DETERMINANTS OF INDUSTRY 4.0 DEVELOPMENT IN PERIPHERAL AREAS - A QUALITATIVE ANALYSIS FROM THE PERSPECTIVE OF ENTERPRISES, NON-GOVERNMENTAL ORGANIZATIONS, AND LOCAL GOVERNMENTS

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Abstract: Industry 4.0, largely equated with digital transformation, is a term referring to the Fourth Industrial Revolution. It has been underway for many years, as the concept was first formulated in Germany as early as 2011. The fourth wave of the industrial revolution refers to the growing digitization and automation of the manufacturing environment. These changes do not affect only the business sector but also impact the functioning of public administration and nongovernmental organizations. The topic of Industry 4.0 has received widespread attention in the literature on the subject. However, a weakness of previous studies is their failure to address the specific conditions of peripheral areas, which lag behind central areas in socio-economic terms. This publication presents the results of a qualitative study conducted using standardized interviews in selected counties of southeastern Poland. As part of the empirical research, 65 interviews were conducted in four counties of the Podkarpackie Voivodeship: Brzozów, Sanok, Lesko, and Bieszczady. The respondents represented three main types of entities: businesses, local government units (LGUs), and the nongovernmental sector (NGOs), which ensured the triangulation of market, administrative, and civic perspectives. The main objective of the study was to identify the barriers and determinants of Industry 4.0 development in peripheral areas. The empirical study indicated that, in the respondents' opinion, the factors hindering the development of Industry 4.0 were predominantly resource-related barriers (financial, human resources, and skills) as well as resistance to change and poor infrastructure. In contrast, the determinants of digital transformation include: digital infrastructure (high-speed internet connections), cooperation and the role of local government, competencies, and financial resources. Among the respondents, the level of knowledge regarding the importance of digital transformation is high but varies. This article presents the most characteristic and valuable statements from the respondents in their full, original form.

Keywords: Poland, Industry 4.0, determinants and barriers, peripheral regions, businesses, local government entities, nongovernmental organizations, qualitative analysis

1 Introduction

Innovation processes in the economy have long been at the very center of interest in economics and management sciences. There are many publications in the academic literature addressing interorganizational collaboration and innovation, including business innovation (see, e.g., Pietruszka-Ortyl 2019; Aluchna et al. 2013; Bratnicka 2014; Wallis 2016). This stems from the fact that innovation and various dimensions of cooperation between organizations are viewed as determinants of corporate efficiency and as a driving force behind the economic and social development of specific regions. Today, a particularly notable manifestation of these processes is the Industry 4.0 concept being implemented in the global economy, which is viewed in many countries as a phenomenon capable of significantly altering the economic landscape at the local, regional, and global levels.

Groundbreaking technological changes have always transformed the manner and structure of production processes and are referred to in the literature as industrial revolutions (see more, e.g., Chalvantharan 2023; Eason et al. 1955; Moloi, Marwala 2020). The First Industrial Revolution began in the 18th century and was associated with the invention of the steam engine (Lu 2017, pp. 1–10) - an economy based on agriculture and artisanal production was replaced by mechanized production utilizing water and steam power. The Second Industrial Revolution, which took place at the turn of the 19th and 20th centuries, was linked to the development of electricity, which enabled mass production and increased the manufacturing efficiency of enterprises; during this period, many management processes designed to boost productivity also emerged, including through the division of labor (Ślusarczyk 2019, pp. 5-6). Both of these revolutions led to increased prosperity among workers and progressive urbanization. The Third Industrial Revolution, which began in the late 1960s, resulted from advances in computers and electronics, which allowed for even more extensive automation and optimization of production processes based on programmable logic control systems, leading to greater efficiency and improved quality (Müller et al. 2018, pp. 2-17).

The next stage of change is the Fourth Industrial Revolution, referred to as Industry 4.0. This concept was formulated in Germany in 2011 as an attempt by the German government to address the negative effects of the economic crisis - the term Industry 4.0 first appeared in November 2011 in connection with a government initiative regarding a high-tech strategy for 2020 (Ślusarczyk 2019, p. 4). Currently, this term refers to the digital transformation of the manufacturing process. There are many definitions of this concept in the literature; one of them, by H. Lasi, states that "Industry 4.0 describes the increasing digitization and automation of the manufacturing environment, as well as the creation of digital value chains to enable communication between products, the environment, and business partners" (Lasi et al. 2014, pp. 239-242). This paradigm thus encompasses digital manufacturing, networked communication, computer technologies, and automation, as well as many other areas of business activity (see also, e.g., Kiełtyka, Charciarek 2019). At the core of the Industry 4.0 concept lies the implementation of digital technologies and the automation of manufacturing processes; the technologies used within this framework include, among others: the Internet of Things (IoT), Big Data, Artificial Intelligence, Robotic Process Automation, Cloud Computing, Virtual Reality, and Additive Manufacturing (see more: Kaczmar-Kolny, Pośpiech 2023; Gajdzik, Grabowska 2018; Różanowski 2007; Szajna et al. 2018).

However, before the concept of Industry 4.0 became firmly established in the literature on the subject, many authors (see, e.g., Moczydłowska 2023; Walicka, Czemiel-Grzybowska 2023; Rządkowski, Sidor-Rządkowska 2024; Januszewska, Fetela 2024) began to formulate the principles of Industry 5.0 - an evolution of Industry 4.0 that emphasizes the design of innovative solutions and sustainable, crisis-resilient, people-centered development. This raises the question of whether the academic discussion regarding the Industry 4.0 concept in the context of economic development and technological change is still relevant, given that the Industry 5.0 concept is already being developed. In the authors' view, it remains relevant, especially with regard to peripheral areas characterized by a lower level of socioeconomic development, where "peripherality" is understood here as a state of lag relative to more developed regions (see more: Idczak 2013; Demianiuk, Szymańska 2016; Wilkin 2003; Feser, Malizia 1999). The Industry 4.0 concept not only influences the development of the industrial sector but also extends to the public and nongovernmental sectors. Consequently, it is particularly important to identify the barriers and determinants of digital transformation, especially in areas characterized by a lower level of socioeconomic development than central regions.

2 Materials and Methods

In order to identify barriers and determinants of digital transformation within the framework of Industry 4.0 in peripheral areas, standardized interviews were conducted in 2026 in selected counties of southeastern Poland. The research was funded by the Ministry of Science and Higher Education under the Science for Society II program (grant no. NdS-II/SP/0347/2024/01). As part of the empirical research, 65 interviews were conducted in four counties of the Podkarpackie

Voivodeship: Brzozów, Sanok, Lesko, and Bieszczady. Each interview was conducted using a standardized questionnaire consisting of eight demographic questions and ten open-ended substantive questions. The respondents represented three main types of entities - local government units (LGUs), nongovernmental organizations (NGOs), and businesses—which ensured the triangulation of administrative, civic, and market perspectives. The analysis of respondents' statements was conducted using qualitative content analysis, supplemented with quantitative elements. During the thematic coding process, at least eight semantic categories were identified for each question. Since respondents often addressed multiple issues simultaneously, a multiple-coding procedure was used, allowing a single response to be assigned to several categories. The resulting categories were then correlated with the respondents' sociodemographic characteristics, treating the type of entity as the main variable and gender, age, years of service, education, job title, county, and type of municipality as supplementary dimensions. The main objective of the research was to identify, in the respondents' opinion, the primary barriers and determinants of the digital transformation of businesses, local governments, and nongovernmental organizations in peripheral areas. This article presents the most characteristic and valuable statements made by the respondents in their full, original wording.

3 Results of the study

A total of 65 respondents participated in the study, which took the form of standardized interviews. Understanding the structure of the sample was a key factor in conducting in-depth qualitative analyses (see Tab. 1).

Tab. 1: Sample structure by selected characteristics (type of entity, respondent's age, position held, county)

TYPE OF ORGANIZATION			***RESPONDENT'S AGE***		
Category	**Percentage (%)**	**Number (n)**	**Category**	**Percentage (%)**	**Number (n)**
Companies	49.2%	32	Companies	49.2%	32
NGOs	30.8%	20	NGO	30.8%	20
Local government units	20.0%	13	JST	20.0%	13
Total	**100.0%**	**65**	**Total**	**100.0%**	**65**
COUNTY SEAT					
Category	**Percentage (%)**	**Number (n)**			
Sanok	40.0%	26			
Brzozów	30.8%	20			
Leski	21.5%	14			
Bieszczady	7.7%	5			
Total	**100.0%**	**65**			
POSITION HELD					
Category	**Percentage (%)**	**Number (n)**			
Management / CEO	41.5%	27			
Specialist / expert	38.5%	25			
Administrative staff	13.8%	9			
Other	6.2%	4			
Total	**100.0%**	**65**			

Source: Own study

The sample of 65 respondents consisted of relatively older, professionally experienced individuals with a high level of education and a clearly decision-making professional profile. Men predominated in the sample - 60.0% (39 people) - while women accounted for 40.0% (26 people). A ratio of approximately 3:2 in favor of men is typical for studies involving executives and company representatives in technical and economic fields. However, the presence of women, accounting for two-fifths of the sample, ensures a significant diversity of perspectives. The largest group consisted of respondents aged 40-49 (38.5%; 25 people), followed by those aged 30-39 (26.2%; 17) and 50-59 (21.5%; 14). The youngest group (up to age 29) accounted for 6.2% (4 people), while the oldest (60 years and older) accounted for 7.7% (5 people). In total, the 30-59 age group comprised 86.2% of the respondents, indicating a strong concentration of the sample among individuals with established professional standing and real influence over organizational decisions. The respondents were characterized by a high level of education; the vast majority held a college degree-78.5% (51 people)-while 21.5% (14 people) had a high school diploma, no respondents in the sample had a primary, lower secondary, or basic vocational education. The respondents had significant professional experience. The largest group consisted of those with over 20 years of experience (44.6%; 29 people). 20.0% (13) reported 11-15 years of experience, and 18.5% (12) reported 16-20 years. Fewer respondents had shorter work experience: 6-10 years (12.3%; 8) and up to 5 years (4.6%; 3). In total, respondents with more than 16 years of work experience accounted for 63.1% of the sample, which may indicate the sample's maturity and a longer comparative perspective in assessing technological changes. In terms of job roles, the sample was dominated by executives/CEOs (41.5%; 27 people) and specialists/experts (38.5%; 25). Administrative staff accounted for 13.8% (9), and the "Other" category accounted for 6.2% (4 people). The combined share of decision-makers and experts was 80.0%, indicating that the survey primarily included individuals with high levels of subject-matter expertise and a real influence on the direction of their organizations' development. The largest number of respondents represented entities from the Sanok County (40.0%; 26 people) and the Brzozów County (30.8%; 20). The Lesko County was represented by 21.5% (14), while the smallest group came from the Bieszczady County (7.7%; 5). The entities' headquarters were most often located in urban municipalities (44.6%; 29), less frequently in rural municipalities (29.2%; 19), and in urban¬rural municipalities (26.2%; 17). Although urban locations predominated, the distribution is relatively balanced - entities from rural or urban-rural areas together accounted for 55.4% of the sample, which allows for a comparative analysis of the conditions of transformation in diverse spatial contexts. Businesses were the most numerous (49.2%; 32 entities), followed by nongovernmental organizations (30.8%; 20) and local government units (20.0%; 13). Nearly half of the sample came from the business sector, which aligns with the study's economic focus; the simultaneous inclusion of NGOs and local government units ensures a triangulation of perspectives - market, civic, and administrative.

An analysis of the structure of the respondent sample, based on the dominant values for each of the characteristics studied, made it possible to outline a synthetic profile of the most typical study participant. This profile is a statistical generalization and does not refer to any specific individual.

Tab. 2: Modal profile of a survey respondent

Characteristic	**Dominant value**	**Percentage**
Gender	Male	60.0%
Characteristic	**Dominant value**	**Percentage**
Age	40-49 years	38.5%
Education	college	78.5%

Years of work experience	Over 20 years	44.6%
Position held	executive / CEO	41.5%
Entity's headquarters	Sanok County	40.0%
Type of municipality	urban municipality	44.6%
Entity type	enterprise	49.2%

Source: Own study

Statistically, the typical survey participant is a man aged 40-49, with a college degree, over 20 years of work experience, and holding a managerial position at a company headquartered in an urban municipality in Sanok County. This profile confirms that the empirical data collected comes predominantly from experienced, well-educated individuals in decision-making positions - that is, respondents with high credibility in assessing the conditions for the development of Industry 4.0.

One aspect of the study was to gather opinions on the barriers and risks associated with digital transformation under the "Industry 4.0" concept in the Brzozów, Sanok, Lesko, and Bieszczady counties, and to determine whether local barriers differ from those at the national level.

According to the respondents, the most serious barrier turned out to be financial constraints, costs, and a lack of capital (64.6% of respondents) - cited by nearly two-thirds of respondents and predominant across all three sectors. The next most frequently cited barriers were: a shortage of qualified personnel (40.0%), low digital literacy and awareness (36.9%), resistance to change and caution regarding investment (30.8%), and poor digital infrastructure (29.2%). These barriers are therefore primarily resource-related - financial, human resources, competency, and infrastructure - rather than technological in the narrow sense.

Tab. 3: Local barriers by type of entity (% of responses within the sector; multiple coding)

Local barrier	**Local Government Units (n=13)**	**NGOs (n=20)**	**Enterprises (n=32)**
Financial constraints and	54%	70%	66%
Shortage of qualified staff	38%	35%	44%
Low digital skills / awareness	46%	55%	22%
Resistance to change / caution	31%	15%	41%
Poor digital infrastructure	38%	30%	25%
Local barrier	**Local Government Units (n=13)**	**NGOs (n=20)**	**Enterprises (n=32)**
Lack of support, guidance, and supplier	8%	30%	19%
Small scale of operations (SMEs)	15%	15%	25%

Source: Own study

The following statements provide the most insightful analysis of barriers in the business sector.

In the local environment, one of the main barriers is the limited financial resources of small and medium-sized enterprises that operate as subcontractors in the automotive industry and are cautious about making large technological investments. There is also a noticeable lack of easy access to specialized consulting firms and Industry 4.0 system integrators in the immediate vicinity, which prolongs and complicates the implementation process. Compared to the national average, barriers related to the region's peripheral location and the lower visibility of local companies in the eyes of major technology partners are felt more acutely.

Respondent ID 15 (male, 40-49 years old, specialist/expert, company, Sanok County)

The most significant local barriers are: a shortage of specialists, limited access to investment financing, a lower level of digitization among SMEs, and limited collaboration between academia and business. Compared to the national level, these barriers are more pronounced, particularly in the areas of human capital and infrastructure.

Respondent ID 56 (female, ages 40-49, specialist/expert, company, Brzozów County)

Although the financial barrier is a common factor, its context varies by sector: in NGOs (70%), it is linked to unstable project funding; in enterprises (66%), it is linked to SMEs' investment caution. Businesses were clearly distinguished by resistance to change and investment caution (41% versus 15% in NGOs); NGOs - by low digital literacy among their audiences and their own staff (55%) and a lack of support and guidance (30%); and local government units - by infrastructure and competency issues.

During the interviews, respondents were also asked whether local barriers differed from those at the national level. A comparison with the national level yielded an almost unanimous conclusion. More than half of the respondents did not directly address the comparison; however, among the 29 who did, as many as 28 (96.6%) considered local barriers to be different from or more significant than national ones; only one person did not perceive a difference. The prevailing interpretation is that the region faces the same types of barriers as the rest of the country but has fewer resources to compensate for them-its peripheral location acts as an "amplifier." A local government representative captured this most comprehensively in systemic terms:

barriers related to competence, infrastructure, and finance; organizational, institutional, cultural, and social barriers; legal and regulatory barriers; information and communication barriers; and demographic barriers. Yes-they are different, though some of them are shared. The differences mainly concern the scale, intensity, and nature of the problems

Respondent ID 14 (female, 40-49 years old, specialist/expert, local government entity, Leski County)

Based on the information presented, it can be concluded that the barriers to the development of Industry 4.0 in the counties studied are primarily resource-related - financial, human resources, skills, and infrastructure - rather than strictly technological. According to nearly all respondents who commented on the comparison, these barriers do not differ in nature from nationwide barriers, but rather in intensity: the region's peripheral location makes them more acutely felt and more difficult to compensate for.

Another objective of the study was to identify the factors determining the technological and organizational transformation of enterprises in the four counties and to determine whether these determinants differ from those at the national level.

Respondents view transformation primarily in pragmatic terms - as a tool for streamlining day-to-day operations. However, the direction of transformation (internal/external) is strongly sector-specific: enterprises focus their transformation almost exclusively inward (optimization, monitoring), local governments - outward, toward serving residents (e-services), and non-governmental organizations - toward analytics,

communication, and competencies. Cybersecurity as an application appeared exclusively in businesses (13%) - in no NGOs or local government units - which signals a gap in awareness of digital risks in the public and social sectors. The picture of intra-organizational integration of the production cycle may be described by a specialist from the business sector, while a statement from a respondent at a non-governmental organization may indicate that this is a way to overcome geographical barriers.

Technological and organizational transformation allows for better integration of a designer's work with production, quality control, and logistics (...). The implementation of integrated PLM and MES systems enables tracking of a part's entire lifecycle-from concept, through prototyping, to mass production and service. Additionally, the use of numerical simulations and digital twins helps reduce the number of costly physical tests and shorten the time it takes to bring new solutions to market.

Respondent ID 15 (male, 40-49 years old, specialist/expert, company, Sanok County)

In our case, solutions such as electronic health records, patient management systems, telecounseling, and remote specialist consultations are key. In Bieszczady County, distance is a real problem, so teleservices can improve access to psychological and therapeutic support. From an organizational standpoint, this also means better team work planning and analysis of data regarding residents' needs.

Respondent ID 20 (female, ages 40-49, executive/president, nongovernmental organization, Bieszczady County)

The question about the beneficial aspects of the transformation and the reasons behind them allowed us to distinguish between what respondents want to implement and what they expect from these implementations. The research indicated that there are sector-specific differences in the types of expected benefits. Businesses "judge" the transformation based on quality and costs; local governments - on the efficiency of services provided to residents (e-services); and NGOs - on accessibility and reach. The most striking contrast concerns the benefit of "greater reach and accessibility": 60% of NGOs cited it, while - significantly - not a single business representative did. System integration remains the common denominator across all sectors. The following statement by a respondent illustrates this point.

The most beneficial tools are: digital communication and social media tools, systems for managing events and participant databases, analysis of audience data, and automation of administrative processes. The primary benefits are improved communication, a faster flow of information, and the ability to better tailor offerings to the needs of the local community.

Respondent ID 23 (female, 60 years or older, administrative staff member, nongovernmental organization, Leski County)

According to the respondents, the most important factor determining digital transformation is digital and technical infrastructure - above all, access to high-speed Internet, the lack of which is perceived as a fundamental constraint. Most factors were described in terms of deficits. A clear pattern is the so-called "local government gap": the factor of cooperation and networks, strongly emphasized by businesses (41%) and nongovernmental organizations (50%), was almost completely overlooked by local governments (8%). The entities that naturally serve as coordinators of local networks are the least likely to recognize this function as a determinant of the digital transformation process. Sectoral profiles are distinct: local governments emphasize infrastructure and competencies as key factors; businesses highlight workforce availability and the structure of the economy; and NGOs focus on collaboration and social attitudes. The following statement offers the most insightful analysis of local conditions, linking the shortage of skilled personnel to the region's peripheral location.

In our local community, the availability of qualified technicians and engineers is a key factor, which is not a given in peripheral counties such as Sanok County due to the outflow of young people to larger cities. Transportation infrastructure and stable cooperation between automotive companies and local schools and universities are also important (...). Compared to the nationwide context, the limitations of market scale and the smaller number of specialized entities supporting implementation are more pronounced here.

Respondent ID 15 (male, 40-49 years old, specialist/expert, company, Sanok County)

In the respondents' view, the region faces the same transformation challenges as the rest of the country, but has poorer infrastructure, fewer specialists, and limited access to capital and research and development centers. The contrast between the local and national levels is best illustrated by the following statements from respondents.

Local: access to high-speed Internet, human resources (whether there are specialists nearby), local service and training companies, and the level of cooperation between local government and businesses. Differences: At the national level, there are support programs and larger R&D centers; locally, access to these resources may be limited, so implementations proceed more slowly and require local adaptation.

Respondent ID 16 (male, 50-59 years old, specialist/expert, business, Leski County)

At the local level, access to infrastructure, the level of social activity, and the ability of various entities to collaborate are key. Compared to the national level, social and demographic factors-such as an aging population and the migration of young people-are more significant here.

Respondent ID 63 (female, ages 40-49, specialist/expert, nongovernmental organization, Sanok County)

A synthesis of the statements made by individual respondents leads to the conclusion that the pace and success of transformation in the region are determined primarily by resource- and infrastructure-related factors, with high-speed Internet taking precedence. These determinants are - in the respondents' assessment - identical to national factors but available on a smaller scale; conversely, barriers and peripheral location weaken the determinants of development. An analysis of applications and benefits further reveals strong, sector-specific "value maps" of transformation: production-and-quality-oriented in businesses, service-and-public-sector- oriented in local government, and relationship-and-accessibility-oriented in nongovernmental organizations. An institutional factor of particular importance-and at the same time one of which local governments are least aware - is cooperation and the networks connecting individual entities from the business sector, public administration, and the non-governmental sector.

The study also assessed the level of knowledge among local and regional entrepreneurs, local government representatives, and non-governmental organizations regarding the transformation within the "Industry 4.0" concept, as well as the variation in this knowledge across the surveyed groups.

Respondents' answers in this regard were notably detailed, indicating familiarity with the "Industry 4.0" concept among the surveyed group. The core of respondents' answers in this area consists of two nearly equivalent associations - digitalization and automation/robotization - common to all sectors. More technical elements (data, IoT/integration, optimization) were significantly more common in the business sector, indicating a more

systematic understanding of the concept there. It is also noteworthy that the topic of data was least frequently mentioned in local government, and cybersecurity was entirely absent in that sector. In addition to the content of the associations, the study assessed the depth of understanding of the term "Industry 4.0." Most respondents demonstrated a general but correct understanding; one-fifth demonstrated an in-depth, expert understanding based on specific technologies; and only 12.3% demonstrated a superficial or uncertain understanding. This indicates a high, though varied in terms of depth, prevalence of the Industry 4.0 concept in the region. The depth of understanding is clearly linked to sociodemographic characteristics. The most technical and comprehensive definitions were provided by specialists and executives at industrial companies - it was within this group that expert-level understanding was concentrated. Non-governmental organizations primarily equated Industry 4.0 with digitization, less frequently referring to data or optimization; local governments presented a balanced understanding, but placed the least emphasis on data and cybersecurity. The following statements by respondents serve as examples.

I associate Industry 4.0 with a strong integration of the physical and digital worlds, in which machines, production lines, IT systems, and people are integrated into a single network that exchanges data in real time. This includes the use of advanced CAD/CAE tools, PLM systems, IoT sensors, data analytics, and artificial intelligence, which enable continuous process optimization. In the automotive industry, this means, among other things, the ability to design components using digital twins and a close link between the design office and actual production.
Respondent ID 15 (male, 40-49 years old, specialist/expert, company, Sanok County)

Connecting machines and systems via the Internet (IoT), automation, robotics. Data collection and analysis (reports, charts) for better planning. Smart manufacturing: remotely monitored machines, predictive maintenance. Overall: "a factory that thinks and communicates," meaning more data and less manual labor.
Respondent ID 16 (male, 50-59 years old, specialist/expert, company, Lesko County)

A notable trend was the deliberate expansion of the concept beyond the industrial sector. Representatives of the social sector and local government adapted the concept to their own contexts - culture, therapy, healthcare, and rural development - treating it as a broad civilizational process rather than solely a manufacturing phenomenon. This demonstrates a functional understanding rooted in the organization's mission.

I understand Industry 4.0 as a stage in economic development based on automation, robotization, the integration of IT systems, and the use of real-time data. It also involves work at the human-machine interface, the Internet of Things, data analysis, and intelligent management support systems. For me, it is not just industry in the manufacturing sense, but more broadly-a transformation of the entire service delivery model.
Respondent ID 24 (female, 40-49 years old, executive/CEO, nongovernmental organization, Leski County)

The level of knowledge about the "Industry 4.0" concept is high among the surveyed population (correct or expert-level understanding), but varies in depth and scope. There is a clear distinction between groups: the deepest, most technical understanding is found among specialists and management staff at industrial companies, as well as among individuals with higher education; the social sector and local government tend to understand the concept in a broader, functional sense - through the lens of their own mission - and are less likely to delve into its technical core (data, integration, cybersecurity). The high, albeit uneven, level of knowledge serves as a favorable starting point: the barrier to transformation is not a lack of understanding of the concept, but a shortage of resources to implement it.

4 Conclusion

The standardized interviews conducted allowed us to draw several concluding insights and to identify barriers and determinants of the development of the Industry 4.0 concept. The empirical study indicated that the strongest factor differentiating respondents' opinions was the type of entity. Each of the groups surveyed employs a different "map" of transformation: businesses view it from a market- and technology-oriented perspective (optimization, competition, quality, engineering staff, dependence on systems); nongovernmental organizations view it from a social and relational perspective (funding, accessibility, digital exclusion, social competencies, communication), and local governments - in terms of public services (e-services, infrastructure, environmental tasks, cybersecurity of residents' data). This sector-specific logic proved stronger than any single individual characteristic and recurred consistently in all respondents' statements. Empirical research has shown that, in the respondents' opinion, the factors hindering the development of Industry 4.0 were dominated by resource-related barriers - financial, human resources, and competency-related - complemented by resistance to change and poor infrastructure. In the assessment of nearly all respondents, these barriers differ from those at the national level not in type but in intensity: their peripheral location exacerbates them. In contrast, the determinants of digital transformation include: digital infrastructure (with a focus on high-speed Internet), cooperation and the role of local government, competencies, and financial resources. Nearly 70% of all respondents believed that the local conditions determining digital transformation in peripheral areas are different (weaker) than national conditions. The level of knowledge about the Industry 4.0 concept and digital transformation is high; and nearly all respondents understood it correctly and with expert-level knowledge; however, this knowledge varies - the most advanced level of understanding is found among industrial enterprises and individuals with higher education, while the social sector and local government tend to understand the concept of Industry 4.0 in a broad and functional sense, rather than from a technical perspective. The patterns presented in the text are descriptive in nature and result from a qualitative study with a limited, unevenly distributed sample. The most significant limitation of the empirical study is the small size of the groups from individual sectors, which necessitates treating the analysis results with a certain degree of caution. However, despite these limitations, the collected data provide a reliable, cross-sectional assessment of barriers, determinants, and the state of knowledge in four counties of southeastern Poland. The identified patterns - with the type of entity as the primary differentiating variable, peripherality as a common denominator, and the disconnect between awareness and resources and institutions - provide an accurate picture of the conditions for the development of Industry 4.0 in a region defined as peripheral, and also indicate the necessary directions for intervention by businesses, local government, and the non-governmental sector.

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Primary Paper Section: A

Secondary Paper Section: AH