

LOGISTICAL ATTRACTIVENESS OF THE SILESIAN VOIVODESHIP

Katarzyna DOHN^{1*}, Edyta PRZYBYLSKA², Marzena KRAMARZ³

¹ Silesian University of Technology; katarzyna.dohn@polsl.pl, ORCID: 0000-0002-4178-1347

² Silesian University of Technology; edyta.przybylska@polsl.pl, ORCID: 0000-0002-9475-5927

³ Silesian University of Technology; marzena.kramarz@polsl.pl, ORCID: 0000-0003-0619-5809

* Correspondence author

Purpose: The subject of the research in this paper is the analysis of the logistic attractiveness of the Silesian Voivodeship. To this end, a number of key factors were identified as determining the competitiveness of the region in the area of transport and logistics.

Design/methodology/approach: The paper uses secondary data from national statistical databases and industry reports on transport infrastructure, logistic activity, investments and employment in the TSL sector.

Findings: The analysis demonstrated that the Silesian Voivodeship is positioned within the group of most attractive logistics regions in Poland. The region's strategic geographical location, well-developed road and rail infrastructure, the presence of an established industrial base, and a high level of investment activity in the TSL sector, are all factors that contribute to its competitive advantage. However, the identification of barriers to development was also a feature of the report, with spatial constraints, environmental burden and challenges related to the region's energy transition all being cited.

Practical implications: The findings of the research will inform the design of a regional development strategy for the province and the promotion of investment. The paper is likely to be of use to local governments, spatial planners, investors and TSL companies when making location decisions.

Originality/value: The paper makes a significant contribution to both academic discourse and business practice by providing a tool for analysing the competitiveness of regions in the context of the development of the transport and logistics sector. The present volume is intended for researchers in the fields of logistics and regional policy, as well as practitioners in the transport and logistics sector.

Keywords: logistical attractiveness, Silesian Voivodeship, regional development, transport infrastructure.

Category of the paper: research paper.

1. Introduction

The contemporary global economy is entirely dependent on the effective functioning of logistics systems. Logistics, with its technological, organisational and infrastructural solutions, exerts a significant influence on changes in the spatial development of cities, including, above all, the spatial allocation of transport flows and the location of appropriate warehouse space. The logistical attractiveness of a specific area therefore becomes a determining factor in the choice of location. This phenomenon can be attributed to the escalating competitive pressures between regions, as well as the aspiration to unlock and augment the latent potential inherent within these regions (Strahl, 2006). As posited by (Kuciński, 1999), two fundamental groups of determinants can be identified as primary factors influencing a region's logistical attractiveness and development potential. These determinants can be categorised as macro-regional and micro-regional. The first group includes elements that are independent of the characteristics of a given city, which are not influenced by the city, and their shaping is significantly limited. Micro-regional factors, by contrast, are those that can be directly stimulated by the self-governing bodies of a given area. In order to facilitate the decision-making process regarding the optimal investment location, a range of economic, demographic and geographical indicators are meticulously analysed by relevant parties, including but not limited to the unemployment rate, the purchasing power of the population, the price per square metre of land, the average cost of transport services, the expense of infrastructure access, tax concessions and long-term demographic forecasts. A further set of factors must be considered, which, though not indicative or criterion-based, are nevertheless of significant importance to investors when determining whether to commit their own capital. The extant literature identifies several key determinants of this type. These include regional and governmental programmes that support the development of logistics and transport infrastructure and the funds for their implementation, the state of road infrastructure and plans for its development, the attitude of public sector institutions towards the investment initiative, the cooperation of state administration bodies and local government units with the private sector, the possibilities of using sources of financing within the framework of public-private partnerships, legal, environmental and ecological conditions (Grondys, Dragolea, 2016).

Recent studies emphasise that logistical attractiveness is becoming a key element of regional competitiveness in the digital economy and e-commerce. According to the OECD (2022) and the World Bank (2023), logistics indicators such as the Logistics Performance Index are being used more and more to measure regions' ability to attract investment and serve global supply chains. In this context, the accessibility of transport and infrastructure, especially the location of warehouses, terminals and urban hubs, plays a particularly important role in shaping a region's potential (Pinheiro et al., 2024; Pourbaix et al., 2025).

Urban logistics and the 'last mile' are also becoming increasingly important. Reports by the ITF/OECD (2024) and the World Economic Forum (2024) highlight that metropolitan areas' attractiveness today depends not only on traditional cost indicators, but also on delivery systems' efficiency and sustainability. Modern solutions such as micro-logistics hubs and parcel locker networks play a significant role in determining the competitive advantages of cities (Ma et al., 2024; Pinheiro et al., 2024).

Researchers also highlight new determinants of logistical attractiveness relating to energy and environmental transformation. The literature emphasises that developing green transport infrastructure and implementing low-carbon solutions (e.g. electromobility and green logistics centres) is becoming a key criterion in assessing areas' attractiveness (Castillo et al., 2024; Schorung et al., 2024).

The following research questions were posed by the authors of the paper:

1. What factors determine the logistical competitiveness of the Silesian Voivodeship?
2. To what extent do infrastructural, economic and technological conditions influence the level of logistic attractiveness of the Silesian Voivodeship?
3. What are the advantages of the Silesian Voivodeship with regard to the development of the transport and logistics sector?
4. What development barriers limit further growth of the Silesian Voivodeship's logistical attractiveness despite its favourable location and infrastructure conditions?
5. How can the identification of logistical attractiveness factors support decision-making processes in regional planning and investment location in the TSL sector?

Given the growing importance of logistics in determining regional attractiveness, it is essential to conduct research that identifies competitive advantages and development barriers in specific areas. This is particularly important in industrialised and urbanised regions such as the Silesian Province, where logistics and transport play a key role in generating economic advantages. This article attempts to evaluate this region's logistical attractiveness, considering infrastructural, economic, technological, and environmental factors, and to identify potential influences on its future development in the context of increasing interregional competition.

2. The concept of logistical attractiveness of a region – literature background

2.1. The presence of logistical attractiveness in the literature

As a preliminary measure, it is recommended to undertake a contemporary bibliometric analysis to delineate and appraise the extant scientific literature in the domain of regional logistical attractiveness. In the initial phase of the research, online bibliographic databases were

reviewed for their applicability to the research presented in this dissertation. Two bibliographic sources were selected for further analysis: The Web of Science (WoS) Core Collection and the Scopus database will be utilised in this study. These databases have been shown to provide reliable and relevant information on scientific papers and are the most common choice for bibliometric analyses. A comprehensive selection of scientific papers was collated from the WoS and Scopus databases for the purpose of analysis. A subsequent review of software tools for bibliometric analysis was then conducted. The authors' intention was to combine the information collected in the WoS and Scopus databases; therefore, VOSviewer was selected as the software tool for bibliometric analysis. In the subsequent stage, a list of search query words was identified:

- region development, city logistics, urban logistics,
- city attractiveness, logistical attractiveness, logistical attractiveness and city (LAC).

The list of formulated queries is presented in table 1. In the final step of this phase, the temporal scope of the analysis was defined. Initially, no initial publication date was entered in the search. However, due to the fact that the first publication in the analysed field (on the concept of LAC) appeared in 1983, the time range was narrowed down to 1983-2020.

Table 1.

Results of the initial bibliometric analysis

Item	Query wording (QW)	Web of Science		Scopus	
		QW Query in title (TITLE)	QW Query in subject (TOPICS)	QW Query in title (TITLE)	QW Enquiry in subject (TOPICS)
1	region development	10577	482 396	12 162	530 107
2	city logistics	815	23 180	1 036	25 115
3	urban logistics	814	27 699	1 103	27 492
4	city attractiveness	106	2 523	153	2 882
5	logistics attractiveness	8	482	9	479
6	logistics attractiveness and city (LAC)	0	71	0	69

Source: own work.

As can be seen from Table 1, by far the most common theme in publications is regional development. In the Web of Science database one can find over 482 thousand literature items on this subject, while in the Scopus database over 530 thousand items. This is justified by the rather general formulation of the question and the great interest of researchers in this issue in the area of very different scientific disciplines (Figure 1).

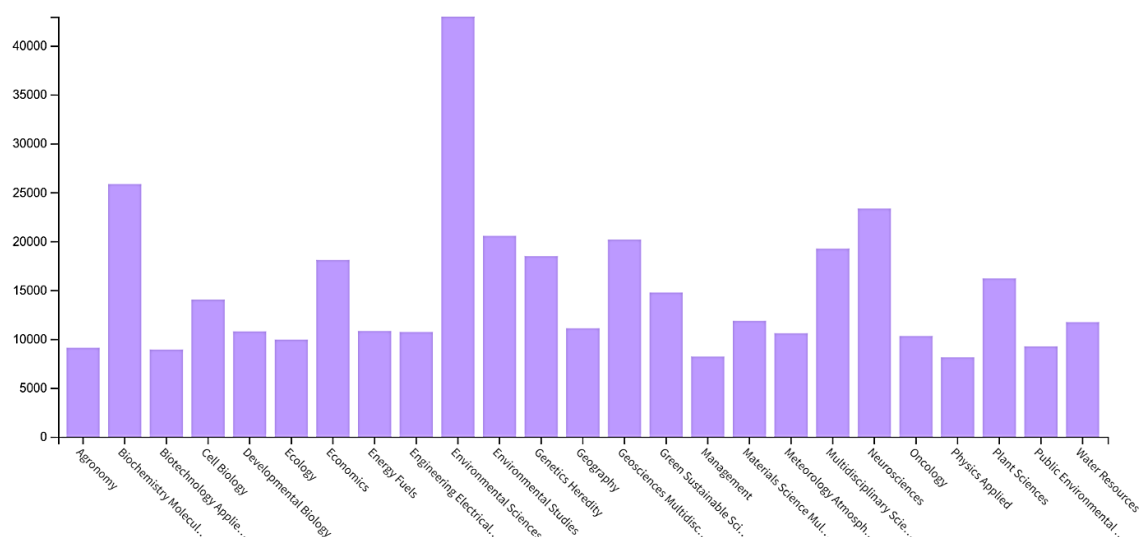


Figure 1. Scientific disciplines within which research topics concerning the development of cities and regions are undertaken.

Source: own work based on results of the analysis from the Web of Science database.

Urban logistics is a frequently addressed issue in scientific publications, with the phrase appearing 815 times in the title of a publication according to the Web of Science database and 1036 times according to the Scopus database. A formulation that appears relatively less frequently in the subject matter of publications is that of city attractiveness, with only 106 publications found in the Web of Science database. A total of 153 such publications were identified in the Scopus database. This finding suggests a paucity of research sophistication in this area. Conversely, the formulation of logistical attractiveness and the logistical attractiveness of a city (LAC) are seldom addressed in publications. Consequently, it is imperative to acknowledge the novelty and significance of the research topic explored in the paper, both within the national context and on a global scale.

After obtaining the data, which are presented in Table 1 on the number of publications containing the analysed keywords in the title or subject, a web analysis was carried out using the VOSviewer software (Figure 2-4).

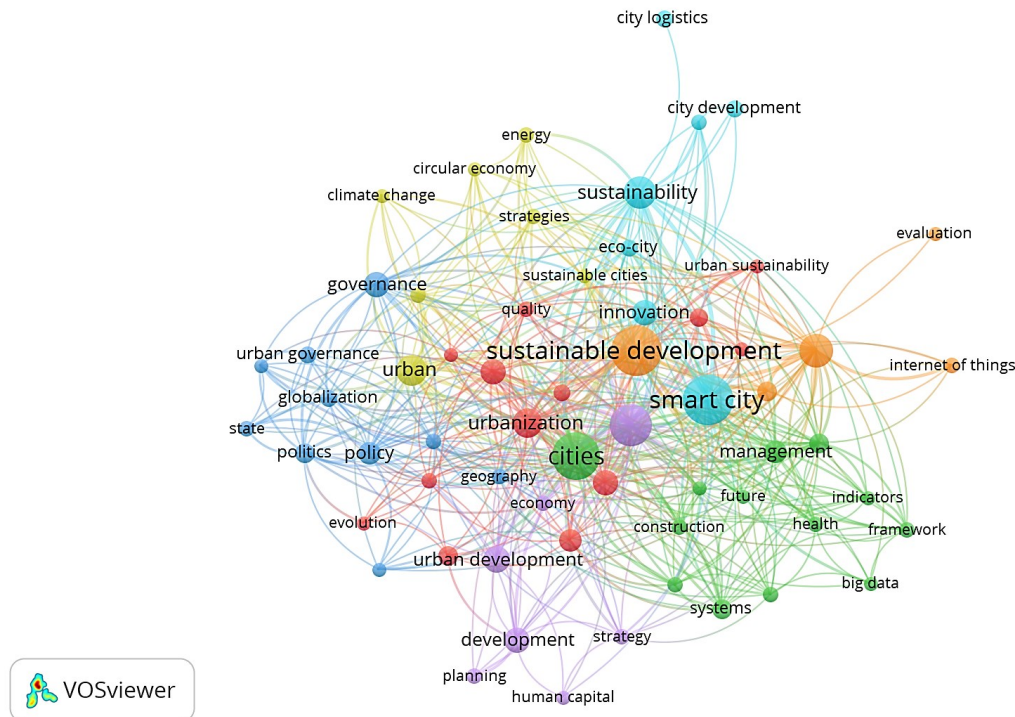


Figure 2. Map of research trends based on co-occurrence of keywords in publications for the words 'city' and 'development' from the Scopus database from 2005 to 2025.

Source: Own work using VOSviewer software.

Analysing the research trend map shown in Fig. 2, it can be concluded that 7 sub-clusters (clusters of author keywords) were identified, which were related to the following areas: red cluster grouping keywords such as: *economic development, economic growth, urbanisation, sustainable city development* (a total of 61 keywords); orange cluster grouping keywords such as: *sustainable development, smart city, internet of things* (a total of 38 keywords); green cluster grouping keywords such as: *big data, city, governance* (42 keywords in total); light blue cluster grouping keywords such as: *smart city, eco city, sustainable cities, urban development* (27 keywords in total); yellow cluster grouping keywords such as: *urban development, circular economy, climate change*; purple cluster grouping keywords such as: *city, planning, strategy, development* (29 keywords in total); dark blue cluster grouping keywords such as: *urban governance, globalisation, policies, government* (41 keywords in total). The results showed significant variation in the co-occurrence of author keywords across publications in the urban development literature. This demonstrates the multifaceted and multidimensional nature of this field of study.

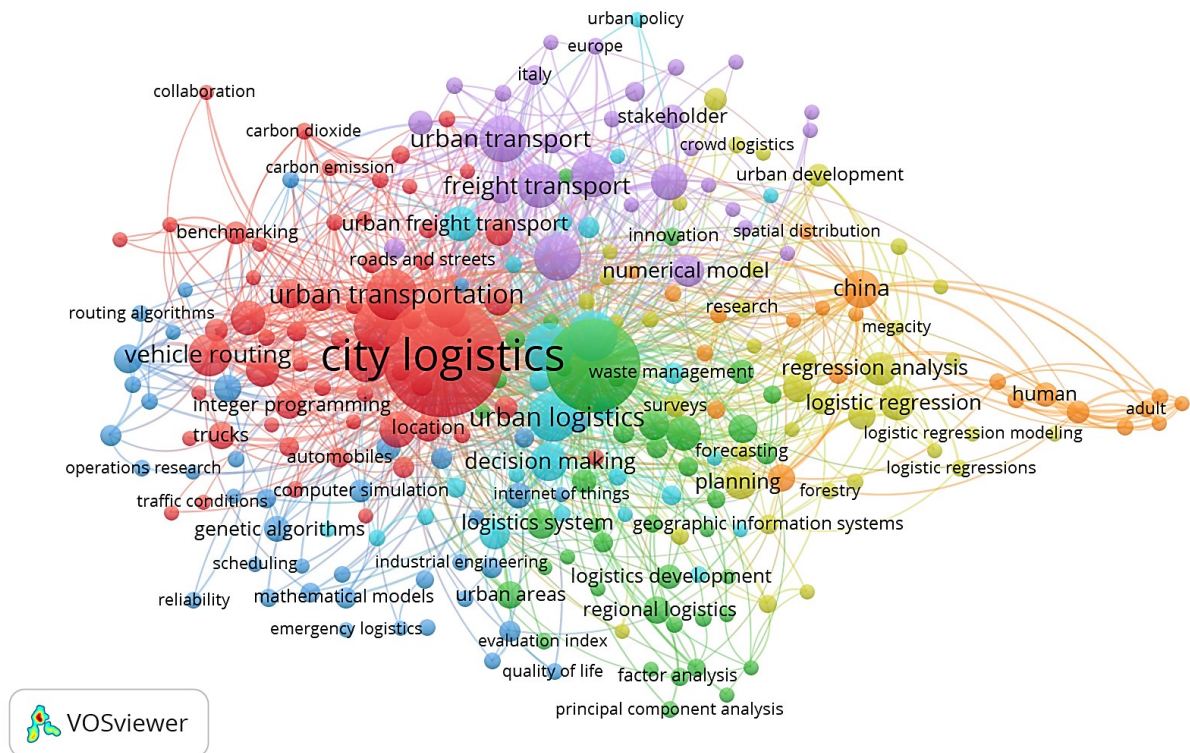


Figure 3. Map of research trends based on co-occurrence of keywords in publications for the words 'city' and 'logistics' from the Scopus database between 2000 and 2023.

Source: Own work using VOSviewer software.

A thorough examination of the research trend map presented in Fig. 3 reveals that the keyword co-occurrence network has demonstrated that research in the domain of city logistics (City Logistics) has predominantly focused on issues that fall within the purview of the field itself, along with associated domains such as urban transport, freight transport, passenger transport, and waste management. The map illustrates a total of seven research clusters, encompassing 259 keywords and a total of 5032 connections. This Figure is indicative of the multidimensionality of the research area in question, as well as the authors' profound interest in the subject matter.

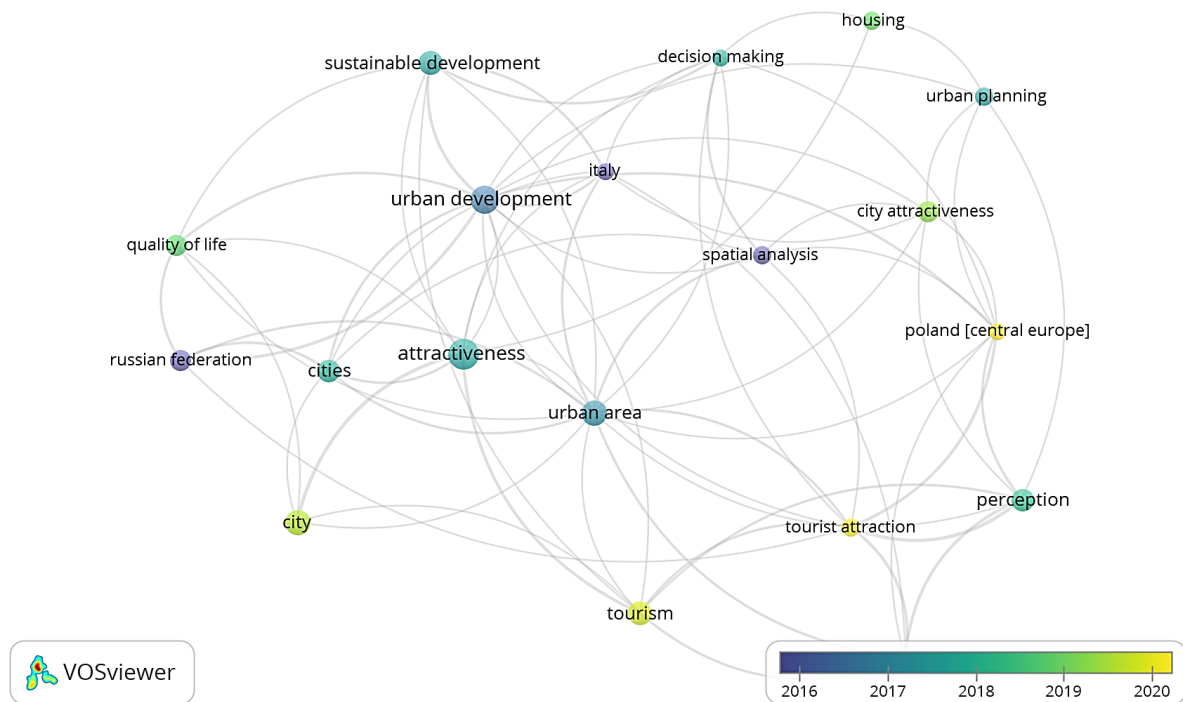


Figure 4. Map of research trends based on co-occurrence of keywords in publications on the words 'city' and 'attractiveness' from the Scopus database between 2015 and 2023.

Source: Own work using VOSviewer software.

Conversely, an examination of the research trend map (see Figure 4) reveals an absence of a predominant trend centred around the domain of city attractiveness. This demonstrates the high level of specialisation that is characteristic of this issue. Conversely, the magnitude of the selection (i.e. the diameter of the points) of the trend, which is associated with the number of paper published in this domain, signifies the limited popularity of the issue within the research topic. In addition, it is important to note that, in contrast to previous analyses, there is an absence of clearly delineated research clusters with a focus on the issue of city attractiveness. It is evident that research focusing on the previously analysed issues is considerably more abundant. With regard to the research topics related to logistical attractiveness, this tendency is indicative of the significant potential of the research undertaken.

The bibliometric analysis presented here is subject to certain limitations, arising from the fact that it was based exclusively on publications indexed by the WoS and Scopus databases. Consequently, it is not possible to assert that it is exhaustive, as there may be other significant publications in the field of analysis that have not been incorporated into these two databases. Moreover, it should be noted that the keywords employed for the analysis may not be exhaustive. It is evident that certain literature items do not align with the adopted inclusion and exclusion criteria, as they lack both keywords related to the attractiveness of the city and its logistical attractiveness. Consequently, these items have been omitted from the analysis. Furthermore, an alternative set of keywords could generate different clusters, resulting in different interpretations of the state of the art in this field. The expansion of keywords could

potentially result in a more comprehensive overview of the field, encompassing a broader range of work exploring the research area under investigation.

2.2. Logistics attractiveness - the conceptualisation

The extant literature does not address the concept of regional logistics attractiveness, a fact that is also evidenced by the bibliometric analysis carried out.

Nevertheless, the integration of scholarly output from the fields of city logistics and regional investment provides a rationale for identifying the relationship between the attributes that determine logistics attractiveness. This will facilitate the establishment of a coherent and comprehensive definition of the concept, thereby contributing to the partial filling of the theoretical gap in the area of management and quality sciences in this regard.

In order to define the concept of logistic attractiveness with precision, it is necessary to define the term 'attractiveness' itself as a theoretical category. In lexical terms, attractiveness is understood as an attractive force and a property of an object or phenomenon that is particularly interesting and at the same time capable of providing benefits in both cognitive and economic terms (SJP, PWN, 2025). This approach underscores the foundational dimension of the concept, emphasizing its role as a pivotal force influencing the decision-making processes of economic agents. Quantitatively, attractiveness can be regarded as a measure of the intensity of this force and the ability of an object to attract stakeholders by offering potential opportunities to satisfy pre-identified needs. In this context, stakeholders (i.e. individuals or organisations) act as active recipients of the impact of this force (Connell, 2010). As posited by various scholars, one of the extant concepts delineated in the extant literature sources, which incorporates the correlation of attractiveness with an identified economic area, is that of investment attractiveness. In a synthetic manner, the concept may be comprehended in terms of the ability to persuade investors to select a region as a location for investment (Gawlikowska-Hueckel, Umiński, 2000). Adopting this definition enables a subsequent evaluation of investment attractiveness to be conducted through the lens of the magnitude of the expenditures incurred. Nevertheless, this criterion, in spite of its simplicity and apparent obviousness, has a drawback in that it does not take into account the type of investment. This criterion favours capital-intensive activities, while knowledge-intensive activities may yield greater added value and non-financial benefits for the development of the area in which the investment is located (Hildebrandt et al., 2006, p. 13). The level of investment attractiveness of a given region is determined by the structure and quality of the combination of spatial, infrastructural, institutional and socio-economic conditions of a given territory (the so-called location factors). It is widely acknowledged within the investment community that locations which offer the optimum combination of location factors are of particular interest, since they enable the minimisation of capital expenditures and operating costs, while favouring the maximisation of the economic efficiency of the venture and the reduction of investment risk (Dziemianowicz, 2005).

In light of the intricacies inherent in the notion of investment attractiveness, R. Lubera (Lubera, 2019) asserts that logistic attractiveness constitutes a pivotal component thereof. It can be demonstrated that each determinant of logistic attractiveness (denoted by A) is simultaneously an element of the set of determinants of investment attractiveness (denoted by B). This can be formally expressed by a collective relation: It is hypothesised that $A \subseteq B$, on the basis that no extraneous factor exerts influence on the logistical location potential, which in turn exerts no influence on the overall investment attractiveness of a given area.

Conversely, the authors of the report on the attractiveness of Wallonia as an international logistics hub (PWC, 2017) defined the concept of a region's logistics attractiveness in terms of identified location factors that are taken into account when deciding where to locate a logistics facility. The factors were then grouped into seven clusters based on common characteristics. In order to arrive at a comprehensive evaluation, a rigorous methodology was employed, whereby each cluster and the individual location factors within it were assigned appropriate weights. The weights reflect the importance of a particular location factor and cluster in the decision-making process for selecting a distribution centre location in a specific region. During the data collection phase, a comprehensive analysis of numerous databases from various institutions (e.g. Eurostat, World Bank, World Economic Forum) was conducted to identify the information that best characterised the selected location factors. The incorporation of a location factor into the analysis was contingent upon the availability of a comprehensive dataset encompassing all 49 regions under scrutiny. Subsequent to the collection of a complete set of data, a quantitative analysis was conducted utilising a predefined scoring method and assigned weights. The resultant data were then subjected to statistical analysis, with the level of logistical attractiveness of each region being indicated by a score on a scale of 1 to 10 (Figure 5).



Figure 5. Logistical attractiveness factors with their weights.

Source: Logistics study on the attractiveness of Wallonia for international logistics hubs. Final report PWC, April 2017, p. 14.

For the purposes of this paper, the authors defined logistics attractiveness as a multidimensional characteristic of a region's space, reflecting the level of ability of that region to attract, maintain and develop a technological area in the field of transport and logistics. The assessment of logistical attractiveness was based on a deductive research approach (see Research Methodology), integrating quantitative and qualitative data. The concept of logistical attractiveness, as understood in this study, facilitates its application in the evaluation of regional development potential in the medium and long term, as well as in strategic planning processes. This is particularly evident in the context of supporting smart specialisations and the development of regional competitive advantages.

3. Characteristics of Silesian voivodship

The Silesian Province covers an area of 12,333 km², which accounts for 3.9% of Poland's total area and ranks it 14th among all provinces. The region is distinguished by its notably high degree of urbanisation and population density, with a population density of 374 people per km², which is the highest in the country. The province is located in the south of the country, in the so-called cross-border area (Figure 6) – it borders the Czech Republic (Moravian-Silesian Region) and Slovakia (Žilina Region). Furthermore, the voivodeship is adjacent to the following regions: The Opole Voivodeship is located in the western part of the country, while the Dolnośląskie Voivodeship is situated in the east. The Łódź Voivodeship is positioned in the north, and the Kielce Voivodeship is located in the north-east (Dohn et al., 2019).

The primary transport corridor of the TEN-T transport network traverses the region, namely the Baltic-Adriatic corridor and the route connecting Eastern Europe and Asia with Western Europe. The aforementioned factors contribute to the significant volume of goods flows involving the Silesian Voivodeship.

For several years, the Silesian Voivodeship has been one of the most attractive regions in Poland in terms of investment attractiveness. This phenomenon can be attributed to a number of factors, primarily associated with the region's abundant natural resources, which have played a pivotal role in shaping the economic development of the region. The primary benefits of the region are as follows (Investment Attractiveness of Regions, 2017):

- Poland's largest urban complex, creating exceptional investment potential.
- Poland's largest transport hub fostering the development of industry with numerous cooperative links. Good transport links provide: International Airport "Katowice", A4 motorway, E40 road (European route), E75 road (European route) and direct railway connections with cities such as Berlin, Vienna, Budapest, Bratislava, Prague, Moscow, Hamburg.

- The most highly industrialised region in Poland, with traditional specialisations (mining, metallurgy, engineering), but undergoing effective restructuring, allowing for the development of services, including transport and logistics.
- Numerous economic sub-zones offering attractive investment areas.
- Main courses of study in the voivodship related to sciences and technical majors (Silesian University of Technology, Częstochowa University of Technology, the University of Technology and Humanities).
- Broad investment opportunities, as confirmed by very high ratings for potential and real investment attractiveness for: national economy, capital-intensive industry, labour-intensive industry, trade, tourism, financial intermediation of business services and education.
- High labour ethos.

In turn, the evaluation of the voivodship's competitiveness from the point of view of the international competitiveness index of European regions (European Regional Competitiveness Index), places the Silesian Voivodship at a comparable level to other regions in Poland (national average) - see Figure 6.

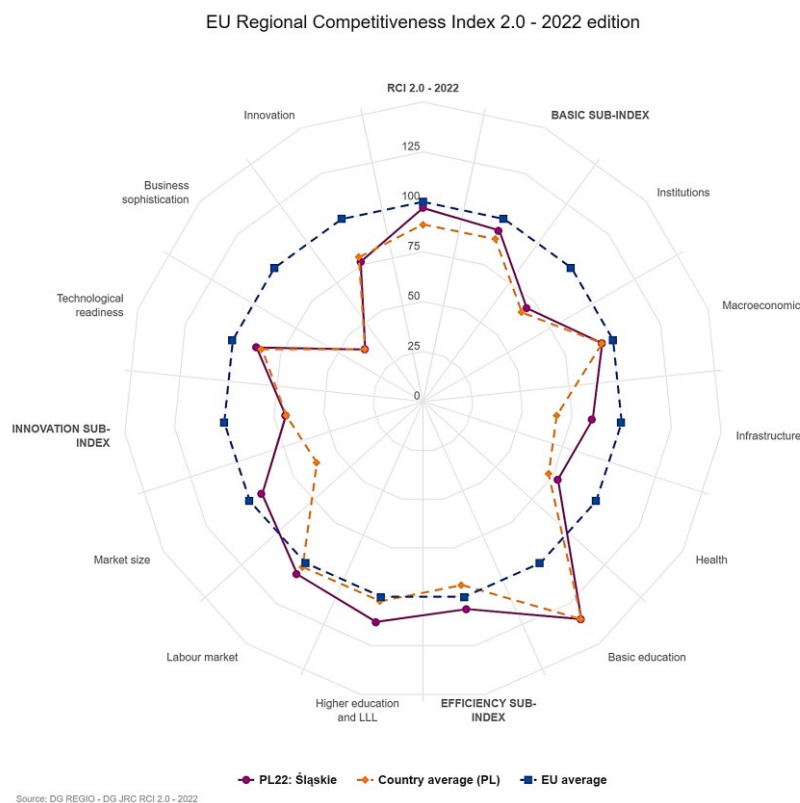


Figure 6. Values of selected sub-indices of the European Regional Competitiveness Index 2022 for the Silesian Voivodship and other Polish and European regions.

Source: compiled on the basis of the EU Regional Competitiveness Index 2.0 - 2022 edition, https://ec.europa.eu/regional_policy/assets/regional-competitiveness/index.html#/PL/PL22.

The research indicates that, in general, the Silesian Voivodeship exhibits comparable values to the national average for specific sub-indices of regional competitiveness. The region's innovative potential, which is slightly higher than the national average, can be attributed to the relatively high quality of its universities and research institutes. However, the voivodship is characterised by a paucity of international research and development centres, design and engineering offices with export potential, and companies offering supra-local consulting or IT services. This situation may, in the long term, act as a barrier to the growth of labour productivity and thus also the level of prosperity in the region. Conversely, this domain, akin to the sphere of transport infrastructure and the efficacy of public institutions, continues to necessitate substantial reforms and an augmentation in the magnitude of financial resources. The Silesian Voivodeship's greatest asset is its high degree of urbanisation and good geographical location, which in itself makes it possible to attract investments to the region that are interested in a deep labour market or a large consumer market. In order to enhance the competitiveness of the Silesian Voivodeship, it is essential that both the central and regional authorities demonstrate a commitment to implementing a long-term modernisation policy. The advantages accruing from Poland's accession to the European Union, such as the enhancement of east-west transport links through road investments that expeditiously connected the Czech Republic and western Poland with German industry, have not been sufficient to counterbalance these disadvantages. Inadequate investment in transport infrastructure, specifically in the domains of road and rail transport, has been identified as a salient issue in the north-south direction. This concern pertains to the inadequate facilitation of connections between the region and the Czech Republic via the Moravian Gate and the Silesia-Poland-Baltic and Silesia-Wielkopolska-West Pomerania lines. Once these gaps are filled, the region's geographical assets will be strengthened through nationwide programmes to modernise road, rail and river infrastructure. Nevertheless, it is imperative that these changes are accompanied by reforms that extend beyond the confines of infrastructure, with the objective of enhancing the scientific potential of the region and achieving a substantial improvement in the international standing of local universities and research institutions (Bukowski, 2018).

4. Research methodology

The research methodology was adopted in accordance with the methodology used for the research task on *Foresight technologies of the Silesian Voivodeship 2050. Identification of priority technologies of the Silesian Voivodeship for the technological area of Transport and Logistics*, within the scope of the research project carried out by the Authors entitled *PPO WSL 2030. Establishment of the Regional Innovation Observatory*. In order to achieve the assumed

research objectives, a deductive approach was adopted, assuming the derivation of conclusions on the basis of previously established theoretical knowledge and available empirical data. A triangulation of research methods was used in the research process, combining quantitative data analysis with expert qualitative assessments.

The primary analytical instruments employed in this study were the Porter's diamond model, utilised to evaluate regional competitiveness from a sectoral standpoint, and the Emerald model, which facilitates an exhaustive examination of technological attractiveness, encompassing systemic conditions and the innovation milieu.

The selection of these methods was justified by their high potential for assessing the attractiveness and competitiveness of technological areas. The integration of the diamond and emerald concepts enabled a multidimensional approach to the problem, encompassing both structural factors and dynamic aspects of technology development. The approach adopted also permitted a flexible selection of evaluation criteria, adequate to the specifics of the sector under study.

A comprehensive analysis of the factors influencing the potential for technology development in the field of transport and logistics was conducted, encompassing four primary groups.

1. **Demand attractiveness of technology** - covering the assessment of the structure and dynamics of demand for products and technological solutions regionally, nationally and internationally.
2. **Supply-side attractiveness** of technology - taking into account the availability and quality of production factors necessary for technology development and implementation.
3. **Competitiveness of technologies** - understood as the ability of the analysed technologies to compete effectively on the market, taking into account both internal and external conditions.
4. **Development of complementary sectors and technologies** - referring to the degree of linkage with other industries and technologies that may support or stimulate the development of the technology area under study.

The applied research procedure was based on the analysis of secondary data (desk research), including both statistical and industry data, as well as market reports, strategic documents and expert opinions. This methodological approach facilitated a multifaceted and integrated evaluation of the technological domain under scrutiny, with a view to its future evolution.

5. Research results

The applied research methodology enabled the identification of the key determinants of technological attractiveness and competitiveness of the region. This identification took into account both supply and demand conditions, as well as systemic factors and the influence of related sectors.

The results of the research were presented in terms of four main groups of analytical factors: The factors to be considered are as follows: firstly, the technology demand attractiveness; secondly, the supply attractiveness; thirdly, the logistics competitiveness; and fourthly, the development of complementary sectors and technologies (Table 2). For each of these categories, a detailed assessment of the region's potential was made, identifying both its advantages and limitations in the context of further development of transport and logistics technologies.

The results presented herein provide a foundation for formulating strategic conclusions regarding the positioning of the Silesian Voivodeship as a centre of innovation development in logistics, and indicate key directions of activities that support the growth of the region's technological competitiveness.

Table 2.

Determinants of logistics competitiveness of the Silesian Voivodeship according to Porter's Diamond combined with the EMERALD method

Demand-side attractiveness	Supply-side attractiveness	Competitiveness in logistics	Development of related and supporting sectors/technologies
• Developing markets for technologies • Implementation of customer-reported technologies • Affordability and digital accessibility of technologies to residents	• Density of linear infrastructure • Availability of point infrastructure • Logistics operators • Availability of suprastructure • Integrated logistics systems of the region • Social capital • R&D potential	• 3D printing and additive manufacturing technologies (Reducing the need to transport components and finished products through local additive manufacturing - application areas: aerospace, automotive, medical) • Closed-loop economy (CLE) and recycling technologies (Reducing the need to transport raw materials and waste through local recycling and reuse of materials in the region) • Development of e-commerce in a decentralised model (based on local micro-distribution centres, e.g. "dark stores") • Development of renewable energy and local microgrids (The ability to generate and store energy locally reduces the need to transport fuels and energy raw materials)	• Internet of Things (IoT) and telematics systems • Digital twins • Robotisation of technologies • Advanced AI systems • Electric and hydrogen drives • Dynamic work management • Advanced materials and smart packaging • Intelligent waste management systems

		• Autonomous manufacturing robots and industrial automation systems • Blockchain technologies and smart contracts (Ability to digitally manage the supply chain without physically moving documentation and goods between intermediaries) • Technologies for local food production (agro-technologies)	
--	--	--	--

Source: own work.

The following graphic summary has been developed for the purpose of illustrating a synthetic assessment of the competitive potential of the Silesian Voivodeship in the area of transport and logistics technologies. The development of this summary has been informed by the results of analyses carried out in four key methodological dimensions, namely demand attractiveness, supply attractiveness, technology competitiveness and the development of related and supporting sectors (Fig. 7).

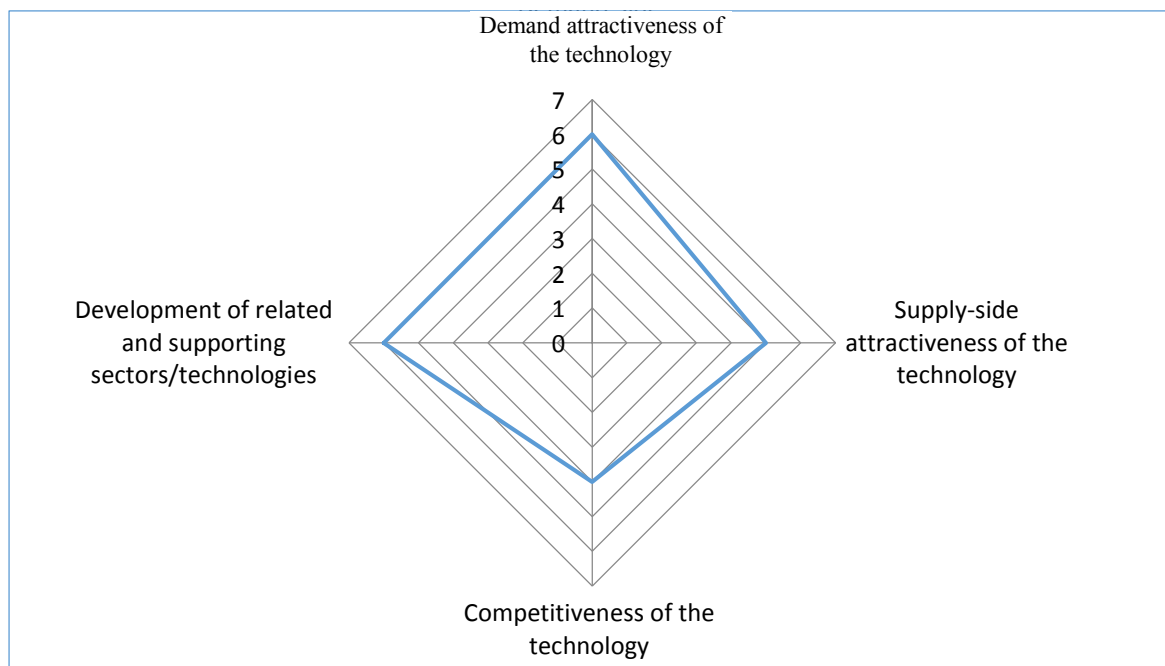


Figure 7. Assessment of competitive potential for the Transport and Logistics technological area.

Source: own work.

An analysis of the logistics competitiveness of the Silesian Voivodeship was conducted using Porter's Diamond and the EMERALD method. This analysis enabled the identification of the key determinants influencing the region's position. With regard to the technological demands that have been observed, it is evident that there is a high demand for innovative transport and logistics solutions. This can be attributed to the favourable geographical location and developed transport and industrial infrastructure. Moreover, the expanding remit of the e-commerce sector, coupled with the escalating imperatives for enhanced transport efficiency, has given rise to the imperative for the implementation of sophisticated technologies, the automation of

warehouse operations, and the adoption of eco-friendly transport methods. The determiners of the supply-side attractiveness of technology in the region are the availability of research and development facilities and the cooperation of universities and research institutes with enterprises, which effectively promotes the implementation of innovative solutions in transport and logistics. Notwithstanding the presence of key players in the logistics services sector, a significant constraint is the shortage of qualified specialists and the high costs of implementing modern technologies. Moreover, the capacity to secure funding for the development of technologies pertaining to green transport transformation constitutes a substantial strategic advantage for the region, underscoring its capacity for an innovative approach to the development of the transport and logistics industry. A thorough examination of technological competitiveness has revealed considerable untapped potential in the domains of automation of logistics processes, intelligent transport systems and electromobility. In comparison to other Polish and European regions, the Silesian Voivodeship boasts a competitive logistics infrastructure. However, in order to further consolidate its position, it is essential that the region invests in digitisation and the implementation of sustainable transport solutions. The transport sector is characterised by high barriers of entry for new players, which have a detrimental effect on the development of innovative solutions. In order to address this issue, a number of actions must be taken, including the provision of financial support for transport start-ups, the simplification of administrative regulations, investment in education and competence development, and the creation of infrastructure to support modern transport technologies in the region. The development of associated sectors and supporting technologies has been shown to have a significant impact on the competitiveness of the region. A robust industrial and manufacturing base fosters conducive conditions for innovation in logistics and transport. The integration of Industry 4.0 technologies, including the Internet of Things, Big Data analytics and artificial intelligence, is a key direction for the modernisation of the sector. The mounting interest in green transport technologies, encompassing electromobility and the utilisation of hydrogen as an energy carrier, necessitates the augmentation of endeavours to establish suitable infrastructure and to foster research endeavours aimed at fortifying the transport and logistics sector.

The recommendations for the positioning of the Silesian Voivodeship on the technology market indicate the necessity to strengthen intersectoral cooperation, which will allow more effective technology transfer and faster commercialisation of innovations. Investment in digital technologies and automation should be accorded a high priority, and the development of intelligent transport systems and the digitalisation of logistics processes are pivotal in enhancing competitiveness. Concurrently, the cultivation of human resource competencies through the implementation of specialised education and training programmes adapted to the requirements of contemporary transport technologies remains an important aspect. Moreover, the advancement of ecological transport solutions, encompassing the development of intermodal transport infrastructure for electric and hydrogen vehicles, and the enhancement of

accessibility to funds from both EU and national sources, are pivotal factors in determining the subsequent technological development of the region. The promotion of the Silesian Voivodeship as a centre of logistics innovation by building a strong technological brand has the potential to attract investors and increase the innovative potential of the region. The consistent implementation of the aforementioned activities will enable the Silesian Voivodeship to consolidate its position as a leader in the field of modern transport and logistics technologies. This, in turn, will ensure the region's sustainable competitiveness on both the national and international stage.

6. Discussion

The obtained results are consistent with those of previous studies on investment attractiveness (e.g. Gawlikowska-Hueckel, Umiński, 2000; Dziemianowicz, 2005), which indicate that logistical factors are an integral part of regional competitiveness. At the same time, this study builds upon Lubera's (2019) approach, which emphasised the autonomous importance of logistical attractiveness in shaping smart specialisation strategies, rather than considering it as a subset of investment attractiveness. Similar attempts to operationalise the concept can be found in international studies, such as the PwC (2017) report on Wallonia, which used a location factor analysis with assigned weights. Unlike these approaches, however, this study not only highlights infrastructural determinants, but also technological and environmental ones. This is consistent with the new paradigm of sustainable regional development (Hildebrandt et al., 2006).

In this sense, the article contributes to the theoretical discussion by conceptualising logistical attractiveness as a multidimensional construct, while also highlighting its practical implications for regional policy and economic practice.

7. Summary

Research indicates that the logistical attractiveness of the Silesian Voivodeship is not solely attributable to its industrial heritage and location, but is increasingly attributed to innovative, adaptive and pro-environmental factors. The increasing significance of sustainable development and effective management of energy and information resources is precipitating a paradigm shift in logistics within the region, transitioning from a heavy infrastructure-based model to a more agile, intelligent, and low-carbon approach. It is therefore vital for the continued enhancement of the province's logistics attractiveness that not only are the

infrastructural advantages maintained, but that there is also consistent investment in competence, digitalisation, sectoral integration and the development of innovative regional logistics models.

The identification of the determinants of Silesia's logistic attractiveness is of paramount importance when utilising an integrated methodological approach (Porter's Diamond + EMERALD method). This will provide significant support for decision-making processes in spatial planning, investment location and the design of development policies. The results and recommendations presented in the paper are of an applied character and may be used by local authorities, companies and business support institutions in the Silesian Voivodeship seeking rational and perspective directions for the development of the TSL sector.

8. Limitations and further research directions

Despite taking a comprehensive methodological approach that combined Porter's Diamond model and the EMERALD framework, the study had some limitations. Firstly, the analysis relied heavily on secondary data (desk research) and expert assessments, which could introduce subjectivity and restrict the scope for generalisation. Secondly, the study primarily covered the regional dimension of Silesia without conducting a more in-depth comparative analysis with other European logistics regions that have a similar industrial structure and geographic location. Furthermore, the dynamic nature of technological and ecological transformation in the TSL sector means that some of the conclusions may become irrelevant in the medium term.

Future research should therefore focus on broadening the empirical base by incorporating primary research (e.g. surveys of logistics operators and investors and Delphi studies with experts) and developing comparative analyses across Polish and EU regions. A promising research direction is the integration of foresight methods with simulation models to test different development scenarios for logistics attractiveness. Furthermore, it would be beneficial to extend the perspective to include behavioural aspects of stakeholders' decision-making processes and to measure the long-term impact of innovative and green technologies on regional competitiveness.

Acknowledgements

The paper presents selected results of the regional project "Creation of Regional Innovation Observatory". The project is financed by the European Funds for Silesia programme and state budget (project number: FESL.01.03-IP.02-06CF/23).

References

1. *Atrakcyjność inwestycyjna regionów 2017* (2017). Raport przygotowany na zlecenie Polskiej Agencji Inwestycji i Handlu S.A. w Instytucie Przedsiębiorstwa Szkoły Głównej Handlowej w Warszawie. Warszawa.
2. Bukowski, M., Śniegocki, A., Wetmańska, Z. (2018). *Od restrukturyzacji do trwałego rozwoju. Przypadek Górnego Śląska*. Warszawa: Agencja Wydawnicza EkoPress.
3. Castillo, C., Panadero, J., Alvarez-Palau, E.J. et al. (2024). Towards greener city logistics: an application of agile routing algorithms to optimize the distribution of micro-hubs in Barcelona. *Eur. Transp. Res. Rev.*, 16, 44, <https://doi.org/10.1186/s12544-024-00669-7>
4. Connell, R.B. (2010). The attractiveness-competitiveness matrix: A methodology used to assist policy makers select priorities for industrial development initiatives. *International Journal of Business and Management*, 5(7), 187-194. DOI: 10.5539/ijbm.v5n7p3
5. Dohn, K., Knop, L., Kramarz, M., Przybylska, E. (2019). *Transport intermodalny w kontekście rozwoju regionalnego*. Toruń: Towarzystwo Naukowe Organizacji i Kierownictwa. Dom Organizatora.
6. Dragolea, L., Grondys, K. (2016). Logistics attractiveness of Poland in relation to logistics centres and global competition. *Polish Journal of Management Studies*, 14(1), 82-92. <https://doi.org/10.17512/pjms.2016.14.1.08>
7. Dziemianowicz, W. (2005). Ranking atrakcyjności inwestycyjnej miast Polski — refleksje po czterech edycjach badań. *Prace i Studia Geograficzne*, 35, 109-127.
8. Gawlikowska-Hueckel, K., Umiński, S. (2000). *Ocena konkurencyjności województw*. Gdańsk: Instytut Badań nad Gospodarką Rynkową.
9. Grondys, K., & Dragolea, L. (2016). Determinants of logistics infrastructure development in regions. *Forum Scientiae Oeconomia*, 4(1), 27-39.
10. Hildebrandt, A., Kalinowski, T., Nowicki, M., Susmarski, P., Tarkowski, M. (2006). *Atrakcyjność inwestycyjna województw i podregionów Polski*. Gdańsk: Instytut Badań nad Gospodarką Rynkową.
11. Kauf, S., Tłuczak, A. (2014). *Logistyka miasta i regionu. Metody ilościowe w decyzjach przestrzennych*. Warszawa: Difin.
12. Kuciński, K. (1999). *Lokalne uwarunkowania rozwoju regionalnego*. Warszawa: Szkoła Główna Handlowa.
13. Lubera, R. (2019). The concept of logistic attractiveness – Theoretical basis. *International Journal of Humanities, Arts and Social Sciences*, 5(3), 109-116. <https://doi.org/10.20469/ijhss.5.20004-3>
14. Ma, B., Teo, C.-C., Wong, Y.D. (2024). Location analysis of parcel locker network: Effects of spatial characteristics on operational performance. *Transportation Research Part E*:

- Logistics and Transportation Review*, 192, 103776. <https://doi.org/10.1016/j.tre.2024.103776>.
15. OECD (2022). Measuring the attractiveness of regions. *OECD Regional Development Papers*, No. 36. Paris: OECD Publishing. <https://doi.org/10.1787/20737009>.
 16. OECD/ITF (2024). *Urban logistics hubs: Summary and conclusions*. Paris: OECD Publishing. www.itf-oecd.org
 17. Pinheiro, C.D.P., Gonzalez-Feliu, J., Bertoncini, B.V. (2024). Addressing spatial heterogeneity and MAUP in urban transport geography: A multi-scale analysis of accessibility and warehouse location. *Journal of Transport Geography*, 116, 103812. <https://doi.org/10.1016/j.jtrangeo.2024.103812>
 18. Pourbaix, J.-L. et al. (2025). Examining spatial patterns and economic interactions of logistics warehouses in Texas metropolitan areas. *Journal of Transport Geography*, 123, 103984. <https://doi.org/10.1016/j.jtrangeo.2025.103984>
 19. Schorung, M., Lecourt, T., Dabanc, L. (2024). Assessing the spatial footprint of e-commerce logistics differentiating the types of warehouses: The case of Amazon in the United States. *Journal of Transport and Land Use*, 17(1), 647-674. <https://doi.org/10.5198/jtlu.2024.2438>
 20. Słownik języka polskiego PWN (2025, lipiec 7). Atrakcyjność. In: *Słownik języka polskiego PWN*. <https://sjp.pwn.pl/sjp/atrakcyjnosc;2432931.html>
 21. Strahl, D. (ed.) (2006). *Metody oceny rozwoju regionalnego*. Wrocław: Wydawnictwo Akademii Ekonomicznej we Wrocławiu.
 22. World Bank (2023). *Connecting to compete 2023: Trade logistics in the global economy – The Logistics Performance Index (LPI)*. Washington, DC: World Bank. <https://lpi.worldbank.org>
 23. World Economic Forum (2024). *Transforming urban logistics: Sustainable and efficient last-mile delivery in cities*. Geneva: World Economic Forum.