and innovative.

SDG-9 aims to build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation and is operationalised through five distinct targets, each paired with one or more indicators to monitor progress in its achievement, described below, based on United Nations (2015).

9.1. Develop quality, reliable, sustainable, and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all;

9.2. Promote inclusive and sustainable industrialisation and, by 2030, significantly raise industry's share of employment and gross domestic product, in line with national circumstances, and double its share in least developed countries;

9.3. Increase the access of small-scale industrial and other enterprises, in particular in developing countries, to financial services, including affordable credit, and their integration into value chains and markets;

9.4. By 2030, upgrade infrastructure and retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes, with all countries taking action in accordance with their respective capabilities;

9.5. Enhance scientific research, upgrade the technological capabilities of industrial sectors in all countries, in particular developing countries, including, by 2030, encouraging innovation and substantially increasing the number of research and development workers per 1 million people and public and private research and development spending;

9.a. Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological, and technical support to African countries, least developed countries, landlocked developing countries, and small island developing States;

9.b. Support domestic technology development, research, and innovation in developing countries, including by ensuring a conducive policy environment for, inter alia, industrial diversification and value addition to commodities;

9.c. Significantly increase access to information and communications technology and strive to provide universal and affordable access to the Internet in least developed countries by 2020.

The importance of the SDG-9 is traduced by different efforts promoted to measure and monitor their evolution in different countries, promoting the comparison between them. Kynčlová et al. (2020) introduced the SDG-9 index as a measure of countries' progress towards achieving SDG-9 industry-related targets, which intends to assess the extent to which countries have industrialised while promoting social inclusiveness and minimising natural resource use and environmental impacts. One year later, Saieed et al. (2021) applied the Green Economy Progress methodology to assess progress in meeting industry-related SDG-9 targets (SDG-9Pro). This progress index allows cross-country comparisons of progress based on five of the seven industry-related SDG-9 indicators that collectively capture the economic, social, and environmental dimensions of sustainable industrial development, including the CO2 emission intensity as the environmental indicator emphasising their relative importance among the five industry-related indicators in measuring progress towards sustainable industrial development. Recently, both indices were applied to measure the progress and performance of 20 sub-Saharan African countries in meeting four industry-related SDG-9, classifying countries as either active or passive and as either leading or lagging (Luken et al., 2022).

This work intended to analyse the SDG-9 at a regional level applied in a case study in the north of Portugal, to monitor the progress in meeting industry-related SDG-9 targets in the region and differences between municipalities.

3. Research methods

3.1. Alto Minho region

Alto Minho is a region in the north of Portugal. It is situated between the Minho River and Lima River, and is composed of ten municipalities: Arcos de Valdevez, Caminha, Melgaço, Monção, Paredes de Coura, Ponte da Barca, Ponte de Lima, Valença, Viana do Castelo and Vila Nova de Cerveira. It is a region of 2219 sq. km, with a total population of around 245 000 (CAOP, 2017). Six of the ten municipalities are considered low-density territories, which are areas with less than 100 inhabitants per sq. km or a GDP per capita of less than 75 % of the national average. Therefore, the challenges for achieving the SDG are higher because it is necessary to join efforts with the neighbouring municipality to use a good investment development policy.

From the municipal context, there are more than one hundred indicators from the seventeen SDGs provided by the Portuguese National Institute of Statistics — INE (2022). In this study, it was decided to centre the analysis on the indicators related to SDG-9.

3.2. SDG-9: Industry, innovation, and infrastructure

According to the United Nations Foundation (United Nations, 2015), investment in infrastructure and innovation are crucial drivers of economic growth and development. At the same time, constructing new greener infrastructures or reconfiguring existing ones could contribute to the reduction of environmental impacts and disaster risks. Thus, the development of industry drives the application of science, technology, and innovation.

The ODSLocal platform (ODSLocal, 2022), which made a preliminary study of some regions of Portugal using INE data, was used to select four indicators related to SDG-9, discretised until the municipal context, as described in Table 1. This platform has information available on the local SDG relating to progress indicator monitoring. However, there is a lack of information about most of the municipalities related to the Alto Minho region. Therefore, this study is a pioneer for the north of Portugal.

Table 1 provides a description of SDG-9 indicators and the units used for the analysis. The baseline value corresponds to the year of reference, 2015, where 5 % of municipalities had already been achieved. The target value is the number desirable to be achieved by 2030.

For this study, data from 2015 to 2020 were collected based on the INE (2022) database. Geographically, data was selected for each Alto Minho municipality and for Portugal to make the national comparison.

After gathering the raw data, the normalisation process was used to allow comparability; then, the

Tab. 1. Indicators used for SDG 9

Indicator	Indicator Description	Target	Unit	Baseline Value	Target Value
I9.1	Proportion of community participation in co-financed projects in the total capital revenues of municipal councils	9.1	%	0	81.7
I9.2	Full-time equivalent researchers (FTE) per 1000 inhabitants in institutions and companies with research and development	9.5	No.	0	5.2
I9.3	Expenditure on research and development of institutions and companies with research and development, per inhabitant	9.5	€ (thousands) /inhab.	0	0.37
I9.4	Broadband Internet access at a fixed location per 100 inhabitants	9.c	No.	14	37.3

Source: elaborated by the authors based on ODSLocal (2022).

aggregation of the indicators was made for SDG-9. The statistical analysis was done using Excel, allowing the visualisation and monitoring of the contributions and progress of each municipality concerning SDG-9.

The information for 2020 for each local region was used, as well as the baseline and target values, to produce maps with the trend and distance to the target value, encompassing the several challenges for each local region.

4. Research results

4.1. Regional evolution and performance

This section presents an analysis of each indicator, considering the evolution of each municipality from 2015 to 2020 through a graphical (a) and a more detailed comparison of the most recent years (b).

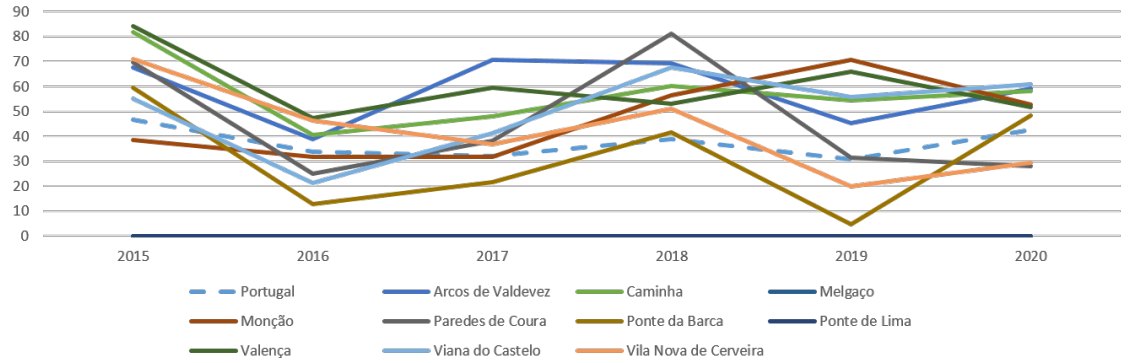
Indicator 9.1, represented in Fig. 1, is concerned with the proportion (%) of community participation in co-financed projects in the total capital revenues of municipality councils. Financial management is a crucial element of municipal management insofar as it enables the local government to plan, mobilise, and use financial resources efficiently and effectively, as well as fulfil its obligation to be accountable to its citizens.

Fig. 1(a) shows that most of the municipalities have a good performance, with higher proportions of community participation when compared to Portugal, which works here as a benchmark. Melgaço and Ponte de Lima have zero participation; therefore, their lines are on the horizontal axis. 2016 denotes a considerable decrease for most regions, but in recent years, the evolution has been more positive. In 2020, only four municipalities were above the national line, namely, Melgaço, Ponte de Lima, Vila Nova de Cerveira, and Paredes de Coura. Fig. 1(b) provides a more in-depth look at the most recent year showing that Arcos de Valdevez, Caminha, Monção, Ponte da Barca, Valença, and Viana do Castelo are the regions with at least around 50 % of community participation in co-financed projects.

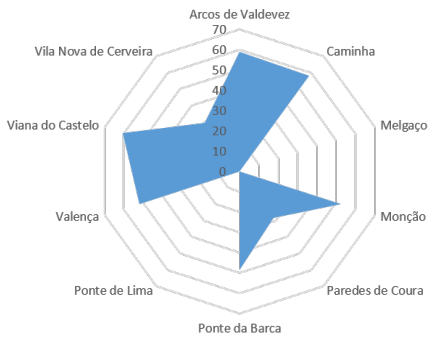
The number of researchers in the EU has increased in recent years: 1.89 million researchers (in full-time equivalents (FTE)) were employed in the EU in 2020, which marked an increase of 546 thousand compared with 2010 (Gustafsson & Ivner, 2018). Fig. 2 presents the results related to full-time equivalent researchers per 1000 inhabitants in institutions and companies in research and development (R&D).

The overall picture for this indicator is not encouraging (Fig. 2 (a)): over the analysed years, all municipalities were below the national benchmark by investing in researchers; the only exception was Vila Nova de Cerveira, which remained at the national level until 2019. It should also be noted that Caminha had a promising value in 2020.

Considering that the target value is 5.2, the Alto Minho region still has a long way to go (Fig. 2(b)). Only Caminha fulfilled the indicator, and Viana do Castelo and Vila Nova de Cerveira are halfway there. While researchers and policymakers recognise the importance of using R&D to create beneficial products and new development measures, translation is hampered by limited opportunities for interaction during the policy-making process and concerns over

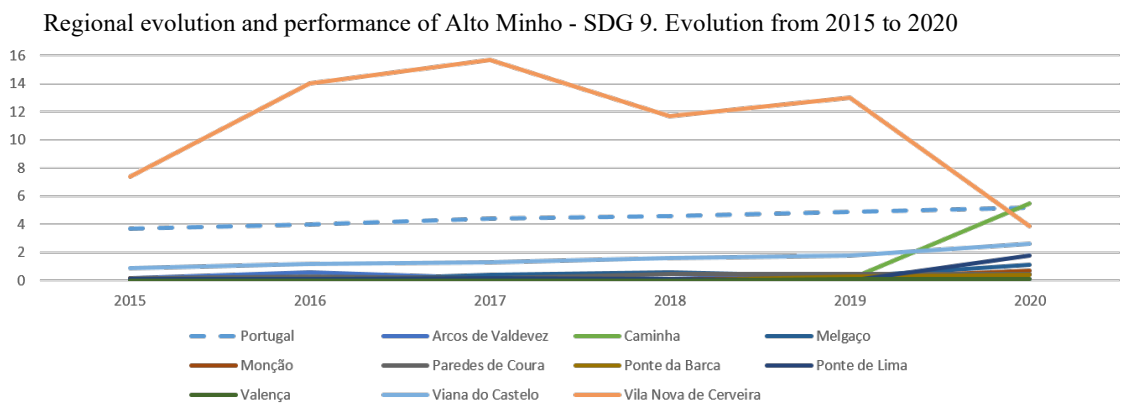


(a) Evolution from 2015 to 2020



(b) Municipalities in 2020

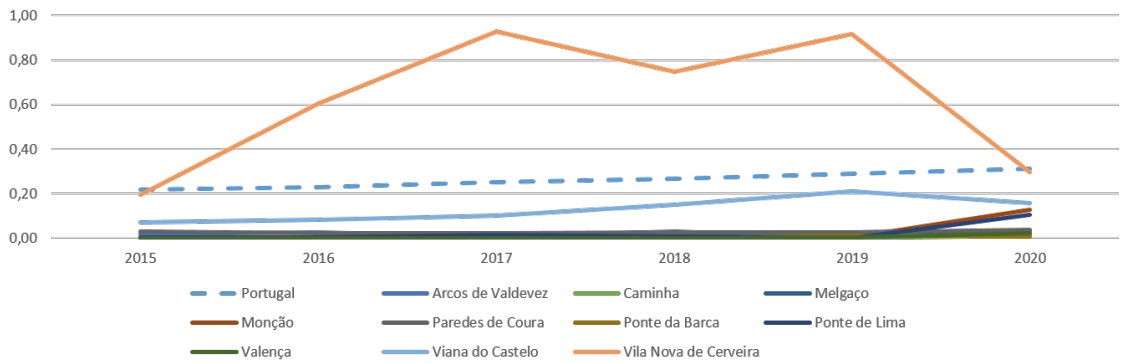
Fig. 1. Indicator 9.1: Proportion of community participation in co-financed projects in the total capital revenues of municipal councils



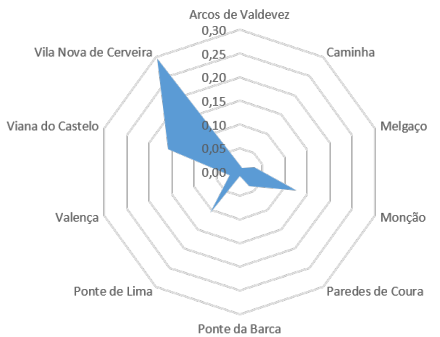
(a) Evolution from 2015 to 2020

(b) Municipalities in 2020

Fig. 2. Indicator 9.2: Full-time equivalent researchers (FTE) per 1000 inhabitants in institutions and companies with R&D



(a) Evolution from 2015 to 2020



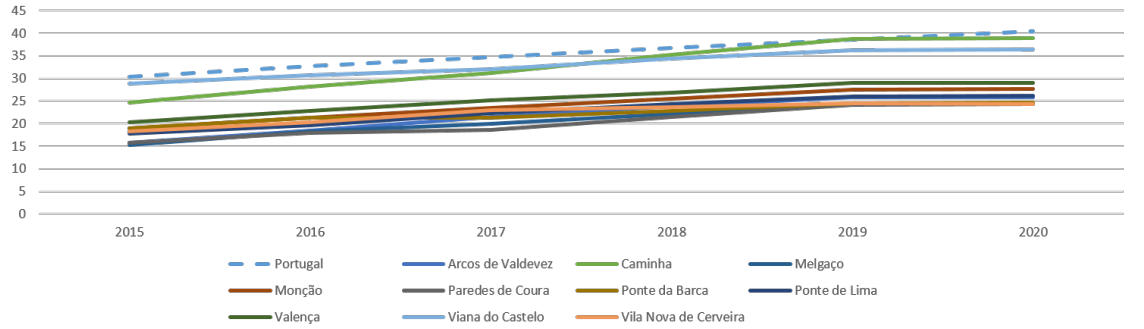
(b) Municipalities in 2020

Fig. 3. Indicator 9.3: Expenditure on R&D of institutions and companies per inhabitant

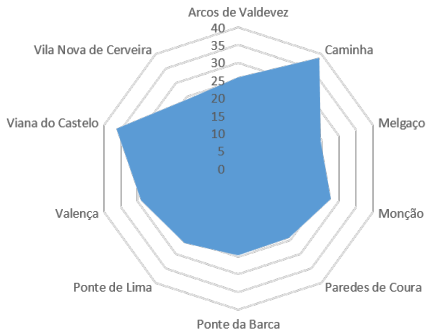
the political sensitivity of research findings. Most companies in these municipalities work in technology and renewable energy, which implies more recent research.

Another related indicator is the expenditure on research and development of institutions and companies per inhabitant. The amount of money spent on research and experimental development (R&D expenditure) is of considerable interest to national and international policymakers because it could work as a leverage on business R&D.

Fig. 3(a) agrees with the analysis of the previous figure, as only Vila Nova de Cerveira stands out. Viana do Castelo has shown an increasing trend,



(a) Evolution from 2015 to 2020



(b) Municipalities in 2020

Fig. 4. Indicator 9.4: Broadband Internet access at a fixed location per 100 inhabitants

except for 2020. The other regions are still in an embryonic state in terms of investment in R&D. When looking at the year 2020 (Fig. 3(b)), it appears that most municipalities have values below 0.05 thousand per inhabitant.

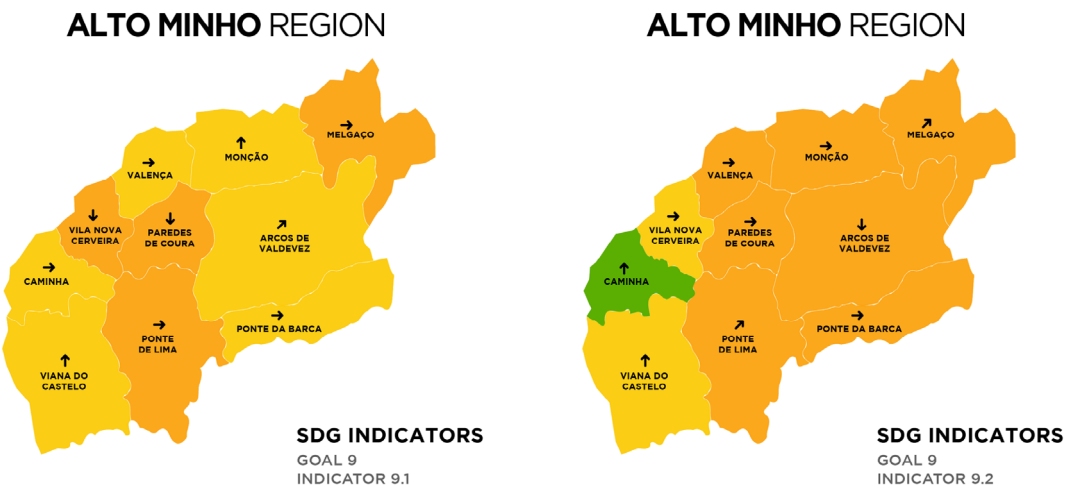
Finally, the last indicator was analysed: broadband Internet access at a fixed location per 100 inhabitants. In the EU, universal service in electronic communications (e-communications), as currently defined, means ensuring that all who so request are provided with those services essential for participation in society and already available to the great majority of citizens. The "access at fixed location" refers to the end user's primary residence (where several members of a household can share the connection) and not to a requirement for operators to use fixed technology.

Fig. 4(a) shows a positive evolution of this indicator. Although all municipalities are below the national proportion of the population that has access to the Internet, the path has always been up, with two localities almost reaching the national value (Caminha and Viana do Castelo). It should be noted that Alto Minho has several municipalities classified as low-density regions; therefore, these regions are not the most desirable for telecom operators. Even so, there is a national effort to cover all territories with broadband Internet to be more appealing for the implementation of new companies, with the final aim of creating more jobs and more dynamics in the local economy. However, analysing Fig. 4(b), this indicator is the one with the greatest homogeneity in its implementation.

4.2. Regional forecasting

Another perspective to assessing regional performance is to understand the status of each municipality on its path to 2030. It built an SDG-9 dashboard of the localities from Alto Minho, using the recent data for 2020: the given value for the municipality, the baseline value, and the target value for 2030, adapted for Portugal. The last two values for each indicator are described in Table 1.

Consequently, the scores gathered by each locality under each indicator were grouped and placed on



(a) Indicator 9.1

(b) Indicator 9.2

(c) Indicator 9.3

(d) Indicator 9.4

Fig. 5. Spatial analysis from Alto Minho of indicators of SDG-9

a "traffic light" table according to the following classification (ODSLocal, 2022):

- green — achieved, meaning that the most recent observed value of the municipality has already reached the 2030 target value;
- yellow — excellent performance, meaning that the most recent observed value of the municipality has not yet reached the target value but is more than halfway between the base value and the 2030 target value;
- orange — positive performance, meaning that the most recent observed value of the municipality is better than the baseline value but is less than halfway between the baseline value and the 2030 target value;
- red — negative performance, meaning that the most recent observed value of the municipality falls short of the base value.

This way, the process of visualising each indicator for each locality on a single map, is found in (Fig. 5). The overview of the Alto Minho region is that there is still a long way to go. Only Caminha has already reached half of the indicators. On the opposite side of the classification are Melgaço and Paredes de Coura, with all indicators in orange. None of the municipalities has any indicator in red, which gives hope that

with some effort, all municipalities will be able to reach the indicators in 2030.

Fig. 5(a) shows that 60 % of the municipalities are with excellent performance (yellow colour) to achieve the indicator. Fig. 5(b) highlights Caminha as the only board that has already reached the 9.2 indicator. Viana do Castelo and Vila Nova de Cerveira present an excellent performance. Interestingly, they are the three most north-western locations in Portugal. Indicator 9.3 is the one with the worst performance (Fig. 5(c)). All municipalities, except for Vila Nova de Cerveira, present a considerable distance from the 2030 objective. Finally, the indicator referring to broadband Internet access at a fixed location shows a heterogeneous behaviour (Fig. 5(d)). Caminha has already reached the goal, and 50 % of the municipalities are coloured yellow. The four municipalities that are still in orange colour are the locations with the least population, which may explain the low attractiveness on the part of telecommunications operators in promoting broadband services.

In addition to this analysis, the trend of evolution was analysed. The same value in 2020 in two different locations may indicate different behaviours considering the history (towards or away from the goal). Thus, the projection of the linear regression trend of all values observed since 2015 is analysed, and the result is classified according to four classes:

- Will reach (↑), meaning that if the observed trend continues, the municipality will reach the target value by 2030;
- Excellent dynamics (↗), meaning that if the observed trend continues, the municipality will not reach the target value but will be more than halfway between the base value and the 2030 target value;
- Positive dynamics (→), meaning that if the observed trend continues, the municipality will not reach the target value and will be less than halfway between the baseline and the 2030 target value;
- Negative dynamics (↓), meaning that if the observed trend continues, the municipality will not reach the target value and will fall short of the baseline value in 2030.

Fig. 5 also provides this information. Indicator 9.4 is the best quoted, with 90 % of the regions achieving this in 2030. For the remaining indicators, only a maximum of 20 % of the municipalities will reach the objective. Keeping the trend of evolution, Viana do Castelo, which is the capital of the district having the largest population, will be the only municipality to reach all the indicators. Usually, the main city has more opportunities to attract specialised human resources and, at the same time, the opportunity to differentiate services, making the area more attractive to live in. The adjacent municipalities of Viana do Castelo (Caminha and Ponte de Lima) will benefit from their location to increase their level of activity and, therefore, partially achieve the indicators. On the other hand, Arcos de Valdevez, Paredes de Coura and Ponte da Barca are the ones that will have more difficulties in achieving the goal. The other municipalities, especially in the north, have the Minho River and border Spain. This can contribute to increasing and/or expanding business opportunities and creating new opportunities for companies, possibly leading to new research projects.

5. Conclusions

Industry and infrastructures must be updated to achieve successful communities that can meet future challenges. Using new and suitable technologies and through investments in R&D, it is possible to construct a stable and prosperous society. This paper selected a performance analysis as a tool informing the amount of effort required to achieve SDG-9 at a local level.

Maintaining the current trend of evolution, in the context of the research questions, only Viana do Castelo will reach the full range of indicators for SDG-9, which is not a surprise since it is the capital of the Alto Minho region with a greater density of main services and population. On the other hand, Caminha already has 50 % of the indicators achieved, and the remaining two indicators will not be reached if there is no additional work.

Besides, indicator 9.4 will be the easiest to achieve for most municipalities. Three municipalities have a negative dynamic, i.e., Arcos de Valdevez for two indicators (9.2 and 9.3) and Vila Nova de Cerveira and Paredes de Coura for one indicator (9.1). This means that these municipalities have to increase their efforts related to human and financial resources if they want to be considered for the 2030 Agenda. The remaining municipalities will present at least half of the indicators, not only to be achieved but with a value lower than half of the target value.

It is, therefore, up to each municipality to define its specific targets to achieve the goals. Targets can be reached by joint action with neighbouring municipalities, verifying good local practices, as well as

redirecting efforts toward some of the indicators that are below the intended values.

This work was limited to the database available due to a huge number of indicators available in relation to different regions but a limited number for municipalities. Therefore, there is a need to have more SDG goals to make a complete framework for each municipality.

As a future effort, this methodology is intended to be adapted for other Portuguese regions with this SDG goal and for a complete analysis of all SDG goals for the Alto Minho region.

Acknowledgements

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Literature

Acuti, D., Bellucci, M., & Manetti, G. (2020). Company disclosures concerning the resilience of cities from the Sustainable Development Goals (SDGs) perspective. *Cities*, *99*. doi: 10.1016/j.cities.2020.102608

Allen, C., Metternicht, G., & Wiedmann, T. (2018). Initial progress in implementing the Sustainable Development Goals (SDGs): a review of evidence from countries. *Sustainability Science*, *13*(5), 1453-1467. doi: 10.1007/s11625-018-0572-3

Berisha, E., Caprioli, C., & Cotella, G. (2022). Unpacking SDG target 11.a: What is it about and how to measure its progress? *City and Environment Interactions*, *14*. doi: 10.1016/j.cacint.2022.100080

BCSD. (2022). Business Council for Sustainable Development Portugal. Retrieved from https://bcsdportugal.org

CAOP. (2017). Carta Administrativa Oficial de Portugal. Retrieved from https://web.archive.org/web/20181005153441/ http://mapas.dgterritorio.pt/viewer/index.html

D'Adamo, I., Gastaldi, M., Imbriani, C., & Morone, P. (2021). Assessing regional performance for the Sustainable Development Goals in Italy. *Scientific Reports*, *11*(1). doi: 10.1038/s41598-021-03635-8

ElMassah, S., & Mohieldin, M. (2020). Digital transformation and localizing the Sustainable Development Goals (SDGs). *Ecological Economics*, *169*. doi: 10.1016/j.ecolecon.2019.106490

Gustafsson, S., & Ivner, J. (2018). Implementing the Global Sustainable Goals (SDGs) into Municipal Strategies Applying an Integrated Approach. In W. Leal Filho (Ed.). *Handbook of Sustainability Science and Research. World Sustainability Series* (pp. 301–316). Cham: Springer. doi: 10.1007/978-3-319-63007-6_18

Haas, P. M., & Ivanovskis, N. (2022). Prospects for implementing the SDGs. *Current Opinion in Environmental Sustainability*, *56*. doi: 10.1016/j.cosust.2022.101176

Han, Z., Jiao, S., Zhang, X., Xie, F., Ran, J., Jin, R., & Xu, S. (2021). Seeking sustainable development policies at the municipal level based on the triad of city, economy, and environment: evidence from Hunan province, China. *Journal of Environmental Management*, *290*. doi: 10.1016/j.jenvman.2021.112554

Ibrahim, A. M. (2022). A mapping towards a unified municipal platform: An investigative case study from a Norwegian municipality. *Sustainable Futures*, *4*. doi: 10.1016/j.sftr.2022.100063

INE. (2022). Instituto Nacional de Estatística. Retrieved from https://www.ine.pt

Kynčlová, P., Upadhyaya, S., & Nice, T. (2020). Composite index as a measure on achieving Sustainable Development Goal 9 (SDG-9) industry-related targets: The SDG-9 index. *Applied Energy*, *265*. doi: 10.1016/j.apenergy.2020.114755

Luken, R. A., Saieed, A., & Magvasi, M. (2022). Industry-related sustainable development Goal-9 progress and performance indices and policies for Sub-Saharan African countries. *Environmental Development*, *42*. doi: 10.1016/j.envdev.2021.100694

ODSLocal. (2022). ODSLocal – Plataforma Municipal dos Objetivos de Desenvolvimento Sustentável. Retrieved from https://odslocal.pt/

Saieed, A., Luken, R., & Zheng, X. (2021). Tracking progress in meeting sustainable development goal 9 industry-related targets: An index for policy prioritization. *Applied Energy*, *286*. doi: 10.1016/j.apenergy.2021.116490

Smith, H., Discetti, R., Bellucci, M., & Acuti, D. (2022). SMEs engagement with the Sustainable Development Goals: A power perspective. *Journal of Business Research*, *149*, 112-122. doi: 10.1016/j.jbusres.2022.05.021

Szpilko, D., & Ejdys, J. (2022). European Green Deal — research directions. A systematic literature review. *Ekonomia i Środowisko*, *81*, 8-38. doi: 10.34659/eis.2022.81.2.455

Vommaro, F., Menezes, J. A., & Barata, M. M. de L. (2020). Contributions of municipal vulnerability map of the population of the state of Maranhão (Brazil) to the sustainable development goals. *Science of the Total Environment*, *706*. doi: 10.1016/j.scitotenv.2019.134629

United Nations. (2015). *Transforming our world: The 2030 Agenda for Sustainable Development*

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Analysis of conditions for supporting employee safety during the COVID-19 pandemic in manufacturing companies in Poland

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ABSTRACT
The COVID-19 pandemic has significantly and permanently changed modern life in the private and professional dimensions, where numerous consequences of the virus have affected employees and employers. Both groups were forced to implement numerous changes to ensure the work process's safety. The multi-dimensionality of this concept and, consequently, the multi-directionality of its potential and required actions taken by companies have become the basis for a theoretical and practical analysis of conditions for supporting broadly understood employee safety during the COVID-19 pandemic in selected production companies in Poland. The pilot studies' results indicated the leading direction and scope of actions taken so far, their main types, stimulating factors and barriers, perceived benefits and future trends. The article's conclusions may form the basis for universal good practices supporting the safety of employees in the production sector, which, regardless of the duration of the pandemic, may be used as effective and efficient improvement measures in generating measurable benefits for all stakeholders.

KEY WORDS
safety management, COVID-19 pandemic, manufacturing companies

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Introduction

The word "pandemic" has been constantly used by almost everybody for the past two years. Many changes were implemented and affected almost all aspects of life and every dimension, regardless of differentiating factors. Their strength, direction or required expenditures varied depending on the area and importance. Multi-directional analyses of the pandemic and its consequences dominated the latest local and international publications. However, research conclusions are still required regarding the specificity of geographical and socio-economic con-

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ditions of the ongoing changes in the B2C and B2B markets, where enterprises undertook numerous actions forced by the changed reality. Some measures were a consequence of various mandatory regulations, while others were undertaken voluntarily as a result of factors deemed important by individual entities. It should also be emphasised that the pandemic contributed to the transformation of long-term business strategies or current policies and became a trigger for a multi-dimensional transformation of behaviour and attitudes among all stakeholders directly and indirectly involved in the activities of enterprises.

The outlined issues contributed to a theoretical and practical analysis of employee safety in the pandemic context and the real associated threats. The overarching research objective was to identify activities contributing to increased employee safety in the production sector. Specific objectives aimed to identify the scope of activities, the stimulating and inhibiting factors and the achieved effects. The conclusions defined further directions in the prevention of possible external and internal threats in Polish production companies, which are also preliminary assumptions for further in-depth research.

The first section of the article presents an overview of the latest international literature on the pandemic implications for the manufacturing industry with a particular emphasis on conditions for workplace changes, which were implemented due to mandatory guidelines or undertaken voluntarily. This part of the article also refers to the new reality's impact on Polish businesses. A reference was made to the results of the latest nationwide research verifying the attitudes of industrial enterprises in the face of perceived threats. The second section explains the assumptions of a methodological approach used in this study. The following section discusses the results obtained and their analysis, and the final section presents the main research conclusions.

1. Literature review

1.1. COVID-19 and the manufacturing industry

The sudden pandemic outbreak shook the world and upset the social and economic balance. Despite the ability to manage risk and potential crises, which had been improved for many years, enterprises were not ready for such a sudden and intense change in their operation and the conditions of the worst recession since World War II. Interrupted supply chains, mainly as a result of the situation in China as the main sourcing site for many manufacturing industries, mandatory lockdowns and diametrical changes in purchasing behaviour, negatively impacted almost all sectors (Xu et al., 2020). Uncertainty and fear dominated the implemented global and local processes. The results of the conducted analyses indicate that the greatest volatility and destabilisation affected the automotive industry, the energy equipment and services industry, the oil, gas and consumable fuels industries and the airline industry. Entities related to distribution, healthcare, thrifts and mortgage finance are also uncertain about their future (Szczygielski et al., 2022). The scale of the consequences was evidenced by significant drops in such indicators as the gross domestic product by as much as 3.4 % in 2020, the global trade by about 5 % or even the Dow Jones Industrial Average Index (DJIA) and other market indices that lost one-third of their value between 2020 and 2022 (Congressional Research Service, 2021).

However, special attention should be paid to manufacturing entities, which have shown a greater susceptibility to disturbances in system continuity compared to the service sector, which contributed to, e.g., decreases in foreign direct investment (FDI) or total factor productivity (TFP) in 2020–2021. Further negative values are predicted in the near future, especially in the context of the raging inflation or the war in Ukraine. It should be noted, however, that the strength of the pandemic impact on the productivity of enterprises depends on many factors, so the declines are not and will not be uniform for the entire manufacturing industry (Bloom et al., 2020). Small and medium enterprises (SMEs) have experienced instant adverse effects due to logistical issues, reduced capacity utilisation and demand-side effects (Juergensen et al., 2020). The results of the conducted research clearly showed that the long shutdown period would have a negative impact on the functioning of SMEs and, in many cases, will lead to bankruptcy due to their limited working capital reserve and simultaneous increase in operating costs with reduced demand (Cai & Luo, 2020).

Undoubtedly, the pandemic has had numerous implications for the manufacturing industry at almost all stages of the production cycle and often resulted in the need to switch exclusively to online sales, which forced many entities to revise their inventory plans to ensure adequate stock coverage for customers

(Ardolino et al., 2022). Some entities were even forced to reorient their core production towards goods that were particularly desirable during the pandemic due to the significantly changed market structure. Such a transformation was successful only for some companies that were characterised by a high level of flexibility and the ability to quickly adapt to new customer needs and expectations, both in the B2C and B2B markets. Competencies in the use of digital technologies turned out to be key, which significantly facilitated the processes (Malik et al., 2020).

The production sector is crucial for the state of the economy; therefore, the losses incurred by the pandemic prompted production entities to implement numerous changes to minimise similar risks in the future. In addition to the diversification of suppliers, particularly in terms of their location and changes in the scope of the offer, great emphasis was placed on the verification of the existing strategic assumptions. Transformation towards an online business model, often as part of partnerships undertaken to strengthen the position, requires multi-dimensional changes from production companies, which, under the influence of a catalyst such as the COVID-19 pandemic, can be considered on three basic levels: organisational, processual and technological. The first highlighted variable concerns the long-term perspective in terms of the planned mission or vision under conditions of limited possibilities. In addition to obvious changes for remote work and the required safety restrictions, special emphasis should be placed on building awareness of the necessary changes and improving employee attitudes. Such surprising situations are often unforeseen and generate additional risk for enterprises, mainly in terms of quality and the disruption of internal and external relations. Therefore, maintaining mutually beneficial relations with customers also required significant changes, e.g., in the field of pre- and post-sales communication or modification of distribution channels and promotion of products. The process includes analyses of the pandemic impact on production management in individual industries, characterised by varying degrees of susceptibility to sudden changes in the business reality. In addition to process flexibility, supported by a high level of staff adaptability, a good, recommended practice is to change the logistics strategy towards reshoring (European Parliament, 2021). The process context is closely related to the technological context, which includes issues related to investments in innovative solutions supporting strategic assumptions. However, it should be emphasised that the specificity of the manufacturing industry often prevents a complete transition to the remote mode. Thus, e.g., the automation of processes or the use of autonomous machines does not solve all the problems arising from the pandemic.

The general changes in the realities of the production industry have forced smart and agile planning and process reengineering, which will probably be a permanent action to strengthen the resilience and transparency of supply chains even after the end of the pandemic (Kamal, 2020). Many manufacturers believe that the pandemic has only accelerated the inevitable digitisation processes, including in the field of forced employee education for better synchronisation on man–machine lines (Ardolino et al., 2022). It should also be noted that the transformation of modern production has also contributed to positive phenomena, such as reduced negative environmental effects resulting from declined transportation (Kumara et al., 2020) or digitised processes, including administrative, in support of production.

Based on numerous analyses regarding the operating conditions of production entities during the pandemic, several practical recommendations have been developed to ensure the pandemic and post-pandemic capabilities and operations. First, adjusting the toolboxes in the direction of ensuring a higher level of resilience and skills of pivoting and repurposing. In addition, the need to build organisational flexibility on multiple activity levels using digital technologies, identifying and dedicating resources for repurposing and rapid decision-making skills (Okorie et al., 2020).

In numerous rankings regarding the greatest potential for regaining the position of the manufacturing sector, specialists point to the economies of China and the USA as leaders. However, it should be noted that in Europe, Poland also has good ratings due to its favourable geographical location and relatively low labour costs with a qualified workforce.

1.2. COVID and workplace safety

The pandemic outbreak also had a measurable impact on the labour market. According to the International Labour Organization, full or partial lockdown measures affected almost 2.7 billion employees or around 81 % of the world's workforce. Now, approximately 38 % of the global workforce is facing a high risk of job loss or massive workforce displace-

ment as long-term consequences of changes in the operating conditions of business entities (International Labour Organization, 2020).

The need to comply with epidemic restrictions also significantly changed work rules. Modified existing guidelines and physical reorganisation of the workplace was not an easy process, although necessary for the continued operations of entities. Changes in the work culture supported by the implementation of modern ICT solutions have enabled many production entities to safely implement processes while maintaining similar and even higher resource efficiency than in traditional, stationary working conditions. Based on research results, this is also due to convenience, autonomy and the high level of psychosocial safety and well-being experienced by some people working from home (Mehta, 2021). However, safety in production enterprises is not only about ensuring social distancing, mandatory mask-wearing or hand disinfection but also different other measures that employers have been systematically obliged to implement. As the observation of economic practice shows, numerous additional actions were undertaken voluntarily by workplaces to protect resources against any undesirable disturbances. McKinsey's Organisation Practice has developed a set of good practices for employers to optimise the process of necessary changes. The recommendations concern areas related to ensuring safety and security, investing in trusting relationships, creating and maintaining a culture that focuses on inclusion, individuality and social harmony, and finally, establishing and linking employees to a clear purpose (McKinsey & Company, 2020).

The obligations of employers are a common dimension of analyses; however, the consequences for the other party to the employment relationship should also be considered. The pandemic, apart from fear for the safety of themselves and their loved ones, has caused many people to feel uncertain about further employment and its conditions, which, in some cases, may have even resulted in a decrease in the work quality and permanent changes in organisational citizenship behaviour, OCB (Vu et al., 2022). From the perspective of employees, the new areas of potential threat sources resulting from the changes include work–family interface, physical presence privilege, anti-foreigners (Asian) racism and discrimination, high health risks, extreme stress, including economic, presenteeism and supervisor support – safety leadership (Sinclair et al., 2020).

In the face of multi-dimensional threats, the key ability to survive in untypical conditions for the economy requires considerable awareness and involvement of all parties involved in the implementation of production processes. Bearing this fact in mind, many entities implement workplace safety management practices (WSPs) guidelines in practice. They contain a whole spectrum of recommended actions in the areas of strategies, policies, procedures, measures and activities that refer to employee health and safety in the organisation. Developing (creating) a safety climate requires a holistic approach and implementation of essential WSP, i.e., practices that are covered by regulatory mandates and "discretionary" WSP", practices perceived by employees as important but not mandated (Subramonya et al., 2022). According to the ILO, during and after the pandemic, employers and employees should focus on the following four WSP dimensions: management's commitment to safety, safety training, safety rules and procedures, and employee involvement to minimise the negative effects on social and economic dimensions (International Labour Organization, 2020). In addition, various system tools are recommended, such as the Total Worker Health approach, which integrates worker safety, health and well-being into the organisation by implementing key aspects of focusing on working conditions, utilising participatory methods, employing comprehensive and collaborative strategies, commitment from leaders, adhering to ethical and legal standards and data-driven change (Dennerlein et al., 2020). As well as numerous concepts optimising risk management actions for COVID-19 in the workplace, such as industrial hygiene decision-making or occupational and environmental health and safety frameworks (Zisook et al., 2020), numerous normative documents are also available, developed by such international organisations as the World Health Organization, the European Commission, the European Agency for Safety and Health at Work or the International Labour Organization. A general summary of guidelines of different international organisations on maintaining safety in the workplace under COVID-19 conditions is presented in Table 1.

To sum up, the pandemic has irrevocably changed the current understanding and perception of the importance of workplace and work culture. The new work standards are focused on ensuring the safety using a different formula than before. Remote work based on a flexible working schedule, regardless of whether and when the pandemic subsides, will remain in some organisations permanently as a more efficient and more economical form of employment.

Tab. 1. Main recommendations of international organisations in the field of safety in the workplace

Recommended actions	WHO (2020)	OSHA (2021)	ILO (2020)	IFMA (2020)	MSA/MC/ GSC (2020)
Enforcing social distancing (information boards, visual inspection, employee self-control)	X	X	X	X	X
Regular hand sanitisation	X	X	X	X	X
The widespread availability of disinfectants	X	X	X	X	X
Nose and mouth covers	X	X	X		X
Safety gloves at work		X		X	X
Disinfection procedures in workplaces, sanitising common surfaces	X	X	X	X	X
Physical barriers between workstations	X	X			X
Employee training on pandemic procedures	X		X	X	X
Ventilation and filtration of indoor spaces	X	X	X	X	X
Remote work, if possible	X	X		X	X
Limiting the number of persons in the room	X	X	X		X
Business continuity plans			X	X	
Flexible work arrangements			X		X

Source: (Kosieradzka et al., 2022).

In addition, current observation of economic practice already shows that as restrictions are relaxed, some companies will implement innovative solutions in the field of social distancing, including a four-day working day or individual days a week with the so-called alternative forms of work, carried out through videoconferencing platforms. However, this emphasis on flexibility applies to many issues related to the work performed, ranging from schedules to location and even dress code issues (Agba et al., 2020). It should also be mentioned that this direction of changes poses threats, e.g., in terms of excessive dehumanisation of the organisation and, consequently, the lack of a sense of identity with it and other employees, as the workplace is not only the physical dimension of the processes carried out but above all a common space for building relationships as well as self-improvement and achieving one's own goals (Ancillo et al., 2020). Therefore, all redesign of workplace procedures must be carried out reasonably and considering the well-being and balance of main stakeholders, primarily employers and employees.

1.3. COVID-19 and the Polish economy

The COVID-19 pandemic has also shaken the labour market in Poland. Despite the research results showing less severe negative economic effects of the coronavirus in this country compared to other European countries, the GDP in Poland decreased by 3.5 % in 2020, with the OECD average of 5.5 % (OECD, 2020). The Polish industry, particularly large entities unrelated to the construction industry, which was most affected by the crisis, also performed relatively well, with no significant economic downturns during the first pandemic year (GUS, 2022). Also, declarative data for the second year of the 2021 pandemic indicate that it was a successful time for Polish entrepreneurs because the profitability of companies was, on average, much higher than before. This does not mean that in practice, Polish production entities, in particular those representing micro, small and medium-sized businesses, did not have to face various challenges, such as maintaining employment or rising raw material prices and operating costs, further disruptions in supply chains and constant changes in the tax system, and sometimes even the need to change a business profile. Some of them were even forced to use commercial financial support instruments (PWC, 2020). The end of the pandemic does not change the cautious prognosis of the Polish industry regarding investment plans. The ongoing war in Ukraine and galloping inflation are among the post-pandemic events causing significant volatility and uncertainty regarding the conditions for the continued operation of Polish enterprises (EY, 2022).

Referring to the situation of workplace safety, it is necessary to quote the key government actions in this

area. First, the Act on special solutions related to the prevention, counteracting and combating of COVID-19, other infectious diseases and crisis situations caused by them was passed in March 2020. It was the first official tool regulating the rules for supporting entrepreneurs, particularly in the field of job protection and other effects of forced economic downtime. In addition, entrepreneurs gained access to various recommendations, aid packages and economic initiatives aimed at minimising any negative effects of the coronavirus, particularly in terms of the need to change social, health and economic behaviour. In terms of conditions for the functioning of workplaces, enterprises had to adapt to many new guidelines contained in newly developed sanitary standards. Obligatory access to disinfectants and other agents ensuring personal protection and the need to keep a distance of 1.5 metres are just examples of employers' obligations in the discussed context (Józefowicz & Smolińska, 2020).

The results of nationwide research conducted in 2020 on a sample of 646 economic entities, including 264 industrial enterprises, indicated the main directions of enterprises' activities in the event of emerging threats. All surveyed companies declared knowledge of at least one sanitary procedure minimising the risk of infection in the workplace. As many as 96 % of the surveyed companies have implemented sanitary procedures and preventive measures against COVID-19. More than three-quarters of the respondents introduced sanitary procedures for employees or their customers. In turn, 29 % of companies introduced more flexible work organisation/working time changes (PARP, 2020). Other national research conducted in 2021 on a sample of 600 manufacturing enterprises only made it possible to determine specific formal, legal, technical and organisational solutions implemented during the pandemic. In the course of the analyses, differences were demonstrated in the scope of measures used depending on the industry or size of the entity. The food industry was the best in terms of the number of safety measures applied, probably mainly due to the high sensitivity of this sector and, thus, the earlier advancement in the area of occupational health and safety (Kosieradzka et al., 2022).

The COVID-19 pandemic consequences can be considered in the internal and external context of entities, e.g., related to maintaining the continuity of the supply chain. However, regardless of the direction of the threat impact analysis on the processes carried out by enterprises, the most important issue seems to be the protection and safety of employees, who are an essential element shaping the adaptive potential of each company regardless of profile or size.

2. Conditions for supporting employee safety during the COVID-19 pandemic in production companies in Poland: results of own research

2.1. Research methodology

The theoretical analysis conclusions on the issue became a reason for practical verification of the pro-safety conditions in Polish production entities during the pandemic. The purpose of the conducted research was to identify the multi-dimensional activities supporting employee safety and the specific research questions addressing such issues as scope, forms, benefits, barriers and directions of planned further initiatives within the framework of the analysed topic. Based on consultations with health and safety specialists from manufacturing companies, it was decided to use an online survey questionnaire. In addition to the received suggestions, the choice of this tool was also influenced by the numerous advantages of online surveys over traditional ones. First, it is time and cost savings and greater convenience and flexibility for respondents.

Considering the specifics of the respondents and the fact that the survey was preliminary for the planned in-depth research, the questionnaire included seven closed questions with a choice of several answer options, and for some questions, an additional option of entering an answer was provided. The structure of the questions resulted from research objectives, and answer options resulted from previous analyses, consultations with practitioners and author's own experience. The questions were primarily sent to top and middle management staff (almost 88 % of respondents) and employees responsible for/involved in safety issues in the organisation. The study was conducted in June 2022. The purposive sampling was primarily guided by the profile of enterprises and the high probability of return. A survey response rate of 70 % was achieved (out of 80 forms sent, 56 were returned filled). The survey was open-ended, maintaining the confidentiality of provided answers.

Tab. 2. Metrics of the respondents

Variables		Number of companies
Industry	Chemical	5
	Clothing and textile	2
	Construction	1
	Electromechanical	16
	Food	4
	Metal	20
	Others	3
Market served	B2C	2
	B2B	46
	B2C and B2B	3
Size (number of employees)	To 10	7
	11–50	35
	51–250	6
	251–500	2
	Over 500	1
Range of activity	Local	6
	National	34
	International	11
Capital held	Polish only	42
	Foreign only	6
	Joint venture	3
Respondent's position	Top management	38
	Middle management	7
	Specialist	4
	Others	2

Source: elaborated by the author based on own research Conditions for supporting the safety of employees during the Covid-19 pandemic in production companies in Poland, June 2022.

In total, properly given and complete responses were received from 51 production entities operating throughout Poland. Respondents represented the following industries: electromechanical, metal, chemical, construction, food and textile. Almost 90 % of respondents targeted their products to the B2B market, and the rest aimed at the B2C market or both. The surveyed sample was dominated by medium-sized and large companies (80 % of responses). The research sample structure is shown in Table 2, including the represented sector, the targeted market, the number of employees, the spatial scope of influence, the capital and respondent positions.

3. Results and discussion

As a result of the pandemic outbreak, all surveyed companies took additional measures to ensure occupational health and safety. The scope of implemented activities concerned the entire organisation among as many as 96 % of respondents. Other indications concerned the company's key departments, such as production or logistic support. This proves a high level of awareness and recognition of the importance of human resources for the ability of companies to survive under conditions of uncertainty and risk. This is probably an optimistic prognosis in the context of the necessary changes in employers' attitudes towards their employees, and not only in the event of threats to life and health or the likelihood of bankruptcy. As for the variety of forms of actions taken, these were primarily systemic changes in the way/philosophy of work (70 % of responses), as well as related modifications in the organisational structure (41 % of responses), probably aimed at facilitating and accelerating, e.g., decision-making processes in structures that are more flexible and dynamic, and, at the same

time, simplified as much as possible. The obtained results confirm the main directions of changes in enterprises, which are very similar to other countries affected by the pandemic (Pereira et al., 2021). Many companies have invested in broadly understood infrastructure, including, above all, in the area of IT tools (41 % of responses), which were supposed to facilitate, accelerate and frequently even enable work. In addition, almost one-fifth of the respondents purchased additional safety equipment for their employees, e.g., mobile robots for interior disinfection, detection gates with nozzles for spraying outer clothing or even steam cleaners on production lines. As part of building awareness of the need for change, many entities intensified their internal communication processes (40 %) and offered numerous workshops to familiarise themselves with the specifics of remote work and the conditions of possible isolation (35 %), as well as training, both in terms of possible threats and ways to minimise them (25 %) as well as modification of stakeholders relations, particularly with external customers (16 % of responses). Such activities, as shown by the results of numerous studies, are absolutely necessary if entities want to stay in the market, despite unfavourable conditions full of customer behaviour perturbations (Sobotkiewicz & Waniowski, 2022). Some entities (approx. 16 %) extended the medical packages offered to their employees, e.g., by a consulting psychologist. Therefore, as the discussed research results indicate, employers have implemented various optional measures that increase the broadly understood safety of their employees. Figure 1 shows the number of indications for individual answers.

When asked what their main stimulants were, over 70 % of respondents mentioned the concern for the existence of the company, associated with the requirement to continue key operational processes (41 %) and the desire to maintain mutually beneficial relationships with customers and other interested parties (31 %). Care for employees (37 %) and external factors, primarily including pressure from customers and other stakeholders (25 %) and actions of competitors (20 %), were important reasons as well. Interestingly, every fifth surveyed company implemented mainly these non-mandatory safety measures for purely marketing reasons to improve its image as a responsible employer (20 %). Expectations of employees, guidelines of normative documents or support from external sources, e.g., as part of financial government subsidies or free protection measures, were the reasons that guided about 10 % of the surveyed producers. Figure 2 shows the number of indications for possible variables.

The barriers encountered by the respondents were primarily related to the costs they had to incur when implementing the described measures (78 % of responses). In addition, a very high rate of resistance/lack of conviction among employees was recorded (67 %), which is surprising in the face of the pandemic and the declared significant fears for the life and health of oneself and loved ones. However, this result confirms the common negation attitude for all innovative activities implemented in companies, which

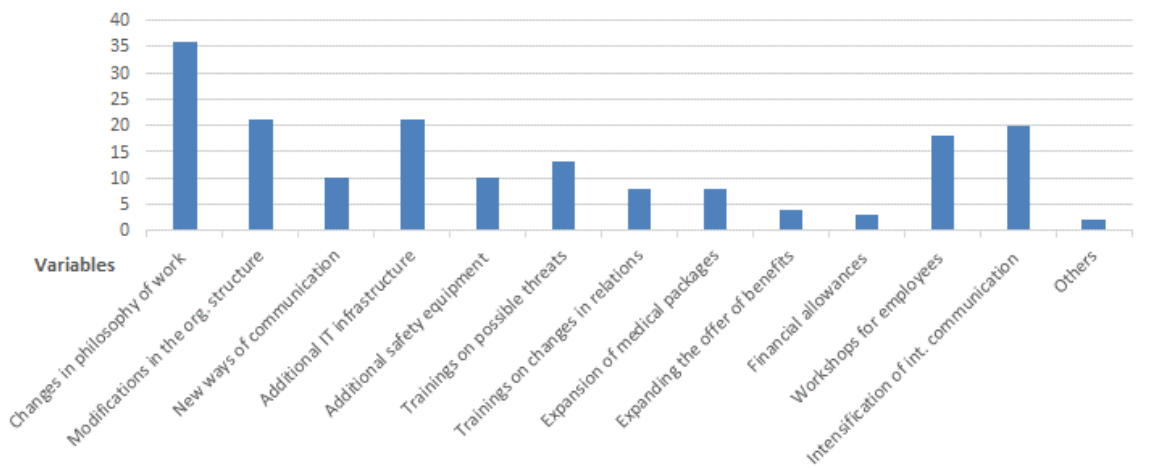

Fig. 1. Actions implemented to improve employee safety

Source: elaborated by the author based on own research Conditions for supporting the safety of employees during the Covid-19 pandemic in production companies in Poland, June 2022.

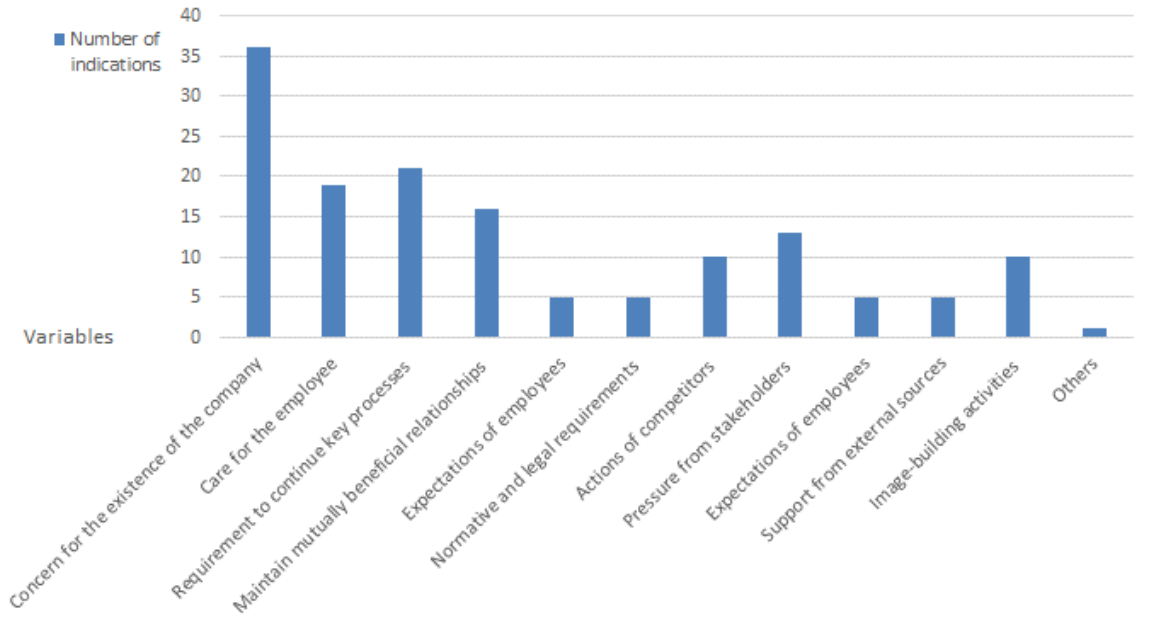

Fig. 2. Main factors affecting actions to improve employee safety

Source: elaborated by the author based on own research Conditions for supporting the safety of employees during the Covid-19 pandemic in production companies in Poland, June 2022.

also applies to the area of safety at work. The issue of changing attitudes towards security is often analysed in international literature. However, in the context of pandemic threats, it seems particularly important and interesting (Faiqa et al., 2022). Also, the obtained result confirms the importance of the skilful, conscious and systemic building of a safety culture in companies. The specificity of the implemented processes (35 %) and excessive bureaucracy (16 %) are often perceived as limitations. Other encountered

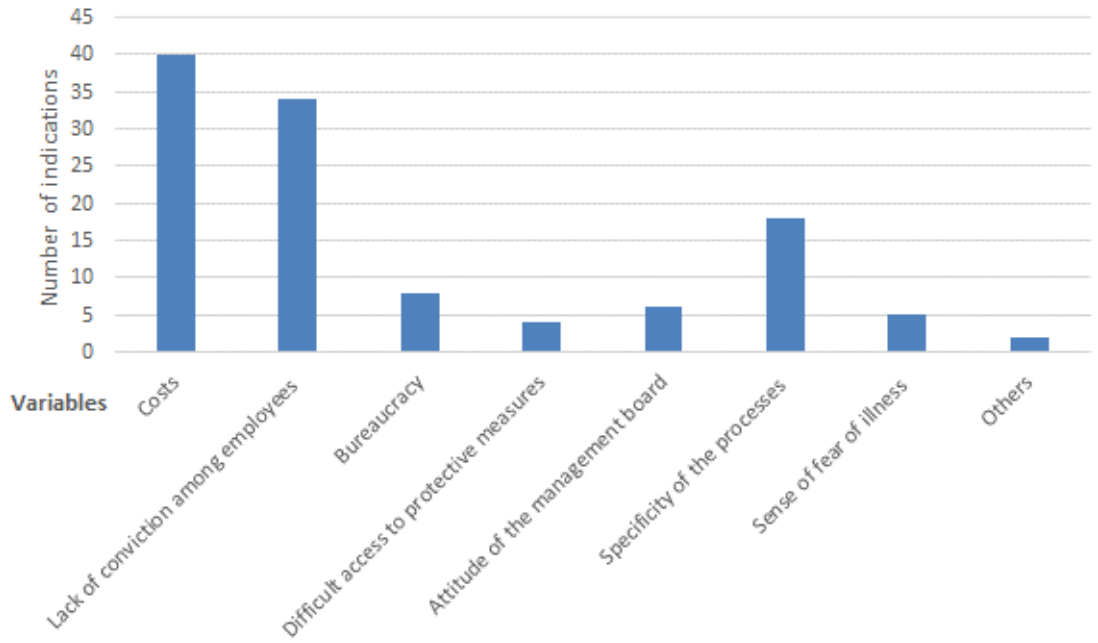

Fig. 3. Barriers encountered during the implementation of changes

Source: elaborated by the author based on own research Conditions for supporting the safety of employees during the Covid-19 pandemic in production companies in Poland, June 2022.

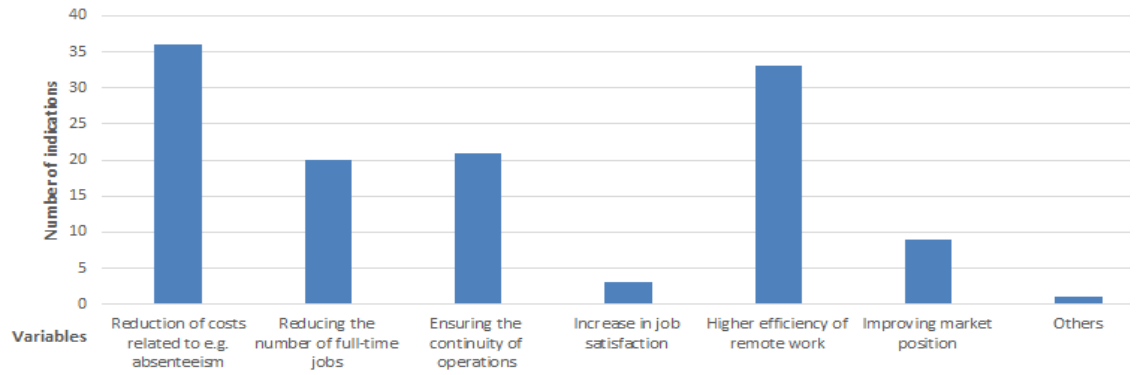

Fig. 4. Effects of the implementation of actions improving the safety of employees

Source: elaborated by the author based on own research Conditions for supporting the safety of employees during the Covid-19 pandemic in production companies in Poland, June 2022.

problems were related to the demotivating attitude of the management board, a sense of fear of illness and difficult access to protective measures. The numerical distribution of individual barriers is presented in Figure 3.

The implemented actions result in numerous consequences, both positive and sometimes negative. Over 70 % of entities reported such financial benefits as higher efficiency of remote work (65 %) while reducing the number of full-time jobs (40 %) or lower operating costs of their infrastructure (70 %). Another benefit is ensuring the continuity of operations (41 %) and, in some instances, improving their market position (18 %). A result of security measures was recorded by only 5 % of the surveyed companies. The most frequent benefits of employee safety measures are shown in Figure 4.

Further activity directions identified by the surveyed companies show that almost 60 % of them plan to maintain the implemented activities regardless of the national and global pandemic situation. 20 % of respondents intend to invest in new processes supporting current activities in the field of employee safety. A complete departure from the measures taken as a result of the pandemic and a return to the previous state was reported by almost 28 % of producers. Such declarations show that despite the experienced difficulties, the vast majority of manufacturing companies will continue the activities undertaken to ensure or improve occupational safety. This proves the growing awareness of the importance of employee safety among industrial entities operating in Poland. This trend is confirmed by the conclusions of global research, indicating the key importance of workplace safety in many aspects of company operations, e.g., in the context of their strategic development (Milijić et al., 2017), productivity (Lelo et al., 2019) or the possibility to implement guidelines regarding currently dominant concepts, such as the Fourth Industrial Revolution (Chia et al., 2019).

Conclusions

The coronavirus threats have changed the world in almost all dimensions, including professional. The contemporary perception of the workplace is no longer limited only to the physical place of work but became a much broader concept consisting of various analysis perspectives, including those related to its social functions, such as building social relationships, gathering, creativity, training, motivation, engagement and self-realisation (Ancillo et al., 2020). Understanding the importance of the workplace in the context of increasing the efficiency and effectiveness of implemented processes, employers are increasingly willing and, above all, consciously and responsibly invest in various measures that increase the minimum required level of safety of their employees.

The so-called "Covid-19 Generation" is characterised by a specific approach to work, which is different than before, requiring reorganisation. The perceived greater productivity and improved work–life balance are the factors that encourage many young employees to stay in the hybrid work mode for good (Zwanka & Buff, 2021). These changes in the mentality of employees mean that the COVID-19 workplace reopening process will require employers to consider many factors, including those related to

the heterogeneity of return-to-work outcomes as well as workplace factors (e.g., supervisor support, ability to accommodate and physical demands), psychological factors (e.g., perceived impairment, job stress, coping, fears of re-injury or worsening health conditions, catastrophising) and also social factors (e.g., family caregiving roles, social support, economic factors) (Shaw et al., 2020).

The pandemic phenomenon has particularly highlighted the importance of workplace safety and intensified the activities of practitioners and theoreticians of the subject in various countries of the world. Therefore, the literature provides numerous practical tips for supporting the management of this area. In addition to the safety management paradigms developed, based on such research results as management commitment to safety, safety rules and procedures, safety training, personal appreciation of risk and safety communication and determining the strength of their impact on employee well-being (Ajmal et al., 2021), many authors significantly emphasise the importance of motivation and other factors that build a sense of employee safety and happiness, which is desirable in a pandemic (Singh & Mishra, 2020). Employers understanding and meeting employee needs during a pandemic can also use the crisis in context theory (CCT) concept framework, which will facilitate the identification of organisational actions or responses to help employees to better adapt to the COVID-19 crisis (Teng-Calleja et al., 2020; Tan & Antonio, 2022).

In conclusion, as per Maslow's motivation theory, security is one of the five basic human needs. This applies to the broadly understood human environment, including the one related to professional life. This is why more employers work on ensuring safety, recognising that employees will be more motivated to work and perform (Wolor et al., 2020). However, the optimal selection of optional measures should be emphasised to increase employee perception of safety as the result of knowing the specifics of the company and its resources because, as research results show, there are significant differences in the scope of managed organisational support, depending on such variables as employment status or work location (Daniels et al., 2022).

Conclusions from the theoretical and practical analysis of workplace safety in production companies can be used to improve the described scope and indicate to employers further directions of action to increase the level of employee safety in accordance with their needs and expectations.

This research is based on a review of recent international literature and a pilot study of production entities in Poland regarding the approach to increasing occupational safety during the COVID-19 pandemic. The subjectivity of the respondents' assessments, mainly managers, can be considered a weakness of the method used. However, it is these subjective leader decisions that largely determine the selection of measures in the field of workplace safety. Since the study was preliminary, future analyses require broader methods and research scope, as well as a wider selection of respondents to compare the perceptions of decision-makers and employees of production entities.

Literature

Agba, A. M. O., Ocheni, S. I., & Agba, M. S. (2020). COVID-19 and the World of Work Dynamics: A Critical Review. *Journal of Educational and Social Research*, *10*(5), 119-130.

Ajmal, M., Isha, A. N. S., Isha, N., & Naji, G. M. (2021). Safety Management Paradigms: COVID-19 Employee Well-Being Impact on Occupational Health and Safety Performance. *Journal of Hunan University Natural Sciences*, *48*(3), 128-140.

Ancillo, A., del Val Núñez, M. T., & Gavrila Gavrila, S. (2020). Workplace change within the COVID-19 context: a grounded theory approach. *Economic Research-Ekonomska Istraživanja*, *34*(1), 2297-2316

Ardolino, M., Bacchetti, A., & Ivanov, D. (2022). Analysis of the COVID-19 pandemic's impacts on manufacturing: a systematic literature review and future research agenda. *Operations Management Research*, *15*, 551-566.

Bloom, N., Bunn, P., Mizen, P., Smietanka, P., & Thwaites, G. (2020). *The Impact Of Covid-19 On Productivity*. National Bureau Of Economic Research. Working Paper, 28233. Retrieved from http://www.nber.org/papers/w2823

Cai, M., & Luo, J. (2020). Influence of COVID-19 on Manufacturing Industry and Corresponding Countermeasures from Supply Chain Perspective. *Journal of Shanghai Jiaotong University (Science)*, *25*(4), 409-416.

Chia, G., Lim, S. M., Sng, G. K. J., Hwang, Y. J., & Chia, K. S. (2019). Need for a new workplace safety and health (WSH) strategy for the fourth Industrial Revolution. *American Journal of Industrial Medicine*, *62*(4), 275-281.

Congressional Research Service, Global Economic Effects of COVID-19. (2021). Retrieved from https://crsreports.congress.gov R46270

Daniels, R. A., Miller, L. A., Mian, M. Z., & Black, S. (2022). One size does NOT fit all: Understanding differences in perceived organizational support during the CO-

VID-19 pandemic. *Business and Society Review*, *3*. doi: 10.1111/basr.12256

Dennerlein, J. T., Burke, L., Sabbath, E. L., Williams, J. A. R., Peters, S. E., Wallace, L., Karapanos, M., & Sorensen, G. (2020). An Integrative Total Worker Health Framework for Keeping Workers Safe and Healthy During the COVID-19 Pandemic. *Human Factors*, *62*(5), 689-696.

European Parliament. (2021). Study Requested by the INTA Committee: Post Covid-19 value chains: options for reshoring production back to Europe in a globalised economy. Retrieved from https://www.europarl.europa.eu/RegData/etudes/STUD/2021/653626/EXPO_STU(2021)653626_EN.pdf

EY Report, (2022). Polish companies in the second year of the pandemic - new challenges replace old ones. Retrieved from https://www.ey.com/en_pl/news/2022/05/ey_companies_pandemic_second_year

Faiqa, A. B., Syeda, M. A. Z., Saadia, A., Syed, R. A., Syed, N. A. Z., Karishma, K. L., & Syeda, S. F. (2022). Non-compliance to social distancing during COVID-19 pandemic: A comparative cross-sectional study between the developed and developing countries. *Journal of Public Health Research*, *11*(1), 2614.

GUS. (2022). Wpływ pandemii COVID-19 na koniunkturę gospodarczą – oceny i oczekiwania (dane szczegółowe) [Impact of the COVID-19 pandemic on economic prosperity – assessments and expectations (details)]. Retrieved from https://stat.gov.pl/files/gfx/portalinformacyjny/pl/defaultaktualnosci/5516/6/1/1/wplyw_pandemii_covid-19_na_koniunkture_gospodarcza__oceny_i_oczekiwania_-_aneks_do_publikacji.pdf

International Labour Organization (ILO). (2020). ILO Monitor 2nd edition: COVID-19 and the world of work–Updated estimates and analysis. Retrieved from https://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/documents/briefingnote/wcms_740877.pdf

International Labour Organization (ILO). (2020). In the face of a pandemic: Ensuring safety and health at work. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/publication/wcms_742463.pdf

Józefowicz, K., Smolińska, K., & Wiza, P. (2020). Działania na rzecz pracowników w czasie pandemii – przykłady wybranych przedsiębiorstw. *Intercathedra, 2*(43), 73-80.

Juergensen, J., Guimón, J., & Narula, R. (2020). European SMEs amidst the COVID-19 Crisis: Assessing Impact and Policy Responses. *Journal of industrial and business economics*, *47*(3), 499-510.

Kamal, M. M. (2020). The Triple-Edged Sword of COVID-19: Understanding the Use of Digital Technologies and the Impact of Productive, Disruptive, and Destructive Nature of the Pandemic. *Information Systems Management*, *37*(4), 310-317.

Kosieradzka, A., Smagowicz, J., & Szwed, C. (2022). Ensuring the business continuity of production companies in conditions of COVID-19 pandemic in Poland – Applied measures analysis. *International Journal of Disaster Risk Reduction*, *72*, 102863.

Kumara, A., Luthrab, S., Manglac, S. K., & Kazançoğlud, Y. (2020). COVID-19 impact on sustainable production and operations management. *Sustainable Operations and Computers*, *1*, 1-7.

Lelo, D., Yusof, S. M., & Purba, J. H. V. (2019). Influence of Work Safety and Work Stress on Productivity. *Proceedings of the International Conference on Industrial Engineering and Operations Management*, *3*(5-7), 3602-3609.

Malik, A. A., Masood, T., & Kousar, R. (2021). Reconfiguring and Ramping up Ventilator Production in the Face of COVID-19: Can Robots Help? *Journal of Manufacturing Systems*, *1*(60), 864-875.

McKinsey & Company. (2020). COVID-19 and the employee experience: How leaders can seize the moment. Retrieved from https://www.mckinsey.com/capabilities/people-and-organizational-performance/our-insights/covid-19-and-the-employee-experience-how-leaders-can-seize-the-moment

Mehta, P. (2021). Work from home – Work engagement amid COVID-19 lockdown and employee happiness. *Journal of Public Affairs*, *21*(4), 1-12.

Milijić, N., Mihajlović, I., & Jovanović, I. (2017). Analysis Of The Occupational Safety Factors In Production Companies, As Important Segment Of Their Strategic Development. *Proceedings of the International May Conference on Strategic Management*, 12-28.

OECD. (2020). Poland: investing in a greener, fairer economy will strengthen recovery from COVID-19 crisis. Retrieved from https://www.oecd.org/newsroom/poland-investing-in-a-greener-fairer-economy-will-strengthen-recovery-from-covid-19-crisis.htm

Okorie, O., Subramoniam, R., Charnley, F., Patsavellas, J., Widdifield, D., & Salonitis, K. (2020). Manufacturing in the time of COVID-19: An Assessment of Barriers and Enablers. *IEEE Engineering Management Review*, *48*(3),167-175.

PARP. (2020). Research COVID-19 Business Pulse Survey (COV-BPS)–Poland (in Polish). World Bank Group and Polish Agency for Enterprise Development. Retrieved from https://www.parp.gov.pl/storage/publications/pdf/PolandCOVBPS2SurveyPolandresultsPolishFINAL.pdf

Pereira, J., Braga, V., Correia, A., & Salamzadeh, A. (2021). Unboxing organisational complexity: how does it affect business performance during the COVID-19 pandemic? *Journal of Entrepreneurship and Public Policy*, *10*(3), 424-444.

PWC. (2020). Raport - Polski mikro, mały i średni biznes w obliczu pandemii COVID-19. Przychody, płynność i reakcja na wstrząs [Report – Polish micro, small and medium business in the face of the COVID-19 pandemic. Revenue, liquidity and response to the shock]. Retrieved from https://www.pwc.pl/pl/pdf/polski-mikro-maly-sredni-biznes-w-obliczu-pandemii.pdf

Shaw, W. S., Main, C. J., Findley, P. A., Collie, A., Kristman, V. L., & Gross, D. P. (2020). Opening the Workplace After COVID-19: What Lessons Can be Learned

from Return-to-Work Research? *Springer.* doi: 10.1007/s10926-020-09908-9

Sinclair, R. R., Allen, T., Barber, L., Bergman, M., Britt, T., Butler, A., Ford, M., Hammer, L., Kath, L., Probst, T., & Yuan, Z. (2020). Occupational Health Science in the Time of COVID-19: Now more than Ever. *Occupational Health Science*, *4*(1-2), 1-22.

Singh, P., & Mishra, S. (2020). Ensuring Employee Safety And Happiness In Times Of Covid-19 Crisis. *Suresh Gyan Vihar University International Journal Of Economics And Management*, *8*(2), 521-552.

Sobotkiewicz, D., & Waniowski, P. (2022). Changes in Relationships with Business Customers under the Influence Pandemic on the Example of a Medium-Sized Enterprise in the Paper Industry. *European Research Studies Journal*, *25*(2), 376-386.

Subramonya, M., Golubovskaya, M., Keating, B., Solnet, D., Field, J., & Witheriffe, M. (2022). The influence of pandemic-related workplace safety practices on frontline service employee wellbeing outcomes. *Journal of Business Research*, *149*, 363-374.

Szczygielski, J. J., Charteris, A., Bwanya, P. R., & Brzeszczyński J. (2022). The impact and role of COVID-19 uncertainty: A global industry analysis. *International Review of Financial Analysis*, *80*(3), 1-17.

Tan, R., & Antonio, F. (2022). New insights on employee adaptive performance during the COVID-19 pandemic: Empirical evidence from Indonesia. *Journal of Entrepreneurship, Management, and Innovation*, *18*(2), 175-206. doi: 10.7341/20221826

Teng-Calleja, M., Caringal-Go, J. F., Manaois, J. O., Isidro, M. Q. Y., & Zantua, R. M. S. (2020). Examining Organizational Response and Employee Coping Behaviors amid the COVID-19 Pandemic. *The Journal of Behavioral Science*, *15*(3), 34-50.

Vu, T. V., Vo-Thanh, T., Nguyen, N. P., Nguyene, D., & Chia, H. (2022). The COVID-19 pandemic: Workplace safety management practices, job insecurity, and employees' organizational citizenship behaviour. *Safety Science*, *145*, 105527,1-11.

Wolor, C. W., Solikhah, Susita D., & Martono S. (2020). How to Maintain Employee Motivation Amid The Covid-19 Virus Pandemic. *International Journal of Economics and Business Administration*, *8*(4),78-86.

Xu, Z., Elomri, A., Kerbache, L., & El Omri, A. (2020). Impacts of COVID-19 on Global Supply Chains: Facts and Perspectives. *IEEE Engineering Management Review*, *48*(3), 153-166.

Zisook, R. E., Monnot, A., Parker, J., Gaffney, S., Dotson, S., & Unice, K. (2020). Assessing and managing the risks of COVID-19 in the workplace: Applying industrial hygiene (IH)/occupational and environmental health and safety (OEHS) frameworks. *Toxicology and Industrial Health*, *36*(9),607-618.

Zwanka, R. J., & Buff, C. (2021). COVID-19 Generation: A Conceptual Framework of the Consumer Behavioral Shifts to Be Caused by the COVID-19 Pandemic. *Journal Of International Consumer Marketing, 33*(1), 58-67.

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Measuring quality perception of public services: customer-oriented approach

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ABSTRACT
The focus of this research is on assessing the perception of public service quality through a customer-centred approach. Public service quality comprises multiple factors that are prioritised differently by customers. Therefore, the study aims to conduct a literature review to identify the primary quality dimensions of public services and evaluate the heterogeneity of their perception within the context of Lithuania. The research measures the user perceptions of public service quality. The literature review allowed for identifying service quality indicators and grouping them into dimensions based on unifying characteristics. Such identification of service quality dimensions grounded the research methodology. An adapted SERVQUAL model was used to analyse data collected by a survey to interview customers of Lithuanian public service organisations. Logit and probit models were applied to examine the effect of socio-demographic characteristics and the type of service on customer perceptions of different quality aspects of the provided public services. Explored heterogeneity of attitudes and detailed analysis of socio-demographic factors revealed that women with higher education are the most satisfied users of public services, while less educated men usually have a negative attitude towards the quality of public services. The study confirmed that marital status and income level are not related to customer satisfaction with service quality. Although gender, age, family size, education level, and employment status explain heterogeneity in customer satisfaction, they still account for only a small amount of variance compared to the place of residence and type of service. The study is a significant contribution to the field of service engineering as it introduces a systematic approach to the development of service quality, incorporating models and methods that enable the assessment of service quality and efficiency. The literature review has identified several research gaps related to public service quality, including a lack of research on general public services and areas such as tourism, real estate management, fire protection and rescue.

KEY WORDS
public sector, public sector organisation, public services, service quality, SERVQUAL model, logit model, probit model

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Introduction

In an era characterised by turbulence, uncertainty, geopolitical tensions, and various challenges, such as the pandemic, energy concerns, and high inflation rates, the importance and role of the public sector have become increasingly significant. Consequently, the role of organisations providing public services has become twofold. First, these organisations are required to manage multiple challenges while demonstrating exemplary behaviour in securing the public health, maintaining economic vitality, ensuring national security and defence, and efficiently

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navigating all disruptions. Second, they must adequately represent the public interest, promptly respond to changing customer needs and provide quality services.

Indeed, service quality in the public sector is a complex and multi-dimensional concept that is challenging to measure and evaluate. Furthermore, many scientists interpret essence and substance of quality management in a different way (Kondrotaitė, 2012). The perception of quality in public services may vary depending on customer expectations, cultural background and personal experience. Moreover, the intangible nature of public services further complicates the process of assessing their quality (Yarmak & Rollnik-Sadowska, 2022; Ocampo et al., 2019). Therefore, it is important to understand and measure different dimensions of service quality that are relevant to customers and develop appropriate methods for evaluating and improving service quality in the public sector. Ultimately, the goal of providing high-quality public services is to meet customer needs and expectations and improve their satisfaction with the services they receive (Nor et al., 2022).

Public services are the primary means through which people interact with the public sector, and organisations offer a broad range of services to meet their needs and requirements. Although there is a diverse array of organisations and services provided in the public sector, most scientific research has focused on specific types of organisations and services. The majority of research has been conducted in the field of healthcare services (Gavahi et al., 2022; Rastoka et al., 2022; Dandis et al., 2022; Barrios-Ipenza et al., 2021; Sun & Li, 2020; Chin et al., 2020; etc.) and e-government (Ramakrishnan et al., 2022; Drobotowicz et al., 2021; Pedrosa et al., 2020; Wang & Teo, 2020; etc.) with a surge in interest since 2020. This growing interest can be attributed to the global pandemic, which highlighted the critical role of healthcare service providers and the transition to online services due to isolation measures. Recent studies on healthcare services have focused on topics such as healthcare quality, patient satisfaction and healthcare delivery. Meanwhile, research on e-government services has concentrated on such innovative technologies as artificial intelligence, electronic service quality and e-government adoption.

Although healthcare and e-government services have received increased attention since the pandemic, other types of public services maintained their level of attention during the analysed period. The literature review revealed a range of public services, including transportation and communication (Bubalo et al., 2022; Uvenc & Kulluk, 2020; de Aquino et al., 2019; Houria & Fares, 2019; Chica-Olmo et al., 2018; etc.) with the focus on such issues as service quality, customer satisfaction and user experience; research on finance, audit and tax administration has addressed such topics as transparency, accountability and the effectiveness of public funding (Furqan et al., 2020; Greenwood & Zhan, 2019; Chaluvadi et al., 2018; etc.); the studies on utility supply and environmental management have examined such issues as service quality, environmental sustainability and customer satisfaction (Pereira et al., 2022; Marques & Simoes, 2020; Li et al., 2019; Andersson et al., 2019; etc.). Meanwhile, research on education has focused such on topics as educational quality, access to education and educational equity (Klein et al., 2022; Hassan et al., 2022; Demircioglu & Audretsch, 2019; Besley & Malcomson, 2018; Jemeljanenko, 2018; etc.); studies on employment have addressed such issues as job creation, workforce development and labour market policies (Akil et al., 2022; Ocampo et al., 2019; Mulinari, 2018; etc.); research on social services has examined such issues as social welfare, poverty reduction and community development (Mu et al., 2022; Kriel et al., 2021; Lapuente & Van de Walle, 2020; Szpilko et al., 2020, etc.); studies on business support have focused on such issues as entrepreneurship, innovation and small business development (Walsh et al., 2022; Harviainen et al., 2019; etc.); research on cultural and sports services has addressed such topics as cultural heritage preservation, sports event management and tourism development (Koronios et al., 2019; Tubillejas-Andres et al., 2019; etc.); and studies on legal services (Waibel et al., 2018; etc.) have examined such issues as access to justice and legal aid provision while research on law enforcement services has focused on such topics as crime prevention and public safety (Araujo & Franca, 2021; etc.).

It appears that while there is a considerable amount of literature on public sector services in general, there is still a lack of research specifically focusing on certain areas of public services, such as tourism, real estate management, fire protection and rescue. Additionally, the existing literature emphasises different aspects of public sector activity without a unified approach, making it difficult to fully reflect the problems of public service quality. Some publications focus on outsourcing (Aragao & Fontana, 2022; Solino, 2019; etc.), institutional trust (Tanny & Zafarullah, 2022), organisational reputation (Aladwan & Alshami, 2021), quality frameworks (Rodgers

et al., 2019), high-performance organisations (Kalimullah et al., 2019), excellence models (AlZawati et al., 2020), total quality management with quality leadership (Kim, 2020; AlShehail et al., 2022; Lopez-Lemus, 2021), entrepreneurship (Rojikinnor et al., 2020), public empowerment (Westrup, 2018), employee creative behaviour (Al Hosani et al., 2021), and knowledge management processes (Balasubramanian et al., 2019), among other factors that affect the overall performance of the organisation. Furthermore, financial context is also considered as researchers explore ways to increase the efficiency of services while maintaining or increasing quality (Fletcher, 2018) etc.

In recent years, researchers have focused on designing a service quality evaluation system (He et al., 2022). However, evaluating public service quality is a complex and challenging task due to the diverse nature of public services and their various stakeholders.

Additionally, the quality of public services is not only determined by the satisfaction of the service recipients but also by the expectations of society as a whole, which often go beyond the specific service outcomes. Therefore, this literature review is a necessary step towards identifying the main dimensions for assessing the quality of public services and providing insights for improving the quality of public services in Lithuanian organisations. This review allows for gaining a deeper understanding of the challenges and opportunities associated with the provision of public services and developing recommendations for enhancing the quality of public services.

1. Literature review

A literature review was conducted to examine recent publications on service quality in the public sector to identify prevailing trends in service quality assessment, key aspects and criteria of assessment, and gaps in current research. The Web of Science database was used to retrieve the latest scientific papers published in the past five years (2018–2022), using such keywords as "service quality", "public organisations", and "service quality of public organisations". The examined period covers two years before and after the COVID-19 pandemic, given the impact of the pandemic on public organisations. All publications were exported to the Zotero bibliography program, which facilitated the initial screening for eligibility and the more in-depth analysis of articles. After the screening process, a total of 123 articles were analysed in detail, including 31 from 2022, 25 from 2021, 22 from 2020, 20 from 2019, and 25 from 2018.

The literature review highlighted the diversity and lack of unity among different types of public services. The distribution of scientific publications based on the type of public services is illustrated in Fig. 1. Public services were categorised according to the recommended classification of public services presented in Appendix 1. The review of recent literature revealed that a quarter of publications analysed public services in general without distinguishing any specific area of provided services, while the remaining publications were dedicated to a particular area of public services.

Despite variations in approaches to the public sector and its service quality indicators, studies can be categorised into three groups. The first group of research focuses on meeting customer needs and expectations. The second group comprises scientific research that emphasises the internal workings of public organisations and their employee attitudes towards work, as well as their motivation to provide quality services. The third research group is a mixture of both. The distribution of publications across these three groups is shown in Fig. 2.

The authors differentiate various quality indicators that can be used to measure service quality and customer satisfaction levels. However, researchers who examine public service quality from the customer's perspective concur that addressing and fulfilling the customer needs is crucial (Tanny & Zafarullah, 2022; Aladwan & Alshami, 2021; Chien & Thanh, 2022; Lim & Lee, 2021; Kelly et al., 2021). Given that customer expectations and satisfaction can be subjective and diverse, a multi-dimensional approach to measuring customer satisfaction is necessary, as evidenced by the varied service quality indicators leading to customer satisfaction identified by the authors. Examples of these indicators include promptness, helpfulness, benevolence, reliability, professionalism, honesty, and fairness (Tanny & Zafarullah, 2022); responsiveness and transparency (Lim & Lee, 2021); accessibility, reception, and handling of comments, feedback, and recommendations (Chien & Thanh, 2022) etc.

Additionally, the authors underscore that organisations can only provide quality public services by implementing a total quality management system (Lopez-Lemus, 2021; AlShehail et al., 2022). Research

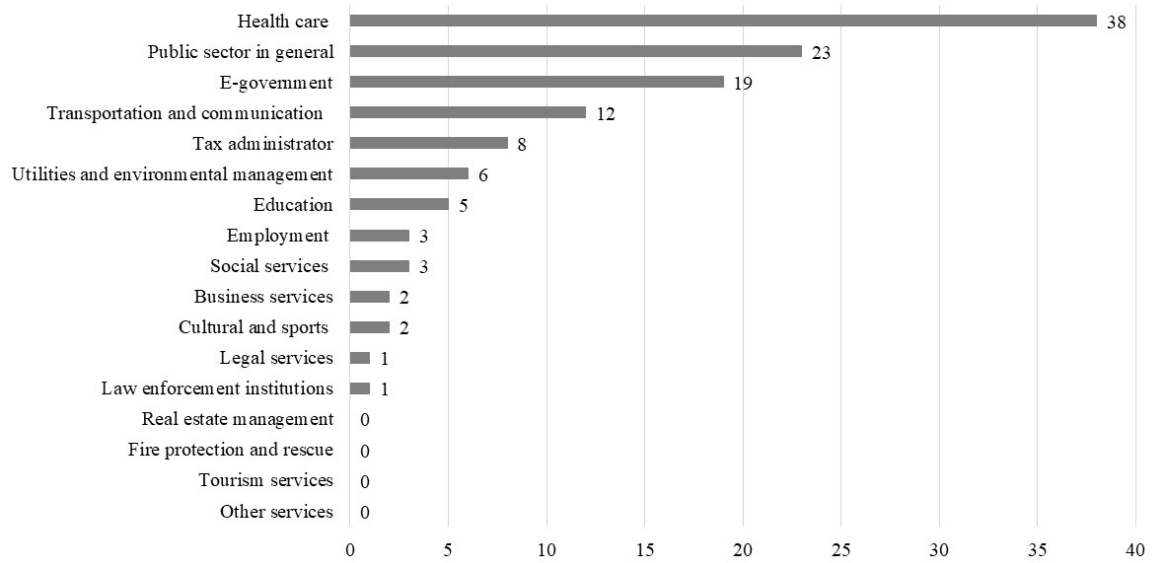

Fig. 1. Distribution of scientific publications according to the type of provided services (2018–2022)

Fig. 2. Distribution of scientific publications according to research orientation (2018–2022)

shows that the total quality management system can impact various dimensions of service quality, such as reliability, response capacity, assurance and empathy (Lopez-Lemus, 2021). Moreover, it can also drive digital transformation (Imran et al., 2022), service innovation (Tukiran et al., 2022) or sustainability performance in the public service sector (AlShehail et al., 2022).

It is imperative to note that while customer-oriented service provision is crucial, the employees of organisations providing such services play an equally vital role, thus making it a two-pronged process. Research suggests that customer service orientation has a positive impact on public employees' performance and work attitudes (Witesman et al., 2022). On the other hand, the delivery of quality services requires a combination of factors, such as skilled and experienced staff, outstanding infrastructure and operational management (Verma et al., 2022). Consequently, service quality can be viewed as a set of related but distinct dimensions comprising input (the bundle of service features) and output (the actual service outcome) (Shi & Cheng, 2021). The output dimensions include such aspects as reliability, thoroughness, efficiency, effectiveness and timeliness.

Following the literature review, articles were included analysing the public sector in general, without distinguishing services in specific areas but focusing on the customer. The selected service quality assessment indicators from recent articles were grouped for further analysis, as presented in Table 1.

The literature review identified public service quality indicators and grouped them into dimensions based on their shared characteristics. This grouping identifies ten service quality dimensions. Therefore, the empirical study was based on the premise that the

Tab. 1. Main quality indicators explored in scientific publications and their counterpart in the empirical model

Bibliography	Service quality indicators	Dimension
Aladwan & Alshami, 2021; Lopez-Lemus, 2021; Tanny & Zafarullah, 2022; Lim & Lee, 2021; Chien & Thanh, 2022	• organisational reputation	Reliability
	• trustworthy behaviour	
	• reliability	
	• safety	
	• inform users about the services they will receive	
	• the reception and handling of comments	
	• the results of the procedure settlement, etc.	
Tanny & Zafarullah, 2022; Lim & Lee, 2021; Lopez-Lemus, 2021; Kelly et al., 2021	• responsiveness	Responsiveness
	• fastness	
	• respond in a timely and timely manner	
	• response capacity	
	• promptness, etc.	
Tanny & Zafarullah, 2022; Lopez-Lemus, 2021	• prioritise the needs of users	Competence
	• competence	
	• professionalism, etc.	
Chien & Thanh, 2022; Witesman, Silvia & Child, 2022; Tanny & Zafarullah, 2022	• accessibility	Access
	• availability of information	
	• easy access to information, etc.	
Lopez-Lemus, 2021; Tanny & Zafarullah, 2022; Chien & Thanh, 2022	• courteous	Courtesy
	• civil servants' ethics and capacity	
	• benevolence, etc.	
Chien & Thanh, 2022; Kelly et al., 2021	• clarity	Communication
	• feedback, etc.	
Witesman, Silvia, & Child, 2022; Lim and Lee, 2021; Lopez-Lemus, 2021; Tanny & Zafarullah, 2022	• transparency	Credibility
	• assurance	
	• institutional trust	
	• honesty, etc.	
Kelly et al., 2021; Lopez-Lemus, 2021; Tanny & Zafarullah, 2022	• fairness	Security
	• empathy	
	• willingness to assist, etc.	
Chien & Thanh, 2022; Tanny & Zafarullah, 2022; Lopez-Lemus, 2021	• personalised attention to users	Understanding
	• recommendations	
	• helpfulness, etc.	
Lopez-Lemus, 2021; Vilke & Vilkas, 2018	• infrastructure	Tangibles
	• safe environment	
	• interior design of the government office	
	• seat in the waiting room	
	• parking, etc.	
AlShehail, Khan & Ajmal, 2022; Chien & Thanh, 2022; Tanny & Zafarullah, 2022; Lopez-Lemus, 2021; Vilke & Vilkas, 2018	• municipal objectives	Other
	• doing the right thing for the country	
	• administrative procedures	
	• leadership	
	• process-based approach	
	• continuous improvement, etc.	

quality of public services, from a customer-oriented perspective, can be assessed using a complex of ten dimensions: Reliability, Responsiveness, Competence, Access, Courtesy, Communication, Credibility, Security, Understanding and Tangibles.

2. Research methodology

2.1. Instrument

The research focuses on the SERVQUAL model for assessing service quality, which was introduced by Parasuraman et al. (1985), who assessed consumer or service user attitudes towards the service providers' service quality. Service quality comprises the following ten factors: reliability, responsiveness, competence, access, courtesy, communication, credibility, security, customer understanding and tangible devices and staff to provide services. Later, these ten items were collapsed into five dimensions, including tangibility, response, reliability, assurance, and empathy (Parasuraman et al., 1988).

Even though the SERVQUAL model, which consists of five dimensions, is most often used in scientific research to investigate service quality, the indicators distinguished during the literature review and their grouping show that a 10-dimensional SERVQUAL model should be used. A SERVQUAL model of the initially conceptualised ten service quality dimensions (Fig. 3.) was used to create the customer survey questionnaire.

Within the SERVQUAL framework, the questionnaire was structured and formulated so that each statement, which is positively worded, reflected one of the ten service quality dimensions. A 7-point Likert scale, with "7" representing strong agreement and "1" presenting strong disagreement, was used to measure how customers strongly agree or disagree with each quality dimension assessing the provision of public services, i.e., how customers perceive different aspects of public service quality and how unsatisfied or satisfied they are with different aspects of public service quality.

2.2. Sampling

The survey for collecting data was conducted by interviewing (May – September 2022) adult (18 y.o.) customers of Lithuanian organisations that provide public services. The interview was organised at the organisations' facilities after service provision.

Since according to 2022 statistics, Lithuania's adult population amounts to 2.311 mil., with a confidence level of 98 % and a margin of error of 2 %; the minimum required sample size is 3389. Data were collected from 3609 users of public services. The sample characteristics and their comparison with the population's characteristics are reported in Table 2.

The distribution of the sample according to different socio-demographic characteristics (gender, age, education, marital or employment status etc.) corresponds rather well with the characteristics of the whole population (Table 2). There is no possibility of comparing the sample with the population in terms of income level since this statistic for the population is not provided. The unknown population size and characteristics of the organisations that provide pub-

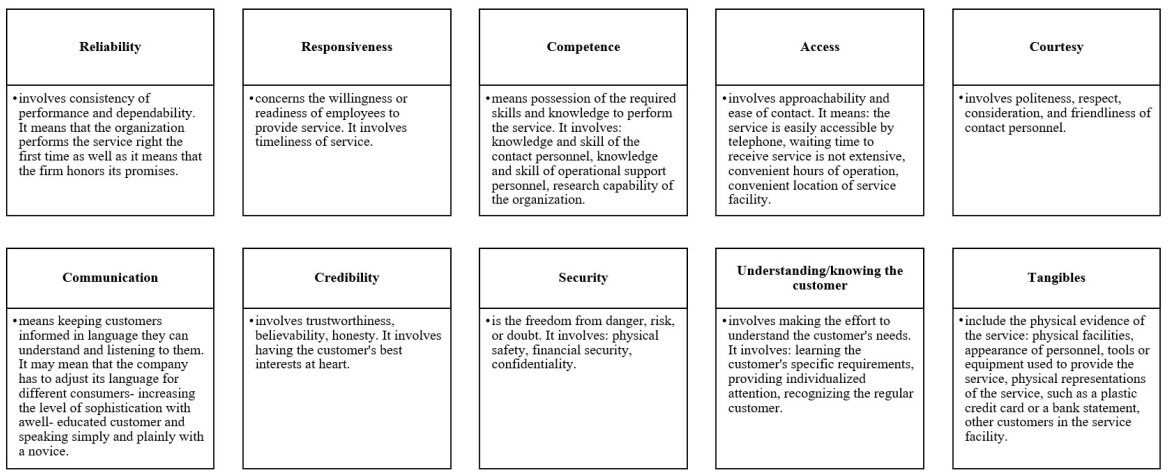

Fig. 3. Service quality dimensions of the SERVQUAL model
Source: Parasuraman et al., 1985.

lic services challenged the authors to ensure a representative sample in terms of the type of the provided services. The overall number of organisations for which the customer data was collected was 392 (to ensure a representative sample size of organisations providing public services when the population size is unknown with a confidence level of at least 95 % and a margin of error of no more than 5 %). Organisations representing all service categories indicated in Appendix 1 were purposefully contacted to represent various types of services. It was assumed that the spatial (regional) distribution of organisations providing public services in Lithuania should follow the spatial (regional) distribution of the population. Therefore, quotas of organisations in each NUTS 3-level region were assigned according to Lithuania's regional population distribution (data for the year 2021).

2.3. Estimation strategy

Since the dependent variable is categorical and ordered, ordered logit and probit (for robustness check) models will be applied to examine the effect of socio-demographic characteristics and the type of service on customers' opinions about different quality aspects of the provided public services. A model for a single latent variable y* (different quality aspects of the provided public service are unobservable, it is only known when it crosses a threshold, i.e., it is not observed how the customer feels about the statement that corresponds to a particular quality aspect, seven categories are only observed ranging from strongly disagree to strongly agree) can be specified as follows:

$$y_i^* = \boldsymbol{x}_i'\beta + \varepsilon_i, \tag{1}$$

where $\boldsymbol{x}_i'$ stands for the vector of regressors, i.e., socio-demographic characteristics and a type of public services, ε_i stands for the error term, and β are parameters to be estimated. In this case, there is a latent continuous variable that would be formed into seven groups with six thresholds, which are cut-off points between seven different categories. If α is those thresholds, there would be y_i=j if the underlying latent variable falls between the two thresholds, i.e., $\alpha_{j-1}<y_i^*<\alpha_j$. The probability for subject *i* to select alternative *j* is:

$$\begin{aligned} p_{ij} &= p(y_i = j) = p\left(\alpha_{j-1} < y_i^* < \alpha_j\right) = \\ &= F\left(\alpha_j - \boldsymbol{x}_i'\beta\right) - F\left(\alpha_{j-1} - \boldsymbol{x}_i'\beta\right) \end{aligned} \tag{2}$$

F is the logistic cumulative density function for the ordered logit, i.e., $F(z)=e^z/(1+e^z)$, and F is the standard normal cumulative density function for the ordered probit.

Tab. 2. Customer sample characteristics

Characteristics		Distribution		Number of observations
	In population	In sample		
Gender[1]	Male	45.55%	44.17%	1594
	Female	54.45%	55.83%	2015
Age[1]	18–24	8.26%	9.11%	329
	25–34	15.53%	15.82%	571
	35–44	16.22%	17.63%	636
	45–54	17.13%	18.11%	654
	55–64	18.61%	18.05%	651
	65–74	12.88%	12.34%	445
	75–84	8.24%	7.80%	282
	85 and above	3.13%	1.14%	41
Education[2]	ISCED 0–2	12.62%	13.30%	480
	ISCED 3–4	50.95%	50.94%	1838
	ISCED 5–8	36.43%	35.76%	1291
Marital status[1]	Never married	25.94%	25.53%	921
	Married	50.58%	52.32%	1888
	Divorced	14.04%	14.08%	508
	Widow(er)	9.44%	8.07%	291

Employment status[1]	Employed	59.74%	69.83%	2520
	Unemployed	3.30%	9.84%	355
	Inactive	36.96%	20.34%	734
Counties (regions)[1]	Telsiai	4.64%	4.57%	165
	Panevezys	7.49%	7.92%	286
	Siauliai	9.24%	6.51%	235
	Taurage	3.21%	2.69%	97
	Vilnius	29.44%	31.28%	1129
	Utena	4.44%	4.66%	168
	Klaipeda	11.65%	12.52%	452
	Alytus	4.80%	5.24%	189
	Kaunas	20.28%	20.23%	730
	Marijampole	4.81%	4.38%	158
Family size[3]	1 person	28.30%	26.68%	963
	2 persons	25.90%	24.17%	872
	3 persons	18.60%	20.05%	724
	4 persons	18.10%	19.53%	705
	5 and more persons	9.10%	9.57%	345
The income per family member	Up to 500	-	20.14%	727
	500-700	-	23.83%	860
	701-900	-	21.09%	761
	901-1200	-	18.29%	660
	1200 and above	-	16.65%	601
The type of provided services	Employment	-	5.93%	214
	Law enforcement	-	2.05%	74
	Real estate management	-	3.85%	139
	Public transport and communication	-	6.68%	241
	Tourism	-	8.23%	297
	Legal	-	1.03%	37
	Other	-	2.91%	105
	Culture and sports	-	10.67%	385
	Business	-	6.43%	232
	Health care	-	7.76%	280
	Utilities and environmental management	-	8.06%	291
	Education	-	14.10%	509
	Social	-	10.17%	367
	Fire protection and rescue	-	6.70%	242
	Taxes administration	-	5.43%	196

Note: [1] 2022 statistics, [2] 2021 statistics, [3] 2019 statistics

3. Estimation results

Analysis of the collected data about different dimensions of public service quality shows that Lithuanians are relatively non-demanding customers. The frequency distribution of all ten quality aspects indicates the clustering of opinions toward a more positive side (Fig. 4).

The 45° black line represents a case of neutral customers, i.e., the distribution along the 7-point Likert scale is even. The convex curve (not presented in Fig. 4) would show demanding customers unsatisfied with the quality of the public services. A concave

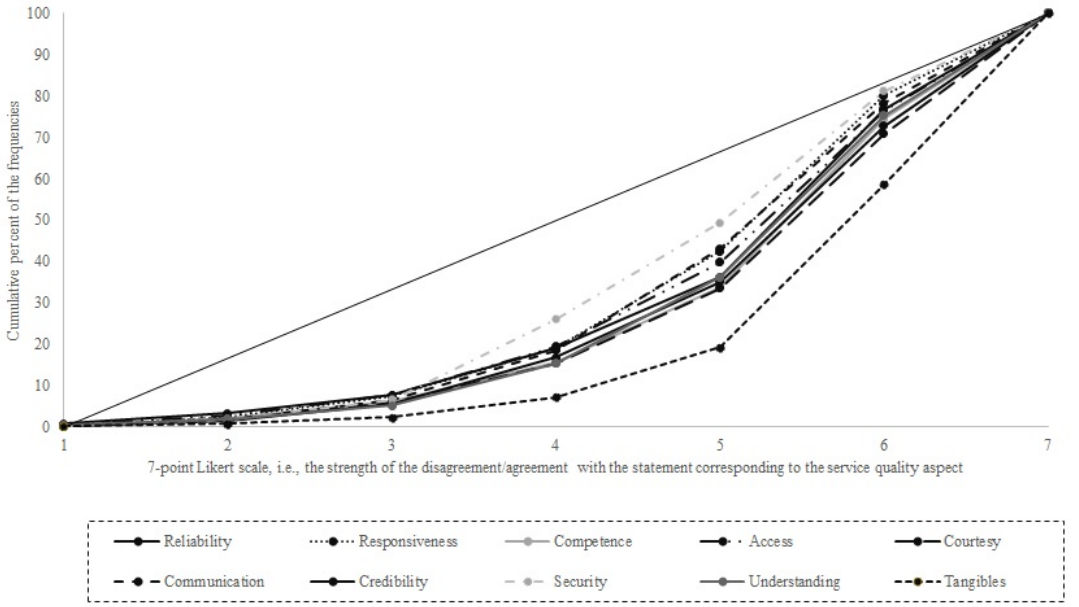

Fig. 4. Distribution of customer dissatisfaction/satisfaction about different aspects of public service quality

shape indicates non-demanding customers who agree with positively worded statements related to the service quality dimensions, i.e., expressing a high level of satisfaction with quality aspects of public services. In this case, all curves are concave, which means that the cumulative percentage of relatively dissatisfied customers (up to three on a 7-point Likert scale) is low (below 10 %), and the majority of customers (more than 50 %) are satisfied (five and more on a 7-point Likert scale).

The highest satisfaction is about the Tangibles aspect, and the lowest is about the Security aspect of the public services quality dimensions. All other curves intersect, and differences between quality dimensions are minuscular.

Analysing further quality perception heterogeneity among customers, customer socio-demographic characteristics and service types were regressed on different quality dimensions using ordered logit and probit models. Tables 3 and 4 report estimates of the ordered logit model. The estimates are rather consistent across ten quality dimensions and model types. Results of the robustness check using an ordered probit model are presented in Appendix 2. Indicators of a good fit indicated that all twenty estimations are reliable.

Tab. 3. Estimates of ordered logit model (1)

		Exp(β) or *1/exp(β)*[(1)]				
Factor	Regressor	**Reliability**	**Responsiveness**	**Competence**	**Access**	**Courtesy**
Gender (*reference category – male*)	female	1.2***	1.28***	1.32***	1.16**	1.14**
Age	age	*1.04***	*1.06***	*1.05***	*1.04***	*1.06***
	age^2	1.00*	1.00***	1.00**	1.00**	1.00***
Education (*reference category – ISCED 3-4*)	ISCED 0-2	*1.08*	*1.04*	*1.15*	*1.17**	*1.14*
	ISCED 5-8	1.22**	1.29***	1.2**	1.18**	1.29***
Occupation (*reference category – employed*)	unemployed	*1.03*	1.01	*1.10*	1.02	1.07
	inactive	1.54***	1.46**	1.38*	1.35*	1.36*
Family size	size	1.25**	1.39***	1.3	1.12	1.19
	size^2	*1.03**	*1.04***	*1.03*	1.00	*1.02*
Marital status (*reference category – married*)	divorced	*1.07*	*1.04*	*1.3***	*1.17*	*1.06*
	widow(er)	*1.58****	*1.43***	*1.11*	*1.47***	*1.09*
	never married	*1.26***	*1.19*	*1.23**	*1.25**	*1.38****
Income per family member (*reference category – 701-900*)	up to 500	*1.29***	*1.26***	*1.14*	*1.21**	*1.38****
	500-700	*1.21***	*1.16*	*1.16*	*1.33****	*1.21**
	901-1200	1.13	1.15	1.14	*1.01*	*1.09*
	1201 and above	1.08	1.10	*1.07*	*1.22**	*1.32***

County (*reference category – Vilnius)*	Telsiai	*1.23*	*1.11*	*1.26*	*2.43****	*1.13*
	Panevezys	*1.57****	*1.4****	*1.74****	*1.19*	*1.02*
	Siauliai	5.1***	4.79***	4.7***	3.16***	5.27***
	Taurage	1.85***	2.76***	2.98***	2.35***	3.63***
	Utena	1.66***	1.28	1.43**	*1.02*	1.07
	Klaipėda	*1*.00	1.09	*1.09*	*1.36****	1.09
	Alytus	*1.66****	*2.61****	*3.76****	*2.67****	*2.35****
	Kaunas	3.2***	2.47***	5.15***	3.52***	5.88***
	Marijampole	*1.1*	1.16	1.28	*1.30**	1.14
Type of provided services (*reference category – Education*)	Employment	*1.81****	*1.47***	*1.9****	*1.89****	*1.44***
	Law enforcement	*2.22****	*1.66***	*2.09****	*2.13****	*2.14****
	Real estate management	*1.50***	*1.05*	*1.14*	*1.78****	*1.09*
	Public transport and commun.	*1.29**	*1.01*	*1.46***	*1.62****	*1.11*
	Tourism	*1.17*	1.62***	1.07	1.16	1.79***
	Legal	*1.52*	*1.02*	*1.45*	*2.15***	*1.25*
	Other	1.24	1.77***	1.61**	1.15	1.84***
	Culture and sports	1.14	1.67***	1.35**	1.07	1.8***
	Business	*1.32**	1.32*	*1.04*	*1.64****	1.22
	Health care	*1.65****	*1.47****	*1.41***	*2.24****	*1.07*
	Utilities and environ. manag.	*2.06****	*1.30**	*1.72****	*2.45****	*1.27**
	Social	*1.08*	1.10	*1.05*	*1.19*	1.34**
	Fire protection and rescue	1.05	2.26***	1.32*	1.28*	1.73***
	Taxes administration	*1.53****	*1.02*	*1.63****	*1.7****	*1.28*
Thresholds (intercepts), β	Cut1	-5.67***	-6.17***	-6.6***	-6.36***	-6.67***
	Cut2	-4.18***	-4.34***	-4.74***	-4.71***	-4.82***
	Cut3	-3.25***	-3.12***	-3.57***	-3.55***	-3.58***
	Cut4	-2.13***	-2.01***	-2.44***	-2.4***	-2.46***
	Cut5	-1.15***	-0.72*	-1.26***	-1.26***	-1.32***
	Cut6	0.84**	1.19***	0.83**	0.58	0.56
p-value of χ^2 for	-2 Log Likelihood test of model fitting	<0.001	<0.001	<0.001	<0.001	<0.001
	Pearson goodness-of-fit	0.360	0.335	0.384	0.375	0.355
	Deviance goodness-of-fit	0.530	0.564	0.549	0.487	0.532
	-2 Log Likelihood test of parallel lines, i.e., a test of proportional odds	0.438	0.489	0.424	0.417	0.406
Pseudo R^2	Cox and Snell	0.157	0.158	0.221	0.175	0.205
	Nagelkerke	0.165	0.166	0.233	0.183	0.217
	McFadden	0.056	0.056	0.085	0.062	0.078
p-value of Likelihood ratio χ^2 test of model factors (df)	Education (2)	0.013	0.002	0.006	0.006	<0.001
	Occupation (2)	0.021	0.060	0.048	0.174	0.171
	Marital status (3)	0.024	0.126	0.058	0.059	0.056
	Income per family member (4)	0.012	0.020	0.085	0.012	0.015
	County (9)	<0.001	<0.001	<0.001	<0.001	<0.001
	Type of provided services (14)	<0.001	<0.001	<0.001	<0.001	<0.001

(1) We report the odds ratio for interpreting the effect magnitude. If the estimated β is negative, the odds ratio is below 1; thus, we report *1/exp(β)* instead of exp(β). Significance is based on the Wald χ^2 test. *, **, and *** represent the 90%, 95%, and 99% significance levels, respectively.

Tab. 4. Estimates of ordered logit model (2)

		Exp(β) or *1/exp(β)*(1)				
Factor	Regressor	**Communi-cation**	**Credibility**	**Security**	**Understan-ding**	**Tangibles**
Gender (*reference category – male*)	female	1.24***	1.06	1.07	1.25***	1.16**
Age	age	*1.07****	*1.05****	*1.03**	*1.03**	*1.01*
	age^2	1.00***	1.00***	1.00	1.00	1.00
Education (*reference category – ISCED 3-4*)	ISCED 0-2	*1.21***	*1.26****	*1.07*	*1.02*	1.00
	ISCED 5-8	1.08	1.15*	1.18**	1.22**	1.22**
Occupation (*reference category – employed*)	unemployed	1.04	1.06	1.22**	1.29**	1.19*
	inactive	1.21	1.35*	1.18	1.31*	1.15
Family size	size	1.1	1.27	1.28**	1.19	1.04
	$size^2$	*1.00*	*1.03*	*1.03***	*1.02*	*1.01*

Marital status (*reference category – married*)	divorced	1.01	1.17	1.06	*1.07*	*1.05*
	widow(er)	*1.49***	*1.24*	*1.09*	*1.21*	*1.05*
	never married	*1.25***	*1.06*	*1.16*	*1.4****	*1.33***
Income per family member (*reference category – 701-900*)	up to 500	*1.18*	*1.09*	*1.00*	1.14	*1.02*
	500-700	*1.22***	*1.02*	*1.15*	1.02	*1.04*
	901-1200	*1.00*	1.18	1.14	1.03	*1.04*
	1201 and above	*1.18*	*1.03*	1.08	*1.15*	*1.49****
County (*reference category – Vilnius)*	Telsiai	1.03	*1.39***	*1.57****	*1.63****	*1.14*
	Panevezys	1.42***	1.47***	*1.09*	3.32***	4.79***
	Siauliai	4.25***	2.95***	1.24	2.36***	3.67***
	Taurage	4.2***	5.66***	1.70***	*1.37*	2.07***
	Utena	1.36*	1.56***	1.30*	*1.3**	*1.64****
	Klaipėda	1.44***	1.20*	1.16	*1.15*	1.89***
	Alytus	*1.78****	*3.85****	*2.46****	*4.43****	*11.55****
	Kaunas	3.85***	3.96***	2.14***	2.43***	4.61***
	Marijampole	1.05	1.56***	*2.34****	*1.45***	1.05
Type of provided services (*reference category – Education*)	Employment	*2.16****	*2.34****	*1.07*	*1.05*	*1.19*
	Law enforcement	*2.43****	*3.48****	*1.96****	*1.52**	*1.65***
	Real estate management	*1.7****	*1.32*	*1.09*	1.10	*1.16*
	Public transport and commun.	*1.34***	*1.19*	1.19	*1.02*	*1.56****
	Tourism	1.11	1.02	1.41**	1.61***	1.35**
	Legal	*2.13***	*2.23***	*1.09*	*1.23*	*2.28***
	Other	1.53**	1.39	2.08***	1.93***	1.68**
	Culture and sports	1.13	1.26*	1.29**	1.65***	1.11
	Business	*1.09*	*1.05*	1.22	1.5***	1.49**
	Health care	*1.68****	*1.33***	*1.19*	*1.13*	1.00
	Utilities and environ. manag.	*1.79****	*1.77****	*1.62****	*1.36***	*1.79****
	Social	*1.11*	*1.07*	1.63***	1.53***	*1.12*
	Fire protection and rescue	1.22	1.47**	1.78***	1.61***	1.27
	Taxes administration	*1.51***	*1.54****	*1.24*	1.07	*1.16*
Thresholds (intercepts), β	Cut1	-7.01***	-6.43***	-5.67***	-5.37***	-6.53***
	Cut2	-5.29***	-4.88***	-4.03***	-4.1***	-5.35***
	Cut3	-4.01***	-3.61***	-2.73***	-3.06***	-4.23***
	Cut4	-2.75***	-2.28***	-1.06***	-1.79***	-2.9***
	Cut5	-1.42***	-1.17***	0.05	-0.55	-1.53***
	Cut6	0.31	0.67	1.63***	1.32***	0.6
p-value of χ^2 for	-2 Log Likelihood test of model fitting	<0.001	<0.001	<0.001	<0.001	<0.001
	Pearson goodness-of-fit	0.350	0.345	0.310	0.337	0.340
	Deviance goodness-of-fit	0.583	0.530	0.590	0.538	0.503
	-2 Log Likelihood test of parallel lines, i.e., a test of proportional odds	0.418	0.461	0.435	0.485	0.460
Pseudo R^2	Cox and Snell	0.148	0.178	0.103	0.138	0.219
	Nagelkerke	0.156	0.188	0.108	0.146	0.239
	McFadden	0.053	0.066	0.035	0.051	0.099
p-value of Likelihood ratio χ^2 test of model factors (df)	Education (2)	0.027	0.001	0.043	0.026	0.041
	Occupation (2)	0.504	0.181	0.111	0.023	0.224
	Marital status (3)	0.030	0.141	0.397	0.039	0.134
	Income per family member (4)	0.111	0.219	0.120	0.336	0.003
	County (9)	<0.001	<0.001	<0.001	<0.001	<0.001
	Type of provided services (14)	<0.001	<0.001	<0.001	<0.001	<0.001

(1) We report the odds ratio for interpreting the effect magnitude. If the estimated β is negative, the odds ratio is below 1; thus, we report *1/exp(β)* instead of exp(β). Significance is based on the Wald χ^2 test. *, **, and *** represent the 90%, 95%, and 99% significance levels, respectively.

4. Discussion of the results

Statistically significantly different perceptions of public service quality were found between males and females for all dimensions except Credibility and Security. Depending on the estimation, a female is 1.14–1.32 times more likely to feel more positive about the quality of the provided services than a male. It seems that even controlling other socio-demo-

graphic characteristics, females are less demanding public service customers than males. The biggest differences observed were in the dimensions of Competence and Responsiveness. It is worth noting that an abundance of studies that emphasise Responsiveness as the most important attribute of public service quality (Javed & Ilyas, 2018; Ocampo et al., 2019; Meleddu, Pulina & Scuderi, 2020; Hassan & Salem, 2022; Gavahi, Hosseini & Moheimani, 2022; etc.).

Estimations show that the likelihood of being in the higher categories on a 7-point Likert scale and customers' age are in a curvilinear relationship except for dimensions of Security, Understanding, and Tangibles. A similar result was obtained by Vilke and Vilkas (2018), confirming that age influences the level of satisfaction with public services and that elderly respondents would be more dissatisfied with public services compared to the younger ones. In the same context, it was found that 48–58 y.o. customers are more likely to disagree with positively worded statements about public service quality compared with other age groups. It means that more demanding public service customers are 48–58 y.o.

Estimations suggest that educational attainment level is statistically significantly related to customers' opinions about service quality. The results are similar to the results of Gavahi, Hosseini and Moheimani (2022), who found that customers' education level has the biggest impact on their satisfaction with the services. Moreover, Meleddu, Pulina and Scuderi (2020) determined that a low level of education led to a low willingness to recommend services. In the research described in this article, for all dimensions, except for Credibility and Communication, customers with higher educational attainment levels (ISCED 5–8) were 1.18–1.29 times more likely to feel more positive about different quality aspects of the provided public services compared to customers with low (ISCED 1–2) and average (ISCED 3–4) educational attainment level. In the case of Credibility and Communication, a higher likelihood of positive evaluation was seen in a group of customers with low educational attainment levels compared with customers that fall in the other two groups.

Results show that occupation is significantly related just to the Reliability, Competence, and Understanding dimensions of public service quality. These findings support previous results on the relationship between satisfaction with public services and occupation, where occupation status is the most influential (Gavahi, Hosseini & Moheimani, 2022) and that unemployed residents are less dissatisfied with public services (Vilke & Vilkas, 2018). In the research described in this article, it is more likely for an inactive customer to stronger agree with quality statements of Reliability and Competence compared to an employed or unemployed customer. In the case of the Understanding dimension, it is more likely for an unemployed customer to be more satisfied compared to an employed or inactive one.

In cases where the relationship is significant (Reliability, Responsiveness and Security dimensions), it is nonlinear between the family size and how strongly a customer agrees with the statement about service quality. Findings suggest the highest likelihood of possessing a positive view towards these quality dimensions of public services is for the families of four members after controlling other socio-demographic factors. Families of 1–3 or 5 and more members seem to be more demanding customers.

We do not find robust evidence that marital status would be crucial in explaining the heterogeneity of customer satisfaction with public services if other socio-demographic factors are controlled. Some evidence was obtained (in the case of Reliability, Communication and Understanding dimensions) that widows(ers) and/or never-married customers are more likely to stronger agree with these quality dimensions than married or divorced customers.

Findings suggest that income is an important factor in customer views towards public service quality in five out of ten dimensions (Reliability, Responsiveness, Access, Courtesy and Tangibles). It is more likely to feel more positive about these quality dimensions (except for Tangibles) for a person in lower income categories than a customer who falls in higher income categories. In the case of the Tangibles dimension, findings suggest the opposite. However, the research conducted by Meleddu, Pulina and Scuderi (2020) shows the opposite and claims that customers with low income are less willing to recommend services.

The findings clearly show that regional variation in customers satisfaction with the quality of public services is much greater than the variations observed in analysing other socio-demographic characteristics. Three groups of regions can be clearly distinguished. The first consists of Siauliai, Taurage and Kaunas counties. Customers in these counties are 1.7–5.9 (on average 3.6) times more likely to feel more positive about all quality aspects of public services compared to the reference (capital) county, Vilnius. In conclusion, customers are either the least demanding in Siauliai, Taurage and Kaunas counties, or the public

service quality is the best in these regions. The second group consists of Telsiai and Alytus counties. Customers in these counties are more likely, on average, to stronger disagree about the quality of the provided public services compared to the reference county. It suggests that customers in these two counties are either the most demanding or the service quality is the lowest. Mixed results were found in the third group, which includes Panevezys, Utena, Klaipeda and Marijampole. In some cases, customer satisfaction does not significantly differ from the capital county, or, in the case of statistically significant differences, there is no clear positive or negative trend considering a particular quality dimension. Territorial differences in customer satisfaction are also confirmed by Vilke and Vilkas (2018), who stated that residents from rural areas and towns were less dissatisfied with services than residents living in cities, but it could be influenced by the factor that public services are used more frequently in urban areas compared to rural areas (Verma, Kumar & Sharma, 2022).

Considering the type of the provided services, no such vast variation was observed in satisfaction as in the case of cross-county analysis. Still, estimated differences remain statistically significant even if controlling customers' socio-demographic characteristics. As a reference, the biggest "Education" service group was used. No statistically significant differences were found comparing customer satisfaction with "Social" and "Education" services. Satisfaction with all other types of public services statistically significantly differs from the reference group. A group of "Tourism", "Culture and sports", and "Fire protection and rescue" services can be distinguished. Customers of these public services are more likely to stronger agree about the quality of the provided services compared to the reference category. It can be assumed that customers are less demanding in consuming "Tourism" and "Culture and sports" as leisure services. Still, this assumption does not hold in the case of "Fire protection and rescue" services, which are of vital importance. Customers of all other types of public services, i.e., "Real estate management", "Public transport and communication", "Business", "Legal" and especially "Employment", "Law enforcement", "Health care", "Utilities and environmental management", and "Taxes administration", are more likely to be in lower categories evaluating different quality aspects of provided services compared to the reference category. It is especially alarming since this group consists of very important public services.

Conclusions

The conducted research measured user perceptions of the quality of public services. The literature analysis enabled the identification of service quality indicators, grouped them into dimensions according to unifying characteristics and grounded the methodology of the empirical study. The analysis of collected customer data revealed that the attitude towards different aspects of public service quality is generally positive, suggesting two possible explanations. First, the quality of public services in Lithuania is relatively high, and second, customers of public services in Lithuania are relatively non-demanding. Results applying logit and probit models and analysing deeper socio-demographic factors that might explain heterogeneity in attitudes suggest that higher-educated but inactive females younger than 48 or older than 58 living in families of 4–5 members are the most satisfied customers of public services. Findings show that marital status and income level are unrelated to customer satisfaction. Less educated 48–58-year olds, employed or unemployed males living in relatively small or big families are most likely to have a negative attitude towards the quality of public service. Although gender, age, family size, educational attainment level and employment status are significant factors explaining the heterogeneity of customer satisfaction, they still account just for a small fraction of variation compared to the place of residence and type of services. It suggests some conclusions. First, there are considerable differences in the level of public service quality across regions in Lithuania. Second, the level of customer demand depends on the type of public service.

The theoretical contribution and practical implications. The literature review and empirical research have uncovered a number of gaps in the research related to public services. First, it was found that the literature focuses predominantly on specific areas of public services, with very little research conducted on public services in general and none on such areas as tourism, real estate management, fire protection and rescue. Second, there is no unified and systematic standardised approach to evaluating the quality of public services. Third, the 5-component SERVQUAL model is insufficient to evaluate service quality, and researchers should return to the more detailed original 10-component SERVQUAL model. Fourth, the empirical research conducted found that standardised approaches to public services and quality assess-

ment are inadequate, and an individualised approach is needed. Furthermore, the research identified variations in the quality of public services across different sectors and socio-demographic groups, highlighting the importance of developing tailored service delivery models that cater to the specific needs and preferences of users. These findings emphasise the need for developing nuanced service delivery models that can accommodate unique characteristics and enhance the overall quality of public services.

Limitations and further research directions. The research measures user perceptions of public service quality. However, the study has several limitations. First, this research measured the quality of public services through ten dimensions. Still, it did not assess how important each of these dimensions was to the quality of public services. Therefore, the future research direction could be identifying the weight of each dimension for public service quality measurement. Second, the research is based on a customer-oriented approach. Future research can be aimed at assessing public organisations' employee perceptions of the services provided by their organisation and what internal factors of the organisation can affect the quality of the provided services. Third, the study does not directly investigate how much customers are satisfied with the quality of public services. Therefore, future research could fill this gap. Finally, future research on the quality of public services should identify improvement areas so that customer expectations are met on time and the public interest is fully protected.

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Literature

Akil, S. R., Soemaryani, I., Hilmiana, H., & Joeliaty, J. (2022). Enhancement of Innovation and Performance in the Public Sector: Does Collaboration Matter? *Quality-Access to Success*, *23*(187), 13-22. doi: 10.47750/QAS/23.187.02

Al Hosani, K., van Ewijk, A., & Hussain, M. (2021). Determinants of employee creative behavior in the UAE public sector. *International Journal of Productivity and Performance Management* [Preprint]. doi: 10.1108/IJPPM-11-2020-0601

Aladwan, S., & Alshami, S. (2021). The impact of service excellence and service innovation on organisational reputation: quantitative evidence from Jordanian public sector. *TQM Journal*, *33*(6), 1544-1560. doi: 10.1108/TQM-05-2020-0117

AlShehail, O., Khan, M., & Ajmal, M. (2022). Total quality management and sustainability in the public service sector: the mediating effect of service innovation. *Benchmarking - an International Journal*, *29*(2), 382-410. doi: 10.1108/BIJ-08-2020-0449

AlZawati, O., Alsyouf, I., & Bashir, H. (2020). An exploratory study of common issues and key differences between the European Foundation for Quality Management and the United Arab Emirates Public Sector Excellence Model: public sector organisation results. *International Journal of System Assurance Engineering and Management*, *11*(6), 1156-1169. doi: 10.1007/s13198-020-00965-0

Andersson, F., Jordahl, H., & Josephson, J. (2019). Outsourcing Public Services: Contractibility, Cost, and Quality. *Cesifo Economic Studies*, *65*(4), 349-372. doi: 10.1093/cesifo/ifz009

de Aquino, J., de Melo, F., Jeronimo, T., & de Medeiros, D. (2019). Evaluation of Quality in Public Transport Services: The Use of Quality Dimensions as an Input for Fuzzy TOPSIS. *International Journal of Fuzzy Systems*, *21*(1), 176-193. doi: 10.1007/s40815-018-0524-1

Aragao, J., & Fontana, M. (2022). Guidelines for public sector managers on assessing the impact of outsourcing on business continuity strategies: a Brazilian case. *Journal of Global Operations and Strategic Sourcing* [Preprint]. doi: 10.1108/JGOSS-07-2021-0051

Araujo, V., & Franca, S. (2021). Evaluation of the efficiency of the 5S methodology in the Public Sector: survey applied in a Military Organization. *Navus-Revista de Gestao e Tecnologia*, *11*. doi: 10.22279/navus.2021.v11.p01-27.1451

Balasubramanian, S., Al-Ahbabi, S., & Sreejith, S. (2019). Knowledge management processes and performance. The impact of ownership of public sector organizations. *International Journal of Public Sector Management*, *33*(1), 1-21. doi: 10.1108/IJPSM-05-2019-0131

Barrios-Ipenza, F., Calvo-Mora, A., Criado-García, F., & Curioso, W. (2021). Quality Evaluation of Health Services Using the Kano Model in Two Hospitals in Peru. *International Journal of Environmental Research and Public Health*, *18*(11). doi: 10.3390/ijerph18116159

Besley, T., & Malcomson, J. (2018). Competition in public service provision: The role of not-for-profit providers. *Journal of Public Economics*, *162*, 158-172. doi: 10.1016/j.jpubeco.2018.04.004

Bubalo, T., Rajsman, M., &Skorput, P. (2022). Methodological Approach for Evaluation and Improvement of Quality Transport Service in Public Road Passenger Transport. *Tehnicki Vjesnik-Technical Gazette*, *29*(1), 139-148. doi: 10.17559/TV-20201031104641

Chaluvadi, S., Raut, R., & Gardas, B. (2018). Measuring the performance efficiency of banks in a developing

economy: The case study of Indian public sector vs private sector. *Benchmarking-an International Journal*, *25*(2), 575-606. doi: 10.1108/BIJ-10-2016-0157

Chica-Olmo, J., Gachs-Sanchez, G., & Lizarraga, C. (2018). Route effect on the perception of public transport services quality. *Transport Policy*, *67*, 40-48. doi: 10.1016/j.tranpol.2017.03.024

Chien, N., & Thanh, N. (2022). The Impact of Good Governance on the People's Satisfaction with Public Administrative Services in Vietnam. *Administrative Sciences*, *12*(1). doi: 10.3390/admsci12010035

Chin, M., Sivasampu1, S., Wijemunige, N., Rannan-Eliya, R., & Atun R. (2020). The quality of care in outpatient primary care in public and private sectors in Malaysia. *Health Policy and Planning*, 35(1), 7-15. doi: 10.1093/heapol/czz117.Dandis, A., Jarrad, A., Joudeh, J., Mukattash, I., & Hassouneh, A. (2022). The effect of multidimensional service quality on word of mouth in university on-campus healthcare centers. *TQM Journal*, *34*(4), 701-727. doi: 10.1108/TQM-12-2020-0295

Demircioglu, M., & Audretsch, D. (2019). Public sector innovation: the effect of universities. *Journal of Technology Transfer*, *44*(2), 596-614. doi: 10.1007/s10961-017-9636-2

Drobotowicz, K., Kauppinen, M., & Kujala, S. (2021). Trustworthy AI Services in the Public Sector: What Are Citizens Saying About It? *Requirements Engineering: Foundation for Software Quality (refsq 2021)*, 99-115. doi: 10.1007/978-3-030-73128-1_7

Fletcher, J. (2018). Opportunities for Lean Six Sigma in public sector municipalities. *International Journal of Lean Six Sigma*, *9*(2), 256-267. doi: 10.1108/IJLSS-07-2017-0086

Furqan, A., Wardhani, R., Martani, D., & Setyaningrum, D.(2020). The effect of audit findings and audit recommendation follow-up on the financial report and public service quality in Indonesia. *International Journal of Public Sector Management*, *33*(5), 535-559. doi: 10.1108/IJPSM-06-2019-0173

Gavahi, S., Hosseini, S., & Moheimani, A. (2022). An application of quality function deployment and SERVQUAL approaches to enhance the service quality in radiology centres. *Benchmarking-an International Journal* [Preprint]. doi: 10.1108/BIJ-07-2021-0411

Greenwood, M., & Zhan, R. (2019). Audit Adjustments and Public Sector Audit Quality. *Abacus-a Journal of Accounting Finance and Business Studies*, *55*(3), 511-534. doi: 10.1111/abac.12165

Harviainen, J., Ekstrom, M., & Ojasalo, J. (2019). Tactical Service Failure: A Case Study on Public Funding as a Marketing Issue. *Journal of Nonprofit & Public Sector Marketing*, *31*(1), 1-19. doi: 10.1080/10495142.2018.1452826

Hassan, S., Ansari, N., & Rehman, A. (2022). An exploratory study of workplace spirituality and employee well-being affecting public service motivation: an institutional perspective. *Qualitative Research Journal*, *22*(2), 209-235. doi: 10.1108/QRJ-07-2021-0078

Hassan, T., & Salem, A. (2022). Impact of Service Quality of Low-Cost Carriers on Airline Image and Consumers' Satisfaction and Loyalty during the COVID-19 Outbreak. *International Journal of Environmental Research and Public Health*, *19*(1). doi: 10.3390/ijerph19010083

He, Q., Li, Q., & Chen, J. (2022). Study on the improvement of medical', service quality in Beijing's Tianqiao Community Health Service Centre, *Engineering Management in Production and Services*, *14*(4).

Houria, B., & Fares, B. (2019). The quality of service in urban public transport in Algeria. *International Journal of Quality and Service Sciences*, *11*(4), 559-575. doi: 10.1108/IJQSS-11-2017-0107

Imran M., Robina-Ramírez R., & Awais M. (2022). Empirical investigation of public service performance improvement factors. *Polish Journal of Management Studies*, *26*(2), 189-208.

Jemeljanenko, A. (2018). Risk management in the educational sector of Latvia. *Human, Technologies and Quality of Education*, 7-14. doi: 10.22364/htqe.2018.01

Javed, S., & Ilyas, F. (2018). Service quality and satisfaction in healthcare sector of Pakistan the patients' expectations'. *International Journal of Health Care Quality Assurance*, *31*(6), 489-501. doi: 10.1108/IJHCQA-08-2016-0110

Kelly, S., Marshall, D., Walker, H., & Israilidis, J.(2021). Supplier satisfaction with public sector competitive tendering processes. *Journal of Public Procurement*, *21*(2), 183-205. doi: 10.1108/JOPP-12-2020-0088

Kim, G. (2020). The Effect of Quality Management and Big Data Management on Customer Satisfaction in Korea's Public Sector. *Sustainability*, *12*(13). doi: 10.3390/su12135474

Klein, L., Vieira, K., Russowsky Marçal D., & Pereira, J. (2022). Lean management practices perception and their influence on organizational performance in a public Higher Education Institution. *TQM Journal* [Preprint]. doi: 10.1108/TQM-11-2021-0311

Kondrotaitė, G. (2012). Evaluation of the Quality of Public Services in Lithuanian Municipalities. *Intellectual Economics, 3*(15), 393-411.

Koronios, K., Kriemadis, A., & Papadopoulos, A. (2019). Exploring service quality and its customer consequences in the sports spectating sector. *Journal of Entrepreneurship and Public Policy*, *8*(1), 187-206. doi: 10.1108/JEPP-03-2019-107

Kriel, Y., Milford, C., Cordero, J., Suleman, F., Steyn, P., & Smit, J. (2021). Quality of care in public sector family planning services in KwaZulu-Natal, South Africa: a qualitative evaluation from community and health care provider perspectives. *BMC Health Services Research*, 21(1). doi: 10.1186/s12913-021-07247-w

Lapuente, V., & Van de Walle, S. (2020). The effects of new public management on the quality of public services. *Governance-an International Journal of Policy Administration and Institutions*, *33*(3), 461-475. doi: 10.1111/gove.12502

Li, W., Pomegbe, W., & Dogbe, C., & Novixoxo, J. (2019). Employees' customer orientation and customer satisfaction in the public utility sector. The mediating role of service quality. *African Journal of Economic and Management Studies*, *10*(4), 408-423. doi: 10.1108/AJEMS-10-2018-0314

Lim, D., & Lee, D. (2021). Non-Face-to-Face Public Services and Perceptions of Public Organizations. *Sustainability*, *13*(21). doi: 10.3390/su132112185

Lopez-Lemus, J. (2021). ISO 9001 and the public service: an investigation of the effect of the QMS on the quality of public service organizations. *International Journal of Organizational Analysis* [Preprint]. doi: 10.1108/IJOA-05-2021-2753

Marques, R., & Simoes, P. (2020). Revisiting the Comparison of Public and Private Water Service Provision: An Empirical Study in Portugal. *Water*, *12*(5). doi: 10.3390/w12051477

Meleddu, M., Pulina, M., & Scuderi, R. (2020). Public and private healthcare services: What drives the choice? *Socio-economic Planning Sciences*, *70*. doi: 10.1016/j.seps.2019.100739

Mu, Q., Guo, P., & Wang, D. (2022). Optimal Subsidy Support for the Provision of Elderly Care Services in China Based on the Evolutionary Game Analysis. *International Journal of Environmental Research and Public Health*, *19*(5). doi: 10.3390/ijerph19052800

Mulinari, P. (2018). A New Service Class in the Public Sector? The Role of Femonationalism in Unemployment Policies. *Social Inclusion*, *6*(4), 36-47. doi: 10.17645/si.v6i4.1575

Nor, R., Gani, A., Saleh, C., & Amin, F. (2022). Organizational commitment and professionalism to determine public satisfaction through good governance, public service quality, and public empowerment. *International Review on Public and Nonprofit Marketing*, *19*(1), 191-217. doi: 10.1007/s12208-021-00297-0

Ocampo, L., Alinsub, J., Casulb, R., Enquigb, G, Luarb, M., Panuncillonb., N, Bongoc, M., & Ocampo, C. (2019). Public service quality evaluation with SERVQUAL and AHP-TOPSIS: A case of Philippine government agencies. *Socio-economic Planning Sciences*, *68*. doi: 10.1016/j.seps.2017.12.002

Parasuraman, A., Zeithaml, V.A., & Berry, L. L. (1985). A Conceptual Model of Service Quality and Its Implications for Future Research.

Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1988). SERVQUAL: A Multiple-Item Scale for Measuring Consumer Perceptions of Service Quality', *Journal of Retailing* [Preprint].

Pedrosa, G., Kosloski, R., de Menezes, V., Iwama, G., da Silva, W., & Figueiredo, R. (2020). A Systematic Review of Indicators for Evaluating the Effectiveness of Digital Public Services. *Information*, *11*(10). doi: 10.3390/info11100472

Pereira, M., Filho, F., Lima, P., Tabak, B., & Constantino, M. (2022). Sanitation and water services: Who is the most efficient provider public or private? Evidences for Brazil. *Socio-economic Planning Sciences*, *79*. doi: 10.1016/j.seps.2021.101149

Ramakrishnan, S., Wong, M., Chit, M., & Mutum, D.(2022). A conceptual model of the relationship between organisational intelligence traits and digital government service quality: the role of occupational stress. *International Journal of Quality & Reliability Management*, *39*(6), 1429-1452. doi: 10.1108/IJQRM-10-2021-0371

Rastoka, J., Petkovic, S., & Radicic, D. (2022). Impact of Entrepreneurship on the Quality of Public Health Sector Institutions and Policies. *International Journal of Environmental Research and Public Health*, *19*(3). doi: 10.3390/ijerph19031569

Rodgers, B., Antony, J., & Penman, D. (2019). A critical evaluation of the public sector improvement framework. *International Journal of Lean Six Sigma*, *11*(2), 398-403. doi: 10.1108/IJLSS-11-2018-0128

Rojikinnor, R., Gani, A., Saleh, C., & Amin, F. (2020). Entrepreneurship Determines Public Empowerment through Good Governance and Public Service Quality. *Journal of Asian Finance Economics and Business*, *7*(11), 491-497. doi: 10.13106/jafeb.2020.vol7.no11.491

Shi, Y., & Cheng, Y. (2021). Nonprofit-as-supplement: Examining the Link Between Nonprofit Financial Support and Public Service Quality. *Voluntas*, *32*(1), 28-44. doi: 10.1007/s11266-020-00302-w

Solino, A. (2019). Sustainability of Public Services: Is Outsourcing the Answer? *Sustainability*, *11*(24). doi: 10.3390/su11247231

Sun, Z., & Li, J. (2020). The Effects of Performance of Public Sector Health System on Quality of Life in China: Evidence from the CGSS2015. *International Journal of Environmental Research and Public Health*, *17*(8). doi: 10.3390/ijerph17082896

Szpilko, D., Szydło, J., & Winkowska, J. (2020). Social Participation of City Inhabitants Versus Their Future Orientation. Evidence From Poland. *WSEAS Transactions on Business and Economics*, *17*, 692-702. doi: 10.37394/23207.2020.17.67

Tanny, T., & Zafarullah, H. (2022). Performance Values, Service Delivery and Citizen Satisfaction: A Study of Institutional Trust in Bangladesh. *Public Organization Review* [Preprint]. doi: 10.1007/s11115-021-00599-1

Tubillejas-Andres, B., Cervera-Taulet, A., & Garcia, H. (2019). Feeling emotions in the public performing arts sector: does gender affect? *International Review on Public and Nonprofit Marketing*, *16*(1), 1-22. doi: 10.1007/s12208-018-0216-4

Tukiran, M., Ghufron, N., Sunaryo, W., Rusli, Z. I., & Dalilah, E. (2022). Public sector management: indispensable facilitating factors in sculpting organisational ambidexterity. *Polish Journal of Management Studies, 25*(1), 425-440.

Uvenc, G., & Kulluk, S. (2020). Measurement of service quality in public transportation: Definition of performance measurement system in service quality. *Pamukkale University Journal of Engineering Sciences, 26*(4), 737-748. doi: 10.5505/pajes.2020.75032

Verma, P., Kumar, S., & Sharma, S. (2022). Evaluating the total quality and its role in measuring consumer satisfaction with e-healthcare services using the 5Qs model: a structure equation modeling approach. *Benchmarking-an International Journal*, *29*(1), 22-46. doi: 10.1108/BIJ-09-2020-0467

Vilke, J., & Vilkas, M. (2018). Discussing municipal performance alternatives: Public perceptions of municipal services delivery in Lithuania. *International Journal*

of Public Sector Management, *31*(4), 525-542. doi: 10.1108/IJPSM-01-2017-0011

Waibel, S., Aevermann, T., & Rueger, H. (2018). International mobility and well-being of public sector expatriates: The role of family formation and gender. *Journal of Global Mobility-the Home of Expatriate Management Research*, *6*(2), 158-177. doi: 10.1108/JGM-10-2017-0043

Walsh, H., Nevalainen, J., Saari, T., Uusitalo, L., Näppilä, T., Rahkonen, O., & Erkkola, M. (2022). Food insecurity among Finnish private service sector workers: validity, prevalence and determinants. *Public Health Nutrition*, *25*(4), 829-840. doi: 10.1017/S1368980022000209

Wang, C., & Teo, T. (2020). Online service quality and perceived value in mobile government success: An empirical study of mobile police in China. *International Journal of Information Management*, *52*. doi: 10.1016/j.ijinfomgt.2020.102076

Westrup, U. (2018). The potential of service-dominant logic as a tool for developing public sector services: A study of a Swedish case. *International Journal of Quality and Service Sciences*, *10*(1), 36-48. doi: 10.1108/IJQSS-02-2016-0013

Witesman, E., Silvia, C., & Child, C. (2022). The Enduring Role of Sector: Citizen Preferences in Mixed Markets. *Journal of Public Administration Research and Theory* [Preprint]. doi: 10.1093/jopart/muac005

Yarmak, V., & Rollnik-Sadowska, E. (2022). Research themes on the quality of public services exemplified by healthcare services — a bibliometric analysis, *Engineering Management in Production and Services*, *14*(2), 82-94.

Appendix 1

Division of public services

Considering the diversity of services in the public sector, it is recommended to divide public services into certain groups according to the direction and nature of the provided services:

1. Employment services, such as job search, counselling, vocational guidance, retraining courses etc.
2. Utilities and environmental management services, such as waste management, water, gas, electricity, heat supply and sewage treatment, housing and building management administration, public environment management and maintenance services etc.
3. Cultural and sports services, such as services provided by cultural institutions and sports organisations, cultural and sports events and infrastructure intended to meet the cultural and sports needs of the population (museums, theatres, parks, sports fields, places for events).
4. Tax administrator services, such as income declaration, tax declaration processing, and tax consulting services.
5. Services for business issuing licenses and permits to business entities, providing support, services related to the promotion and development of small and medium-sized businesses, and training and consulting for representatives of small and medium-sized businesses.
6. Fire protection and rescue services, such as services intended for the protection of society, material property and the environment in emergency situations (firefighting and rescuing people, helping residents in domestic disasters, evacuation from places of emergency situations etc.).
7. Services related to real estate management, such as property registration, cadastral measurements, real estate valuation services, issuance of permits for construction, and renovation of buildings.
8. Social services, which are services providing assistance to a person (family) partially or completely unable to independently take care of personal (family) life and participate in public life due to age, disability or social problems; this group of services also includes social benefits and compensations, social insurance and benefits.
9. Transportation and communication services, such as public transport services, car parking and postal services.
10. Health care services, which are services provided by state health care institutions (services provided by emergency services, primary health care, treatment and wellness facilities, rehabilitation centres etc.).
11. Education services, which are services provided by formal and informal institutions, as well as informational, psychological, social pedagogical, special pedagogical and special help and health care at school, informational, consulting, qualification improvement and other help for educators.
12. Services of law enforcement institutions (police, courts, prosecutor's office etc.).
13. Legal services, i.e., primary and secondary legal assistance services, services of notaries and bailiffs.
14. Tourism services, which are services provided by tourism information centres etc.
15. Other services. This group of services includes services that cannot be assigned to any other group listed above (registration of civil status acts, issuance of personal documents, issuance of certificates and extracts, examination of complaints and requests).

Appendix 2

Tab. 2-1. Estimates of ordered probit model (1)

		Exp(β) or *1/exp(6)*[(1)]				
Factor	Regressor	**Reliability**	**Responsi-veness**	**Compe-tence**	**Access**	**Courtesy**
Gender (*reference category – male*)	female	1.12***	1.16***	1.18***	1.1***	1.09**
Age	age	*1.02***	*1.04***	*1.03***	*1.02***	*1.03***
	age^2	1.00*	1.00***	1.00**	1.00*	1.00***
Education (*reference category – ISCED 3-4*)	ISCED 0-2	*1.04*	*1.02*	*1.08*	*1.11***	*1.06*
	ISCED 5-8	1.13***	1.16***	1.11**	1.09**	1.16***
Occupation (*reference category – employed*)	unemployed	*1.02*	*1.00*	*1.08*	*1.01*	1.04
	inactive	1.3***	1.22**	1.22**	1.20**	1.20*
Family size	size	1.12*	1.19***	1.14**	1.03	1.10
	size^2	*1.01*	*1.02***	*1.01*	1.00	*1.01*
Marital status (*reference category – married*)	divorced	*1.05*	*1.04*	*1.16***	*1.11**	*1.03*
	widow(er)	*1.29****	*1.26***	*1.06*	*1.22***	*1.06*
	never married	*1.17***	*1.13**	*1.14***	*1.17***	*1.23****
Income per family member (*reference category – 701-900*)	up to 500	*1.16***	*1.15***	*1.10*	*1.12**	*1.22****
	500-700	*1.12***	*1.1**	*1.11**	*1.19****	*1.13***
	901-1200	1.07	1.08	1.08	*1.01*	*1.05*
	1201 and above	1.05	1.05	*1.03*	*1.11**	*1.18***
County (*reference category – Vilnius)*	Telsiai	*1.17**	*1.09*	*1.16*	*1.58****	*1.08*
	Panevezys	*1.3****	*1.23****	*1.30****	*1.07*	1.01
	Siauliai	2.61***	2.41***	2.46***	1.9***	2.62***
	Taurage	1.35***	1.75***	1.88***	1.55***	1.94***
	Utena	1.31***	1.16*	1.26**	1.02	1.04
	Klaipėda	*1.03*	1.01	*1.08*	*1.23****	1.02
	Alytus	*1.3****	*1.73****	*2.09****	*1.72****	*1.59****
	Kaunas	2.03***	1.75***	2.67***	2.18***	2.89***
	Marijampole	*1.07*	1.07	1.18*	*1.18**	1.07
Type of provided services (*reference category – Education*)	Employment	*1.47****	*1.25***	*1.56****	*1.47****	*1.22***
	Law enforcement	*1.58****	*1.40***	*1.61****	*1.59****	*1.52****
	Real estate management	*1.28***	*1.03*	*1.11*	*1.45****	*1.06*
	Public transport and commun.	*1.16**	*1.01*	*1.29****	*1.37****	*1.07*
	Tourism	*1.1*	1.33***	1.02	*1.11*	1.39***
	Legal	*1.24*	1.00	*1.3*	*1.60****	*1.18*
	Other	1.16	1.4***	1.3**	1.09	1.46***
	Culture and sports	1.07	1.32***	1.15*	1.03	1.38***
	Business	*1.18**	1.18*	*1.03*	*1.33****	1.12
	Health care	*1.37****	*1.25****	*1.27****	*1.64****	*1.06*
	Utilities and environ. manag.	*1.54****	*1.18***	*1.40****	*1.72****	*1.15*
	Social	*1.05*	1.07	*1.03*	*1.13*	1.20**
	Fire protection and rescue	1.03	1.60***	1.13	1.12	1.40***
	Taxes administration	*1.26***	*1.01*	*1.35****	*1.37****	*1.15*
Thresholds (intercepts), β	Cut1	-3.02***	-3.19***	-3.36***	-3.33***	-3.39***
	Cut2	-2.38***	-2.45***	-2.62***	-2.66***	-2.68***
	Cut3	-1.92***	-1.87***	-2.07***	-2.10***	-2.10***
	Cut4	-1.30***	-1.26***	-1.45***	-1.46***	-1.50***
	Cut5	-0.72***	-0.49**	-0.76***	-0.79***	-0.83***
	Cut6	0.48**	0.65***	0.48**	0.32	0.29
p-value of χ^2 for	-2 Log Likelihood test of model fitting	<0.001	<0.001	<0.001	<0.001	<0.001
	Pearson goodness-of-fit	0.380	0.342	0.322	0.396	0.373
	Deviance goodness-of-fit	0.551	0.567	0.587	0.530	0.591
	-2 Log Likelihood test of parallel lines, i.e., a test of proportional odds	0.407	0.403	0.423	0.481	0.482
Pseudo R^2	Cox and Snell	0.165	0.163	0.223	0.178	0.207
	Nagelkerke	0.173	0.171	0.236	0.186	0.218
	McFadden	0.059	0.058	0.086	0.063	0.078
p-value of Likelihood ratio χ^2 test of model factors (df)	Education (2)	0.010	0.001	0.008	0.006	<0.001
	Occupation (2)	0.011	0.079	0.015	0.106	0.152
	Marital status (3)	0.018	0.054	0.055	0.040	0.028

	Income per family member (4)	0.011	0.018	0.055	0.014	0.009
	County (9)	<0.001	<0.001	<0.001	<0.001	<0.001
	Type of provided services (14)	<0.001	<0.001	<0.001	<0.001	<0.001

(1) We report the odds ratio for interpreting the effect magnitude. If the estimated β is negative, the odds ratio is below 1; thus, we report *1/exp(β)* instead of exp(β). Significance is based on the Wald χ^2 test. *, **, and *** represent the 90%, 95%, and 99% significance levels, respectively.

Tab. 2-2. Estimates of ordered probit model (2)

		Exp(β) or *1/exp(β)*[(1)]				
Factor	Regressor	**Communi-cation**	**Credibility**	**Security**	**Understan-ding**	**Tangibles**
Gender (*reference category – male*)	female	1.13***	1.04	1.05	1.14***	1.1**
Age	age	*1.04****	*1.03****	*1.02***	*1.02***	*1.00*
	age^2	1.00***	1.00**	1.00*	1.00	*1.00*
Education (*reference category – ISCED 3-4*)	ISCED 0-2	*1.11***	*1.14***	*1.05*	*1.02*	1.00
	ISCED 5-8	1.06	1.09*	1.11**	1.13***	1.11**
Occupation (*reference category – employed*)	unemployed	1.00	1.02	1.11*	1.13**	1.10
	inactive	1.10	1.21**	1.06	1.18*	1.11
Family size	size	1.05	1.15**	1.15**	1.08	1.02
	size^2	*1.00*	*1.02*	*1.02**	*1.01*	*1.01*
Marital status (*reference category – married*)	divorced	*1.01*	1.08	1.01	*1.05*	*1.05*
	widow(er)	*1.24***	*1.12*	*1.05*	*1.14*	*1.07*
	never married	*1.17***	*1.05*	*1.13**	*1.24****	*1.18***
Income per family member (*reference category – 701-900*)	up to 500	*1.1*	*1.06*	1.01	1.05	*1.02*
	500-700	*1.13***	*1.03*	*1.06*	*1.01*	*1.03*
	901-1200	*1.01*	1.1	1.11*	1.02	*1.03*
	1201 and above	*1.11*	*1.03*	1.07	*1.06*	*1.28****
County (*reference category – Vilnius)*	Telsiai	*1.00*	*1.2***	*1.32****	*1.35****	*1.08*
	Panevezys	1.21***	1.21***	*1.08*	1.87***	2.17***
	Siauliai	2.29***	1.81***	1.08	1.59***	2.1***
	Taurage	2.21***	2.63***	1.33**	*1.15*	1.39***
	Utena	1.2**	1.29***	1.17*	*1.14*	*1.30****
	Klaipėda	1.14**	1.06	1.01	*1.14***	1.39***
	Alytus	*1.4****	*2.19****	*1.75****	*2.34****	*3.61****
	Kaunas	2.22***	2.28***	1.59***	1.72***	2.43***
	Marijampole	*1.00*	*1.30****	*1.62****	*1.25***	1.03
Type of provided services (*reference category – Education*)	Employment	*1.58****	*1.61****	*1.05*	*1.06*	*1.11*
	Law enforcement	*1.66****	*1.99****	*1.46****	*1.27**	*1.32**
	Real estate management	*1.35****	*1.17*	*1.07*	1.05	*1.10*
	Public transport and commun.	*1.19***	*1.12*	1.07	*1.04*	*1.33****
	Tourism	1.08	1.02	1.21**	1.27***	1.14
	Legal	*1.54***	*1.64****	*1.11*	*1.18*	*1.77****
	Other	1.28**	1.23*	1.51***	1.5***	1.35**
	Culture and sports	1.06	1.11	1.12	1.29***	1.01
	Business	*1.04*	*1.00*	1.09	1.27***	1.31***
	Health care	*1.37****	*1.21***	*1.14*	*1.12*	*1.02*
	Utilities and environ. manag.	*1.39****	*1.41****	*1.38****	*1.22***	*1.4****
	Social	*1.06*	*1.04*	1.32***	1.27***	*1.08*
	Fire protection and rescue	1.15	1.26**	1.39***	1.27***	1.12
	Taxes administration	*1.27***	*1.28****	*1.17**	1.02	*1.08*
Thresholds (intercepts), β	Cut1	-3.6***	-3.26***	-2.94***	-2.79***	-3.07***
	Cut2	-2.95***	-2.67***	-2.31***	-2.31***	-2.70***
	Cut3	-2.35***	-2.10***	-1.71***	-1.84***	-2.26***
	Cut4	-1.66***	-1.39***	-0.79***	-1.19***	-1.65***
	Cut5	-0.87***	-0.74***	-0.11	-0.46*	-0.94***
	Cut6	0.17	0.37	0.84***	0.67***	0.31

p-value of χ^2 for	-2 Log Likelihood test of model fitting	<0.001	<0.001	<0.001	<0.001	<0.001
	Pearson goodness-of-fit	0.354	0.354	0.361	0.397	0.353
	Deviance goodness-of-fit	0.548	0.598	0.511	0.558	0.590
	-2 Log Likelihood test of parallel lines, i.e., a test of proportional odds	0.431	0.456	0.437	0.456	0.471
Pseudo R^2	Cox and Snell	0.151	0.178	0.107	0.137	0.201
	Nagelkerke	0.158	0.187	0.112	0.144	0.220
	McFadden	0.054	0.066	0.036	0.050	0.090
p-value of Likelihood ratio χ^2 test of model factors (df)	Education (2)	0.026	0.001	0.017	0.018	0.079
	Occupation (2)	0.585	0.139	0.192	0.055	0.224
	Marital status (3)	0.022	0.175	0.226	0.013	0.127
	Income per family member (4)	0.089	0.159	0.078	0.582	0.002
	County (9)	<0.001	<0.001	<0.001	<0.001	<0.001
	Type of provided services (14)	<0.001	<0.001	<0.001	<0.001	<0.001

(1) We report the odds ratio for interpreting the effect magnitude. If the estimated β is negative, the odds ratio is below 1; thus, we report *1/exp(β)* instead of exp(β). Significance is based on the Wald χ^2 test. *, **, and *** represent the 90%, 95%, and 99% significance levels, respectively.