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Article

Criteria for Assessing the Safety and Functionality of Tram Stops

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Abstract: The selection of criteria in the developed methods of analysis and evaluation has a significant impact on the implemented decision-making processes. For this reason, the very process of identifying the correct criteria is a research challenge worth undertaking. The conducted literature review shows that in the methodology of assessing tram and bus stops, the researchers focus primarily on aspects related to safety. Assessment of the functionality of tram stops becomes no less important. However, a literature review shows that this range of stops is sporadically mentioned in publications. Meanwhile, from a practical point of view, the aspects related to ensuring the required functionality in the tram stop zone are as important as the safety of passengers. That is why we surveyed experts who perform official functions in cities with a tram transport system. The conducted research was aimed at: (1) assessment of the elements and selected parameters of the stop infrastructure in terms of their impact on the safety and functionality of stops; (2) assessment of the inter-relationship between safety and functionality criteria when analyzing individual factors. The article aims to present the results obtained during the structured interviews and their interpretation. The obtained research results and their classification constitute not only scientific material, but they can also be used by people and organizations involved in the design, evaluation, and modernization of tram stops. The obtained results should also be analyzed by teams developing urban standards for transport infrastructure.

Keywords: safety; functionality; tram stop; criteria

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1. Introduction

Multi-criteria assessment methods support decision-making processes and consider the real world's multidimensionality. These methods are typically called multi-criteria decision-making methods (MCDM), multi-criteria decision-making analysis (MCDA), or simply multi-criteria analysis (MCA) [1]. These methods are used in various decision processes where the analysis and evaluation of multiple objects or treatment alternatives are required. A literature review on the multi-criteria methods used in decision-making processes regarding infrastructure can be found in [2–4]. Based on these reviews, it can be concluded that multi-criteria analyses usually use hybrid methods to address different realities in the infrastructure assessment. The general course of multi-criteria analyses covers four basic stages of implementation [1,5]:

- Stage 1: Definition of the main problem and identification of the analysis (evaluation) criteria.
- Step 2: Determining the weights for the various criteria of the analysis.
- Stage 3: Assessment of individual criteria for the analyzed alternatives.
- Step 4: Assessing the alternatives according to the weighting of each criterion.

Therefore, the critical issue in the multi-criteria analysis is correctly identifying evaluation criteria and assigning them appropriate weights. The selection of criteria affects the results of the assessment and the final decision made by the decision-maker. For this reason, the very process of identifying the correct criteria is a research challenge.

The subject of our interest is research on the safety and functionality of tram stops. We focused our attention on tram stops because, as Corazza and Favaretoo [6] emphasize, bus/tram stops and their surroundings can become the weakest link in the journey chain if they provide users with negative meanings (too distant, uncomfortable, unsafe, etc.). The literature review we present in Section 2 shows that most publications focus on the safety assessment of stops. This analysis concerns elements of the infrastructure of tram stops but also the behavior of travelers. However, practitioners increasingly emphasize that apart from safety, it is also important to provide the infrastructure to determine the stops' functionality. This functionality affects the comfort of travel, which may determine the choice of means of transport for everyday journeys by the inhabitants of a given city. However, it is difficult to find publications on methods for assessing the functionality of stops. Therefore, this can be considered a research gap. It is also worth noting that the elements of the stop's infrastructure, which positively affect the improvement of functionality, may also have a negative impact on safety. Therefore, the aim of our research was:

- Assessment of the elements and selected parameters of the stop infrastructure in terms of their impact on the safety and functionality of stops.
- Assessment of the inter-relationship between safety and functionality criteria when analyzing individual factors.

We invited experts who participate in managing the infrastructure of stops in cities with a tram communication system. The article aims to present the results obtained during the conducted structured interviews and their interpretation. The article's structure is presented in Figure 1.

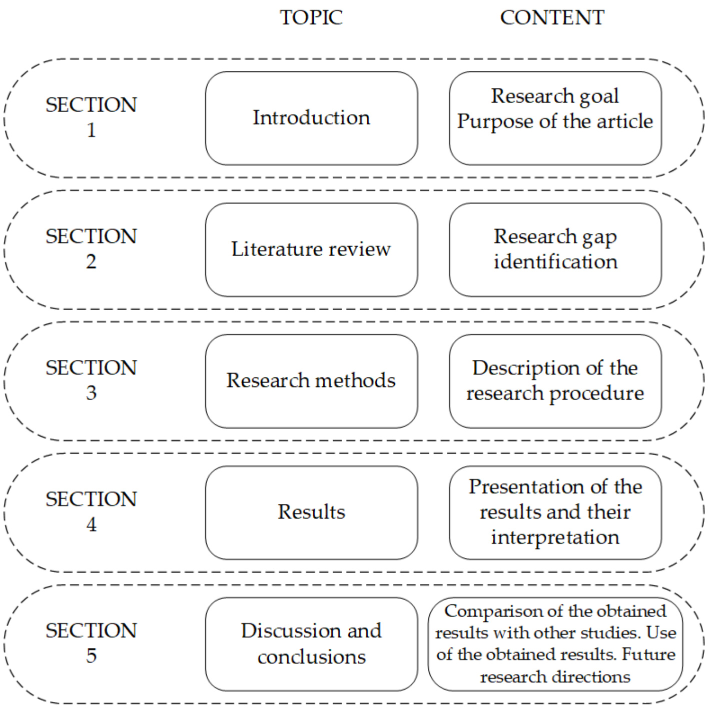

Figure 1. The article's structure.

The main contribution of this study is:

- Selection of criteria for assessing the safety and functionality of tram stops based on a literature review.
- Conducting direct interviews among experts aimed to determine the impact of selected elements of stops on their safety and functionality.
- Analysis, interpretation, and classification of the obtained results following the proposed grouping criteria.

2. Literature Review

The conducted literature review shows that in the methodology of assessing tram and bus stops, the researchers focus primarily on aspects related to safety. Transport safety, including tram transport, is usually analyzed regarding threats and risks associated with implementing transport services. In the case of tram services, two types of safety risks should be analyzed, those related to the operation and maintenance. Szmagliński et al. [7] state that there will be a different character of risk in using the tram system and others in its operation. It is assumed that during tram operation, passengers, tram personnel, and road users, including pedestrians, will be at risk, while during tram maintenance, maintenance staff will be at risk. Therefore, research on tram system safety covers an extensive range of analyses in both the operation and maintenance areas. One of the areas studied related to the safety of the tram system is the safety of tram stops. Our literature review shows that the safety assessment of tram stops focuses primarily on the four areas shown in Figure 2.

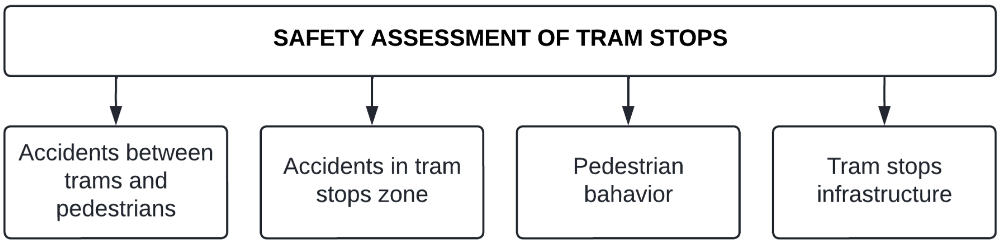

Figure 2. Safety assessment of tram stops.

Tram stops are considered a critical element affecting the safe operation of the tram system. This is because the fundamental problems observed in city centers are conflicts between pedestrians and trams within tram stops, particularly when the stops are located near busy areas [8]. Although tramway accidents are very limited in terms of numbers when compared to the total number of road accidents, their consequences, especially when involving pedestrians, can be severe and, therefore, cannot be neglected [9]. Hedelin et al. [10] found that pedestrians were the most-injured category of participants in these accidents. For this reason, many researchers focus on pedestrian safety [8,11]. Passenger exchange zones are significant. The priority task of the tram stop is to provide users with safe areas for waiting and getting on and off the tram [12].

For this reason, many publications focus on pedestrian safety at tram stops. Aspects of pedestrian safety in the area of tram stops have been analyzed in Australia [13–15], Germany [16], Austria [17], Switzerland [11,18], and Poland [19], among others.

In publications, researchers pay attention to the type of stops and their impact on safety [14,20] and requirements for their infrastructure [21,22], including different conditions, for example, the edges of the stops [23].

The critical aspect examined as part of safety in the tram stop area is also pedestrian behavior and its impact on the risk of accidents. As Ou et al. [24] noted, most accidents are caused by the unsafe behavior of people. Research on dangerous behavior in the area of stops has been described in [24–28], among others. Bernhoft and Carstensen [26] stated that pedestrian behavior compromises security, legality, and mobility. The desire to reach a public transport vehicle is one of the factors affecting pedestrian mobility and, at the same time, may prompt them to take dangerous actions. This is also confirmed in the study described by [25]. The authors studied the impact of an approaching tram at a stop on pedestrian compliance with traffic rules. The study aimed to determine whether the need to get into a vehicle approaching a stop had a visible impact on pedestrians' readiness to break traffic rules, despite the possibility of a traffic accident. The conclusions confirmed that the attempt to reach the tram is important in analyzing violations of the red signal, but its impact may also depend on other factors.

The literature studies presented in [29] indicate that five dominant research areas can be distinguished in assessing the safety of stops. The methods used to assess the safety of the stops are presented in Figure 3.

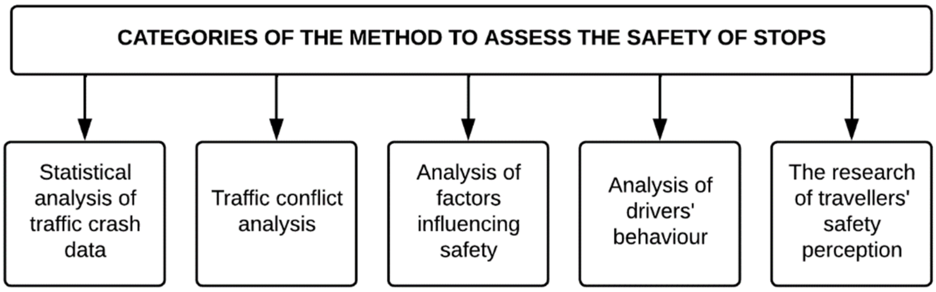

Figure 3. Categories of the method to assess the safety of bus and tram stops with sample publications. Source: based on [29].

When assessing the safety of stops, researchers focus primarily on factors influencing the rate of accidents near stops. The main variables affecting the number of accidents are usually speeding and traffic volume [30]. However, these are not the only factors. Among the other most frequently analyzed variables, the following stand out [30,31]:

- Frequency of buses and trams stopping;
- Number of driving lanes;
- Number of pedestrians, cyclists, or passengers using or passing the bus/tram stop;
- Cycle lane or path and position relative to bus/tram stop;
- Pedestrian crossing nearby (with or without signals);
- Number of bus/tram stops along the stretch of road;
- Pavement or pedestrian islands;
- Lamp posts or surrounding lighting conditions;
- Season, weather, and driving conditions;
- Location relative to junctions and side roads;
- Road curvature and sighting possibilities;
- The number of parked cars.

At the same time, the literature review shows that there is currently a need for research on the safety assessment of bus and tram stops and a need to develop concepts to improve the current solutions [29].

Much fewer publications refer to testing the functionality of tram and bus stops. The functionality of the stops is analyzed by researchers most often in three cases: (1) when the stop is an element of a transfer terminal in public transport, which connects various types of transport (e.g., tram loops connected with park and ride, terminals connecting agglomeration railway with city tram/bus lines, interchanges) (for example [32,33]); (2) when the assessment concerns adapting the stop to the needs of people with disabilities (for example [34,35]); (3) when guidelines for stop design are the subject of research. These areas are shown in Figure 4.

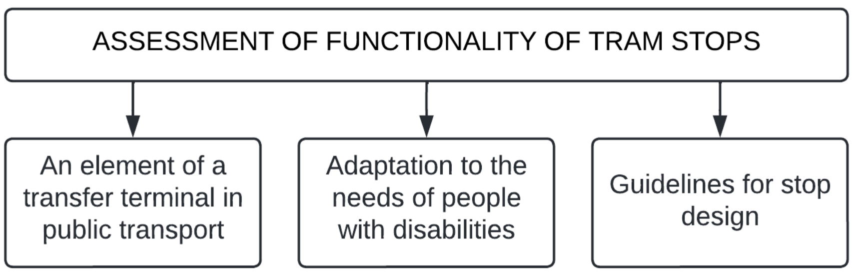

Figure 4. Assessment of functionality of tram stops.

Additionally, the functionality of the stops was researched by Askerud and Wall [36]. The authors emphasize in their publication that several factors affect whether a bus terminal is considered adequate. They distinguish the three most important factors: information, design, and functionality. At the same time, the authors indicate that it is crucial to consider required space, dimensioning, and functionality when planning a bus terminal [36]. The functionality of the stops was also researched by Bryniarska and Zakowska [37] as part of the multi-criteria evaluation method for public transport interchange. In our literature research, we found only a single publication that referred directly in the title to the functionality of bus/tram stops. These are studies presented by Kołodziejczyk [38], Szaumkessel et al. [21], and our publications (including [39]).

However, the literature review we conducted allowed us to distinguish additional areas of research in which issues related to the evaluation of the functionality of the stops appeared. Corazza and Favaretoo [6], while examining the availability of bus stops in the area of cities, emphasized the need to assess their functionality and not only focus on them being "walkable". The authors also emphasize in their research that each stop should take into account different solutions that will meet several requirements and functions for different types of passengers, e.g., walkability; comfort while waiting or boarding/alighting; ability to autonomously perform other travel functions such as purchasing tickets, getting information, resting; reading and comprehending signs and directions, etc. In some articles, functionality is incorrectly equated with usability. For this reason, researchers refer to this concept to assess the comfort and convenience of traveling. An example may be the review of factors influencing the decision-making processes of travelers in cities presented in [40].

Summing up, it should be stated that in the case of the criteria for assessing the safety of bus/tram stops, there are many publications concerning both the methods of analysis and the assessment criteria, while concerning the functionality of the analyzed urban infrastructure, a significant research gap can be identified. In addition, it should be emphasized that both the safety of stops and their functionality affect the comfort of passengers. They belong to the group of factors that determine city residents' choice of means of transport. For this reason, selecting appropriate parameters for the used multi-criteria assessment method is an important research area related to improving the passenger transport system in cities.

3. Research Methods

The method presented in the article consists of four main steps. A detailed description of each step is presented below, while a diagram showing the structure and sequence of steps is shown in Figure 5.

The first step of the method is an overview of knowledge about stops in the city. The scope of this step includes getting acquainted with the three types of data and information: scientific literature, standards described in the form of documents, and guidelines. From the point of view of the scientific review of the literature, the critical element was the aspects related to assessment methods as well as the safety and functionality of tram stops and, due to their similar form, bus stops located in cities. The other two elements constitute the first step concerning a review of the standards (especially accessibility for people with disabilities) and guidelines for designing tram stop infrastructure, which are in force in many Polish cities.

This way, the literature review allowed, in the second step, to identify the factors assessed in the method. These include infrastructure elements, mainly the stop equipment and the technical parameters of the platform. In total, 23 different factors were identified and described later. All of them were used in the prepared questionnaire, a form of the conducted research. Assessed aspects are presented below (the numbering given below is used consistently in all parts of the article):

1. Adjusting the platform width to the passenger flow.
2. Adjusting the platform length to the serviced tram.
3. Raising the platform to a height adapted to the serviced tram.

4. Presence of a stop shelter.
5. Presence of the lighting of the stop shelter.
6. Lighting of the entire stop zone.
7. Presence of a detectable warning lane along the entire edge of the platform.
8. Presence of a guidance path for the blind.
9. Presence of a waiting place for people with disabilities.
10. Presence of a bench in the stop area.
11. Presence of trees in the stop area.
12. Presence of greenery in the pots in the stop area.
13. Direct vicinity of a bicycle path without its fencing.
14. Direct vicinity of a bicycle path with a fence.
15. Sharing the stop area with the pavement.
16. Sharing the stop area with the pedestrian and bicycle path.
17. The stop area is fenced off with a barrier.
18. Separating the stop from the pedestrian route using a different surface type.
19. Separating the stop from the pedestrian route by painting a line.
20. Separating the stop from the bicycle path by using a different type of surface.
21. Separating the stop from the bicycle path by painting a line.
22. Presence of the passenger information board in the stop area.
23. Presence of service point in the stop area. Adjusting the platform width to the passenger flow.

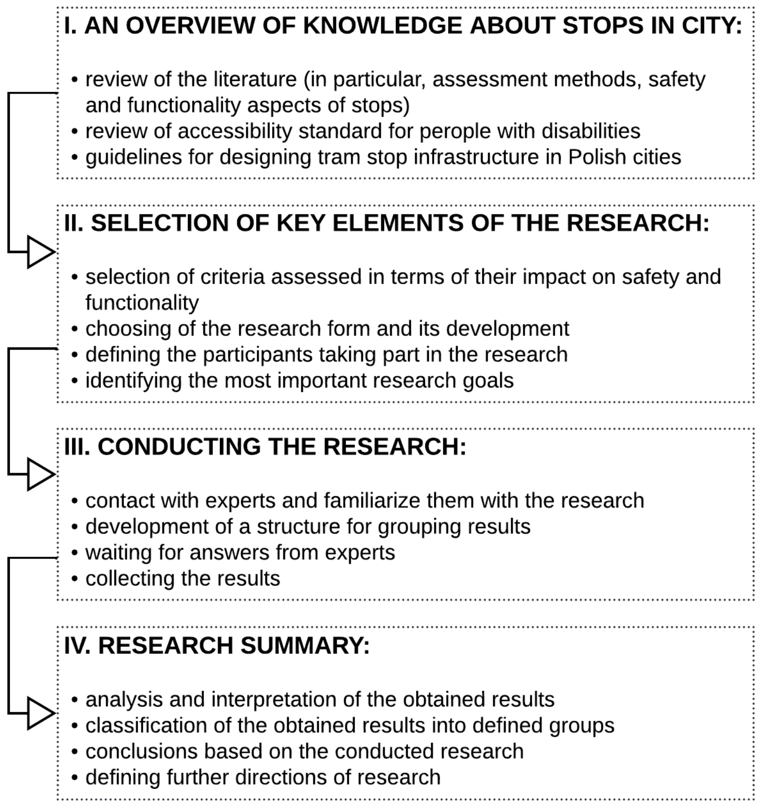

Figure 5. Steps of the research procedure. Source: own works.

This step also defined the group of recipients for the prepared survey. Due to the thematic specificity of the study, it was decided to invite experts in the design, management, and supervision of the infrastructure of tram stops in Poland. The group of experts for the study were people whose official duties included the control of the infrastructure of tram stops in Polish cities. In Poland, there are 15 local government units with a tram transport system, and networks of tram stops are used to service passengers. The task of the group of experts selected for the study was to assess the elements presented below and determine their impact on safety and functionality. Thanks to such a selection of respondents, the research results make it possible to observe the assessment of selected elements in terms of safety and functionality based on the knowledge of experts whose work is related to the supervision, design, or maintenance of tram stops. Participation in the study of experienced people closely related to the subject of stops allows us to say that they are an appropriate representative group. Based on their responses, conclusions regarding the stop infrastructure can be made.

The study aimed to independently assess the individual components in separate assessments related to safety and functionality. This action allows for the assessment of the impact of individual solutions on both criteria of the stop evaluation in a particular approach and the possibility of observing the phenomenon of a potential reduction in the value of a given criterion at the expense of improving the value of the second one.

The research was a structured interview based on a prepared questionnaire. The study aimed to assess the 23 elements described above in terms of their impact on the safety and functionality of the tram stop. This step also prepared a consistent rating scale for each issue in both scopes. These scales are presented in Figure 6.

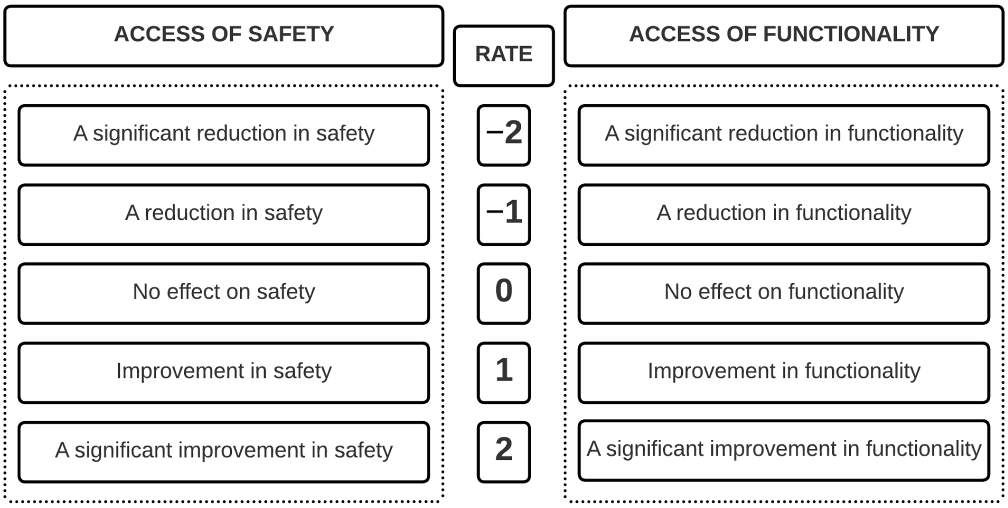

Figure 6. Safety and functionality rating scales for all factors assessed.

A questionnaire was prepared based on the developed rating scale, collected factors, and determination of the target group. Internet software (LimeSurvey) was used to conduct the survey.

The third step was to conduct the research. Queries were sent to all these units with a request to participate in the survey of people related to the stop infrastructure. Interviews were carried out from 01–31.10.2021. Data were collected based on expert responses, which were provided on a request sent individually to each municipal institution responsible for designing, operating, or maintaining tram stops.

In parallel with the implementation of the survey developed, a scheme for classifying the obtained results into the identified groups was developed based on the obtained result. Figure 6 presents the distinguished categories in the proposed classification. The obtained results can be classified depending on the selected division criterion. The division characterizes the first evaluation criterion according to the predominant influence of a given factor on the aspect of safety (S1) or functionality (F1). The second division relates to the consistency of assessment among the respondents. Within this division, one can observe factors characterized by high consistency (Cs or Cf) or large discrepancy (nCs or nCf) of the obtained results. Within this division, the elements represented by the respondents' highest and lowest consistency of responses were classified into each group. The last of the division criteria is grouping according to the obtained assessment result, and thus we can distinguish three types of impact on the assessed aspects:

- Reduced safety or functionality—Ls, Lf, Lsf.
- No impact/negligible impact on safety or functionality—Ns, Nf, Nsf.
- Improved safety and/or functionality—Hs, Hf, Hsf.

The last step is the stage related to working on the obtained results of the survey and are based on the proposed divisions of the classification of these results. These steps include the analysis and interpretation of the received data, classification in line with the one given in Figure 7, and discussion of the results and development of conclusions. The last task in this step was to define further research directions. All of these tasks are detailed in the next section of this article.

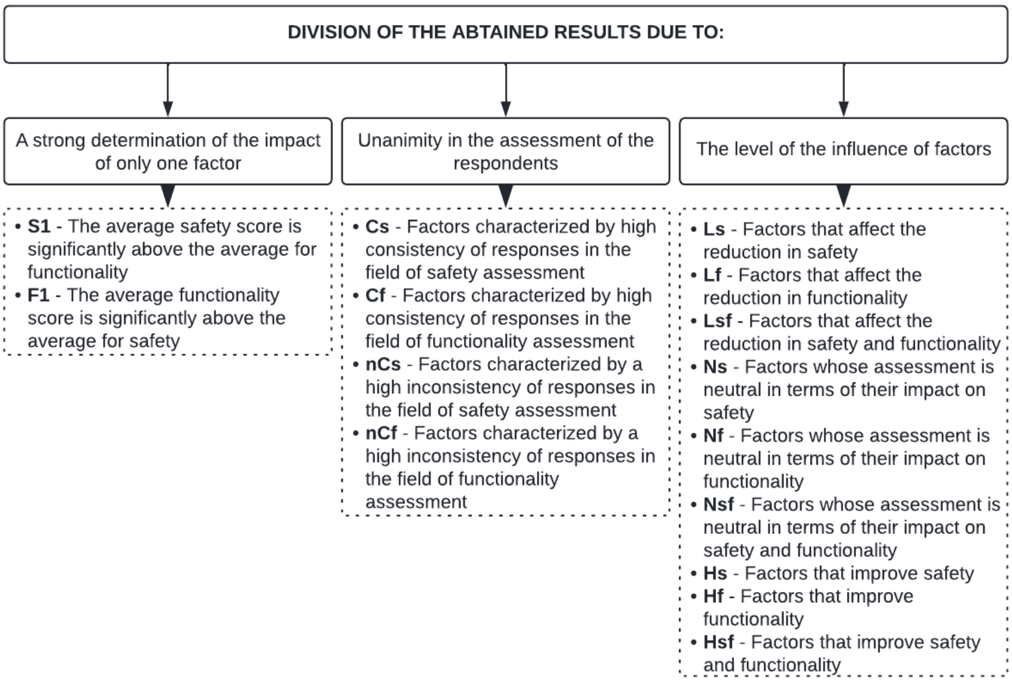

Figure 7. Division of the obtained results according to the adopted criteria.

4. Results

The response rate for all communes is over 77.8%. It should be noted that the specific region of Poland, the Upper Silesian Conurbation, consisting of 13 municipalities directly adjacent to each other and with common connections to the tram network, was treated here individually. This means that slightly more than $\frac{3}{4}$ out of 27 communes in Poland through which the tram network runs took part in the study. In total, 62 people participated in the survey whose professional duties, knowledge, and experience primarily included the maintenance, supervision, and design of tram stops. The detailed results of the study were collected and are presented later in the article.

The results obtained during the research were grouped according to safety and functionality. The results obtained for each element are shown in Figure 8. The analysis concerned the assessment of the influence of the given factor on each criterion separately. In addition, the mutual relation between them was assessed. Thanks to this, it was possible to estimate the influence of the given factor on each criterion and indicate the advantage of the impact of only one criterion for the analyzed factor. At the same time, the analyzed elements were grouped in terms of unanimity in their classification by the respondents.

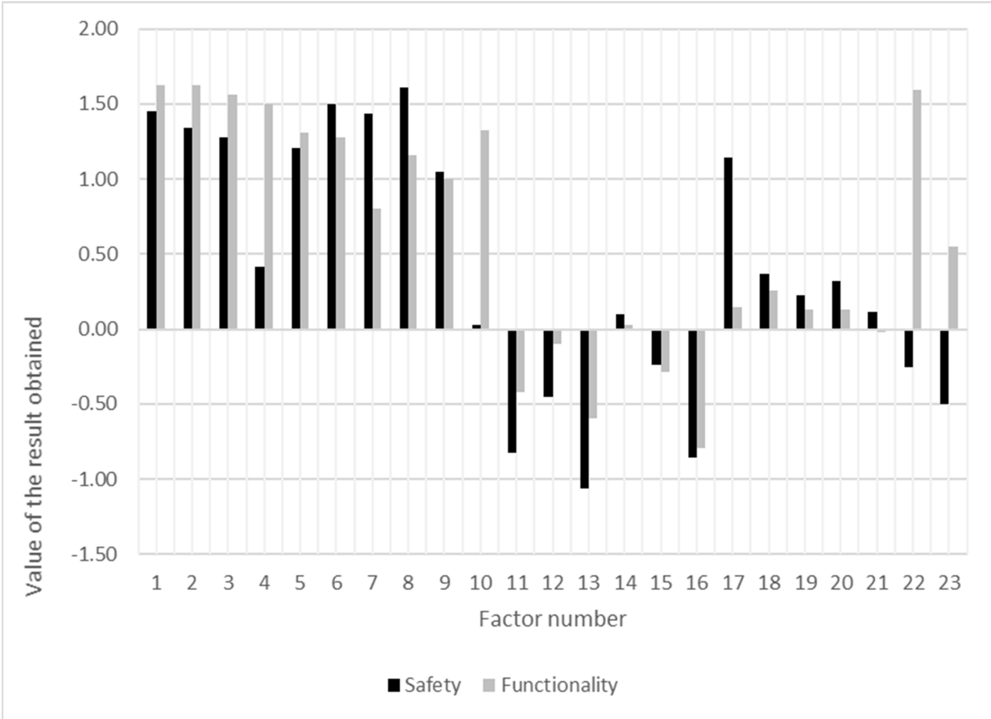

Figure 8. Comparison of safety and functionality assessments.

The obtained results are presented according to the following scheme (X; S: 1.22; F: 0.12). This notation should be read as follows:

- X—factor numbers as specified in the previous part of the article;
- S: 1.22—the value of the average factor impact score on safety (in this case, 1.22);
- F: 0.12—the value of the average factor effect on functionality (in this case, 0.12).

Among the 23 factors assessed by experts, 5 elements can be distinguished for which compliance has been demonstrated regarding the classification of its positive and negative impact, only for 1 assessment criterion, i.e., safety (S1) or functionality (F1). In the case of safety, these were the following factors:

- Presence of a detectable warning lane along the entire edge of the platform (7; S: 1.44; F: 0.81);
- The stop area is fenced off with a barrier (17; S: 1.15; F: 0.12).

Both of the above factors are important from the point of view of safety. Both elements are intended to separate the waiting space at the stop from the details accompanying them in the immediate vicinity. The warning strip informs about the edge of the platform. It also protects the blind (through an invoice) or the visually impaired (using a contrasting yellow color) from entering the track. On the other hand, a barrier in the form of a railing regulates issues related to waiting for a vehicle and car, bicycle, or pedestrian traffic along the sidewalk directly adjacent to the stop.

The respondents indicated a critical impact on the functionality of the stop concerning three assessed factors. These are:

- Presence of a stop shelter (4; S: 0.42; F: 1.50);
- Presence of a bench in the stop area (10; S: 0.03; F: 1.32);
- Presence of the passenger information board in the stop area (22; S: –0.26; F: 1.60).

Among the experts' opinions, it can be observed that the bench in the stop area does not play a significant role in terms of its impact on safety. At the same time, in the case of functionality, it significantly improves the functionality of the stop. A passenger information board, in turn, has a more significant impact on functionality than a bench with a simultaneous deterioration of the safety of the stop. It may be due to the visibility and location aspects of such boards, which often require positioning in the right place to ensure good visibility for passengers. Such grouping of passengers at the stop may reduce the freedom of movement on the platform, which increases the possibility of a hazardous situation. The benches are usually located at the edges of the platforms and are a stable element. It is also worth paying attention to the presence of a bus shelter, which improves both functionality and safety. It is worth emphasizing, however, that the impact on functionality is much more significant here.

Then, for each analyzed factor, the standard deviation was estimated to identify the consistency of opinions expressed by experts regarding the classification of the influence of factors on both assessed criteria. Standard deviation was calculated on the basis of the formula:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n-1}} \tag{1}$$

where:

- x_i—Response result value "i";
- $\overline{x}$—Mean value of all scores;
- n—Number of responses provided.

Figure 9 presents the values of standard deviations of individual factors broken down into safety and functionality ratings. The authors recognized the deviation value at the level of 0.65 due to classifying the responses to high consistency. This value classifies four factors in each assessment as characterized by the high consistency of the answers.

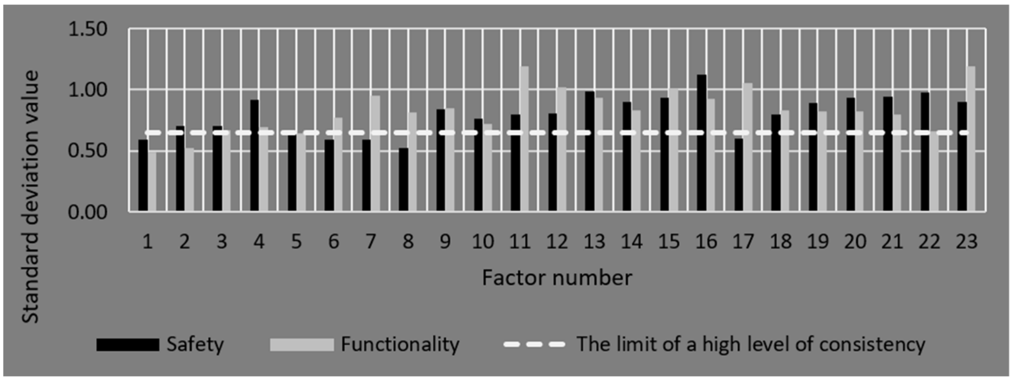

Figure 9. Standard deviations in the assessment of factors.

Table 1 presents the highly consistent elements in the respondents' view (low value of the registered standard deviation).

The high consistency of the answers proves that respondents' opinions from various centers with a tram network in Poland are consistent. Concerning the safety criterion, it should be emphasized that two out of four assessed factors with the most significant convergence of elements refer to facilities for people with disabilities. Concerning the functionality criterion, the highest compliance in the experts' assessment included two factors relating to the dimensions of the stop platform, i.e., its width and length adjusted to the size of the passenger stream and the length of the rolling stock stop served. These are undoubtedly essential elements that have a very significant impact in terms of functionality. The factor related to the lighting of the bus shelter has a slightly smaller impact on the functionality, with similar compliance of the experts. The presence of the passenger information board at the stop has a high impact on the functionality, with reasonably high submission of the ratings.

However, in many cases, the assessments of experts differed significantly from each other. Examples of highly variable factors in impact assessment are presented in Table 2 for the safety criterion and Table 3 for the functionality criterion.

Table 1. Highly consistent elements in the respondents' view.

Analyzed Element	Element Structure	Estimated Deviation
Safety criterion		
Presence of guidance path for the blind	(8; S: 1.61; F: 1.16)	0.52
Adjusting the platform width to the passenger flow	(1; S: 1.45; F: 1.63)	0.59
The lighting of the entire stop zone	(6; S: 1.50; F: 1.27)	0.59
Presence of a detectable warning lane along the entire edge of the platform	(7; S 1.44; F: 0.81)	0.59
Functionality criterion		
Adjusting the platform width to the passenger flow	(1; S: 1.45; F: 1.63)	0.49
Adjusting the platform length to the serviced tram	(2; S: 1.34; F: 1.63)	0.52
Presence of the lighting of the stop shelter	(5; S: 1.21; F: 1.31)	0.64
Presence of the passenger information board in the stop area	(22; S: −0.50; F: 1.60)	0.65

Table 2. Factors characterized by a wide variation in the safety impact assessment.

Analyzed Element	Element Structure	Estimated Deviation
Safety criterion		
Sharing the stop area with the pedestrian and bicycle path	(16; S: −0.85; F: −0.79)	1.13
Direct vicinity of a bicycle path without its fencing	(13; S: −1.06; F: −0.60)	0.99
Presence of the passenger information board in the stop area	(22; S: −0.26; F: 1.60)	0.97
Separating the stop from the bicycle path by using different type of surface	(20; S: 0.32; F: 0.13)	0.94
Separating the stop from the bicycle path by painting a line	(21; S: 0.11; F: −0.02)	0.94
Presence of a stop shelter	(4; S: 0.42; F: 1.50)	0.92

Table 3. Factors characterized by a large discrepancy in assessing the impact on functionality.

Analyzed Element	Element Structure	Estimated Deviation
Functionality Criterion		
Presence of the service point in the stop area	(23; S: −0.50; F: 0.55)	1.20
Presence of trees in the stop area	(11; S: −0.82; F: −0.42)	1.19
The stop area is fenced off with a barrier	(17; S: 1.15; F: 0.15)	1.05
Presence of greenery in the pots in the stop area	(12; S: −0.45; F: −0.10)	1.02
Sharing the stop area with the pavement	(15; S: −0.24; F: −0.29)	1.01

The cycling-related factors are characterized by the most significant inconsistency in the safety assessment. Four of the six collected results with the most significant discrepancy in the assessments of safety experts refer to the organization of bicycle traffic in the area or near the stop. This result may be a direct result of various cycling policies applied in Polish cities as well as the size of the bicycle path network or the mere share of cyclists in urban traffic. In the area of individual cities from which responses from several experts were received, there are no such significant discrepancies as in comparing global responses.

In the opinion of experts, there is a lack of consistency in terms of elements related to the so-called "Green stops", which are characterized by vegetation in their area. Apart from the visual aspects, this vegetation is also supposed to provide ecological values and shade for travelers waiting at stops. Equipping stops with these types of elements is a relatively new phenomenon from the point of view of stop design, which may be caused by a large variety of assessments of the impact of these elements on functionality. However, the service point in the stop area remains the most significant doubt here, the average result of which in terms of functionality indicates a slight impact of this factor on this aspect.

In the next stage of the analysis, the obtained results were divided according to the assessment of their impact on each of the two examined criteria. These factors were classified into three distinguished groups that defined a positive, neutral, or negative aspect of functionality and safety. Table 4 presents the classification of individual elements.

Table 4. Classification of assessed factors depending on the nature of their impact on the safety and functionality of tram stops.

<table>
<tr><th></th><th>Safety</th><th>Functionality</th></tr>
<tr><td rowspan="2">Factors that influence reduced safety or functionality</td><td>Ls
Presence of trees in the stop area (11; S: −0.82; F: −0.42)
Presence of greenery in the pots in the stop area (12; S: −0.45; F: −0.10)
Presence of the service point in the stop area (23; S: −0.50; F: 0.55)</td><td>Lf
–</td></tr>
<tr><td colspan="2">Lsf
Direct vicinity of a bicycle path without its fencing (13; S: −1.06; F: −0.60)
Sharing the stop area with the pedestrian and bicycle path (16; S: −0.85; F: −0.79)</td></tr>
<tr><td rowspan="2">Factors with neutral influence</td><td>Ns
Presence of a bench in the stop area (10; S: 0.03; F: 1.32)
Separating the stop from the pedestrian route by painting a line (19; S: 0.23; F: 0.13)</td><td>Nf
Presence of greenery in the pots in the stop area (12; S: −0.45; F: −0.10)
The stop area is fenced off with a barrier (17; S: 1.15; F: 0.12)</td></tr>
<tr><td colspan="2">Nsf
Direct vicinity of a bicycle path with a fence (14; S: 0.10; F: 0.03)
Sharing the stop area with the pavement (15; S: −0.24; F: −0.29)
Separating the stop from the bicycle path by painting a line (21; S: 0,11; F: −0.02)</td></tr>
<tr><td rowspan="2">Factors that influence improved safety and/or functionality</td><td>Hs
Presence of a detectable warning lane along the entire edge of the platform (7; S: 1.44; F: 0.81)
The stop area is fenced off with a barrier (17; S: 1.15; F: 0.12)</td><td>Hf
Presence of a bench in the stop area (10; S: 0.03; F: 1.32)</td></tr>
<tr><td colspan="2">Hsf
Adjusting of the platform width to the passenger flow (1; S: 1.45; F: 1.63)
Adjusting of the platform length to the serviced tram (2; S: 1.34; F: 1.63)
Raising the platform to a height adapted to the serviced tram (3; S: 1.27; F: 1.56)
Presence of lighting of the stop shelter (5; S: 1.21; F: 1.31)
Lighting of the entire stop zone (6; S: 1.50; F: 1.27)
Presence of guidance path for the blind (8; S: 1.61; F: 1.16)
Presence of a waiting place for people with disabilities (9; S: 1.05; F: 1.00)</td></tr>
</table>

In this case, the presence of the guide strips has a much more significant impact in terms of functionality than using a warning strip at the edge. This is a critical remark because, in practice, there is often not enough space to designate the guide strips. It should also be emphasized that no factors that could be classified into the Lf group (deterioration of the stop functionality only) were identified among the analyzed results. However, as many as three elements that currently appear as part of green stops have been identified, which may have a negative impact on the level of safety of stop users. Most of the assessed factors were classified as positively impacting the safety and functionality of stops (Hsf).

5. Discussion and Conclusions

The stop is an important infrastructure element for the tram network. It is an integral part of the city structure; however, it often combines more functions than just a waiting area for a public transport vehicle. The results of the literature review presented in Section 2 show that most researchers assessing the stop infrastructure focus primarily on safety. In publications, researchers pay attention to the type of stops and their impact on safety [14,20,41], conflict interactions between tram passengers and road vehicles or other road users [41], and requirements for their infrastructure [21,22]. It is fully justified, as protecting passengers' health and life is a critical element in managing their journeys. However, it should be noted that the current trends in the design of stops (green stops, stops adapted to different types of passengers, stops as transfer nodes) force decision-makers to pay attention to aspects increasing the functionality of these urban transport infrastructure facilities. Equipping tram stops with functional elements usually improves the comfort of passengers waiting for a vehicle, which positively influences the willingness to use public transport among city residents. It is crucial to consider the congestion of large cities and the urban policy to reduce individual transport in favor of collective journeys.

However, as indicated in Section 2 in the research on the evaluation of stops, the functionality criteria appear sporadically. They are usually not the subject of exclusive research on their selection but only constitute a component of the assessment of travel comfort. For this reason, research usually considers the point of view of users who assess it subjectively, and it is not always supported by knowledge of urban transport infrastructure design. For this reason, the results presented by us in this article are very important. The experts participating in the study were people who not only had a high level of knowledge about the design and operation of stops but also had extensive practical experience. For this reason, their perception of the analyzed factors takes into account various aspects of the functioning of the stops, and the assessment represents the point of view of different participants of the traffic taking place in the area of the stop. The literature research we conducted shows that so far, no one has published such research results in international journals.

The obtained research results and their classification constitute not only scientific material. They can also be used by people and organizations involved in the design, evaluation, and modernization of tram stops. The obtained results should also be analyzed by teams developing urban standards for transport infrastructure. For us, the results of the conducted research are critical. Our research shows that the most important elements related to the assessment of the stop infrastructure in terms of safety include warning fields and guidance paths for the blind, lighting, and adjusting the platforms' width to the volume of passenger traffic. According to experts, the key elements influencing the stops' functionality are the platform's technical parameters (length, width, and height adapted to the rolling stock served) and the availability of passenger information at the stops. Based on the results obtained in this research, we will create a method of assessing the safety and functionality of tram stops. However, before we give it its final scope, we plan to conduct a similar study among the inhabitants of selected cities in Poland with a city tram system. We believe that obtaining opinions from this group of respondents may positively impact the verification of the range of factors assessed by users of the public transport system.

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