

## URBAN TRANSPORT, LOGISTICS, AND TOURISM: REVIEW OF A CUTTING-EDGE SOCIALLY-ORIENTED APPROACH TO INDUSTRIAL DEVELOPMENT

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### ABSTRACT

**Motives:** Rapid urbanization has increased public awareness about logistics support for urban traffic flows. Given this interest, the relevance of this research is beyond any doubt.

**Aim:** The study aims to identify the most cutting-edge approaches for facilitating traffic and tourism flows using various urban transport modes, and to define the opportunities for their application on the domestic market.

**Results:** The results of the conducted analyses suggest that the development of rail transport is the most promising and vital step in improving urban transport and logistics infrastructure, including in the tourism sector. The study established that intelligent transport systems in urban areas, including public transport, logistics flows, tourist flows, parking, and road traffic control, are complex management systems. A critical examination of several cases supported the identification of regularities in factors that affect the dynamics of urban traffic flows. In view of the rapid development of transport and logistics infrastructure around the world, development opportunities in rural areas bordering large cities were identified. The most effective approaches to resolving logistics problems in a period of war were determined.

**Keywords:** innovative approach, traffic management system, tourist flow, flexible logistics support system, military escalation

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## INTRODUCTION

Urban areas have increased dramatically, which generated the need for new development strategies for city transport infrastructure. The predominant solution is to introduce intelligent transport systems in urban areas. This system represents a complex management system, including public transportation, logistics flows, parking, and road traffic control. In addition to the above, the authors of this article believe the intelligent transport system should involve the tourism element. Tourist flows are inalienable elements in the urban transport systems, and their successful management largely contributes to the logistic support for urban transport flows. Currently, the tourism industry is still trying to recoup from negative consequences of the Covid-19 pandemic and restrictive measures and thus requires the most cutting-edge socially oriented and legal approaches to hasten this process. Porta et al. (2006) studied various urban networks in detail and suggested a number of models for each particular case. An intriguing scientific accomplishment was made by the authors, who compared some structural features of double graphs and looked for substantial resemblance and replication between clusters of various cases.

Daganzo (2007) suggested a new adaptive strategy, which could enhance urban mobility and minimize congestion at the district level. It provides for monitoring and management of cumulative traffic congestion. Since the suggested dynamic models are simple to operate and require the observation of initial data, they have precedence over various similar tools. Geroliminis and Daganzo (2008) conducted the study and found a distinct feature of extensive urban areas. It is a macroscopic, fundamental diagram that provides an immediate connection between the space-mean flow, density, and speed. Furthermore, space-mean flows are characterized by a stable relationship across the network. The urban flow estimation required taking data from minibusses equipped with GPS assistance. Further examination showed that the previously proposed analytical theories were inferior for analyzing the relationships between network

structure and a macroscopic, fundamental diagram for urban areas since they did not consider the influence of turns (Geroliminis & Boyacı, 2012). The authors of this article believe that the methodologies suggested in this research represent a significant theoretical and practical advancement because they allowed for the consideration of variability for cities and signal structures. Bo et al. (2019) assessed the introduction of the management system for freight traffic.

Guo and Lu (2016) examined unweighted and undirected models of road networks and suggested two modeling approaches based on complex network theory and data trajectory filtering. The authors also established that urban transport development has a partially arbitrary nature. Galkin et al. (2019; 2020) consider the following research areas as the most promising ones in logistics: virtual management, logistics 4.0, and delivery technological scheme modeling. Since congestion is a frequent issue for intelligent transport systems, it is necessary to consider the effects of various solutions on urban traffic flow, which becomes possible with the creation of the most applied mathematical apparatus. Zambrano-Martinez et al. (2017) believe the improvement of congestion modeling should start with a heuristic technique. Notably, only some roadway segments fall within the scope of the general traffic flow theory, which ensures adequacy through quadratic regression, while other categories are typical in different situations (Zambrano-Martinez et al., 2018). The network centralization assessment system developed by Zhao et al. (2017) is applicable for a more in-depth road network analysis since it considers its topological features and geometric properties.

Wang et al. (2018) studied how the demand for urban transport changes during peak hours and found this distribution is not equal at various crossings and roads, while peak-hour flows and daily flows correlate. The authors' model of the relationship between urban road structure and function is a truly innovative idea that has to be put into action. In general, one of the principal cutting-edge strategies for supporting logistics in terms of urban transport flows is the involvement of systematic traffic management. These studies

provoke interest due to information solutions designed to assess urban traffic flows. Lu et al. (2018) developed a technique for selecting tools that would facilitate urban traffic and established such a feature of the urban road networks as spatial correlation. In their monumental study, Zhang et al. (2021) designed a spatial network of traffic flows with the indication of their cold and hot zones. The study found the division of such networks into communities by two criteria – centralization and density. The authors of this article believe this study provides a better examination of the characteristics of urban traffic flows.

This study aims to identify the most cutting-edge approaches for facilitating traffic and tourism flows using various urban transport modes and define opportunities for their application in the domestic market.

## **MATERIALS AND METHODS**

In order to optimize urban transportation and logistics, it is essential to strike a balance between societal and commercial interests. Society always strives to make living comfortable, which inextricably entitles confidence in food security, ecological safety, and transport accessibility. Urban delivery, in turn, is a critical factor for many logistic and transport businesses. Urban delivery is frequently subject to considerable delays and correspondingly high expenditures. Since the delivery segment plays a crucial role in the logistics industry, it is necessary to implement cutting-edge solutions while reducing costs. This is advantageous for the general public because it facilitates the movement of heavy vehicles in cities and allows for better customer service and better societal integration. Lu et al. (2014) developed a two-parameter community dynamic model for designing social networks within the framework of their research. As the criteria, the authors accepted communication speed and exchange rate. The authors believed their research could confirm by experiment that the suggested model was efficient for developing networks as they became capable of qualitatively and significantly simulating the networks of social contacts.

The implementation of any new social practice requires accurate knowledge about the level of education among the population since it is closely tied with the further adoption of this practice. It is necessary to consider a systematic approach as a mean to determine the level of education among the population, and the analysis and assessment of results obtained should be in the context of information society development (Martynovych et al., 2019). Consumers more often consider mobility a determinant when assessing the tourism offering, i.e., the ability to move around when traveling becomes the quality factor, particularly in big cities. The level of tourism predetermines the demand for public transport and, consequently, promotes its development. However, urban residents often face the issues of congestion and lack of supply (Albalade & Bel, 2010). Hacia (2019) supported the above statement and emphasized the need for a study focused on resolving these issues by creating efficient tools.

Yang et al. (2019) conducted an experimental study and established the difference between the impact of air and rail service on two-way tourist flows, where the latter was less. The authors also determined that the effects of transport links and multimodal transport competition directly depend on the general distance between departure destination points. Gutierrez and Miravet (2016) established an intriguing regularity in tourists' demand for public transport. The group of tourists, who flew by plane and were supposed (according to their profile) to travel by public transport rarely, resorted to it the most. The second group used their cars as the primary means of transport even if it was more opportunely to travel by public transport. The tourist profile consequently loses some of its importance; instead, it is crucial to determine if the travelers will drive their vehicles. The tourism industry largely depends on numerous laws and rules governing transportation services, lodging, food service, consumer protection, e-commerce, leisure development, tourism facilities, etc. Particular locations have established standards for living and food, the observance of which significantly affects the location itself.

The following regulatory legal instruments govern tourist services within the European Union: Directive (EU) 2015/2302 on package travel and linked travel arrangements, Directive (EU) 2011/83 on consumer rights, and the EU Regulation on platform-to-business relations. The study of Russo et al. (2021) is worth considering as it focuses on defining the adequate approach to developing urban courier and express delivery logistics centers. The authors applied a linear optimization model as the mathematical instrument of their research, and the criterion was the maximum utility with the optimum allocation of joint infrastructure capacities in terms of the subjects of the courier and express delivery market. Altuntaş Vural and Aktepe (2021) study urban logistics in the context of sustainable innovations. The authors believe they are primarily the mechanisms that support the collection-and-delivery sites and thus implement recent market offers. Here, the authors correctly underline the need for other logistical services in addition to collection-and-delivery sites, which will increase the offer and improve its execution.

Logistics modernization is inextricably linked with the application of software, which can significantly facilitate the process. The study of Šourek (2021) focuses namely on these issues. The author employs modeling and computational software to address various planning issues and urban logistics optimization procedures. The suggested strategies work particularly well in simulating typical urban logistics processes, where outcomes are incredibly reliable. In his research, Gardrat (2021) strived to create the foundations for the conception that combines urban logistics growth with other localization dynamics as a primary determinant of the mobility of commodities. Ímre et al. (2021) dedicated their research to urban freight fleets regarded through the prism of electric freight vehicles and factors that prevent their introduction. The authors, in particular, found serious issues with the data accuracy on the suggested tools. The study made use of expert analysis techniques, probability theory, formalization and generalization techniques, statistical analysis, etc.

## RESULTS

Nations with rapidly expanding and emerging economies usually account for the largest share of land transportation. Urban transportation is on a similar upward trajectory. While industrialized countries – particularly the USA and the EU -make the most effort to lessen the effects of emissions, nations with rapidly expanding and emerging economies are far behind in solving this issue. The main reason is that technological advancement runs slowly in these countries; freight transport produces the largest share of emissions, and the use of outdated vehicles has a very detrimental impact (ITF, 2021). One example of a prosperous innovative approach is the active substitution of electric cars for motorcycles in mail delivery in several Korean cities. According to a cost-benefit analysis, the benefits of employing electric vehicles outweighed the expenditures by 243 percent, delivery time fell by 6 percent, and the mileage was 20 percent lower than that of a motorcycle. Delivery providers from particular cities in China, the United States, and the United Kingdom are also interested in testing similar projects. The results obtained are uncertain, even though the benefits of using electric vehicles for delivery are acknowledged in all research (ITF, 2019).

The COVID-19 pandemic has increased the role of the following processes for market participants: digitization, e-commerce, trade regionalization, use of more dependable and tested supply chains, and accelerated introduction of current technology and business models (ITF, 2021). Additionally, supply chains are becoming more regionalized, and the significance of local deliveries in cities, particularly the “last mile”, is growing. The “last mile” delivery will also influence international trade, which is to some extent localized. The ITF freight model analyzes global freight activity in its entirety. At the same time, its content is extensive and involves 27 types of freight for all transportation modes, including urban, domestic, suburban, and international transit (ITF, 2020). This model, suggested in 2015, is subject to regular update and expansion with new modules. The model

is a way to solve the existing problem in urban transport flows and ensure their logistic support.

Urban transport flow management is a challenging task with various particular issues that require addressing. First, it concerns the need to distinguish formative principles in urban transport flows. Below are listed the guidelines for managing transport flow. As was already said, the tourism industry directly affects urban logistics, and tourist flows are a crucial component of urban transport flows. Infrastructure for urban transportation and logistics is developing as a result of the growth of tourism. The assessment of the satisfaction level among urban residents with public transport requires taking the influence of tourist flows into account to be qualitative (Martyn et al., 2022). The tourism industry is a vast intersectional complex that has the potential to push forward both local and national economies (Sarana et al., 2019). Unregulated traffic on main streets and traffic lights usually complicate side street transport flows. Traffic lights with various operating principles are used, ranging from those with a fixed duration of red and green signals to more sophisticated devices that respond to the presence of moving vehicles.

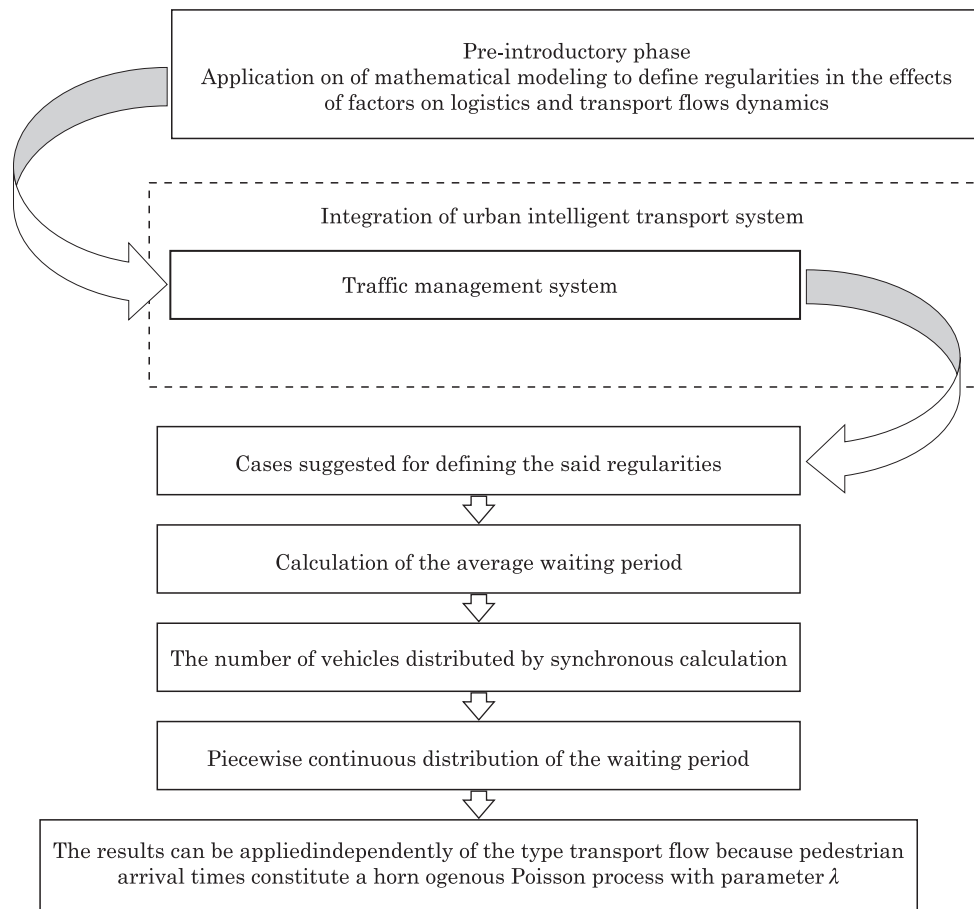
Vehicles must wait in line, whereas pedestrians can move together even if they gather in large numbers when the right circumstances allow it. The above also falls upon single cars because their delay is unrelated to that of other vehicles. Therefore, if side street transport flows are somewhat infrequent, it allows to avoid the probability of queuing, and the results applicable to pedestrians will also apply to any means of transport. The typical service device of a classical queuing system is responsive; it begins to operate when a new requirement enters the system, along with the accomplishment of the service for a previous one. If such a requirement existed, it would imply that the waiting time is equal to zero for the requirements entering the system at a time when it is free (Horobets et al., 2021). At the same time, this presumption is incorrect in the case of street intersections. Even if there isn't a line when a vehicle arrives, it will still have to wait. The service device is insensitive until vehicles arrive on the side street and occasionally

permits the passway if the passway permission process is perceived as a maintenance procedure.

In the case of a turnstile, it is possible to consider it an insensitive service device if only a single object is going through at a given instant. A traffic light can be such a device if there is no regulation of traffic flows on the main street, and several objects pass at once. It is also necessary to keep in mind that a traffic signal system is essential when planning urban logistics. As noted, this study aims to single out the regularities in the effects of various factors on urban transport flows. Thus, in addition to using modern technologies to solve this problem, this includes resolving several theoretical issues. The identification of the said regularities presupposed taking the following cases into account. According to the authors of this article, the queuing theory views blocking free movement as a service, while its duration means the service duration.

However, only a narrow range of problems connected to the traffic flow theory can directly benefit from this hypothesis. It is hardly possible to perceive transport delays at crossing roads as a service operation. According to probability theory, the service duration is not necessarily a random variable distributed under the same law, and they most certainly won't have known distribution densities. In the case of the exponential distribution, it is absolute nonsense for the service duration. The matter is that vehicles start moving at random and keep doing so only after meeting specific conditions. The arrival of delayed objects (on a side street) typically occurs according to Poisson distribution. Determination of either vehicles or pedestrians as objects to delay depends on the probability of a queue forming. Figure 1 represents a scheme for defining regularities in the effects of various factors on the dynamics of urban transport flows.

It is possible to describe the main street traffic flow by two criteria. They are the interval distribution between subsequent vehicles (including initial interval distribution) and the stop sign. The traffic flow on the main street should not affect the arrival of the delayed vehicle. A stop sign presupposes a vehicle avoids



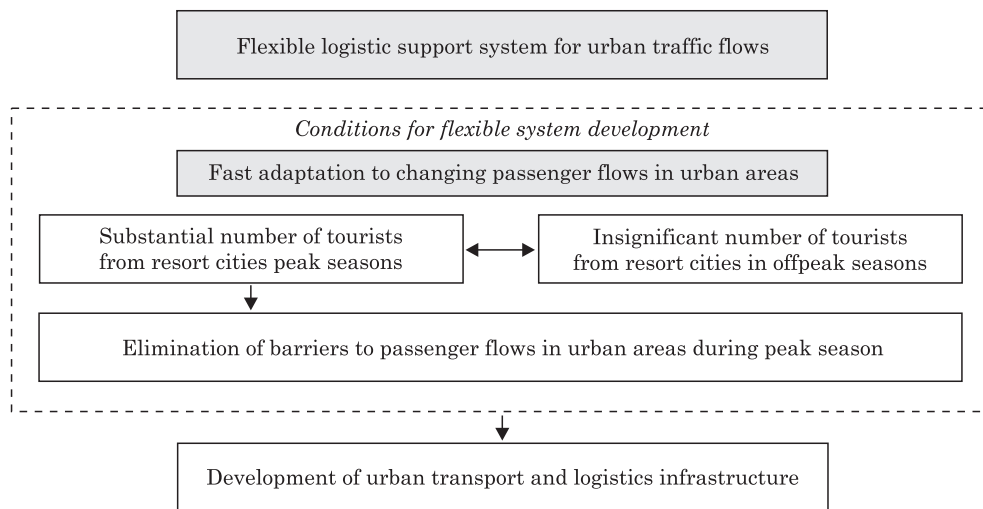
**Fig. 1.** Scheme for defining regularities in the effects of factors on the dynamics of urban transport flows

Source: Compiled by the authors according to Zhang et al. (2021).

the rapid intersection crossing, which prevents speed differences on a side street. In the case of delay of a vehicle, the difference concerns only their speed-up. It turned out that switching streets to one-way traffic had positive results in terms of less traffic congestion in cities. As a result, there was a decrease in traffic and an increase in average vehicle speed. It is highly encouraging to use this method along with traffic limitations for the central urban areas, particularly on side streets. The seasonal nature of tourist flows makes it hard to predict how they would affect urban transportation and logistics infrastructure. Tourists from resort cities typically arrive in substantial numbers during peak season, although the number is minimal during off-peak seasons. Addressing this

challenge demands the development of a flexible logistic support system for urban traffic flows. Figure 2 represents the conditions for its development as a guarantee for tourism growth.

It is not a good practice to ignore the mentioned features of management of urban traffic flows when designing intelligent urban transport systems, even though it is today's realia. Thus, there is a need for a qualitative theoretical justification, which involves a thorough examination of the characteristics of specific components of the urban traffic system. The urban areas closest to the best transport systems typically have light rail transport, which is convenient for passengers and freight transportation. It is a good practice to use this railway to service tourist flows



**Fig. 2.** The conditions for the development of a flexible logistic support system for urban traffic flows  
*Source:* Compiled by the authors according to Gardrat (2021).

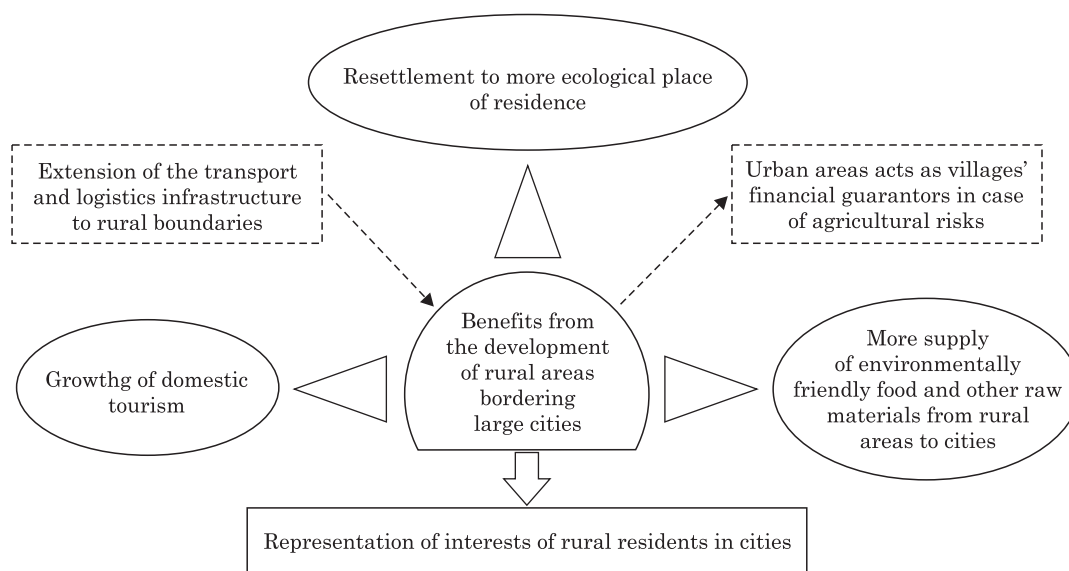
during peak seasons. Fast adaptation to changing passenger flows is a principal benefit of urban light rail, which is especially important for resorts where passenger flows change dynamically and enormously increase during peak seasons. Furthermore, a well-integrated city light rail can ensure the fewest obstructions to urban passenger flows during tourist peak season. The necessity to keep the mobility of urban residents at a high level during this season only contributes to the relevance of the above.

## DISCUSSION

The degree to which the priorities of those involved in the urban transportation and logistics industry should be taken into account is a contentious issue. In addition, given the growth of the urban transportation and logistics infrastructure, it is significant to assess the prospects for rural area development near such cities. The authors of this article believe the interests of a country and its rural and urban areas should come first, taking precedence over those involved in the transport and logistics industries, including the tourism sector. In order to increase their mobility, society strives to improve urban transportation and logistics infrastructure, which involves the increased technological support for

urban traffic, connectivity, and integration of urban and suburban modes of transport, including airports. Transfer of labor to cities requires suburban transport modes not to fall in development behind urban transport and be completely integrated with it.

However, tourist flows should complement sustainable urban traffic flows, and the ease of their mobility in cities should serve as the cornerstone for assuring it. When determining whether the tourism sector is beneficial for a city or a country, it is necessary to consider the satisfaction level among tourists with service, the transportation and logistical support provided, and the money spent. In other words, these factors are tourism success indicators (Al Ani, 2022). Therefore, urban areas make efforts to involve the most affluent tourists who desire a better and more complete product while having the slightest influence on the city infrastructure. The way to achieve this is to build more cutting-edge transportation and tourism facilities, such as hotels, amusement parks, shopping centers, and transportation hubs, including ports, airports, and train and bus terminals. Rural areas bordering large cities can benefit from extending transport and logistics facilities to their boundaries. It will contribute the development of rural areas, intensify domestic tourism, and relocate some urban residents to a “greener” environment (Fig. 3).



**Fig. 3.** Benefits from the development of rural areas bordering large cities in terms of extending transport and logistics infrastructure

Source: Compiled by the authors according to Lu et al. (2014).

Additionally, rural areas can step up their initiatives to supply cities with environmentally friendly food and other raw resources, speaking for territorially united rural communities. Urban areas can benefit from agricultural information and rural management principles. Moreover, cities can act as financial guarantors to reduce agricultural risks for villages involved in growing crops.

### Tourist and logistical problems of Ukraine in the conditions of war

With the military escalation by the Russian Federation, the temporary occupation of some of the most touristic regions in the summer and the constant civil population bombing, tourism in Ukraine has collapsed. In the first four months of 2022, representatives of the tourism industry of Ukraine paid 18% less taxes than in the same period of 2021 (Zhiriy, 2022). However, as noted by the State Tourism Development Agency, currently Ukraine is just beginning to enter the period of the greatest economic losses. After all, our season actually started in May-June, reached its peak in July-August, and the

business season usually started in September-October (State Agency for Tourism Development of Ukraine, 2022).

Along with tourism, the logistics system of Ukraine suffered serious losses. Now the situation is difficult – both in import and export operations. Despite the fact that they are vital for the global economy (Kostyuchenko et al., 2019). Ukraine is a part of the civilized world and is integrated into world trade. Especially since air and sea deliveries do not work, and rail deliveries are limited. However, urban and long-distance logistics, which served as the backbone of the tourism industry, will suffer the greatest losses, due to the fact that: many fleets have been destroyed, bridges have been blown up, logistics routes have become longer, using detours through safe roads, the fuel situation is currently critical, and most of the employees have been forced to leave their homes or are currently at the front.

In such large cities as Kyiv and Kharkiv, the key logistics route – the metro – serves as a shelter during bombings, which significantly complicates the logistics of large cities. During an air alert, the vast majority of transport stops or minimizes its movement, which



complicates and is also a negative consequence for the implementation and introduction of new socially oriented and innovative practices in the logistics of urban transport flow. A large number of logistics companies were retrained in humanitarian cargo, and air and sea transportation became impossible altogether.

Regarding the call of the President of Ukraine Volodymyr Zelenskyi to businesses to resume work, everything in the logistics industry directly depends on the situation in the country: both the number of drivers and road safety. In order to simplify logistics in our opinion, there are several ways. In particular, to cancel the limit on refueling for carriers – some gas stations have daily limits. If these restrictions are removed, the number of flights will increase. It is still being necessary to create safe routes for logistics companies in cooperation with the Ministry of Infrastructure, Armed Forces of Ukraine and TRD (Territorial defense), so that drivers can bypass dangerous areas. Currently, there is a lack of such information, and it is not easy to form routes.

Currently, initiatives that can be useful for transporters, volunteers and refugees have already begun to appear, for example, the Crisis Logistics Center (2022), *VzayemoDiyia* (2022). The Ministry of Digital Transformation and other relevant ministries should also join this process. In the current situation, it is not possible to limit oneself to the creation of logistics centers and electronic services that facilitate and optimize movement. It is necessary to create conditions where optimal solutions become part of the overall experience. It is necessary to remember not only the need to optimize logistics, but also corruption risks. Therefore, it is needed to combine the advantages of the centralized capabilities of the state, public initiative, feedback mechanisms and the selection of the best organization models should be taken into account.

## CONCLUSIONS

A thorough investigation is necessary to determine whether socially-oriented innovative techniques are applicable for the logistic support of tourist and urban traffic flows. The achievement of the defined aim predetermined the need for critical examination of the scientific output of the leading scholars. The authors of this article analyzed numerous theoretical and practical advancements that confirmed partial randomness in the development of urban traffic, contributed to the role of tourism in urban logistics, and highlighted the variable nature of urban traffic light systems for various cities and signal configurations. The authors of this article distinguished that a characteristic feature of city roads is a spatial correlation and substantiated the necessity for a traffic management system – a dominant innovative tool for logistic support of urban transport and tourist flows. It is also necessary to develop the most applied mathematical apparatus in order to assess how various solutions affect the transport flow in urban areas. The authors of this article recognized integrated logistics centers as essential constituents of innovative logistics management in urban areas. Furthermore, they hold that one of the elements that might affect both freight and passenger flows is the urban light rail.

In the course of the research, the authors determined the principles of the formation of urban transport flows, including tourist flows. According to the research conducted by the authors of this article, the queuing theory views free movement as a service, while delay time means the service duration. Furthermore, the service duration does not imply a random variable distributed under the same law, and they most certainly won't have known distribution densities. The authors of this article found opportunities for rural areas bordering cities to develop; these areas should supply urban areas with environmentally friendly food and other raw materials, receive financial guarantees from the cities to reduce agricultural risks, and spread agricultural knowledge and management principles throughout the cities. This study provides

for the analysis conducted on the state of tourism and logistics industries in Ukraine under the war and suggests ways to improve the current situation.

**Author contributions:** authors have given approval to the final version of the article. Authors contributed to this work as follows: Roman Sushchenko developed the concept and designed the study, Yaroslav Zapara collected the data, Volodymyr Saienko and Viktor Kostiushko analysed and interpreted the data, Larysa Lytvynenko prepared draft of article, Svitlana Pron revised the article critically for important intellectual content.

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