Developing Sustainable Spatial Plan Decisions Based On Digital Data From The Turkish Traffic Safety And Density Analysis Platform

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Abstract **Rapid urbanization and increasing motorized mobility create interrelated challenges concerning density, traffic safety, accessibility, and spatial sustainability. This study examines how digital data generated by Türkiye's Traffic Safety Analysis Platform (TSAP) and Traffic Density Analysis Platform (TDAP) can be integrated into sustainable spatial planning decisions. The research adopts a qualitative case-study approach consisting of three stages: a structured review of the platforms, an analysis of their visual outputs at different planning scales, and a data–spatial problem–decision analysis. The findings show that TSAP provides data on accident severity, type, location, time, and high-risk areas, whereas TDAP provides segment-based information on speed, density, queues, peak hours, and travel time. When evaluated together, these datasets can support decisions concerning safety-prioritized corridors, speed management, pedestrian continuity, access management, transfer areas, logistics conflicts, and the equitable distribution of transportation investments. The study proposes a framework for transforming digital traffic data into traceable spatial planning decisions and intervention priorities.**

Keywords— Traffic Safety Analysis Platform, Traffic density analysis platform, safe system approach, sustainable spatial planning, Türkiye.

I. INTRODUCTION

Increasing urbanization, population concentration in metropolitan areas, and the rise in motor vehicle use are driving up demand for road mobility. This process gives rise to numerous challenges in urban transportation systems, including capacity and accessibility, traffic safety, conflicts among road users, traffic density, and the quality of public spaces. Furthermore, the density, delays, speed disparities, and accident risks emerging in road networks affect not only the technical performance of transportation systems but also the sustainability of spatial planning decisions. Consequently, safety assessments in transportation systems are becoming an increasingly important area of research. Particularly in developing countries, it is crucial to link road traffic safety to planning issues such as land use, accessibility, public space, and social justice in relation to accident risks.

Globally, traffic accidents result in approximately 1.19 million deaths and 20–50 million injuries each year [1]. Most of these fatalities and injuries involve vulnerable road users such as pedestrians, cyclists, and motorcyclists. More than 90% of traffic-related deaths occur in low- and middle-income countries [1]. In Türkiye, which ranks among the countries with the highest traffic risks globally, approximately 288,000 traffic accidents resulting in fatalities or injuries occurred in 2025 according to TUİK data, resulting in over 6,000 fatalities [2]. These indicators highlight the importance of developing various safety measures and planning decisions aimed at reducing accident risks using traffic safety data.

In the road traffic safety literature, various modeling approaches are used to examine the likelihood and severity of traffic accidents, as well as the factors that determine them. These approaches often reveal safety issues only after an accident has occurred. However, problems such as incomplete or inconsistent accident records, underreporting of minor accidents, failure to reflect the cause-and-effect relationships of incidents, and the inability to make the data directly usable at the planning scale limit the use of these methods as decision-support tools. At the same time, traffic accidents are not events that can be explained solely by road geometry and traffic volume. Numerous spatial variables—such as pedestrian access, intersection layout, the location of public transit stops, roadside land uses, speed behavior, density distribution, and the organization of public spaces—influence accident risk. For this reason, road traffic safety assessments must be based not only on historical accident statistics but also on multidimensional traffic data generated spatially and temporally.

These modeling approaches evaluate traffic safety performance through indicators such as total number of crashes, crash records, traffic volume, and geometric characteristics. However, these indicators provide only a limited explanation of the spatial distribution of crashes, risks that vary by user type, behavioral factors, the relationship between land use and transportation, and the long-term effects of planning decisions. Furthermore, among other factors, measurement inconsistencies, changes in parameters over time, and unobservable socioeconomic effects reduce the reliability of model results [3].

In recent years, technological advancements have enabled the development of more comprehensive and proactive approaches to traffic safety and traffic density assessments. Road safety audits, the safe system approach, pedestrian safety audits, traffic conflict techniques, automated image processing systems, natural driving data, and microsimulation applications contribute to the identification of high-risk areas before accidents occur [4] [5] [6] [7]. These approaches reveal not only where past accidents occurred but also interactions among road users, changes in traffic density, speed differences, potential conflict points, and intervention priorities. Thus, traffic safety assessment evolves from a reactive analytical process into a proactive decision-support tool that informs planning decisions.

Particularly from the perspective of sustainable spatial planning, digital traffic data serves as a crucial tool for creating safe transportation networks, protecting vulnerable road users, enhancing the quality of public spaces, and establishing a more balanced relationship between transportation and land use. In this context, this study aims to discuss the integration of digital traffic data generated by the Traffic Safety Analysis Platform (TSAP) and the Traffic Density Analysis Platform (TDAP)—both developed in Türkiye—into sustainable spatial planning decisions.

This paper addresses the following four research questions: (I) What types of digital traffic data do traffic safety and traffic density analysis platforms generate? (II) For which planning tools can the visual materials obtained from these platforms be used? (III) What spatial issues do the data obtained from these platforms reveal? (IV) How can digital traffic data be integrated into sustainable spatial planning processes?. To answer these questions, the paper first establishes the conceptual relationship between traffic safety, the built environment, and spatial planning. It then reviews the data and analytical capabilities of TSAP and TDAP. Finally, the platform outputs are linked to spatial problems, planning scales, and potential planning decisions.

II. CONCEPTUAL FRAMEWORK

A. Traditional Traffic Safety and Safe Systems Approach

The traditional approach to traffic safety relies on estimating the impact of certain measures taken to improve traffic safety on the frequency and severity of accidents. This approach aims to change the behavior of road users, reduce human errors by enforcing traffic laws, and develop strategies to improve road infrastructure [8] [9] [10]. Accident-based assessments, a fundamental component of traditional traffic safety analyses, utilize existing accident data to identify high-risk areas, examine the spatial distribution of accidents, and interpret accident outcomes according to their severity levels [11] [12]. Accident-based assessment methods are classified into four groups. Firstly, accident black spot analysis is one of the most common applications of this approach [13]. This analysis identifies road sections and intersections where high accident, injury, or death rates are observed in a specific time period. In identifying these areas, road geometry, traffic characteristics, environmental conditions, and accident records are used. Geographic information systems, Bayesian methods, and clustering approaches are used to increase the accuracy of the analysis. Another group of methods are before-and-after observation studies, which evaluate the impact of intervention by comparing traffic safety conditions before and after the implementation of specific safety measures [14] [15]. Changes in the number and severity of accidents after intersection redesign, speed reduction applications, road signage, and inspection programs are examples of this method.

The third group of methods consists of statistical models that strengthen the quantitative aspect of the traditional approach and address safety performance in detail. These include descriptive statistics that describe current safety conditions, risk exposure and accident outcomes; statistics that predict future accident probabilities by considering the relationship between road geometry, traffic volume and environmental characteristics and the number of accidents; risk statistics that measure the effect of different safety measures on risk reduction; accident outcome statistics that affect injury and death outcomes; and multiple linear regression analyses that address the problems of distribution, extreme zeros and data heterogeneity in accident data [16] [17].The final group of methods is expert opinion and engineering assessments. Traffic safety experts make adjustments to address safety issues by identifying field conditions, road geometry, user behavior, visibility distances, and infrastructure deficiencies. This method offers a solution, particularly in areas with data deficiencies. However, expert opinions may contain subjective interpretations, institutional pressure, or methodological limitations. Therefore, they need to be evaluated in conjunction with data-driven analyses [18] [88].

The traditional approach to traffic safety has some limitations. These include: (I) It is based on data generated after an accident occurs, (II) safety problems become visible only after the number of accidents increases in a particular location, (III) accident records are incomplete and small-scale accidents are not reported, (IV) it considers human error as a significant cause and fails to explain the conditions that lead to this error. These limitations have increased the need for proactive, holistic, and systems-based approaches in the field of traffic safety. In this context, the safe systems approach has emerged as a significant paradigm shift in the field of traffic safety. Its origins lie in the Class Vision program developed in Sweden and the Sustainable Safety approaches developed in the Netherlands [19] [20]. The safe systems approach aims to identify and reduce risks before accidents occur, and to design a system where human error does not result in death or serious injury. Road design characteristics, speed behavior, traffic density, pedestrian-vehicle collisions, and intersection arrangements are analyzed within the system. Thus, safety assessments are not limited to improving black spots, but become a holistic planning tool for risk reduction. This approach is based on some fundamental principles [21]:

- Accepting that traffic accidents will never completely disappear, severe consequences must be prevented. - Transportation systems should be designed taking into account the possibility of road users making mistakes. - The force that the human body can tolerate during a collision is limited. Therefore, design decisions that manage speed and reduce collision severity should be made. - A safe road transportation system requires shared responsibility among road managers, planners, designers, implementers, maintenance units, inspection agencies, emergency response teams, vehicle manufacturers, civil society, and academic stakeholders. Examples of safe systems approach practices include the widespread use of speed control cameras, the conversion of four-way intersections into roundabouts, the promotion of technologies that enhance vehicle safety, and prioritizing the protection of vulnerable road users in urban areas [22][23]. These practices demonstrate that traffic safety should be addressed through system-level policy and planning decisions, in addition to engineering interventions. Therefore, it is important to consider traffic safety together with spatial determinants that affect accident risk.

B. Spatial Determinants of Traffic Safety

Traffic accidents and pedestrian-vehicle collisions are related to spatial factors including land use, road network type, road function, speed, population density, pedestrian mobility, and socioeconomic characteristics. Therefore, in the traffic safety literature, it is important to consider the built environment characteristics and social structure together with accident risks. Research in this context focuses on injury and fatal accidents and examines all modes of transportation. Pedestrian and cyclist accidents are particularly prominent. The built environment is considered in two ways: land-based and street-based. Land-based includes the location, layout, and density of land use, as well as the physical design aspects related to streets. Street-based includes the design of adjacent streets, intersections, and street networks. In addition, it is considered in the social dimension, which includes employment and population density and the demographic characteristics of users. The impact of the built environment on traffic safety is primarily discussed through land use. Land use is one of the strategies used to prevent and reduce accidents [24]. Land use types generate different levels of journeys and influence user behavior. This situation increases the potential for traffic accidents. In the literature, commercial and mixed-use areas are identified as high-risk areas for pedestrian and cyclist accidents [25][26][27][28]. In contrast, single-family residential areas and areas with low activity density are reported to have a lower risk of accidents. However, higher rates of collision and injury accidents have been found in social infrastructure areas such as schools [29][30].

Both the type of land use and the level of mobility generated by these uses increase the risk of accidents. Vehicle-to-vehicle collisions are concentrated in commercial and industrial areas, as well as manufacturing and industrial zones.

Vehicle-pedestrian and vehicle-bicycle collisions are higher in areas with tourist accommodations and public services, and high pedestrian activity [31]. [32], in their research, found that housing-population density, commerce and service sector were positively correlated with the number of traffic accidents. [33] found that the number of bars, shops selling alcoholic beverages and restaurants per kilometer along the road was related to pedestrian injuries. In general, it shows that the risk of accidents is affected by the spatial location, density and land use of the surrounding activities. Therefore, the proximity of activities that generate and attract travel can offer a planning approach that reduces the need for vehicle travel and encourages pedestrian and bicycle use [34].

Land use-related mobility patterns become important in terms of traffic safety when evaluated together with road network density and street layout. Road network density, level of connectivity, number of intersections and block structure affect both the level of mobility and the probability of encounters between vehicles and vulnerable road users. High accessibility density increases the probability of collisions. and increases the risk of accidents [35][36]. Similarly, more accidents occur in areas with dense road networks or intersections [27][37][38][39][40]. In their study examining the effect of street layout on accident frequency, [38] classified street layouts into four categories: grid, skewed parallel, loops and lollipops, and mixed. They found that skewed parallel, loops and lollipops, and mixed layouts, which provide limited access, were safer and had lower accident rates compared to grid layouts [38][41][42][43]. This shows that highly interconnected road networks increase accessibility but also increase points of conflict.

However, findings regarding the road network are not always one-sided. [42] state that increased intersection density is less associated with accident rates, but increased street connectivity is more strongly associated with accidents. At the same time, the difference in intersection types affects the severity of the traffic safety impact [27]. For example, in an area with a high density of three-way intersections, the number of injury-related accidents decreased while the total number of accidents increased. Cities with narrow streets and small blocks have a lower risk of fatal traffic accidents. This supports high-density and mixed-use neighborhood designs for pedestrians and cyclists in line with sustainable development goals [44][45][46][47][48].

Another variable related to road network type is the function and speed level of the road. Main arteries, multi-lane streets, and high-speed limit roads are associated with serious injuries and high accident risks [27][49][50][51]. In this context, it has been found that more accidents occur in areas with main arterial roads, and pedestrian and bicycle accidents are particularly prevalent on such roads [52][53]. This is because main arterial roads are designed to accommodate high traffic volumes. As vehicle speed and traffic volume increase on these roads, the risk to vulnerable road users also increases. This situation is explained by the fact that pedestrians and cyclists do not have protection inside vehicles, increasing the risk of injury and death under high-speed conditions [54][55]. The speed variable is a factor that affects the severity of accidents more than the number of accidents. [56] states that the pedestrian and bicycle accident rate is lower in areas with high traffic speeds. However, bicycle and pedestrian accidents cause more serious injuries on roads with high-speed limits [57]. Therefore, traffic safety should be evaluated together with accident severity, user type, and exposure level. The impact of sidewalks on vulnerable road users, bicycle lanes, traffic accidents and injuries, and traffic safety is a controversial area in the literature. While some studies find that sidewalks reduce the risk of accidents for pedestrians [58][59][60][61], others show that there are more pedestrian and cyclist accidents in areas with longer sidewalks, more pedestrian crossings, or more bicycle lanes [62][63][64]. This indicates that the density of pedestrians and cyclists should also be considered in areas where infrastructure is available. Similarly, [65] found that pedestrian accidents involving elderly individuals were higher at signalized pedestrian crossings compared to intersections without signalized crossings. [42] found that injury-causing bicycle accidents increased in areas with a high density of bicycle lanes. [66] stated that bicycle lanes on main arteries increase collisions, while accident rates are lower in bicycle lanes on side streets.

Spatial determinants of traffic safety, including characteristics of the built environment, social structure, and demographic composition, play an important role in shaping the spatial distribution of accident risk. Higher population and employment densities are generally associated with greater pedestrian and vehicular activity, which may increase exposure to traffic conflicts and, consequently, the number of recorded accidents. Accordingly, several studies have reported lower accident frequencies in areas with low population density [27][67], while higher numbers of accidents have been observed in areas with greater population and employment density [68]. Positive associations have also been identified between density and pedestrian injury collisions [33][69][70][71]. However, higher density does not necessarily correspond to greater accident severity. Dense urban environments are often characterized by lower operating speeds, shorter travel distances, and more constrained road conditions, which may reduce the likelihood of fatal outcomes. This may explain the negative relationship reported between density and fatal accidents [72][73][74]. Therefore, density should be interpreted as a factor that may increase exposure and accident frequency while simultaneously reducing accident severity under certain spatial and traffic conditions.

Demographic structure is also an important determinant, especially in terms of pedestrian safety. Children and the elderly are among the most vulnerable groups to pedestrian accidents. [75][76]; found that the death rate among elderly pedestrians is higher during daytime, weekdays, and winter months. In their research, [75] found that elderly pedestrians cross the road more frequently when vehicles are approaching and use unsafe road crossing strategies. According to [77], elderly pedestrians are exposed to vehicle traffic for longer periods because they walk slower than younger pedestrians. On the other hand, disadvantaged demographic groups also have a higher accident risk rate [56][78][79][80][81]. It is debated whether this situation stems from disadvantaged groups walking, cycling, and using public transport more, or from the fact that the transportation infrastructure and traffic conditions in their environments are riskier [82].

In general, the literature shows that traffic safety can be explained by considering land use, road network type, road function, speed, transportation infrastructure, and social vulnerability variables together. High population density, average daily traffic and number of intersections per kilometer, vehicle speed and types, vehicle characteristics and conditions are directly related to accident risks. However, it is stated that the risk of accidents is higher in city centers and low-to-medium density commercial areas compared to villages and city center periphery areas [33][83][84][85]. Therefore, it is important to consider traffic safety not only as an engineering-focused road arrangement, but also as a holistic spatial planning problem that must be addressed together with land use decisions, urban density, accessibility, speed management, and social vulnerability.

III. METHOD

This research is based on a qualitative case study examining the Traffic Safety Analysis Platform (TSAP) and the Traffic Density Analysis Platform (TDAP) as digital decision support tools that can be linked to sustainable spatial planning decisions. The data sources used in the research include the interfaces of the Traffic Safety Analysis Platform (TSAP) and the Traffic Density Analysis Platform (TDAP), the official websites and reports of the Ministry of Environment and Urbanization, the types of decisions included in zoning plans, implementation zoning plans, and transportation master plans published in the official gazette, and the implementation tools used in urban design guidelines. The research methodology consists of three main stages. The first stage is a digital platform review analysis that evaluates the Traffic Safety Analysis Platform (TSAP) and the Traffic Density Analysis Platform (TDAP) through a structured review framework. In this stage, the platforms are systematically examined and defined. This definition is evaluated within the framework of the platforms' purpose, analysis method, filtering tools, visualization methods, data type used, target users, limitations, and decision support potential. The second stage is a visual material analysis examining how digital traffic data obtained from the platforms can be used as input for different planning scales (master zoning plan, implementation zoning plan, transportation master plan, and urban design guidelines). Map layers, thematic visuals, accident density representations, speed and queue analyses, time-space distributions, and graphical outputs from the platforms were evaluated. The final stage is a data-space-decision analysis where the data obtained from the platforms are related to planning decisions within the framework of spatial problems identified at different planning scales. In this stage, inferences regarding spatial planning decisions based on spatial problems identified at different planning scales in the literature are discussed.

IV. FINDINGS

A. Digital Platform Review Analysis in Türkiye

The traffic safety analysis platform was developed within the Ministry of Environment, Urbanization and Climate Change as part of the “2020-2023 National Smart Cities Strategy and Action Plan” and the “2021-2023 Road Traffic Safety Action Plan”. It is a big data-driven, web-based software platform that provides decision support for traffic safety analysis and planning on urban road networks using information on accidents and their underlying mechanisms [86]. The platform centrally collects data on accidents resulting in death and injury from the IVME (Ministry of Interior Data Center) project, which was put into use by the Ministry of Interior in 2022, and data on accidents resulting in material damage from the Insurance Information and Monitoring Center. The data can be filtered for parameters such as accident severity, accident types, weather conditions, accident causes, location information, road characteristics, and time, and can be displayed on a map using heat maps, point mapping, and clustering methods. Thanks to traditional traffic engineering methods and an artificial intelligence algorithm, the platform enables the calculation of Accident Black Spots and High Accident Density Areas. The platform allows for the identification and analysis of factors causing accidents in a defined region and period, areas requiring improvement, and potential situations that may arise under specific conditions. Furthermore, statistics obtained from the data are visualized and reported on the panels within the platform. Launched in 2023, the platform is used by local governments on a national scale [86]. Figure I presents the distribution of traffic accidents across Türkiye and the layers of the platform.

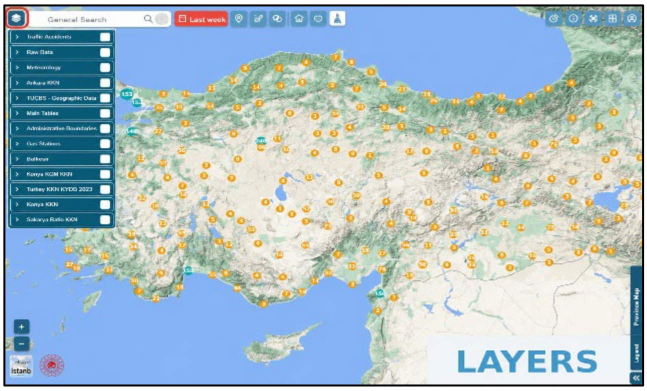

FIG. I TRAFFIC SAFETY ANALYSIS PLATFORM LAYERS

Traffic density analysis platform was developed within the Ministry of Environment and Urbanization under the scope of the "National Smart Cities Strategy" and Action Plan. Its aims are: (I) to display, compare, and report current and historical data on urban traffic density, queue lengths, and peak traffic hours in all 81 provinces on the web; and (II) to enable the sharing of data with other platforms supporting appropriate infrastructure. The platform utilizes mobile vehicle data from 2020, 2021, 2022, 2023, and 2024 to determine traffic flow speed on road networks. It also provides segment-based speed data in 5-minute intervals between 06:00 and 23:00. The platform is used by local governments on a national scale [87] [Fig. II].

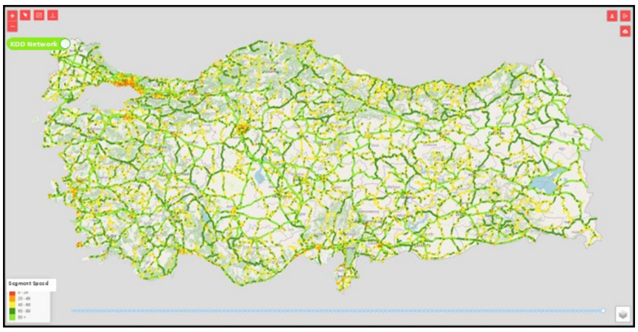

FIG. II TRAFFIC DENSITY ANALYSIS PLATFORM INTERFACE

B. Visual Material Analysis

The potential of digital traffic data generated by the Traffic Safety Analysis Platform (TSAP) and the Traffic Density Analysis Platform (TDAP) was evaluated in relation to different spatial planning scales. At the master zoning plan scale, accident density, traffic congestion, segment-based speed, queuing, and travel-time data can be used as analysis and synthesis inputs for strategic decision-making. These indicators make it possible to identify corridors where traffic safety and accessibility problems overlap and to define safety-prioritized corridors, public transport-prioritized axes, and areas requiring further transportation investment.

At the implementation zoning plan scale, platform data can support more detailed and location-specific planning decisions. Information on pedestrian accidents, intersection accidents, queue lengths, local speed reductions, and roadside congestion can be associated with decisions concerning sidewalk continuity, safe pedestrian crossings, parking and parcel access, intersection arrangements, and target speed regulations. In this way, traffic safety indicators can be translated into plan notes and implementation provisions rather than remaining solely as descriptive analytical outputs.

At the transportation master plan scale, digital traffic data can be used both as a model input and as a tool for determining intervention priorities. Peak-hour congestion, bottlenecks, queue lengths, travel times, speed variations, and accident concentrations can support decisions on public transport corridors, intersection improvements, traffic calming, speed management, freight movement, and logistics organization. The simultaneous evaluation of safety and traffic performance data also allows transportation investments to be prioritized according to both operational efficiency and accident risk.

At the urban design guideline scale, the platforms can inform micro-scale design decisions affecting the daily experience and safety of road users. Local accident patterns, pedestrian movements, vehicle approach speeds, stopping conditions, and congestion around public transport stops can guide decisions concerning sidewalk width, pedestrian waiting areas, crossing locations, lighting, bus stop arrangements, street furniture, and street cross-sections. Therefore, the visual outputs of TSAP and TDAP can contribute to the development of measurable and location-specific design principles at different planning scales.

C. Data – Spatial – Decision Correlation Analysis

Digital traffic data generated from the Traffic Safety Analysis Platform (TSAP) and the Traffic Density Analysis Platform (TDAP) were related to spatial planning decisions through a data–spatial problem–decision framework. Within this framework, accident type, severity, location, and density data were evaluated together with traffic volume, speed, queue length, peak-hour congestion, and travel-time indicators. The combined evaluation of these datasets makes it possible to move beyond the identification of individual accident locations and to reveal broader spatial problems related to road hierarchy, land use and density, vulnerable road users, access management, social vulnerability, roadside activities, transfer areas, and logistics mobility.

Path Hierarchy

The safety of main transportation corridors (highways and main arterial roads, urban main arterial roads, local connecting roads) and pedestrian axes accessing public transport stops and transfer points are included. In the traditional planning approach, road hierarchy is defined in terms of vehicle capacity, connectivity level, and road function. However, when road hierarchy is evaluated using indicators such as accident black spots, pedestrian and vehicle accidents, serious injury and fatal accidents, and corridor-based traffic volume, low speed, queues, bottlenecks, and travel time, it provides input for a safety and accessibility-focused planning decision that identifies priority intervention areas.

Land use – the relationship between density and transport capacity

Decisions regarding building density and spatial arrangement (building density, building regulations, ground floor use, setback distance, and building approach limit), as well as commercial and mixed-use decisions, encompass issues related to development area decisions. The relationship between land use and transportation is defined as building regulations and density decisions. However, when evaluated using indicators that highlight safety risks, such as pedestrian accidents, intersection accidents, and accident density, and analyze transportation capacity, such as peak hour density, queues, low speeds, and travel times, it provides input for a holistic planning approach that considers multimodal transportation accessibility and traffic safety components together.

Safety for vulnerable road users

Urban accessibility decisions (schools, hospitals, parking lots) and issues related to pedestrian, cyclist, elderly, child, and disabled user decisions are included. The safety of vulnerable road users is classified as accessibility and post-accident response decisions. However, when evaluating accident events such as visible road user accidents, cross-traffic accidents, and the relationship between accident risk and transportation performance, such as peak hour density, approach speed, queuing, slowdown during stops, and passenger density, the development of planning decisions ensures the inclusion of safe access planning decisions. Preventive decisions include combining design reports focusing on lane width and continuity, ramp and safe pedestrian distance location, lighting, target speed decisions, barrier-free walkways, and pedestrian waiting areas.

Access management

This includes issues related to intersection and signal decisions (pedestrian crossing time, turning restrictions, signal phase) and target speed and traffic calming decisions (speed management in school, hospital and residential areas, low-speed zones). Access management is defined as engineering interventions aimed at accelerating vehicular flow and as nodal points of transportation networks. However, when evaluated with indicators such as side impacts, turning accidents, intersection accidents, pedestrian accidents, which reveal safety problems around the intersection, and queuing, delay, peak hour density, and intersection approach speed, which relate these problems to operational performance; it provides input for safety-oriented design decisions in terms of speed control and pedestrian access.

Social vulnerability and security inequality

In low-income neighborhoods, the inadequate pedestrian infrastructure in areas inhabited by children, the elderly, and individuals with disabilities leads to poor accessibility and high traffic, creating inequality. Injury accidents, pedestrian accidents, and accident densities at the neighborhood/district level, along with indicators analyzing mobility in vulnerable neighborhoods such as peak hour density, queues, and low speeds, highlight safety inequalities. These indicators provide input for planning decisions that prioritize safety investments and focus on the equitable distribution of safe transportation infrastructure.

Parking and roadside use

This includes issues related to access management decisions (parcel entry/exit, parking lot entrance, service access) and roadside usage decisions (short-term stopping, sidewalk encroachment). These decisions are generally defined as parcel and property regulations. However, when side collisions, turning accidents, pedestrian accidents, and indicators of traffic density such as slowing down, queuing, low speed, and narrowing, which reveal accidents caused by roadside and visibility restrictions, are evaluated, they provide input for planning decisions focusing on public road safety and pedestrian access.

Transfer and station area safety

Public transport access includes issues related to stop-pedestrian crossing relationships, waiting areas, sidewalk width, vehicle-pedestrian separation, and speed conditions around stops. When evaluating safety risks such as pedestrian accidents around stops, transfer area accidents, and vulnerable user accidents, as well as indicators measuring transportation performance such as passenger density, slowdown around stops, queuing, low speed, and peak hour, planning and design decisions focusing on pedestrian access and road user safety around stops and transfer areas are provided input.

Logistical mobility and conflicts

Industrial, warehousing, and large-scale commercial use involve freight and heavy vehicle mobility, truck parking, and loading and unloading issues. Indicators such as heavy vehicle accidents, side-impact collisions, and pedestrian-vehicle accidents, which highlight safety risks, as well as peak hour density, low speed, queuing, and access time indicators analyzing the pressure of logistics mobility on the road network, are evaluated. This provides input for planning decisions aimed at reducing conflicts between logistics corridors and scheduling policies and urban living spaces.

V. CONCLUSION

This study aims to discuss the integration of digital traffic data produced by the Traffic Safety Analysis Platform (TSAP) and the Traffic Density Analysis Platform (TDAP), developed in Türkiye, into sustainable spatial planning decisions. First, the platforms were systematically examined according to specific review criteria, and then aspects where digital traffic data could serve as input for different planning scales were evaluated. Subsequently, the generated data was linked to planning decisions within the framework of specific spatial problems.

When the research questions presented in the study are evaluated within the scope of the research results: (I) What types of digital traffic data do the traffic safety and traffic density analysis platforms produce? The platforms offer significant potential in terms of producing traffic data in a digital environment. In this context, Traffic Safety Analysis Platform (TSAP) produces data on traffic safety risks with accident black spots, high accident density areas, accident severity, accident type, time, and location data. Traffic Density Analysis Platform (TDAP), on the other hand, reveals the density and accessibility in the urban transportation system with speed, queue, peak hours, traffic density, travel time, and segment-based performance data. (II) For which planning tools can the visual materials obtained from the platforms be used? The digital traffic data generated by the platform contribute to spatial planning processes at three levels. Firstly, platform data can make existing traffic safety and density problems visible in analysis and synthesis maps. Secondly, it can provide input for plan explanation reports, plan notes, transportation master plan strategies, and urban design guides. Thirdly, with new analysis tools to be added to the platform, it can produce concrete planning outputs such as direct intervention priority, target speed decision, safe access area, pedestrian continuity, access management, lighting priority, logistics conflict area, and development area traffic pressure. (III) Which spatial problems do the digital traffic data obtained from the platforms make visible? They make visible the safety problems of pedestrian axes accessing the main transportation corridor and public transport stops and transfer points, problems related to construction and spatial settlement, commerce and mixed use, development area, urban infrastructure access and problems related to pedestrian, cyclist, elderly, child, and disabled users, intersection and signal decisions, and problems related to target speed and traffic calming decisions. (IV) How can digital traffic data be integrated into sustainable spatial planning processes? The platforms function as decision-support tools that provide input for the identification of safety-prioritized corridors and public transport-prioritized axes. The development of decisions regarding sidewalk continuity, safe pedestrian crossings, parking access, and target speeds, prioritizing intersection improvements, speed management, and traffic calming policies, and the creation of micro-scale design principles such as street cross-section, bus stop surroundings, pedestrian waiting areas, lighting, and crossing safety.

In conclusion, Traffic Safety Analysis Platform (TSAP) and the Traffic Density Analysis Platform (TDAP) offer significant potential for integrating urban transportation and traffic safety data into planning processes in Türkiye. For this, it is necessary to develop the platforms not only as data-generating systems but also as decision support infrastructures that carry data to the levels of spatial problems, analysis tools, planning decisions, and implementation priorities. When this integration is achieved, planners, transportation experts, and urban decision-makers will be able to support traffic safety, accessibility, density management, and sustainable mobility goals with stronger, data-driven, and traceable decisions. In future studies, the data obtained from these platforms should be tested practically through specific cities, corridors, or problem areas; It is suggested that the impact of planning decisions be measured and the relationship between traffic safety and spatial sustainability be evaluated with more concrete indicators.

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