

CONSTRUCTION LAST MILE DELIVERIES AND URBAN QUALITY OF LIFE

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Purpose: The purpose of this paper is to assess the extent to which last-mile deliveries associated with the implementation of construction projects—covering infrastructure developments, residential buildings, and non-residential structures—affect the quality of life of residents in urban areas.

Design/methodology/approach: The paper adopts an analytical approach grounded in construction logistics and supply chain management theory. It examines the specific characteristics of construction as a project-based industry and their implications for supply chain configuration, with particular emphasis on last-mile delivery processes in urban construction projects. Data related to different types of construction investments and delivery practices are analyzed to identify their influence on urban residents' quality of life.

Findings: The analysis indicates that last-mile deliveries in urban construction projects constitute a significant source of negative externalities affecting residents' quality of life, including disturbances related to traffic congestion, noise, and accessibility. The magnitude of these impacts varies depending on the type of construction project, the project delivery system, and the organization of the construction supply chain.

Research limitations/implications: The study is limited by its reliance on survey-based perceptions of residents, which may be influenced by individual sensitivity and proximity to construction sites. The analysis does not include quantitative measures of last-mile delivery intensity or long-term post-construction effects. Future research should incorporate objective traffic, noise, and emission data, longitudinal analyses, and comparative studies across different urban contexts, particularly in relation to sustainable urban planning and transport systems.

Practical implications: The findings indicate the need for improved planning and management of last-mile deliveries to urban construction sites, particularly to mitigate mobility disruptions, congestion, noise, and air pollution. Construction firms should optimize delivery schedules and logistics organization, while local authorities should integrate construction logistics into urban transport planning, especially for civil engineering projects with higher perceived impacts.

Social implications: The findings demonstrate that construction-related last-mile deliveries affect residents' mobility, daily functioning, and environmental comfort in urban areas. The study supports the need for socially responsible construction logistics and may inform public policies aimed at improving urban livability and quality of life.

Originality/value: The paper provides original empirical evidence on the impact of construction-related last-mile deliveries on urban residents' quality of life.

Keywords: construction logistics; last mile delivery; urban quality of life; urban construction projects; supply chain.

Category of the paper: Research paper.

1. Introduction

Construction plays a crucial role in the development of urban spaces. The implementation of construction projects enables the satisfaction of the needs of an increasingly large population of residents, both in the context of residential and service provisions, as well as through access to products and infrastructure. Consequently, this industry has a significant impact on quality of life in cities. The products resulting from construction activities largely bring positive outcomes to communities; however, the processes necessary for their creation may exert negative effects on various aspects of the functioning of urban agglomerations. Particular attention should be devoted to processes related to the functioning of construction supply chains.

Construction Supply Chains (CSC) have a specific nature and consist of investors, designers, contractors, and suppliers (Vrijhoef, Koskela, 2000). Due to the project-based character of the activity, CSCs are characterized by low durability, fragmentation, and continuous reconfiguration. Typically, individual links participate in more than one supply chain, and the chain itself is typical to production make-to-order (Vrijhoef, Koskela, 2005). The links do not exist within a customer-directed flow; consequently, different flows do not occur in a standardized manner. The configuration of the supply chain is significantly determined by the selected system of construction project implementation, the procurement system, the type of final client (public or private entity), and the type of project being executed. Additionally, CSCs possess different levels: basic (materials), auxiliary (equipment), and human (labor force) (Al-Werikat, 2017). Flows at different levels may occur in opposite directions. A further complication is the substantial influence of the client on the final project in both logistical and physical aspects, the transactional nature of relations between the buyer and the supplier, the number of involved stakeholders, the short planning horizon, resistance to change, and the cyclical nature of demand (Behera, Mohanty, Prakash, 2015). These characteristics determine a specific approach to supply chain management in construction (CSCM) (Papadopoulos, Zamer, Gayialis, Tatsiopoulos, 2016).

Last-mile deliveries represent the most costly and least efficient segment of the supply chain. Furthermore, they are considerably less sustainable (Yılmaz, Aktaş, Demirel, 2022). In the construction industry, they constitute an even greater challenge for SCM due to the nature of the cargo being transported, the participants in the supply chain, and the manner of organization of construction processes. The impact they exert on the urban environment can be considered exceptionally significant and negative (Osypchuk, Iwan, 2019). Consequently, they may also influence quality of life in cities. A review of the relevant literature indicates insufficient exploration of the subject. Publications in this field predominantly focus on sustainable construction and sustainable construction supply chains, with particular emphasis on environmental and economic aspects (Karlsson et al., 2020; Ogunmakinde, Egbelakin, Sher, 2022; Tabassum, Mir, 2023; Zhang, 2024). The neglect of social sustainability aspects indicates the presence of a research gap.

The aim of this article is to assess to what extent last-mile deliveries associated with the implementation of construction projects—encompassing infrastructure, residential, and non-residential facilities—affect the quality of life of residents. The collected data may serve as a foundation for developing recommendations for local authorities and construction firms to mitigate the identified negative impacts in the examined area.

In Section 2, the authors present the specific characteristics of last-mile deliveries in the construction industry and their impact on quality of life in cities. In Section 3, the authors present the research methodology, Section 4 discusses the research findings, whereas Section 5 presents the conclusions.

2. Last Mile Deliveries in construction in reference to quality of life in cities

Last-mile deliveries constitute a frequently addressed issue, particularly within the context of their environmental impacts. Urban freight deliveries are characterized by the involvement of multiple stakeholders, short transportation routes, reduced vehicle speeds, limited effective driving time, constrained spatial capacity, insufficient traffic infrastructure coupled with elevated transportation demand and operational inefficiency. Furthermore, urban freight transport is contingent upon local infrastructural conditions and limitations (such as designated unloading zones) as well as emerging trends, including increasing demand for service provisions (Bosona, 2020). The construction industry, in this context, additionally confronts the necessity of utilizing heavy-tonnage transportation, absence of delivery optimization, fragmentation, partial cargo loading, and exceptionally elevated empty-return trip rates (Zhang, 2024). Consequently, last-mile deliveries in construction represent a significant challenge for urban areas, considering their impacts on air pollution, noise emissions, safety levels, traffic

congestion phenomena, and infrastructural conditions (Giuliano, 2023). The intensification of these challenges naturally contributes to a deterioration in residents' quality of life.

Quality of life (QoL) is defined heterogeneously depending on the utilization context. It is assessed through multiple parameters spanning the dimensions of health, education, natural environment, infrastructure (social, residential, and municipal), economic well-being, safety, labor market conditions, personal fulfillment, individual freedom, and social relationships (Sapena, 2021). Increasingly, scholarly attention has been directed toward urban quality of life as an element affecting overall QoL. For the purposes of this article, specific parameters of urban quality of life have been identified, which may be susceptible to impact from last-mile construction deliveries, as illustrated in Figure 1.

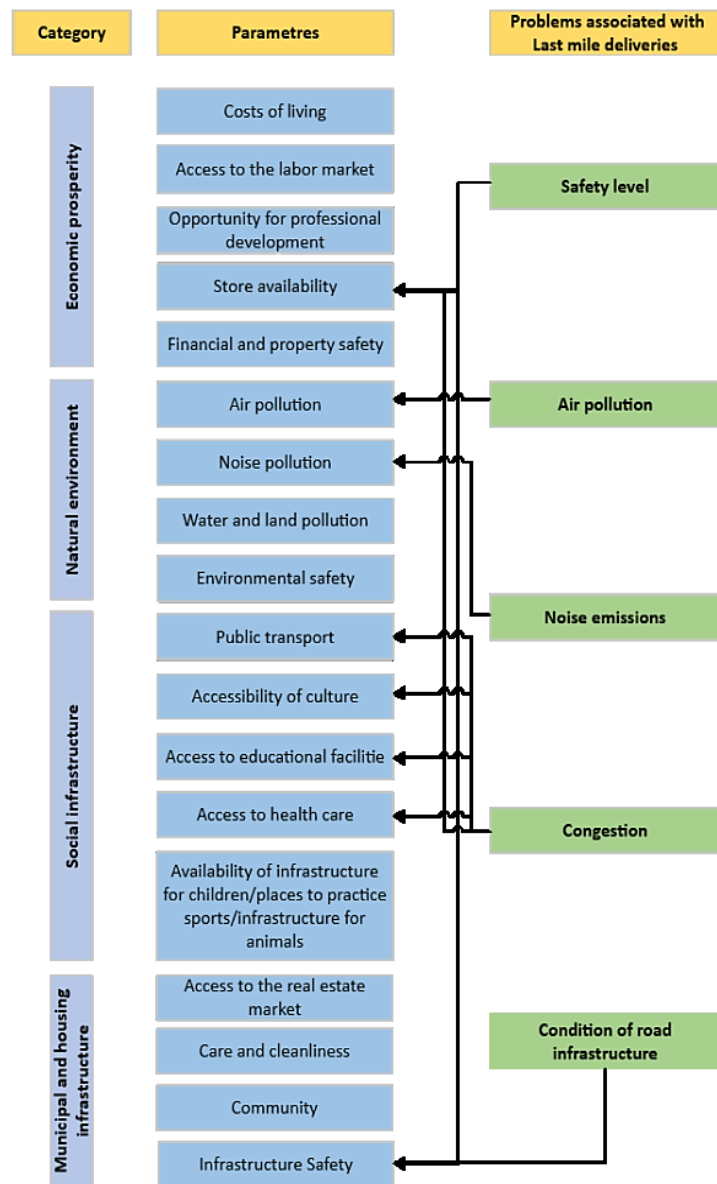


Figure 1. Selected Urban Quality of Life (UQoL) Parameters That May Be Influenced by Last-Mile Delivery Operations.

Source: own study.

The elevation of transport volume associated with construction material supply contributes to an intensification of congestion phenomena, which in turn may exert significant impacts on economic well-being (store availability) as well as on elements of social infrastructure (public transportation, cultural facility accessibility, educational institutions, and medical facilities). This occurs both through the extension of travel duration and the unavailability of parking capacity in connection with loading and unloading operations. Additionally, freight transport creates heightened accident hazards (McDonald, Yuan, Naumann, 2019), thereby affecting infrastructure safety, constitutes a significant source of noise emissions and air pollution, and may adversely impact infrastructural conditions.

3. Research Methodology

The adopted research process involved a comprehensive literature review, during which the authors identified a research gap regarding the assessment of the impact of last-mile delivery in construction project implementation on residents' quality of life. The research subjects encompassed construction projects related to the development of infrastructure facilities as well as residential and non-residential buildings.

The research process was structured in several phases. The first phase consisted of expert consultations conducted to identify the elements comprising quality of life in urban areas. The subsequent step involved the development of a standardized questionnaire based on current scientific knowledge in the field of construction investments' impact on quality of life. To ensure questionnaire validity and eliminate potential errors, preliminary research was conducted on a targeted sample comprising five researchers employed in scientific research institutions. This phase lasted from December 2022 to February 2023. The refined questionnaire enabled the execution of survey research. The questionnaire consisted of two components: demographic questions section and substantive section. Data collection was conducted using the snowball sampling method, which involved distributing the questionnaire online to successive participants. To increase response rates, the authors also conducted offline surveys. All collected data from both online and offline questionnaires were integrated into a single database. This phase lasted five months, from March to July 2023.

The geographic scope of the research was the city of Szczecin, the capital of the West Pomeranian Voivodeship, located in the northwestern region of Poland. Due to its strategic location, this city holds important administrative, economic, and transportation roles in the country (Office of the Association of the Szczecin Metropolitan Area, 2025).

Quantitative research participants included residents of Szczecin of working age. The sample size was calculated based on 2022 data, when the working-age population of Szczecin was 227,971 individuals. The calculations were based on the following assumptions:

the fraction size was determined at 0.5, the confidence level was set at $\alpha = 0.85$, and the measurement error was established at 5%. During the implementation of the research process, $n = 210$ completed questionnaires were collected. This indicates that the sample selection is appropriate and representative for the research area.

Formal consent from respondents was not necessary for the utilization and publication of survey data, as the survey was conducted anonymously.

4. Survey results

A quantitative study encompassing 210 respondents was conducted. The initial section of the survey instrument consisted of demographic questions. With respect to gender composition, the research sample comprised 124 female participants (59.05%) and 86 male participants (40.95%). Analysis of participant age distribution revealed the following distribution: 174 individuals (82.86%) fell within the 18-25 years age bracket, 24 individuals (11.43%) were aged 26-35 years, and 6 individuals each (2.86% respectively) belonged to the 36-45 years and 46-59 years age groups. Regarding educational attainment: 58 respondents (27.62%) possessed higher education credentials, while 152 individuals (72.38%) had completed secondary education.

The second section of the survey questionnaire comprised targeted research questions. The initial query was formulated as follows: "Is there a construction site for residential or non-residential buildings in the vicinity of your place of residence or employment?" In response, 122 respondents (58.10%) provided affirmative responses, whereas 88 individuals (41.90%) indicated negative responses, signifying the absence of construction sites in their residential and/or employment vicinity. The obtained findings demonstrate a considerable degree of exposure of local communities to construction activities. This query was subsequently posed to respondents in the context of projects associated with civil engineering structures, formulated as: "Is the construction, reconstruction, or renovation of civil engineering structures (all construction objects not classified as buildings) occurring in the vicinity of your place of residence or employment?" Affirmative responses were provided by 110 individuals (52.4%), while 100 individuals (27.6%) furnished negative responses. The fact that more than half of the respondent population declares the presence of construction sites within their immediate surroundings constitutes a substantial justification for the continuation and deepening of research investigations in this domain.

In the subsequent survey questionnaire item, respondents were requested to evaluate the impact of ongoing construction projects on their daily functioning, with the query formulated as: "Do you perceive the impact of ongoing construction projects on your daily functioning?" Respondent replies were distributed as follows: 23 individuals (11.0%) indicated that they

experienced very significant impacts, 38 individuals (18.1%) reported substantial impacts, 70 individuals (33.3%) identified moderate impacts, 20 individuals (9.5%) reported minimal impacts, and 59 individuals (28.1%) declared that they did not perceive any impacts from the ongoing construction investments.

The responses to this query permit the article authors to conclude that a decisive majority of respondents (72%) declares perceptible impacts of construction investments and accompanying material deliveries on their daily existence—varying in intensity levels. Fewer than one-third of the surveyed population (28%) reported no significant alterations in their daily functioning related to the material deliveries and construction projects being undertaken. These findings substantiate the appropriateness of further exploration of this phenomenon, particularly within the context of residents' quality of life.

In the two subsequent multiple-choice questions, respondents were requested to identify which of the enumerated elements were affected by construction investments and their accompanying material deliveries (Fig. 2). The initial query concerned residential and non-residential building projects. The most frequently identified area of impact was noise level—this element was selected by 145 respondents. Subsequent responses included, respectively: traffic congestion (100 responses), delays in transportation services (passenger and public transportation) (97 responses), and mobility (86 responses). The least frequently selected responses were: transportation costs (23 individuals) and operation of enterprises, services, or shops (34 individuals). In the query addressing civil engineering projects, respondents identified elements such as: traffic congestion (143 individuals), noise level (120 individuals), mobility (111 individuals), delays in transportation (109 individuals), and difficulties in route planning (102 individuals). The least frequently selected responses were: transportation costs (27 individuals) and operation of enterprises, services, or shops (35 individuals).

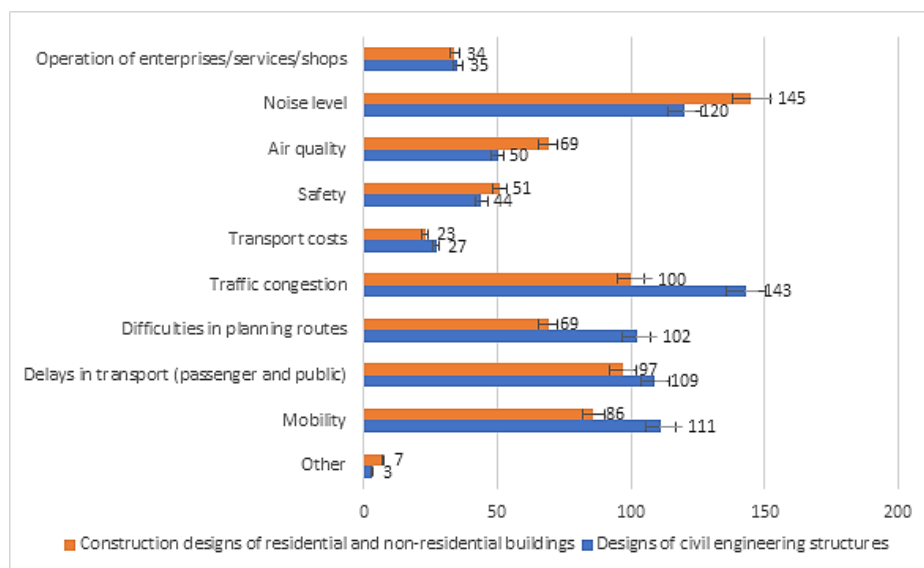


Figure 2. Impact of construction investments and last-mile material deliveries on selected elements – respondents' assessment.

Source: own study.

The findings unequivocally indicate that the greatest burdens associated with the implementation of construction projects—encompassing both residential and non-residential buildings, as well as civil engineering infrastructure—as perceived by residents concentrate around aspects such as noise pollution and transportation-related factors (congestion and mobility). These impacts may be directly correlated with the intensification of construction activities, the necessity of executing last-mile construction material deliveries, as well as the unloading and temporary storage of construction materials. Comparatively diminished significance was attributed to the impact of ongoing construction investments on local commercial and retail operations, as well as transportation expenses.

Subsequent research questions were structured and administered in reference to the examined dimensions of quality of life. Respondents were asked to evaluate the impact of construction projects associated with residential buildings, non-residential structures, and civil engineering infrastructure on quality of life aspects related to economic prosperity, specifically regarding retail accessibility (Figure 3). The majority of respondents indicated a substantial impact at 30% and a moderate impact at 24%. Approximately 20% of surveyed participants identified no impact on retail accessibility. In the case of civil engineering projects, responses similarly demonstrated a predominance of substantial impact at 31% and moderate impact at 27%, whereas 23% of respondents assessed the impact as minimal.

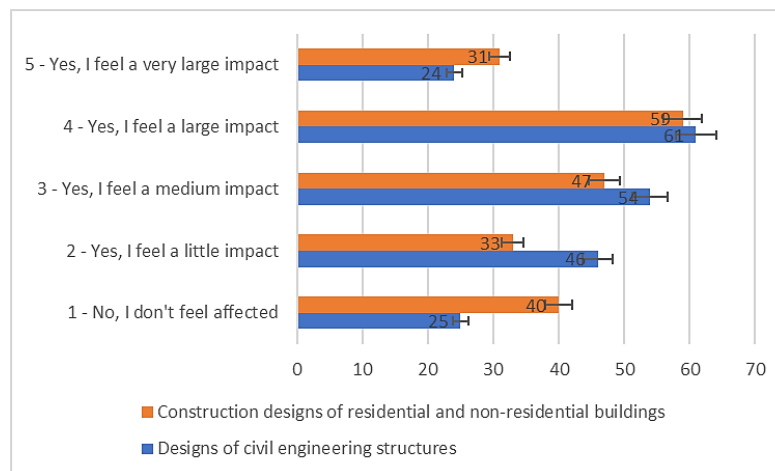


Figure 3. Assessment of the Impact of Construction Project Implementation and Associated Last-Mile Delivery Operations on Individual Aspects of the Economic Prosperity Dimension: Store Availability.

Source: own study.

The subsequent examined dimension was the natural environment (Figure 4). Considering last-mile delivery operations associated with the implementation of residential and non-residential building projects, the largest respondent cohort indicated a moderate impact of 34% and substantial impact of 22% on air pollution levels (Figure 4a). For civil engineering projects, responses were predominantly characterized by very substantial impact at 27%, moderate impact at 26%, and substantial impact at 25%. Analyzing the impact of residential and non-residential building project implementation on noise pollution (Figure 4b), responses were predominantly categorized as very substantial at 39% and substantial at 23%. In civil

engineering project implementation, responses similarly predominated, with very substantial impact at 41% and substantial impact at 27%. The analyzed data demonstrate that respondents perceive construction project implementation as significantly affecting the natural environment dimension, particularly in the context of noise emissions and air pollution. During the execution of construction investments, air pollution may be attributable to both delivery operations and the implementation of specific construction activities (such as demolition, drilling, and material cutting), which may generate particulates and other contaminants. Noise accompanying construction investments may result not only from transportation operations but also from a broad spectrum of contributing factors, including, among others, pile driving for building foundations, aforementioned demolition activities, and noise emissions from construction equipment and vehicles.

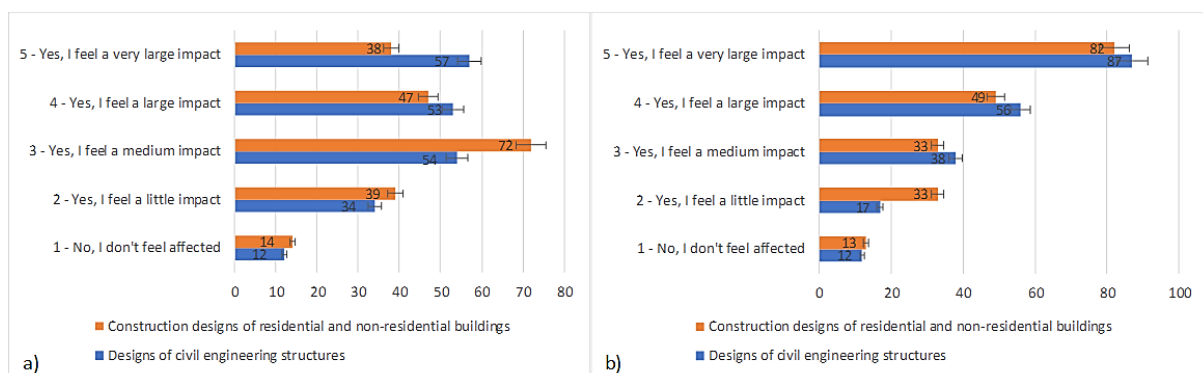


Figure 4. Assessment of the Impact of Construction Project Implementation on Individual Aspects of the Natural Environment Dimension: a) Air Pollution; b) Noise Pollution.

Source: own study.

In the subsequent analytical section, the social infrastructure dimension was evaluated (Figure 5). Regarding the implementation of residential and non-residential building projects, respondents most frequently indicated a moderate impact of 27% and minimal impact of 21% on public transportation accessibility and functionality (Figure 5a). For civil engineering projects, responses were predominantly characterized by very substantial impact at 52%, with substantial impact constituting the second most prevalent category at 23%. The implementation of residential and non-residential building projects in the context of cultural accessibility (Figure 5b) was primarily assessed as exhibiting no impact at 28%, moderate impact at 27%, or minimal impact at 26%. In civil engineering projects, respondents most frequently indicated moderate impact at 30%, minimal impact at 23%, and substantial impact at 22%. Regarding accessibility to educational facilities (Figure 5c), during the implementation of residential and non-residential building projects, responses predominantly reflected minimal impact at 25% and moderate impact at 24%; conversely, during civil engineering project implementation, respondents similarly indicated primarily moderate impact at 30% and substantial impact at 26%. In the context of healthcare accessibility (Figure 5d), for building projects, responses were distributed equally across three categories: no impact at 25%, moderate impact at 25%,

and minimal impact at 25%. When evaluating civil engineering project implementation, respondents characterized the impact as moderate at 30%, substantial at 24%, and minimal at 23%. Based on the compiled empirical data, it can be concluded that the implementation of construction projects—encompassing both residential and non-residential buildings as well as civil engineering projects—demonstrates moderate impact on urban quality of life in the social infrastructure dimension across most cases. The most substantial effects were observed in the public transportation sector, particularly for civil engineering projects. Based on the obtained results, it is noteworthy that construction site location may necessitate modifications to urban transportation operations, particularly in the case of infrastructure investments. Furthermore, as a consequence of last-mile delivery operations in construction and material unloading activities, congestion phenomena may emerge, which consequently may substantially affect the functionality of urban transportation systems.

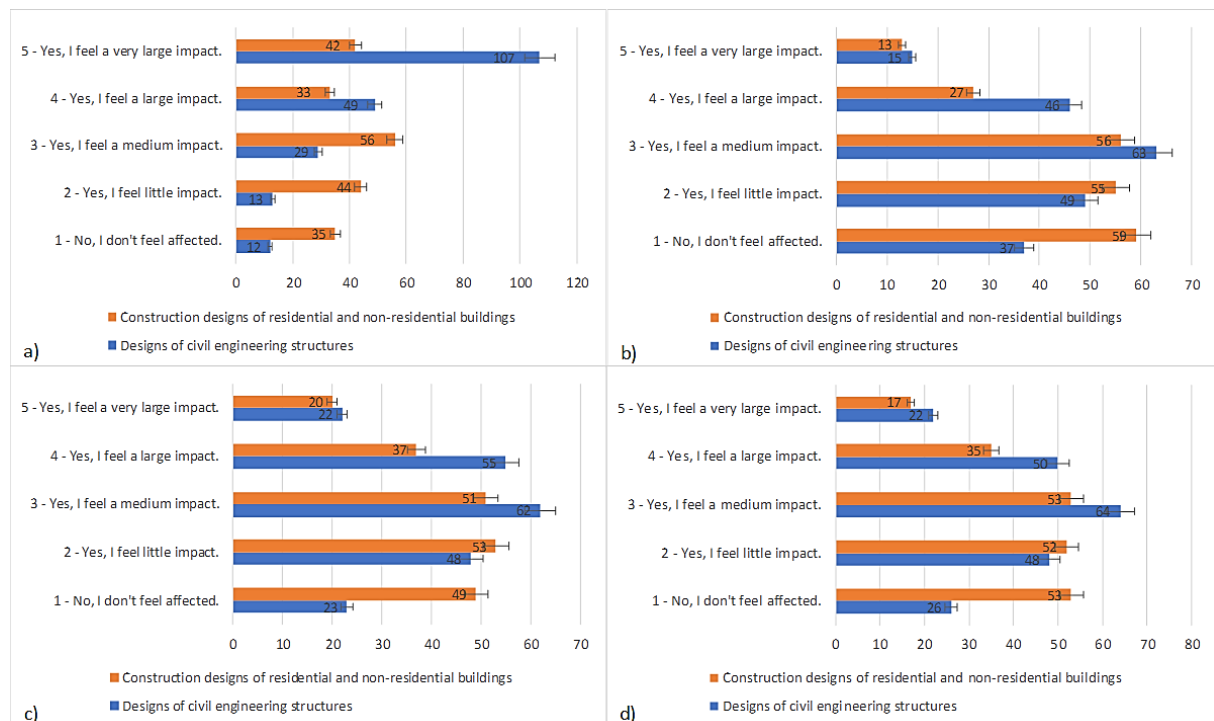


Figure 5. Assessment of the Impact of Last-Mile Delivery Operations Associated with Construction Project Implementation on Individual Aspects of the Social Infrastructure Dimension: a) Public Transportation; b) Cultural Accessibility; c) Access to Educational Facilities; d) Access to Healthcare Services.

Source: own study.

The subsequent quality of life dimension subjected to analysis was municipal and housing infrastructure in the context of infrastructure safety (Figure 6). In the first examined domain, encompassing residential and non-residential building projects, respondents assessed the impact as follows: moderate impact at 30% of respondents, very substantial impact at 20% of respondents, and substantial impact at 20% of respondents. Regarding civil engineering project implementation, respondents characterized the assessed impact as: moderate impact at 28% of respondents, minimal impact at 20% of respondents, substantial impact at 19% of respondents,

and very substantial impact at 19% of respondents. Based on the obtained empirical data, it can be inferred that the execution of delivery operations to construction sites is perceived as an element of moderate influence on the sense of safety within urban space. Both project types were evaluated comparably by respondents in this analytical dimension.

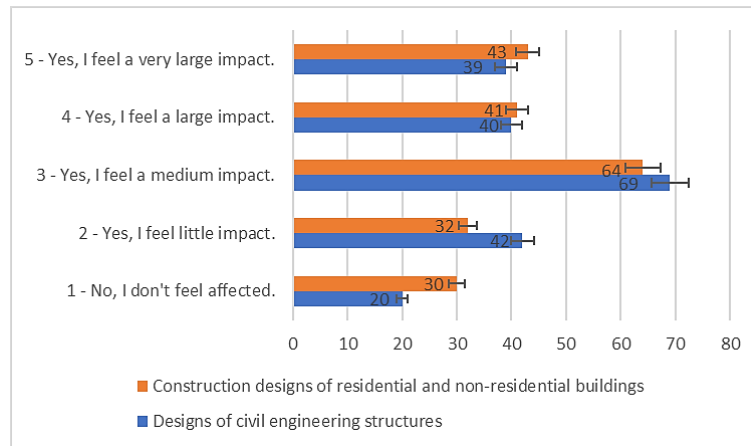


Figure 6. Assessment of the Impact of Construction Project Implementation on Infrastructure Safety.

Source: own study.

The conducted research affirms that the majority of respondents are directly exposed to the impacts of delivery transportation associated with the implementation of construction projects in urban environments, encompassing both residential and non-residential buildings as well as civil engineering infrastructure. More than half of the study participants identified the presence of construction sites within their immediate surroundings, which translates into a substantial proportion of individuals perceiving the effects of ongoing construction investments and last-mile delivery operations on their daily functioning. Across the examined quality of life dimension, construction projects demonstrate heterogeneous yet predominantly moderate impacts. Respondents observed the most substantial effects in domains pertaining to noise emissions, air pollution, urban transportation systems, and residential mobility. The empirical research findings indicate that the degree of impact from construction project implementation and associated last-mile delivery operations depends upon both the type of construction investment on which last-mile delivery operations are executed and the specific operational characteristics of the given investment.

5. Discussion and Conclusions

Analysis of the obtained survey results indicates that the implementation of construction projects, both residential and non-residential, as well as civil engineering projects, does impact the examined quality of life based on assumed measurements mentioned in this article. When considering the social infrastructure dimension, changes in public transport were most

noticeable in civil engineering projects, they were perceived with significantly greater impact (75% of responses indicating a significant or very significant impact), while residential and non-residential projects generated mainly a medium or small impact. In other areas – such as access to culture, education, and healthcare – responses were indicating none or moderate impact. This suggests that the overall toll and disruptions associated with construction projects are more localized, primarily affecting public spaces and residents' mobility. These results are consistent with the literature, which indicates that the impact of construction investments is primarily concentrated in areas of mobility (Harleman, 2023).

In the economic prosperity dimension, respondents most frequently indicated that construction projects have a noticeable impact on the accessibility of shops, most often to a large or moderate extent. This means that investments of all types – both residential and non-residential buildings, as well as civil engineering infrastructure – are perceived as disrupting to residents' daily routines.

In the natural environment dimension, the impact of construction projects in terms of noise and air pollution was assessed as significant. Civil engineering projects were assessed as having a greater impact than residential and non-residential buildings. Literature indicates that factors such as last-mile transport intensity, project duration, and investment scale are key drivers of environmental impacts during the construction phase (Zou, Ergan, 2018; Ballesteros, 2010).

An assessment of the municipal and housing infrastructure dimension in the context of infrastructure safety indicated that the impact of last-mile deliveries is perceived as moderate by residents, and the responses provided by respondents were similar for both types of projects. Based on this, it can be concluded that, that type of investment does not significantly differentiate the perceived level of safety in urban spaces.

The data obtained from the research process indicates that the implementation of construction projects affects local communities daily. More than half of the surveyed participants confirmed that there was a construction site in their immediate vicinity, both for residential and non-residential buildings, as well as for civil engineering projects. Because 72% of surveyed people indicated that ongoing construction projects (to varying degrees) their daily functioning makes this to be a significant point. By referring to the multidimensional understanding of quality of life presented in the literature (Sapena, 2021), the results indicate that last-mile construction deliveries influence several interconnected dimensions of urban quality of life, particularly mobility, environmental conditions, and economic accessibility. This confirms that construction logistics should be considered not only as an operational issue, but also as a socially relevant urban challenge. Considering the results, continued research in this area is crucial, especially in the context of sustainable urban planning and urban transport. Last-mile deliveries to construction sites are impacting the functionality of transportation systems, which then is reflected in congestions in the transportation network, mobility of local communities, traffic flow, and travel comfort, while also increasing noise and pollution emissions.

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