

THE IMPACT OF CHANGES IN ROAD TRANSPORT INFRASTRUCTURE ON ROAD TRAFFIC SAFETY IN POLAND AS ILLUSTRATED BY LUBELSKIE VOIVODSHIP

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Purpose: The aim of the study is to identify the concept of transport infrastructure and to evaluate the impact of changes in road transport infrastructure on road traffic safety.

Design/methodology/approach: The study comprises a theoretical part, which encompasses the concept of transport infrastructure and its importance for the proper operation of state's economy and a research part, which contains an analysis of survey results conducted among the road users – residents of the Lubelskie Voivodeship.

Findings: Road infrastructure facilitates the movement of people across the globe. Over recent years, road transport infrastructure has developed noticeably, which may also have an impact on the economic development of Poland. Road users rated the technical condition of road infrastructure as rather satisfactory and average. Similarly, aspects of traveling by car or other vehicles on public roads have improved over the past years. According to the respondents, road transport infrastructure affects road traffic safety. Consequences of inadequate infrastructure conditions may include increased traffic intensity on certain sections, likelihood of road or vehicle damage, accidents and collisions, increased travel costs, extended travel time and routes, and changes in designated routes that are burdensome, even significantly so, for road users.

Research limitations/implications: Future research on transport infrastructure could be expanded to encompass other branches of transport, such as rail, air, sea, and inland water transport, and a comparison of transport infrastructure in Poland with that of other European and world countries.

Social implications: It can be inferred that the development of transport infrastructure will enhance citizens' quality of life by increasing road safety.

Originality/value: From the perspective of the study's value, the topic of changes in transport infrastructure and road traffic safety is vital and relevant, as many people use roads daily, and their safety is crucial for both individuals and the state.

Keywords: road traffic safety, transport infrastructure, road transport.

Category of the paper: empirical research, scientific research.

1. Introduction

From the point of view of its impact on the country's economic development, transport infrastructure is assessed based on its technical condition, level of accessibility and capacity, as well as its utilization, i.e., the infrastructure's ability to handle the flow of vehicles, goods, and passengers within in good time. A significant developmental challenge is to increase the density and coherence of the road network, along with its entire infrastructure, to high-quality standards in relation to GDP growth and transport intensity. A consistent improvement of the value can enhance the conditions according to which Polish entrepreneurs can compete against foreign business entities on international markets, thereby strengthening the competitiveness of the Polish economy (Sustainable Development Strategy).

2. Concept and Significance of Transport Infrastructure

The starting point for considering the impact of infrastructure on road traffic safety is the definition of the concept of transport infrastructure itself. Infrastructure refers to man-made, permanently located, linear and point public utility objects that form the foundation of socio-economic life, given their functions of transporting people, goods, information, electricity, and water (Witkowski, Starościc, 2008). Transport infrastructure includes the points and locations utilized by transport means during movement and stops. These include natural and artificial roads, transport points such as seaports and airports, and the equipment of roads and points with fixed assets and non-durable items required for the infrastructure to function (Gołębska, 2010). Transport infrastructure encompasses man-made, permanently located basic roads of all transport branches (i.e., road, rail, air, water, sea), transport points, and auxiliary devices that assist the operation of roads and transport points (Szymonik, 2013). Transport infrastructure consists of constructions that are permanently attached to the terrain and serve as the foundation for transport lines and points, and as the basis for socio-economic development (Wojewódzka-Król, Rolbiecki, 2018).

Transport infrastructure has an impact on transport processes primarily regarding their efficiency, reliability, and cost levels. Its main task is to ensure an uninterrupted flow of products and to maintain expected stock levels. In this aspect, transport infrastructure can be considered primarily as an organizational-technical system whose paramount goal is to minimize operational costs within the entire supply chain while ensuring efficiency and reliability of the processes. Thus, without a doubt, the presence of a good level of transport and communication infrastructure facilitates the overcoming of temporal and spatial discrepancies between supply and demand in transport. It can therefore be concluded that transport infrastructure determines transport capabilities and, consequently, the performance of all supply chains. This impacts the costs and the quality of transport services provided (Kauf et al., 2016).

3. Impact of Changes in Road Infrastructure on Road Traffic Safety

To determine the impact of changes in road infrastructure on road traffic safety, own research was conducted. The subject of the study was the diagnosis and evaluation of road traffic safety levels concerning the changes implemented in road transport infrastructure in the Lubelskie Voivodeship from 2010 to 2022.

It was assumed that the causes of road accidents could be attributed to driver error, the road and its surroundings, or the vehicle moving on the road. The choice of the research sample was based on the following criteria:

- condition of road infrastructure,
- organization of road traffic,
- experience of road users,
- skills of drivers,
- road users' compliance with traffic regulations.

A survey was conducted among road users to explore opinions of the residents of the Lubelskie Voivodeship regarding road traffic safety. The survey was carried out from 2022 to 2023 via the Internet, receiving 260 responses from various road users. The questionnaire was completed by 164 men, accounting for 63% of the respondents, and 96 women, making up 37% of the respondents. The largest group of participants was 18 to 20 years old, comprising 28% of the sample. This was followed by 25% aged 21 to 25, 14% aged 31 to 40, 10% aged 26 to 30, 8% aged 41 to 50, and 8% under the age of 18. Those aged 51 to 60 constituted 5%, and the smallest group was those over 60 years old, making up only 2% (see figure 1).

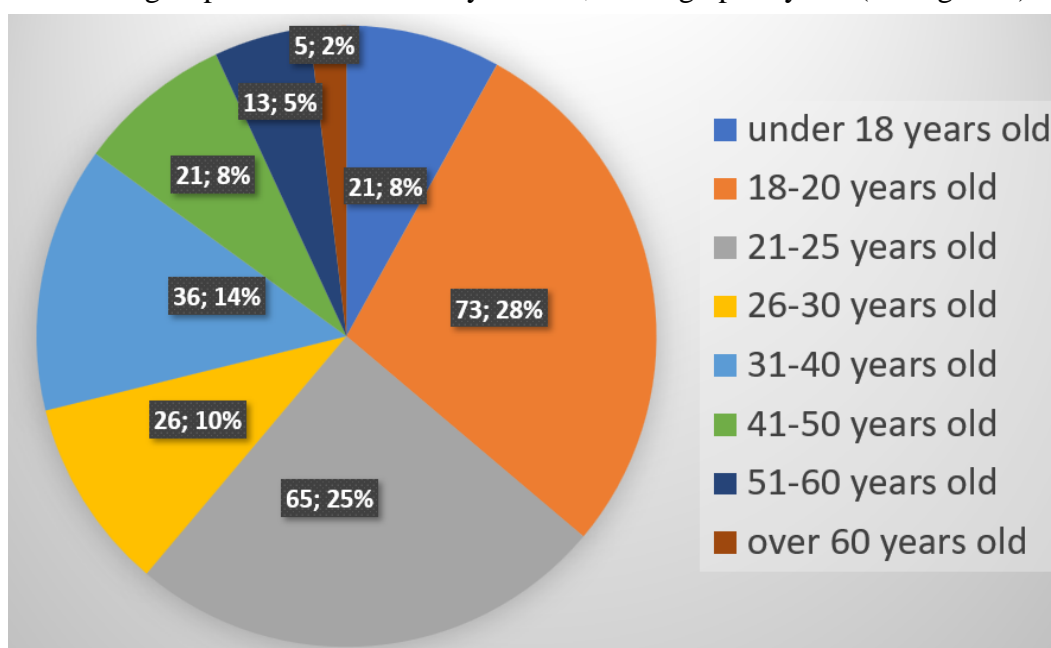


Figure 1. Age Structure of Respondents.

Source: Own elaboration based on survey results.

The majority of the participants in the study, that is 48%, had secondary education. Additionally, 28% of the respondents had higher education, 9% had vocational education, and the smallest group, at just 9%, had primary education (see figure 2). Approximately 91% of the respondents (237 people) have the qualifications to drive, i.e., a driving license, while 9% of the respondents (23 people) do not have a driving license.

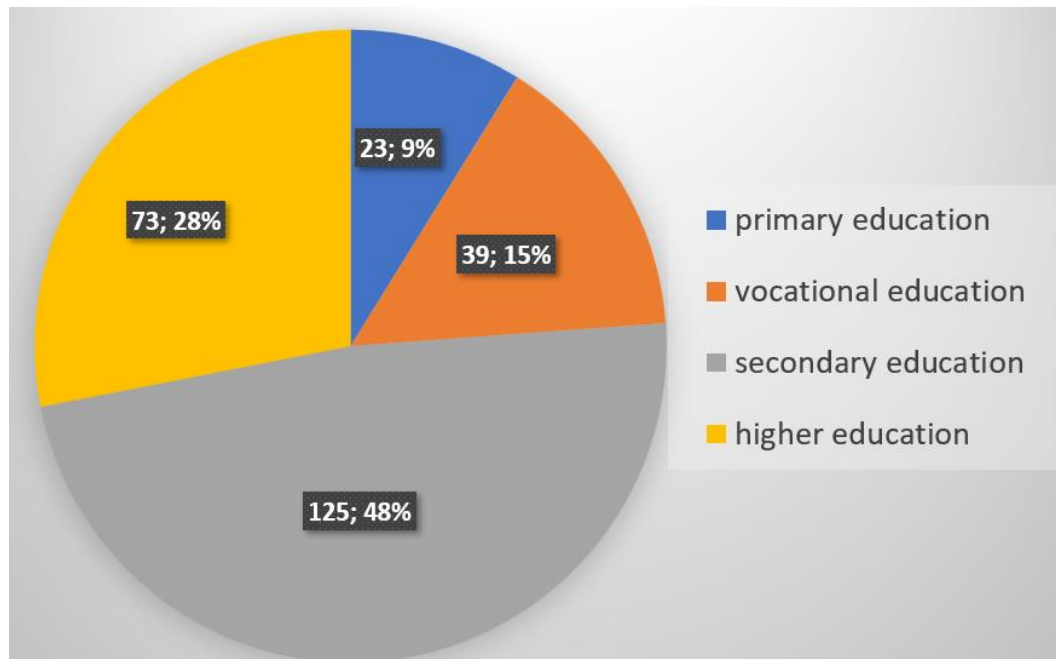


Figure 2. Educational Structure of Respondents.

Source: Own elaboration based on survey results.

The majority of the respondents hold a category B driving license, accounting for 85% (201 individuals). Nineteen respondents indicated that they possess a category C driving license, making up 8% of the total, and sixteen respondents indicated that they have a category A driving license, constituting 7%. Fifty respondents, representing 21%, indicated they hold another category of driving license, most frequently specifying categories such as C+E, T, and AM (see figure 3). In this question, each respondent could select more than one answer.

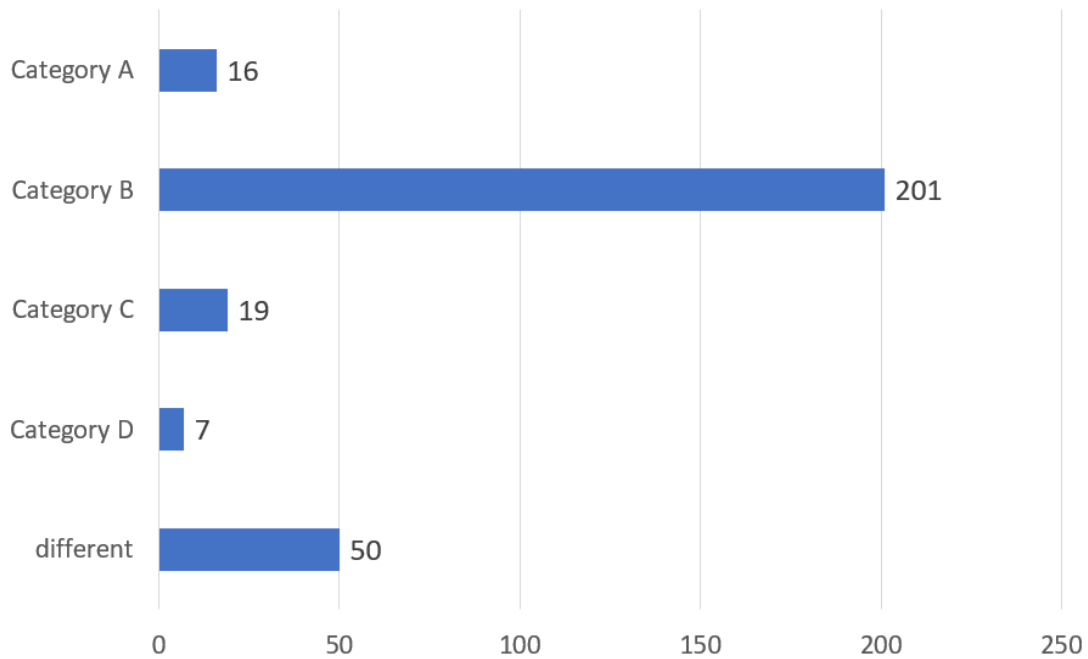


Figure 3. Driving License Categories Held by Respondents.

Source: Own elaboration based on survey results.

The respondents most frequently use passenger cars in road traffic, accounting for 72% of the total. Additionally, 16.7% of the respondents choose vans or buses, and 8% primarily use trucks. Bicycles are most commonly used by 3% of the respondents, while the least used mode of transport is motorcycles, with only 0.3% of the respondents indicating they use them most often (see figure 4).

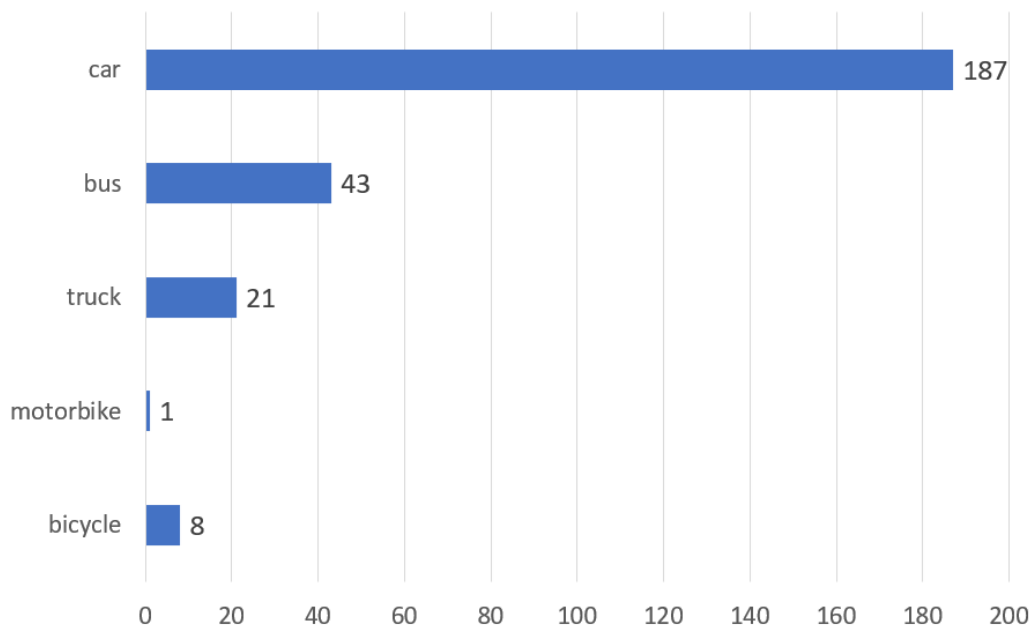


Figure 4. Types of Vehicles Used Most Frequently in Road Traffic by Respondents.

Source: Own elaboration based on survey results.

Regarding travel time on public roads, the majority of respondents, 43%, found it to be rather satisfactory, followed by 32% who deemed it average, 12% considered it rather unsatisfactory, 10% rated it as satisfactory, and the least, 2%, found it unsatisfactory. The second factor evaluated by road users was the technical condition of road surfaces. The majority, 81%, assessed the technical condition of road surfaces as average, 10% considered it rather satisfactory, 7% found it rather unsatisfactory, while approximately 1% of respondents rated the technical condition of roads as either unsatisfactory or satisfactory. Regarding the number of city bypasses, 71% of respondents evaluated it as average, 23% considered it rather unsatisfactory, and 6% deemed it rather satisfactory. None of the respondents selected the options of unsatisfactory or satisfactory for the number of city bypasses. The next evaluated factor was the number of expressways. The majority, 52%, stated that the number of expressways is rather unsatisfactory, 47% said it is average, and the least, approximately 1%, found it rather satisfactory. None of the respondents considered the number of expressways as either unsatisfactory or satisfactory. As for the number of grade-separated intersections, 92% of respondents considered this factor average, while 8% found it rather satisfactory. None of the respondents chose the options of unsatisfactory, rather unsatisfactory, or satisfactory. Regarding the number of unguarded railway crossings, 79% of respondents assessed this factor as average, 11% found it rather satisfactory, 6% considered it satisfactory, and the least, 4%, found it rather unsatisfactory. None of the respondents deemed the number of unguarded railway crossings as unsatisfactory. In evaluating the number of roadworks, 70% of respondents found it to be average, 25% considered it rather unsatisfactory, and the least, 5%, deemed the number of roadworks rather satisfactory. None of the respondents selected the options of unsatisfactory or satisfactory for the number of roadworks. Regarding road traffic organization, 41% of respondents rated it as average, 36% considered it rather satisfactory, 17% deemed it satisfactory, and the least, 6%, found the road traffic organization rather unsatisfactory. None of the respondents considered it unsatisfactory. The next factor evaluated by road users was the quality and type of road surfaces. In this case, 68% of respondents found the quality and type of road surfaces to be average, 27% deemed it rather satisfactory, and the least, 5%, rated the quality and type of road surfaces as rather unsatisfactory. None of the respondents considered the quality and type of road surfaces as either unsatisfactory or satisfactory. Respondents assessed drivers' skills, with 42% rating them as average, 33% as rather unsatisfactory, 18% as rather satisfactory, and the least, 7%, rated them as unsatisfactory. None of the respondents found drivers' skills satisfactory. The last factor evaluated was the number of road inspections. In this case, 65% of respondents found them to be average, 12% rated them rather satisfactory, 11% considered them rather unsatisfactory, 9% rated them as unsatisfactory, and the least, 3%, deemed them satisfactory (see figure 5).

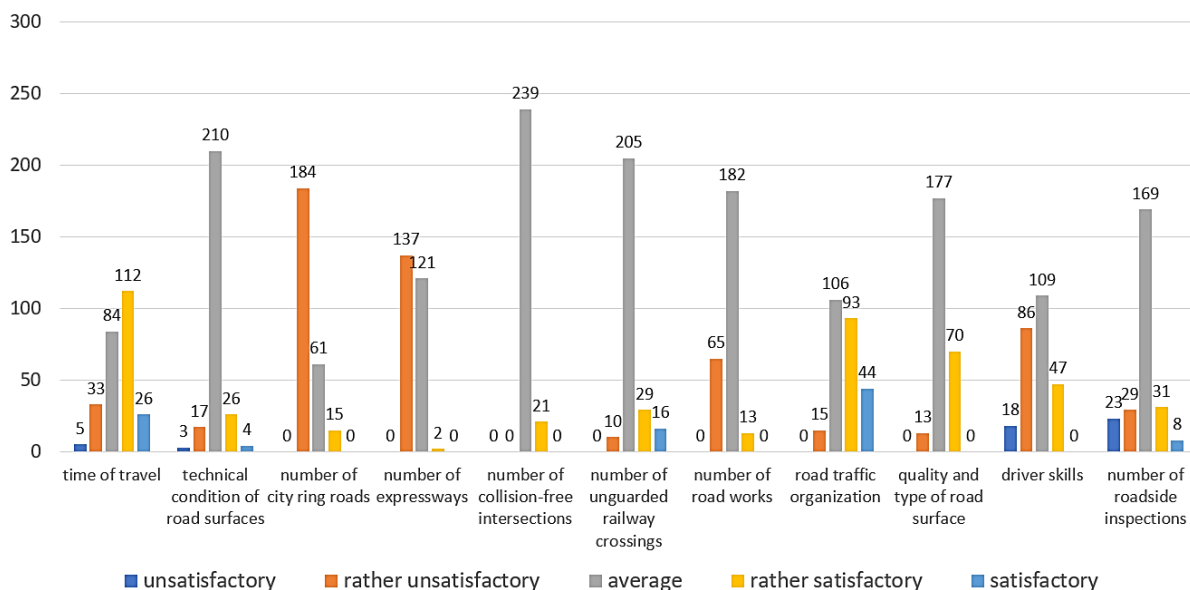


Figure 5. Evaluation of Road Infrastructure and Safety Factors.

Source: Own elaboration based on survey results.

When evaluating aspects of traveling by car or other vehicles on public roads that have improved over the past few years, it can be stated that most respondents, 47.5%, believed that the greatest improvement was in the technical condition of road surfaces. Following this, 40% of the respondents did not believe that travel time saw the greatest improvement, 32.5% felt that signposting improved the most, and the least, 2.5%, indicated that the greatest improvement was in the number of unguarded railway crossings. Additionally, nearly 8% of the respondents believed that the greatest improvements were in the number of roadworks and drivers' skills (see figure 6).

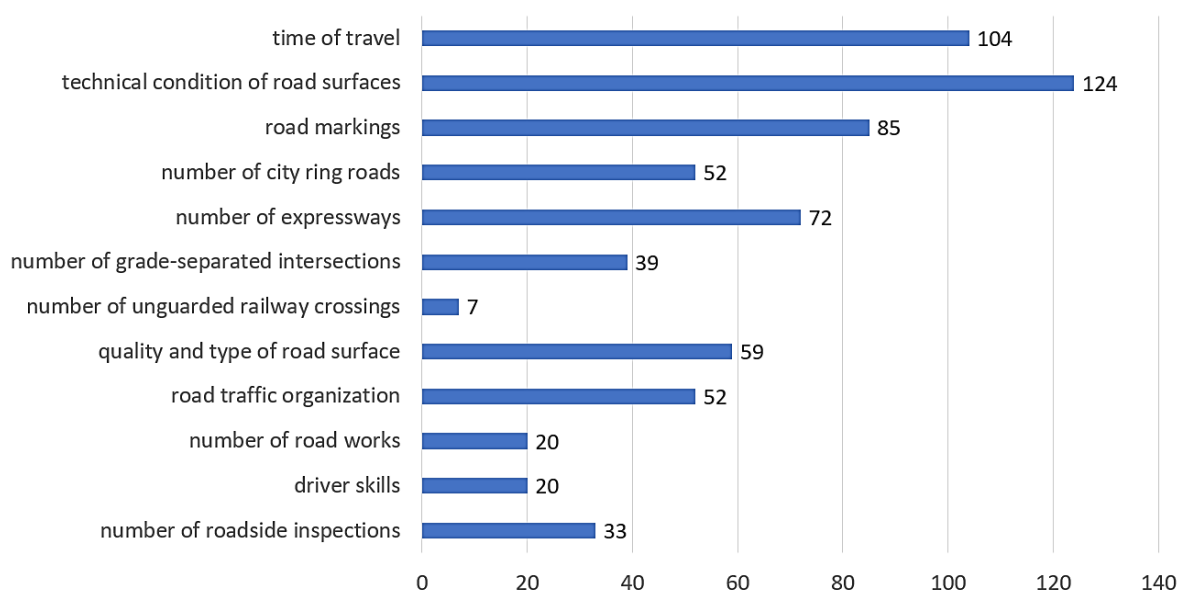


Figure 6. Aspects of Public Road Travel that Have Improved.

Source: Own elaboration based on survey results.

According to the respondents' opinions, the condition of road infrastructure affects road safety – 42.5% believed it had an effect, while 32.5% stated that the condition of road infrastructure significantly affected road safety. Twenty percent asserted that the condition of road infrastructure was likely to affect road safety. The least, 5% of respondents, reckoned that the condition of road infrastructure was unlikely to affect road safety. None of the respondents selected the option stating that the condition of road infrastructure does not affect road safety (see figure 7).

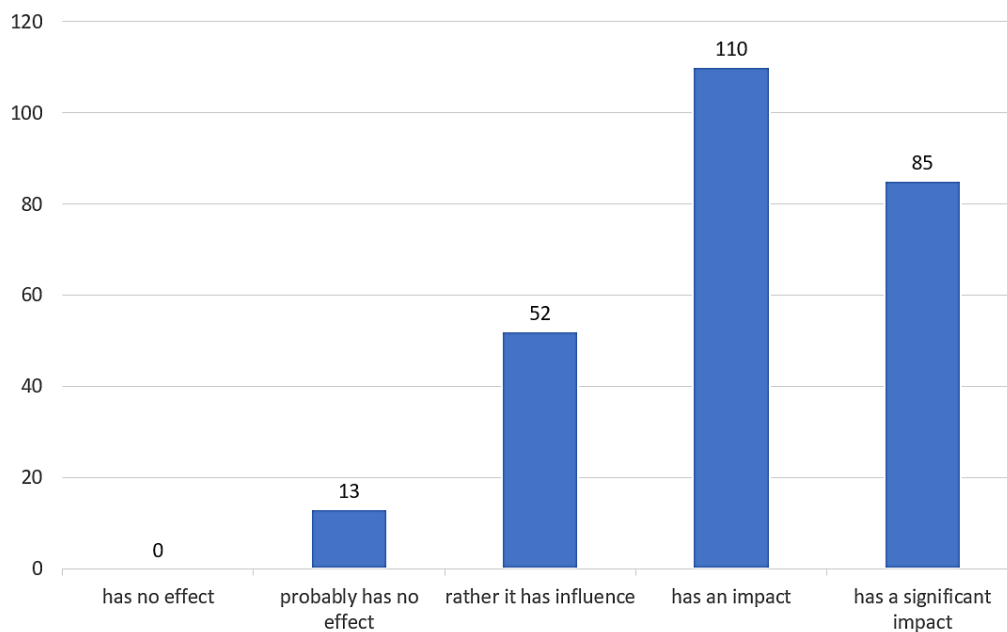


Figure 7. Perception of the Impact of Road Infrastructure Condition on Road Safety.

Source: Own elaboration based on survey results.

According to respondents' opinions about the consequences of inadequate road infrastructure conditions, which could be most burdensome for road users, it can be observed that, regarding increased traffic intensity on selected road sections, the majority, 58.46%, considered it burdensome, while 23.46% deemed it decidedly burdensome, and 18.08% stated that it was neither burdensome nor decidedly burdensome. None of the respondents selected the options indicating that increased traffic intensity on selected road sections was not burdensome or rather not burdensome. The probability of road or vehicle damage was deemed burdensome by 48.46% of respondents, decidedly burdensome by 30%, neither burdensome nor decidedly burdensome by 18.85%, and rather not burdensome by 2.69%. None of the respondents indicated that the probability of road or vehicle damage was not burdensome. The vast majority of respondents, 66.54%, reckoned road accidents and collisions to be decidedly burdensome. It was burdensome for 27.69%, and neither burdensome nor decidedly burdensome for 5.77%. None of the respondents stated that road accidents and collisions were not burdensome or rather not burdensome. Considering increased travel costs, 45.77% of respondents found them burdensome, 34.23% decidedly burdensome, 14.62% neither burdensome nor decidedly burdensome, and 4.62% rather not burdensome, with only 1%

stating that increased travel costs were not burdensome. Regarding extended travel time and route, 64.23% of respondents considered it burdensome, 25% decidedly burdensome, 8.46% neither burdensome nor decidedly burdensome, less than 2% rather not burdensome, and less than 1% stated that extended travel time and route are not burdensome. Evaluating changes in designated routes, the majority, 43.46%, stated that it was neither burdensome nor decidedly burdensome, 32.69% considered it burdensome, 10.38% definitely burdensome, 10% rather not burdensome, and 3.46% stated that changes in designated routes were not burdensome (see figure 8).

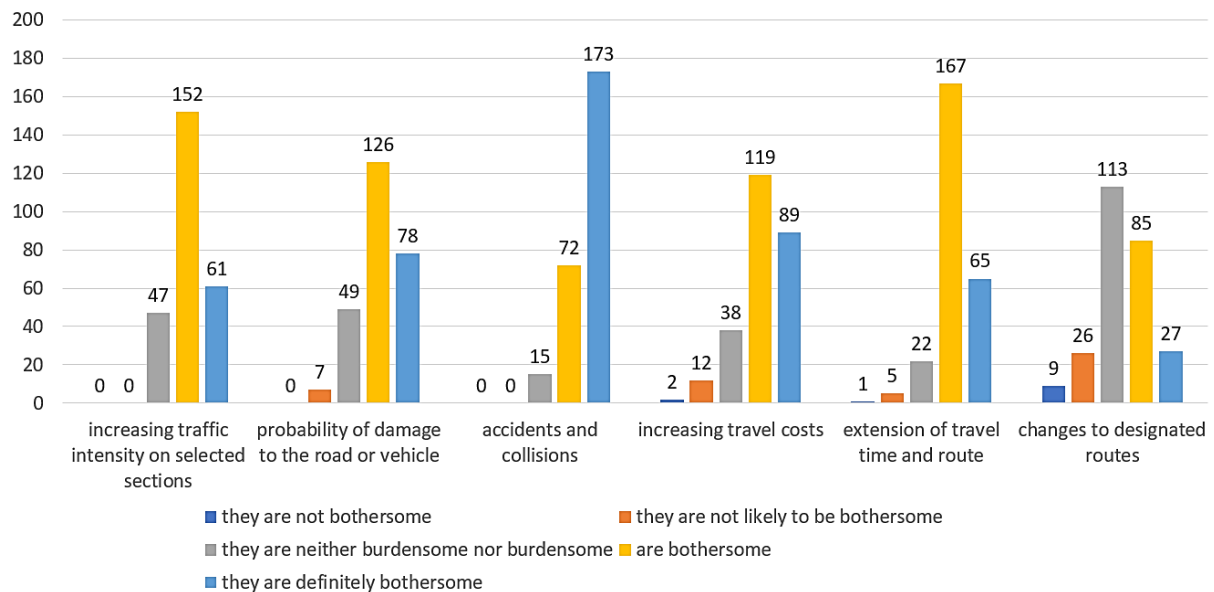


Figure 8. Respondents' Opinion on the Consequences of Inadequate Road Infrastructure Conditions Most Burdensome for Road Users.

Source: Own elaboration based on survey results.

4. Summary

Population can move across the globe thanks to road infrastructure. Over recent years, the road transport infrastructure has developed markedly, potentially influencing the Polish economic growth. Road users have evaluated various aspects of their journeys, including travel time, road surface condition, the number of collision-free intersections and guarded railway crossings, road construction activities, road surface quality and type, as well as the frequency of road inspections. According to respondents, the number of city bypasses and expressways is perceived as rather unsatisfactory. However, traffic management and drivers' skills were rated as average to satisfactory. In evaluating aspects of travel that have improved in recent years, respondents identified significant enhancements in road surface condition and reduced travel time, with the least improvement noted in the number of unguarded railway crossings.

Road transport infrastructure has a major impact on road traffic safety. Negative consequences of inadequate infrastructure may include higher traffic volumes on certain road segments, greater likelihood of road or vehicle damage, increased number of accidents and collisions, elevated travel costs, prolonged travel time and route changes, which are considered inconvenient or even highly burdensome for road users.

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