




The impact of construction projects on transport accessibility in cities based on the example of Szczecin

Aleksandra Chelstowska^{1✉}, Oleksandra Osypchuk², Katarzyna Sosik³

¹  <https://orcid.org/0009-0000-3193-1973>

²  <https://orcid.org/0000-0002-2712-245X>

³  <https://orcid.org/0000-0003-1298-9955>

Maritime University of Szczecin, Faculty of Economics and Transport Engineering
11 Pobożnego St., 70-506 Szczecin, Poland
e-mail: ¹a.chelstowska@pm.szczecin.pl; ²o.osypchuk@pm.szczecin.pl; ³k.sosik@pm.szczecin.pl
 corresponding author

Keywords: construction projects, transport infrastructure, public transport, transport accessibility, mobility, city logistics, urban mobility

JEL Classification: L91, R11, R41, R58

Abstract

With the dynamic socio-economic development of cities, actions of key importance have become necessary to ensure the required accessibility of urban transport. This goal can be achieved by expanding and modernizing the transport infrastructure and expanding the public transport network. It is transport that ensures the flow of goods and the movement of people in cities and beyond their borders. This state of affairs results in an increased importance of appropriate infrastructure, where construction investments have a fundamental role, and the method of their implementation affects a number of areas that significantly determine transport accessibility. This article aims to assess the impact of construction projects involving civil engineering facilities on transport accessibility based on the example of the city of Szczecin. The research process is based on unstructured observation and expert interviews, which allow for the development of a structured survey questionnaire. The authors manage to identify the elements of transport accessibility that are most negatively affected by construction projects. The collected data may constitute a basis for developing recommendations for local authorities and construction companies to reduce the diagnosed negative impact in the studied area.

Introduction

Cities have long ceased to be the main place of human existence. Currently, they play a number of other roles, being the economic exchange institutions, administration centers, culture and science centers, social and community spaces, and innovation centers (Cardoso, Sobhani & Meijers, 2022). This is the result of the increasing demands of city residents in terms of quality of life. Currently, city authorities must strive to continuously improve living conditions by ensuring mobility, social life, opportunities for professional development, access

to culture, a high level of health protection, safety, prosperity and high quality of the environment, access to housing, and transport infrastructure (Szołtysek, 2009, pp. 16–17). It is difficult to imagine guaranteeing these elements without efficiently functioning transport.

An extensive network of transport connections is necessary for socio-economic development. Transport enables the flow of materials and products and the movement of people both within cities and beyond their borders. This state of affairs contributes to the increased importance of transport processes and the appropriate infrastructure (Witkowski

& Kiba-Janiak, 2012). Additionally, the urbanization processes taking place around the world further intensify their role (United Nations, 2019, pp. 9–12). An efficient and high-quality transport network determines the quality of flows in supply chains and contributes to the smooth flow of people, which increases the mobility of city residents, improves their standard of living, and responds to social needs (Polyzos & Tsiotas, 2020).

The growing number of city inhabitants requires continuous improvement of transport infrastructure and increasing its availability. This is achieved by implementing solutions in the field of intelligent transport systems (ITS) (Shaheen & Finson, 2013), organizational and legal solutions, and direct construction works related to the building, reconstruction, and renovation of infrastructure facilities (Kwarciański, 2010).

Construction is one of the premises for the development of modern cities. It is difficult to imagine the growth of urban agglomerations without the implementation of construction projects, both those related to buildings and construction, as well as the reconstruction and renovation of infrastructure facilities. The results of construction activities clearly contribute to greater social comfort and quality of life. However, at the implementation stage, these investments may pose difficulties for both residents and business entities (Onat & Kucukvar, 2020). This is primarily related to the specific nature of construction activities. It requires a large number of deliveries by high-tonnage vehicles to construction sites, which may be located in places with building density and congestion. The work is often conducted by a large number of subcontractors, which makes coordination difficult, and the implementation time of projects is often up to several years (Janné, 2020, pp. 14–15). Construction projects of infrastructure facilities are a particular challenge for cities because their implementation leads to the need for changes in traffic organization. This constitutes a significant impediment to both passenger traffic: individual and collective, as well as freight transport. Thus, it affects the entire city's transport system, which naturally leads to reduced transport accessibility.

This article aims to determine the impact exerted by construction projects on the transport accessibility of cities based on the example of Szczecin. The authors attempt to assess the impact of investments implemented in the city on its perception by residents. This may be a starting point for planning the implementation of projects, taking into account the impact on the quality of life.

The first section presents the issue of transport accessibility. The second describes the impact of construction investments on transport accessibility in cities, and the third contains the results of our own research. The article is completed with the conclusions.

The essence of transport accessibility

The work of Hansen (Hansen, 1959) can be considered the beginning of research on the concept of transport accessibility. In the following years, the issue of accessibility was discussed by researchers such as Pirie (Pirie, 1981), Guy (Guy, 1983), Song (Song, 1996), and Handy and Niemeier (Handy & Niemeier, 1997), who indicated two possible scopes of examining transport accessibility. The first one is related to spatial analysis, and the second one corresponds to the analysis of service availability.

Referring to the “Glossary of terms” attached to the *Transport Development Strategy until 2020 (with a perspective until 2030)*, transport accessibility is the ease of reaching a selected place from other locations thanks to the existence of a network of infrastructure and transport services (Figure 1).

A selected destination is more accessible in terms of transport when other points can be reached from it in a time, financial, and organizational manner that is effective (avoiding the need to change the means of transport). In the literature, there are a number of concepts of transport accessibility that emphasize its various aspects, including time accessibility, branch accessibility, multi-modal accessibility, accessibility of public transport, accessibility to transport hubs, potential accessibility, and others (Ministry of Transport, Construction and Maritime Economy, 2013).

A commonly used research measure is the time accessibility of selected areas, because the universality and comparability of this tool make it possible to compare numerous locations and isolate areas with good time accessibility (these may also be areas further away but better connected), which determine the free movement of people within the concept of proximity, ease of spatial interaction, or (potential) contacts with an activity or function – commuting to school, work, hospital, etc. (Kwarciański, 2012; Śleszyński, 2014). Moreover, a frequently used method, especially in regional research, is potential accessibility, which measures the possibility of interactions between individual sources and destinations, e.g., the gravity model (Sierpiński, 2010). Transport accessibility also influences the migration of people

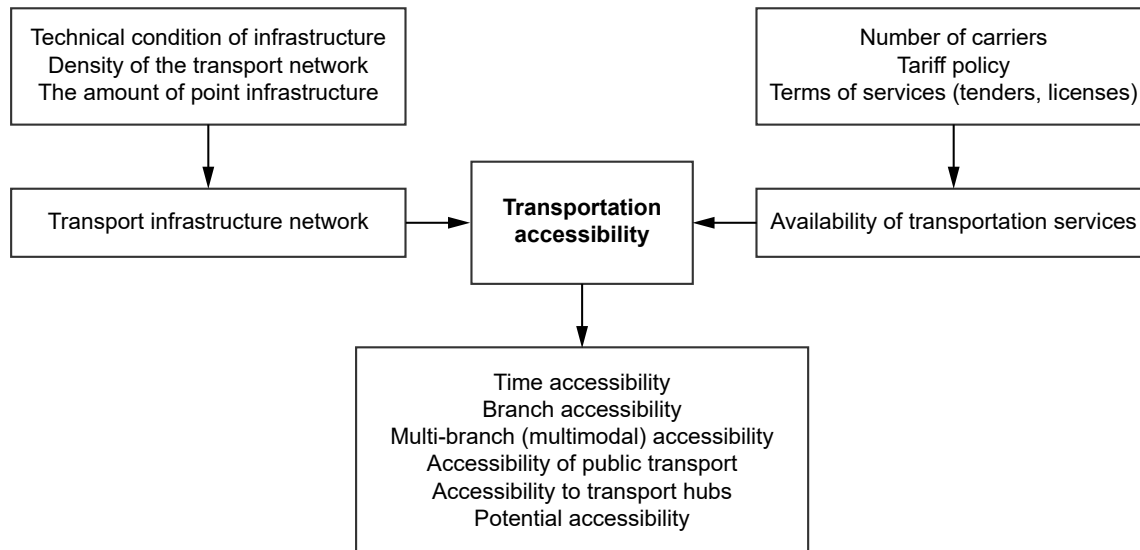


Figure 1. The concept of transport accessibility (own study based on available literature)

and the inflow of capital, so it can be assumed that the greater the accessibility, the greater the potential for social and economic development of cities and regions (Marshal's Office of the West Pomeranian Voivodeship, 2020).

Transport infrastructure is indicated in the literature as a key condition shaping the level of transport accessibility, the basic infrastructure parameters of which are determined, e.g., by measuring the network density related to the area or population number. It can also be assumed that for the point infrastructure of transport (i.e., its density, distribution, catchment area of potential passengers, time to reach, or distance to a transport point), the possibility of using many modes of transport or means of transport in one place, without the need to move to another bus/tram stop (coherence), is the main condition for the availability of transport services and communication accessibility of the studied area (Kwarcinski, 2012). Improving local transport accessibility, alongside the implementation of the sustainable development policy in transport, should be one of the key objectives of transport infrastructure investments (Sierpiński, 2010), which, in a broader perspective, may contribute to improving the socio-economic attractiveness of cities and regions.

The impact of construction investments in cities on transport accessibility

The implementation of construction projects related to the building, reconstruction, and renovation of infrastructure facilities affects transport accessibility primarily through the need to exclude infrastructure

facilities from use for the duration of the work, the need for changes in the rules of use, changes in the organization of traffic in the vicinity of the construction site, and the impact on the transport system of the supply construction purposes. Work conducted in one place affects not only the surroundings of the construction site but the entire transport system. This means that particular attention should be given to project planning processes in order to limit the negative impact on the quality of life of residents.

During work related to the construction, reconstruction, and renovation of infrastructure facilities, their use is often not possible or is limited. Therefore, it is necessary to change routes, available modes of transport, relocate stops, and change delivery schedules and timetables. This may lead to a reduction in the frequency and availability of public transport, availability of transport hubs, thinning of the transport network, reduction in the number of carriers in a given direction, and deterioration of the quality of transport services. Additionally, the implementation of construction projects requires the implementation of complex supply processes. Their planning largely determines the investment implementation dates, costs, occurrence of difficulties, and the impact on the surroundings of the construction site and city residents (Browne, 2015, pp. 161–182; Jaśkowski, Sobotka & Czarnigowska, 2018). The specific nature of construction materials requires deliveries to be made using high-tonnage vehicles, which contributes to the deterioration of road infrastructure in cities.

Deliveries may be a source of transport congestion, both due to the number of vehicles and

unloading. Unloading construction materials can often pose a danger to other road users, both due to the risk of impact or crushing vehicles and pedestrians with the unloaded load, as well as limited visibility. Another effect of construction projects in progress may be the reduction of parking spaces. Additionally, materials are often stored directly on the sidewalk. This creates a danger both for pedestrians who have to travel on the road, as well as for vehicles whose road width and visibility are limited. The implementation of construction supplies may lead to transport delays, reduced safety of road users, deterioration of infrastructure, and reduced mobility of residents, thereby reducing transport accessibility.

Research analysis

Research methodology

During this research, the authors reviewed the literature on the subject, during which it was noticed that researchers largely focus on the effects of completed construction investments. Thus, a research gap was diagnosed in the area of the impact of these investments on the surroundings of the construction site in the context of transport accessibility in cities during their implementation.

To identify the impact of construction projects on transport accessibility in cities, the first stage of the research process was based on the use of an unstructured observation method of areas covered by the construction, reconstruction, and renovation of infrastructure facilities located in the urbanized area of the city of Szczecin. In the next stage, we conducted non-standardized interviews with experts, which allowed for the determination of parameters enabling the assessment of the studied impact. The next stage of the research process was the preparation of a preliminary survey questionnaire based on data obtained from unstructured interviews, which was distributed to a purposefully selected control group of five scientific researchers in order to detect logical and substantive errors. The verification stage lasted from December 2022 to February 2023. Then, the authors of the article started conducting research using an appropriate and structured survey questionnaire. These surveys were conducted both online and offline, depending on respondents' preferences. Both data collected from online and offline questionnaires were compiled into one database for further analysis of the collected research material. Data collection occurred from March 2023 to July 2023.

The area covered by this research was the city of Szczecin, which is the capital of the West Pomeranian Voivodeship (located in the north-west of Poland). Szczecin is the third largest city in Poland in terms of area occupied, and, due to its proximity to the German border, it is an important communication hub in international transport relations. Additionally, Szczecin, as the core city of the Szczecin agglomeration and the Szczecin metropolitan area, has an important administrative, economic, and communication role in the country (Office of the Association of the Szczecin Metropolitan Area, 2020). The city is divided into four districts: Downtown, North, West, and Right Bank (part of the city located on the right side of the Odra River). This division is presented in Figure 2. Each district is divided into housing estates. The current division was adopted in 1990 by the Resolution of the City Council of Szczecin (City Council of Szczecin, 1990).

This city is characterized by dynamic development, which can be confirmed by the number of construction projects in progress, including the analyzed infrastructure investments. Referring to the data of the company *Szczecińskie Inwestycje Miejskie* (access to website available at: <http://sim.szczecin.pl>), which was established to implement the city's investment activities, 12 infrastructure projects were implemented in 2020–2023 (including bus/tram stops), street sections were expanded and rebuilt, transfer hubs were created, and the infrastructure necessary for charging electric buses was done (Table 1).

As of October 31, 2023, another 21 investments are underway, including, apart from the projects mentioned above, the revitalization of public areas. Two more investments are planned in the near future. At the same time, in many districts of the city, projects related to the reconstruction of the existing tram infrastructure are being conducted, consisting of changing the layout of the tracks and the traction network as well as the expansion and reconstruction of road systems in their immediate vicinity (access to the pertinent website available at ts.szczecin.pl). The project covers a total of 21.7 % of the length of functioning tracks.

The survey research was based on a targeted group of respondents, which consisted exclusively of people of working age. The adopted approach resulted from the fact that, in the study group, there is a greater need to travel for work or study purposes. According to data from the Central Statistical Office, in 2022, 227,971 people in the target age group lived in Szczecin (access to the local database via the

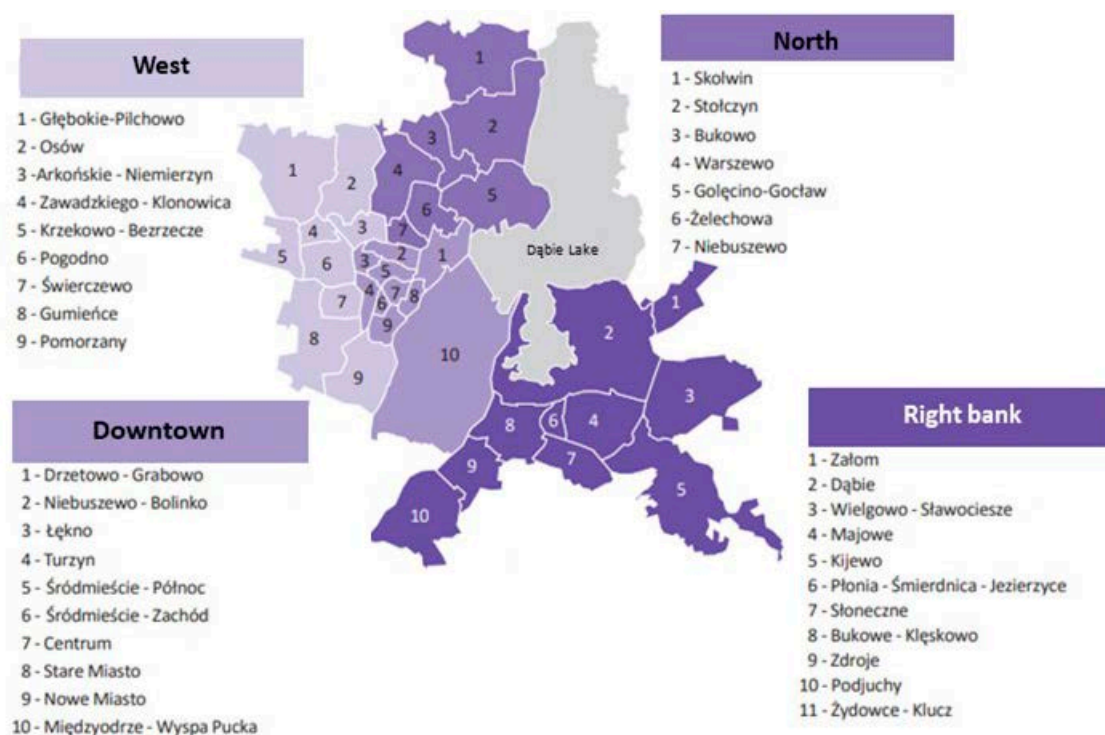


Figure 2. City of Szczecin – administrative division (own study based on Statistics Poland (Statistics Poland, 2020))

Table 1. Infrastructure projects implemented in Szczecin between 2020 and 2023

District / Housing estate	Year of completion of the construction investment	Type of construction investment	Subject of construction investment
West / Świerczewo	2020	Street reconstruction	Twardowskiego St., Witkiewicza St.
Downtown / Międzyodrze – Wyspa Pucka	2021	Street reconstruction	Górnośląska St.
West / Głębokie-Pilchowo	2021	Construction of an interchange	Kupeczyka St., Miodowa St., Wojska Polskiego Ave., Zegadłowicza St.
Downtown / Międzyodrze – Wyspa Pucka	2022	Expansion and reconstruction of the street	Gdańska St.
Downtown / Niebuszewo – Bolinko	2022	Construction of infrastructure for charging electric buses	Kołątaja St.
Downtown / Nowe Miasto	2022	Construction of infrastructure for charging electric buses	Kolumba St., Owocowa St.
North / Skolwin	2022	Construction of stop infrastructure, reconstruction, and construction of the road system	Stołczyńska St.
West / Arkońskie – Niemierzyn	2022	Construction of stop infrastructure	Arkońska St.
West / Gumieńce, Pomorzany	2022	Construction of stop infrastructure, construction and expansion of street sections	Mieszka I St.
Downtown / Międzyodrze – Wyspa Pucka	2023	Street reconstruction	Bulwar Gdański, Bulwar Śląski, Bytomska St., Celna St., Energetyków St., Hryniewieckiego St., Logistyczna St., Kujota St., Rybnicka St., Spichrzowa St., Świętego Floriana St., Władysława IV St., Zbożowa St.
North / Skolwin	2023	Construction of stop infrastructure, expansion of streets	Artyleryjska St., Orłowska St.
Right bank / Wielgowo-Sławocieszce	2023	Construction of stop infrastructure, construction of streets	Bałtycka St., Gościniec St.

office's website available at stat.gov.pl). Quantitative research was conducted on a group of respondents numbering 210 people, including 86 men (41 %) and 124 women (59 %). The participants represented all age groups included in the study: 174 people aged 18 to 25 (83 %), 24 people aged 26 to 35 (11 %), 6 people aged 36 to 45 (3 %), and 6 people aged 46 and over to 59 years (3 %). 151 respondents had secondary education (almost 82 %), 58 respondents had higher education (over 27.5 %), and 1 respondent had basic vocational education, constituting almost 0.5 % of the research sample. Assuming the fraction size to be 0.5, the confidence level set at $\alpha = 0.85$, and the measurement error of 5 %, it is concluded that the research sample was selected correctly.

Results

The main part of the questionnaire began with the question: "Is there any building/reconstruction/renovation of civil engineering facilities taking place near your place of residence/work?", to which more than half of the respondents (52.4 %) answered affirmatively. Next, respondents were asked: "Do you feel the impact of construction projects in progress on your daily functioning?" Despite the lack of construction near the place of residence/work for 47.6 % of respondents, only 28.1 % of them declared that they did not feel any impact of these investments (Figure 3). A significant part of respondents (33.3 %) declared that they felt their average impact on their daily functioning.

In the next question, respondents were asked to indicate from the available answers what elements are, in their opinion, influenced by projects in progress related to the building, reconstruction, and renovation of civil engineering facilities. Each respondent also had the opportunity to add their own suggestions in the "Other" answer. According to the majority of respondents, the discussed investments contribute to traffic congestion. This answer was given by 143 respondents (68.1 % of respondents). Considering age groups, the estimated percentage

was, in all cases, close to 70 % (Figure 4), but it was the most frequently selected answer among people aged 18–25 and 26–35 (67.8 % and 70.8 %, respectively, for the specific age groups). The second category was "Noise level", which was mentioned by 57.14 % of all respondents and, when divided into age groups, it accounted for 55.7 % to 66.7 % of the responses of individual groups. At the same time, it was noticed that this factor is more noticeable with age. The next parameter that most respondents gave attention to was "Mobility" (almost 53 % of respondents), which was also the most frequently chosen answer in the age groups 36–45 and 46–59 (83.3 % of each group). Moreover, in the 36–45 age group, the answer was equally often given that the above-mentioned investments affect difficulties in planning routes (in the entire study, this answer was chosen by 48.57 % of respondents).

Among the less frequently selected answers, it was noted that the factor "Delays in transport (passenger and public)" was most often indicated in the 18–25 age group (52.9 % of responses), the "Transport costs" factor was noticed in the 36–45 and 46–59 age groups (33.3 % and 50 %, respectively, of a given age group), and the greatest attention was given to the issue of deterioration of safety in the group of 46–59 years old (66.7 % of a given age group). A significant dependence was also noticed in the context of "Operation of enterprises/services/shops" because, with age, this factor gained an increased percentage of responses in individual age groups (13.8 %, 25 %, 33.3 %, and 50 %, respectively, of responses in individual groups). In the "Others" category, there was also information that construction works were inconvenient due to the lack of parking spaces in the area around the construction site.

Another area in which respondents were asked to assess the impact of the implementation of infrastructure projects related to the building, reconstruction, and renovation of civil engineering facilities was mobility, which included issues related to access to selected public utility facilities (Figure 5).

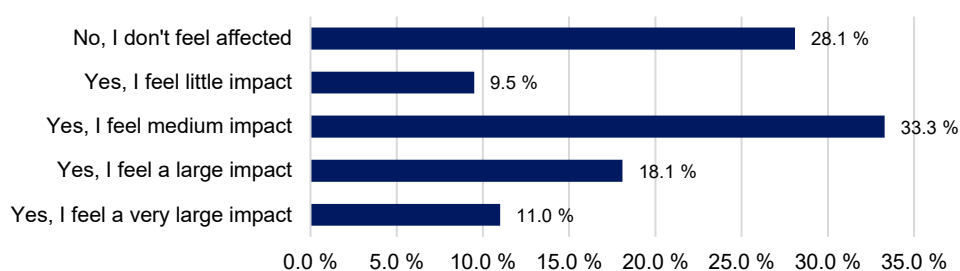


Figure 3. Assessment of the impact exerted by construction projects on daily functioning

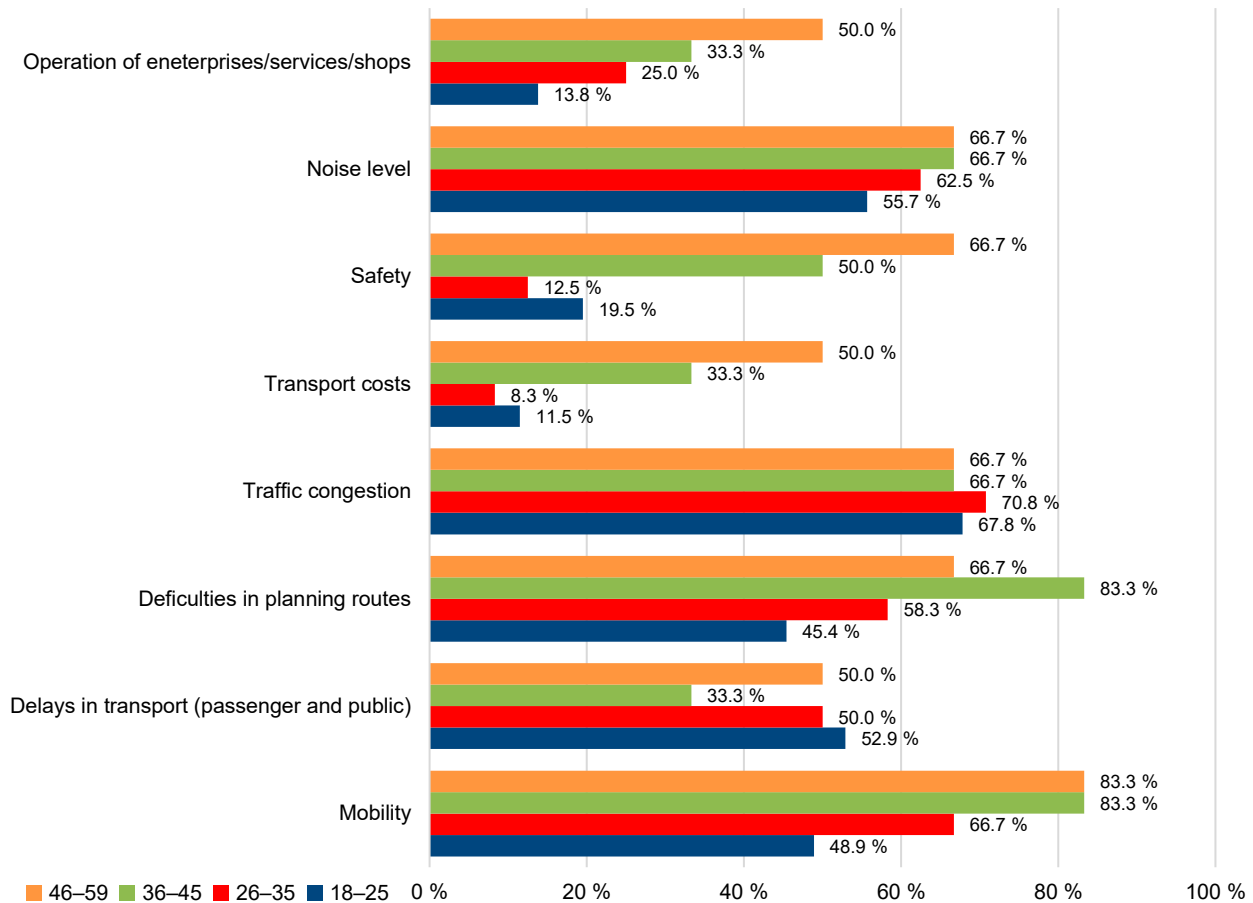


Figure 4. Areas of impact of construction projects in progress on the functioning of communities in cities – division by age categories

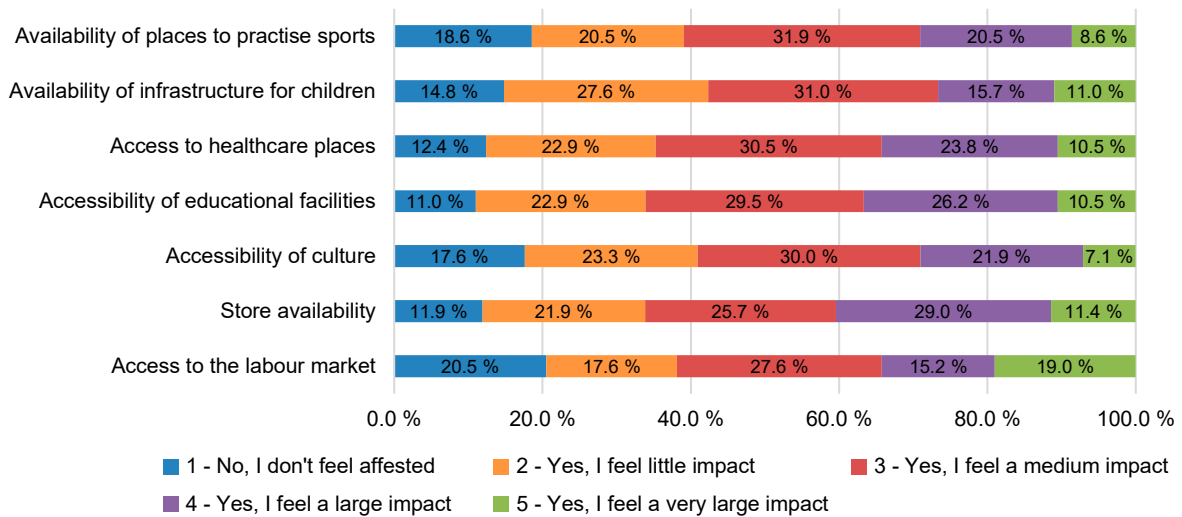


Figure 5. Assessment of the impact exerted by construction projects on mobility

A 5-point scale was adopted for evaluation, in which 1 denotes that the implementation of the construction project has no impact on the element, and 5 signifies that the implementation of the construction project has a very large impact on the element. The first element to be assessed was access to the labor market, as the implementation of construction

investments may cause complications in this area related to the impossibility or significant difficulties in reaching the workplace, the impossibility of taking up employment due to logistic difficulties, and a resulting reduction in the number of jobs due to disappearance of economic activities in the area around construction sites. The research showed that

a significant proportion of the respondents (27.6 %) assessed the impact of construction investments on this element as a medium.

Respondents were also asked about the impact of construction works on the store availability. Due to the location of construction sites, access to commercial facilities may significantly deteriorate, both as a result of inconvenience to residents driving and pedestrians. During the shutdown of renovated civil engineering facilities, there is a need to change the current route to the shops, there are restrictions on the number of parking spaces, travel time is extended, and other complications arise. Additionally, construction projects in the vicinity of stores may result in the disappearance of economic activity as a result of the above-mentioned complications and difficulties related to the implementation of supplies. When assessing the impact of construction investments on this element, 29.1 % of respondents indicated that, in their opinion, this dependence is high.

The implementation of construction projects, which causes logistic difficulties, may also lead to reduced access to cultural facilities. Additionally, a construction site in the immediate vicinity of cultural centers may contribute to difficulties in using them (due to the already mentioned limited parking spaces, problems with access, or safety reasons). Nearly one third of respondents (30 %) assess the impact of investments related to the building, reconstruction, and renovation of civil engineering facilities in the context of cultural accessibility as a medium.

In a similar way, the respondents assessed the impact of the implementation of infrastructure projects related to the building, reconstruction, and renovation of civil engineering facilities on other areas of mobility, including access to educational facilities, availability of infrastructure for children, availability of places to practice sports, and availability to healthcare places. The impact on all the above-mentioned elements was assessed by a significant proportion of respondents as medium (29.5 %, 31 %, 31.9 %, and 30.5 %, respectively). Construction projects contribute to logistical problems related to reaching the mentioned places and the risk of their limited accessibility due to construction works occurring in the immediate vicinity.

Respondents also assessed the impact of construction projects on public transport as an element of the city's social infrastructure. The implementation of projects relating to the building, reconstruction, and renovation of civil engineering facilities directly affects disruptions in the operation

of urban public transport. Construction works result in a decrease in transport accessibility by requiring changes to the routes of particular lines, which often translates into an extension of travel time and an increase in its costs (this is due to the need to purchase a ticket with a higher face value). More than half (51 %) of the respondents assessed the impact of construction projects on civil engineering facilities on public transport as very large. The obtained result clearly proves that residents feel the effects of construction activities.

The respondents also assessed the impact of construction investments related to civil engineering facilities on the cleanliness and maintenance of the infrastructure (i.e., the construction site and its surroundings in the immediate vicinity). Unfortunately, construction works are often associated with deterioration of the infrastructure (roads, sidewalks and point infrastructure), both visually and technically, which results from the need to deliver materials using high-tonnage vehicles and their storage. The impact of this element was assessed by the largest percentage of respondents (32.4 %) as medium.

The last assessed element, which is somewhat related to the above, is safety. This concept is a broad category, including, among others, road safety; due to infrastructure works, road accidents may occur that cause temporary traffic disruptions and reduce transport accessibility on the blocked section. In addition, construction may affect the safety of assets, as there is a risk of damage in the immediate vicinity of the construction site, hence the need to park vehicles in further locations (outside the area covered by construction works), which additionally results in deterioration of transport accessibility, because part of the route must be covered on foot or by public transport. Respondents' answers in this area are not uniform. A significant part of the research sample (28.6 %) assesses the impact of construction on broadly understood safety as a medium. The answer that construction projects have a very large impact on safety was also highly ranked (24.3 %).

Conclusions

Construction is an important factor in the development of modern cities. Nowadays, building activities are increasingly discussed in the context of their impact on urban mobility. This issue is even more important as, in recent years, there has been an intensification of investments aimed at the construction, reconstruction, and modernization of civil engineering facilities due to the need to settle financial

resources obtained from European funds on time. Another long-term factor influencing the need to implement the investments discussed is the progressive urbanization of cities, which forces actions to improve the mobility, comfort, and safety of residents. Unfortunately, during the implementation of these investments, the effect may be opposite to the intended one.

Despite the topic being increasingly discussed, researchers have approached the impact of construction mainly in the context of sustainable development. According to the authors of this article, this is not a sufficient approach as construction activity affects functioning in a broader spectrum, especially when it is conducted in urban environments.

Construction activities may affect the urban environment and its inhabitants with varying intensity, depending on the location of the construction site, the type of investment, the construction technologies used, and the organization of work. Assessing this impact was a challenging task due to the subjective nature of residents' opinions on transport accessibility as an interpretation of urban mobility. For research purposes, after expert consultation, the authors determined the elements that constitute transport accessibility. As part of the research analysis, it was found that the implementation of construction investments related to the building, reconstruction, and renovation of civil engineering facilities affects transport accessibility in cities; however, this impact varies depending on the selected category. In most questions, there was no significant impact of the respondent's gender, age, or education on the answers provided, and if such a relationship was found, it was demonstrated during the analysis of a specific area. For most areas, respondents rated the impact as medium to very large. The greatest impact was identified in the areas of public transport and safety. Moreover, a significant impact was noticed on mobility, understood as the availability of facilities to the public.

Considering the aging population and the changes taking place in cities in recent years (including the expansion of settlements in peripheral areas), the effects of reduced transport accessibility will be increasingly felt (UNECE, 2020). Therefore, accounting for the above limitations, it is necessary to take appropriate action.

The conducted research and analysis of the literature indicate the need to take actions aimed at identifying the areas with a possible negative impact of the investment and to prepare solutions to limit this impact in the context of transport accessibility.

It seems reasonable to have more rational investment planning by adapting work schedules to transport needs and traffic flows. This means dividing the work into stages that consider, for example, seasonal fluctuations in daily traffic intensity and ensuring a high capacity of alternative routes to the closed sections. Local authorities, as the entity ordering the implementation of works, should consider factors affecting transport accessibility in tenders and formal and legal approval processes.

The positions on which the impact was assessed as large and very large in the conducted study (i.e., deterioration of public transport, difficult access to shops, safety, mobility, traffic congestion, and difficulties in planning routes) should constitute a significant determinant in the course of planning and implementing investments both for the authorities local and entities implementing construction projects. The research results can serve as a guide for local authorities to create requirements and frameworks. The solutions that can most effectively contribute to this include rational work scheduling, selecting the optimal type of supply, developing a construction logistic plan, night deliveries, establishing a Construction Consolidation Center, and taking into account non-price criteria during tenders (MEAT) (Osypchuk & Iwan, 2023; Thompson, Osypchuk & Iwan, 2023). The authors believe that it is advisable to continue such a study to assess the validity of implementing specific solutions. Furthermore, actions should be initiated to disseminate knowledge among construction companies about good practices and their impact on transport accessibility in cities.

Acknowledgments

This paper was funded by the Maritime University of Szczecin (grant Młody Badacz 1/MN/KZIL/24).

References

1. BROWNE, M. (2015) The challenge of construction logistics. In: Lundesjo, G. (ed.) *Supply Chain Management and Logistics in Construction*. London: Kogan Page.
2. CARDOSO, R., SOBHANI, A. & MEIJERS, E. (2022) The cities we need: Towards an urbanism guided by human needs satisfaction. *Urban Studies* 59 (13), pp. 2638–2659, doi: 10.1177/00420980211045571.
3. City Council of Szczecin (1990) *Uchwała Nr VIII/53/90 Rady Miejskiej w Szczecinie w sprawie utworzenia w mieście Szczecinie dzielnic i osiedli z dnia 28 listopada 1990 r.* Available at: <http://bip.um.szczecin.pl> [Accessed: January 29, 2024].

4. Statistics Poland (2020) Rocznik Statystyczny Szczecina – 2020. Available at: <https://szczecin.stat.gov.pl> [Accessed: January 29, 2024].
5. GUY, C.M. (1983) The assessment of access to local shopping opportunities: a comparison of accessibility measures. *Environment and Planning B: Planning and Design* 10 (2), pp. 219–238, doi: 10.1068/b100219.
6. HANDY, S.L. & NIEMEIER, D.A. (1997) Measuring accessibility: An exploration of issues and alternatives. *Environment and Planning A* 29 (7), pp. 1175–1194, doi: 10.1068/a291175.
7. HANSEN, W.G. (1959) How accessibility shapes land-use. *Journal of the American Institute of Planners* 25 (2), pp. 73–76, doi: 10.1080/01944365908978307.
8. JANNÉ, M. (2020) *Construction logistics in a city development setting* (Vol. 2091). Thesis for Doctor of Engineering, Linköping University Electronic Press, doi: 10.3384/diss.diva-170231.
9. JAŚKOWSKI, P., SOBOTKA, A. & CZARNIGOWSKA, A. (2018) Decision model for planning material supply channels in construction. *Automation of Construction* 90, pp. 235–237, doi: 10.1016/j.autcon.2018.02.026.
10. KWARCIŃSKI, T. (2010) Efekty ekonomiczne rozwoju inwestycji infrastrukturalnych. *Zeszyty Naukowe Uniwersytetu Szczecińskiego* 601, *Ekonomiczne Problemy Usług* 59, pp. 171–184.
11. KWARCIŃSKI, T. (2012) Dostępność transportowa jako paradygmat kształtujący wielkość przewozów w publicznym transporcie pasażerskim. *Logistyka* 2, pp. 169–174.
12. Marshal's Office of The West Pomeranian Voivodeship (2020) *Dostępność przestrzenna*. [Online]. Available at: <https://eregion.wzp.pl/obszary/dostepnosc-przestrzenna> [Accessed: October 16, 2023].
13. Ministry of Transport, Construction and Maritime Economy (2013) *Słownik pojęć strategii rozwoju transportu do 2020 roku (z perspektywą do 2030 roku)*. Available at: https://www.gov.pl/static/mi_arch/media/3510/Sownik_pojec_SRT.pdf [Accessed: October 24, 2023].
14. Office of the Association of the Szczecin Metropolitan Area (2023) *Przebudowa torowisk tramwajowych w Szczecinie – etap II*. [Online]. Available at: <https://ts.szczecin.pl/strona/przebudowa-torowisk-tramwajowych-w-szczecinie-etap-ii> [Accessed: November 02, 2023].
15. ONAT, N.C. & KUCUKVAR, M. (2020) Carbon footprint of construction industry: A global review and supply chain analysis. *Renewable and Sustainable Energy Reviews*, 124, 109783.
16. OSYPCHUK, O. & IWAN, S. (2023) Analysis of selected solutions for sustainable urban deliveries in the construction industry. *Sustainability* 15 (4), 3567, doi: 10.3390/su15043567.
17. PIRIE, G.H. (1981) The possibility and potential of public policy on accessibility. *Transportation Research Part A: General* 15 (5), pp. 377–381, doi: 10.1016/0191-2607(81)90143-6.
18. POLYZOS, S. & TSIOTAS, S. (2020) The contribution of transport infrastructures to the economic and regional development: a review of the conceptual framework. *Theoretical and Empirical Researches in Urban Management* 15 (1), pp. 5–23.
19. SHAHEEN, S. & FINSON, R. (2013) *Intelligent Transportation Systems*. UC Berkeley. Transportation Sustainability Research Center. Available at: <https://escholarship.org/uc/item/3hh2t4f9> [Accessed: October 19, 2023].
20. SIERPIŃSKI, G. (2010) The measures of transport accessibility of cities and regions. *Zeszyty Naukowe Politechniki Śląskiej. Seria: Transport* 66, 1825, pp. 91–96 (in Polish).
21. ŚLESZYŃSKI, P. (2014) Temporal accessibility and its Tramwaje applications. *Przegląd Geograficzny* 86 (2), pp. 171–215, doi: 10.7163/PrzG.2014.2.2 (in Polish).
22. SONG, S. (1996) Some tests of alternative accessibility measures: A population density approach. *Land Economics*, 72 (4), pp. 474–482.
23. SZOŁTYSEK, J. (2009) *Podstawy logistyki miejskiej*. Katowice: Wydawnictwo Akademii Ekonomicznej w Katowicach.
24. THOMPSON, R.G., OSYPCHUK, O. & IWAN, S. (2023) Construction and urban logistics. In: Monios, J., Budd, L., Ison, S. (Eds) *The Routledge Handbook of Urban Logistics*. Routledge, pp. 175–186, doi: 10.4324/9781003241478.
25. UNECE (2020) Ageing in sustainable and smart cities. *UNECE Policy Brief on Ageing* 24, Available at: https://unece.org/fileadmin/DAM/pau/age/Policy_briefs/ECE_WG-1_35.pdf [Accessed: January 29, 2024].
26. United Nations (2019) *World Urbanization Prospects: The 2018 Revision*. Report of Department of Economic and Social Affairs Population Division, ST/ESA/SER.A/420, New York.
27. WITKOWSKI, J. & KIBA-JANIĄK, M. (2012) Correlation between city logistics and quality of life as an assumption for referential model. *Procedia – Social and Behavioral Sciences* 39, pp. 568–581, doi: 10.1016/j.sbspro.2012.03.131.

Cite as: Chełstowska, A., Osypchuk, O., Sosik, K. (2024) The impact of construction projects on transport accessibility in cities based on the example of Szczecin. *Scientific Journals of the Maritime University of Szczecin, Zeszyty Naukowe Politechniki Morskiej w Szczecinie* 78 (150), 5–14.



© 2024 Author(s). This is open access article licensed under the Creative Commons Attribution (CC BY) License (<https://creativecommons.org/licenses/by/4.0/>).