

<https://doi.org/10.19195/2658-1310.27.3.3>

Svitlana Rakytska

ORCID: 0000-0002-0874-6670

Odessa State Academy of Civil Engineering and Architecture, Odesa, Ukraine
rakisaska@ogasa.org.ua

Olga Kambur

ORCID: 0000-0003-2370-293X

Odessa State Academy of Civil Engineering and Architecture, Odesa, Ukraine
kmb@ogasa.org.ua

The influence of the COVID-19 pandemic on the contemporary and expanded situation of urban mobility

Date of submission: 30.06.2021; date of acceptance: 9.08.2021

JEL classification: R41

Keywords: urban mobility, traffic monitoring, transport approachability, COVID-19

Abstract

The influence of the COVID-19 pandemic on the contemporary and expanded situation of urban mobility

The COVID-19 pandemic has influenced all dimensions of human living, including, exponentially, the road transport situation in large cities. The factors of influence are subjective or objective, and have an multidirectional impact on the degree of traffic congestion, travel time to the destination and the situation of the environment. The characterization of the cumulative influence of these factors involves the use of statistical, analytical methods and models to parallel the situation “before” and “after,” as well as predict its development in the future.

Predicated on the information of traffic congestion, it was exposed how the quarantine severity influenced the traffic intensity, particularly the largest cities in Ukraine: Kyiv, Odesa, Kharkiv, Dni-pro. The influence of the time factor on the road situation is analyzed, and an assessment is made of how traffic flows are redistributed in accordance with the new conditions.

The directions for improving transport accessibility and urban mobility in the context of the epidemic are proven: digital transformation, spreading the network of bike paths, organization of convenient pedestrian paths, nano-districts and micro-districts where everything needed is nearby.

Introduction

It is substantially true that the influence of the COVID-19 pandemic on all dimensions of human life changed the road transport situation in large cities. It is essential for the urban mobility department to have a streamlined and uninterrupted functioning of the city's transport system. It has to be said that the effectiveness of the transport department organization allows them to solve such problems of the urban economy as:

- residents' transport services, transport accessibility to get to the destination (work, study, resting place, hospital, etc.), residents' access to social benefits and services;
- urban economy satisfaction in the area of transportation and exchanging of goods;
- creation of the organizations' functioning conditions for health care, education, and culture;
- assuring the possibility of protection and fire safety;
- and removal of domestic waste and refuse, assuring residents' sanitation health.

The United Nations Sustainable Development Goals (SDGs) include Sustainable Cities and Communities (Goal no. 11), and Target 11.2 is affordable and sustainable transport systems. UN definition: by 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons (SDG Tracker, 2021).

The best possible and reasonable territorial transport system has the following items:

- the structure of the transport system implements all these tasks;
- the scale of the transport network is sufficient to pass the existing flows; objects of transport infrastructure and vehicles provide safe and comfortable movement for passengers of individual motorized transport, passengers of public transport, cyclists, and pedestrians, regardless of their physical capacities;
- public passenger transport provides affordable (financially and physically) services for residents and is an acceptable alternative to private cars in cases where trips by private vehicles can overload the road network;
- traffic on streets and roads is operatively regulated by the traffic control department in order to reduce congestion, as well as to lessen the impact of vehicles on the environment.

Inefficiency of the transport system, especially the usual congestion on the street and road network, as well as the poor quality of pedestrian traffic and public

transport, lead to the deterioration of the population's quality of life and limited access to social and cultural benefits, and the level of safety and the city's comfort of living decrease.

It is imperative to find out the starting point of urban transport system, the main dynamics of the development of urban mobility, and advanced directions for its adaptation to new conditions.

Theoretical framework of the research

Amongst the factors in COVID-19's influence on urban mobility are: a decrease in the demand for mobility, an increase in the demand on "last mile logistics," an increase in private transport and a reduction in public transport, and an increase in shared mobility (EIT Urban Mobility, 2021).

At the same time, the risk of infection becomes a key factor in choosing a vehicle for both private and business trips (McKinsey, 2020). Another feature of the pandemic's impact on mobility is the reduction of median travel distance (Gao et al., 2020).

Research on the individual changes to daily travel during COVID-19 travel restrictions (Fatmi, 2020) found that while the overall number of trips was reduced, the share of trips by individual vehicles increased.

The rankings of several studies (Sharifi and Khavarian-Garmsir, 2020; Eeshan et al., 2020) show that the pandemic affected not only the socio-economic situation in the country and the quality of the environment, but also transport and urban design.

A study of the preference for certain modes of transport during the pandemic (Teixeira and Lopes, 2020) showed the negative consequences of the increased use of private road transport, namely, the increase in traffic congestion and pollutant emissions. As an alternative, it is proposed to expand bicycle rental use as the most sustainable mode of transport.

Research methodology

It is worth remarking that an indicator of the city's transport organization structure is the level of congestion of the transport network, which is assessed by the presence, level, extension and time of congestion. The data sources for this analysis are indicators in the TomTom Historical Traffic Stats (TomTom, 2020). Since 2008, TomTom has been collecting anonymized GPS location data from the global providers and community. Using this massive industry to analyze, predict, and improve traffic, TomTom Historical Traffic Stats is a self-service product that

analyzes historical location data and provides traffic insights on speed, travel time and sample size on the road network. This product is able to create customized reports to identify congestion bottlenecks, mobility pain points, and capacity on the road. These reports contain insightful data visualizations and can be supplemented with our own calculations.

A significant amount of data and access to historical information make it possible to compare the traffic situation before and after the introduction of quarantine restrictions and to assess the changes degree and principles that have occurred.

Analysis of research results or scientific problem

Predicated on the information of traffic congestion (by data company TomTom), it can be seen how the severity of quarantine influenced the traffic intensity. The congestion level shows the percentage of travel time in congestion condition that depends on an empty transport network. TomTom's weekly traffic pointers in 2019 and 2020 show that there was no significant lowering of traffic rates. We can see the lowering in March–April 2020, when strict quarantine restrictions were introduced, but already by the second half of 2020, the congestion level had increased again (Figure 1).

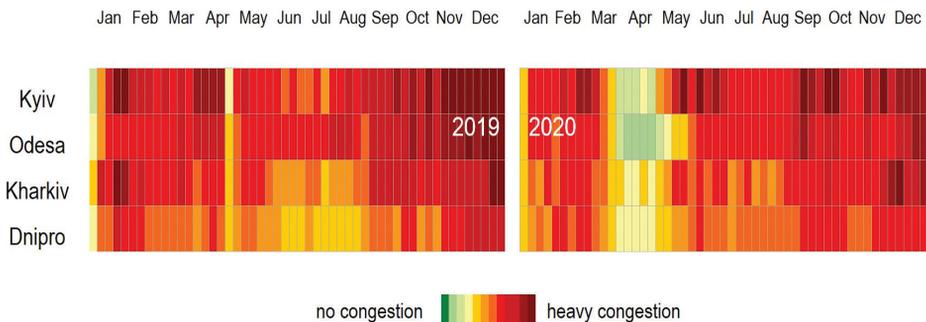


Figure 1. Weekly congestion, 2019–2020

For a detailed analysis of this situation, we have selected the cities of Ukraine that have major problems with traffic: Kyiv, Odesa, Kharkiv, and Dnipro. There is a more detailed analysis in Figure 2.

The sky-blue line shows the level of 2019, the dark blue line shows 2020. The graphs show that during the lockdown of 2020, which in Ukraine was from 12 March to 2 June 2020 year, firstly, the traffic intensity decreased briefly, then gradually ran at the same level as in 2019, and even exceeded it a bit.

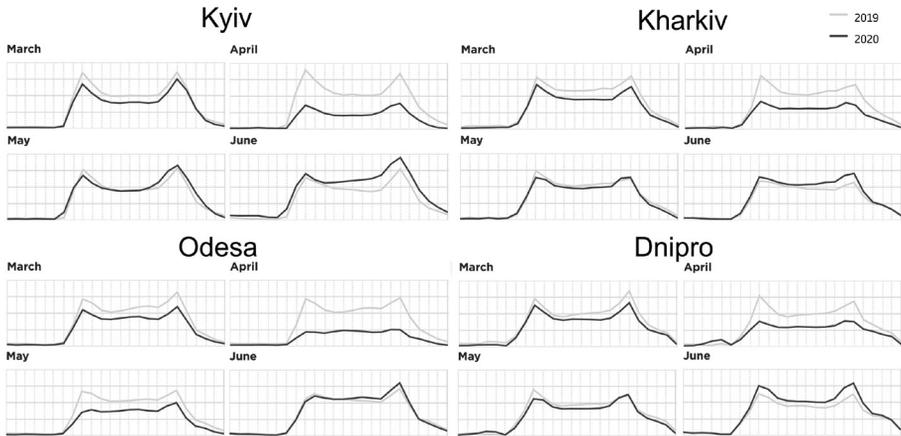


Figure 2. Working day travel patterns

Frankly speaking, the more traffic jams in the city (according to the TomTom rating), the more pronounced the lockdown effect in 2020 (Figure 3).

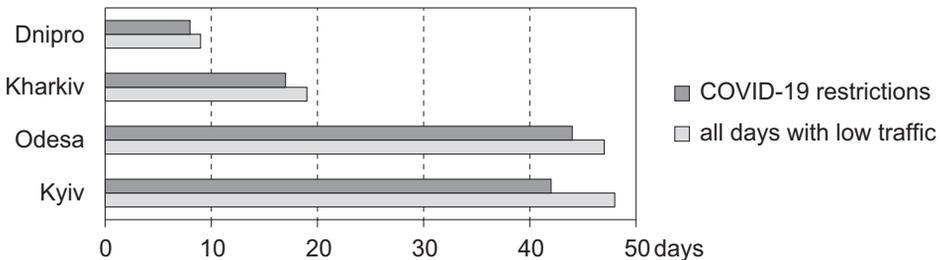


Figure 3. Days with low traffic in 2020 (days in 2020 were at least 50% less congested than their corresponding day in 2019)

We can see this in the figure. The biggest difference occurs between the congestion levels in 2019 (sky blue line) and the days of the quarantine restrictions (orange line).

As for traffic in 2021, despite the restrictions on entertainment events and the introduction of remote work in educational forums, we do not see a decrease in the traffic congestion level. On the contrary, we see its increase (Figure 4).

The factors of influence are subjective or objective, and have an impact multi-directional on the degree of traffic congestion, trip time to the destination and the situation of the environment.

The factors of this effect have influenced the degree of traffic congestion in the same manner. These factors had a positive influence on the traffic situation during the quarantine: a lot of workers and employees partook in remote work, a significant number of services, including government services, were online, and the amount of movement decreased because of the idea that travel is not essential, due to the quarantine and delivery.

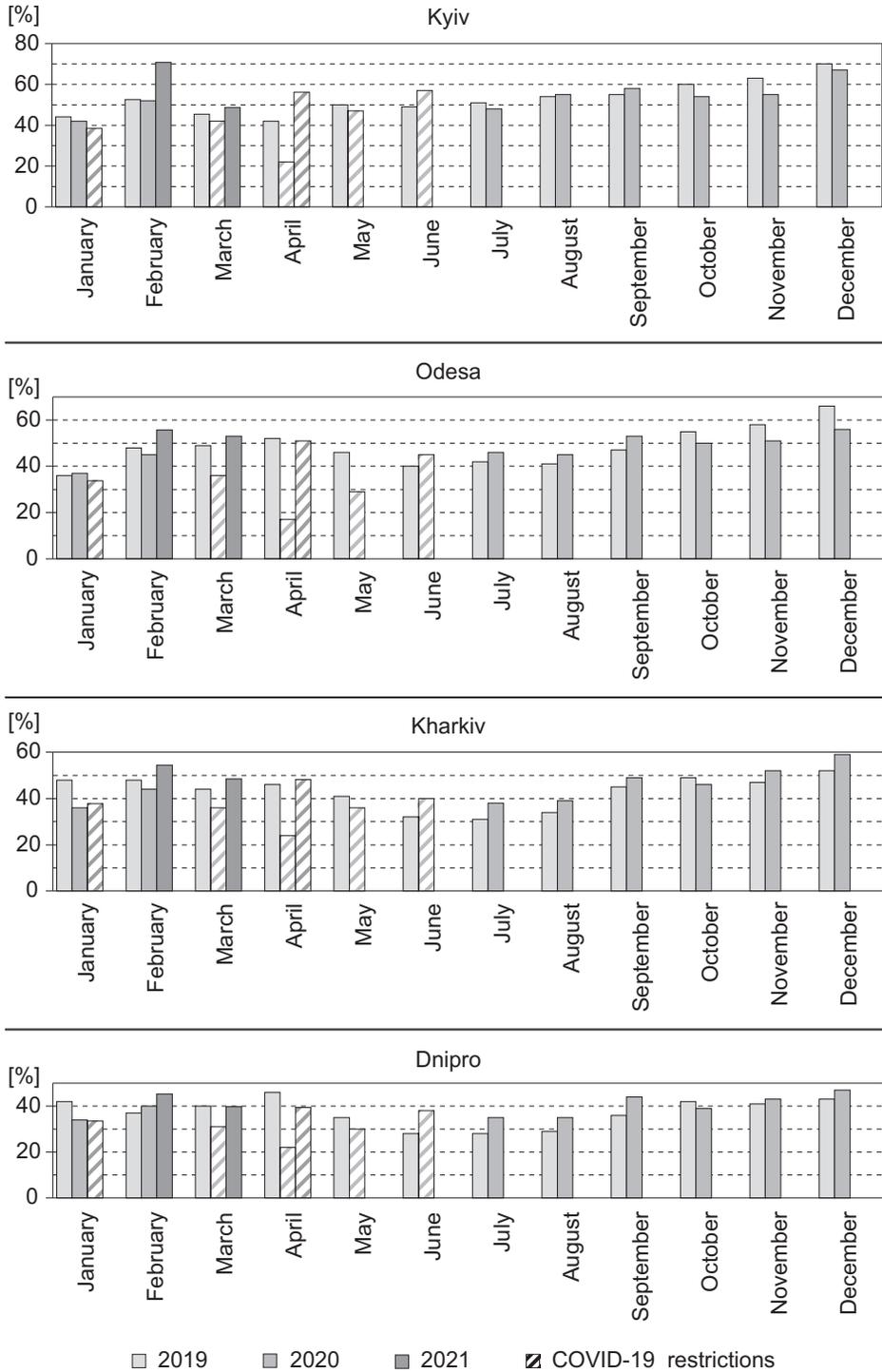


Figure 4. Congestion levels monthly

COVID-19 has created new business trends, straightforwardly associated with digital transformation:

— quarantine procedures stimulated the development of new digital solutions for company's remote management, the implementation of online teamwork and productive management risk, and using dashboards reflecting the current situation in real time;

— the online delivery service popularity of goods and medicines has increased, the number of websites and mobile applications has risen, E-commerce has developed, and Saas systems have been introduced;

— instead of closed educational, cultural, and sports institutions, online schools and online training applications have appeared.

These innovations are accompanied by legislative support. In the spring of 2020, the Cabinet of Ministers of Ukraine authorized online medicine trading for the quarantine period, and in September 2020, the Law of Electronic Retail Trade of Medicines (Verchovna Rada of Ukraine, 2020) entered into force. In February 2021, a law was adopted in Ukraine (Verchovna Rada of Ukraine, 2021) that established legal forms of remote working, which legalized the actual trends in the employment market and the digitalization of this area.

The new digital technologies' convenience and benefits lead to the fact that their use remains relevant even after the removal of quarantine restrictions, which helps to reduce the city's transportation system load.

But there were issues which negatively affected the transport situation: the attractiveness of trips by one's own transport has increased because people were afraid of being infected with COVID-19, even for those who had preferred public transport before. In lockdown, the traffic load increased, for cases where one family member in a private vehicle takes or picks up someone close, and then returns back to work. This also affects road traffic.

Nevertheless, all the work transport system intensification possibilities have not yet been settled in Ukraine. Public transport development using the modernization of rolling stock, the introduction of high-speed transport, and the organization of separate traffic lanes will compete with private transport in speed and comfort, and increase the attractiveness of public transport.

To improve traffic conditions, the car park system should be expanded, a convenient cross-walk has to be formed, and the length of bike paths should be increased as well as a digital transport system transformation which provides information support for transport processes, and the installation of smart traffic lights which take into account the traffic intensity of cars and pedestrians.

In many countries, to ensure social distancing, municipalities are offering their citizens new ways of getting around to avoid crowds in the public transport and overusing private cars.

As a result, many cities implemented new bike infrastructure: 27 kilometers of pop-up lanes during COVID-19 in Berlin, 30 kilometers of permanent lanes

in London, 40 kilometers of provisional lanes in Brussels, and 12 kilometers of provisional lanes in Madrid (EIT Urban Mobility, 2021).

It is noteworthy that these directions for improving transport usability and urban mobility in the context of the pandemic are spreading the network of bike paths and the organization of convenient sideways. E-scooter use is thriving in cities across Europe. The two-wheel ride is transforming urban environments by reducing CO₂ emissions, congestion, and pollution (Ajao, 2019). Actually, the absence of legal regulation is a factor holding back the development of micromobility. In particular, Bill 3023 was registered in February 2020, which was supposed to regulate the use of personal light electric vehicles in Ukraine. It passed the committees and the first reading, but it was never adopted (Verchovna Rada of Ukraine, 2020).

In order to have a positive impact on the environment and public health, micromobility policies should promote, as far as possible, the replacement of public transport and passenger cars by micromobility, as a replacement with pedestrian and bicycle trips has the opposite effect.

According to a Ukrainian survey conducted from 15 to 21 March 2021, more than half of respondents have their own means of micromobility: 23% used rolled electric scooters, 8.8% plan to buy them in 2021, and 17.7% used rolled scooters in 2021 (you could choose a few answers). Only 9.7% of respondents did not use and do not plan to start using this kind of transport. There was a question about preference in the way of kind of micro-mobility transport replacement for respondents: 32.7% chose public transport, 31% — bicycle, 10.6% — own car, 8.8% — walking, and 5.3% — taxi/car-sharing (United Nations Development Programme, 2021).

Accordingly, the positive replacement of travel by car and public transport with means of micromobility is observed in 48.6% of responses, and the negative nature of the replacement of walking and cycling in 36.3%.

In this way, the development of micromobility is really important for cities such as Odesa. There is no subway here, so the charge of transporting the population is imposed on surface public transport. The use of e-scooters allows for unloading the historical part of the city, reducing transport congestion and improving the traffic infrastructure. There are several companies providing electric scooter rental services in Odesa.

In 2020, an automated rental of electric scooters, Kiwi, was opened in Odesa; in 2021, the operator Bolt appeared in the city, which actively promotes electric transport in the Baltic States, Germany, Poland, Portugal, and the Czech Republic, and has offices from Iraq to Uganda and Mexico to Sri Lanka. Conspicuously, the rental Jet company and the local company Citrus have been providing the service of renting individual electric vehicles for several years.

The crisis situation has become a reason for developing a different eco-friendly transport, which will be important for the improvement of the city after the pandemic ends.

The limiting factor is the underdeveloped network of bicycle paths in the city. In Table 1, one can see the comparative indicators for cities in the length of the bicycle paths, including per 100 thousand residents (“Monitor,” 2021).

Odesa is in last place among the major cities of Ukraine for both the total length of bicycle paths and the length per 100 thousand residents. Actually, there is only one path for hiking, jogging and cycling, known as the HealthPath. Likewise, the factor that contains the development of micromobility is the absence of regulatory provisions that determine the status of the transport and the deliberate speed. Now the city administration of Odesa is considering the issue of e-scooters restriction and the use of scooters on the HealthPath, because of their instability. However, there is not any alternative path for microelectric transport in Odesa. Therefore, it is necessary to limit the speed of scooters to 20 km per hour but not interdict, because we can use the distance programming. Therefore, we think that it is the most advanced idea for the development of transport network and the unloading of road traffic.

Table 1. Length of the bicycle paths in major cities of Ukraine

	All distance, km	1 km per 100 000 residents
Lviv	108.20	14.94
Vinnitsia	67.00	18.07
Chernihiv	38.80	13.52
Kyiv	38.24	1.29
Kharkiv	23.00	1.59
Ivano-Frankivsk	17.65	7.42
Dnipro	7.90	0.79
Zaporizhzhia	5.50	0.75
Odesa	4.30	0.42

Conclusions

The comparative analysis of traffic intensity levels in large Ukrainian cities (Kyiv, Odesa, Kharkov, and Dnipro) showed some decrease in traffic levels during quarantine as compared to 2019. This effect is most pronounced in cities with the highest traffic congestion, and has a temporary nature: the traffic increased in 2021, despite the persistence of many restrictions. This is due to the fact that the factors influencing the level of road congestion are multidirectional. During a pandemic, the companies and services transition to online reduced traffic, and the preference for personal transport to public ones due to fear of infection, on the contrary, increased.

The directions for improving transport accessibility and urban mobility in the context of an epidemic are: digital transformation, spreading the network of bike

paths, organization of convenient pedestrian paths, nano-districts, and micro-districts where everything needed is nearby.

The transport system optimization is especially important for Odesa, where there is no metro, and the development of micromobility will solve many problems associated with the congested road traffic.

The implementation of these solutions will allow the government to not only reduce the incidence rate, but also in the future, when the pandemic ends, help to optimize the road traffic situation, reduce the level of environmental pollution, and save on travel time and waiting time for receiving any service. In general, it will lead to an improvement in the quality of life and a relative release of human resources for increasing the efficiency of activities, obtaining additional time for good rest, physical activity, creativity, and personal self-development.

The quarantine, like any emergency or unexpected situation, in the process of resolving incipient problems necessitates the development and implementation of distinct economical, technical, social, and innovative solutions that can significantly change the usual approaches to organizing the living of citizens and will be important after the end of the pandemic.

References

- Ajao, A. (2019). Electric Scooters And Micro-Mobility: Here's Everything You Need To Know. *Forbes*. Retrieved from <https://www.forbes.com/sites/adeyemijao/2019/02/01/everything-you-want-to-know-about-scooters-and-micro-mobility/?sh=4a8e6fa65de6>.
- Eeshan, B., Manoj, B.S., Wadud, Z., Goswami, A.K., Choudhury, C.F. (2020). Modelling the effects of COVID-19 on travel mode choice behaviour in India. *Transportation Research Interdisciplinary Perspectives*, 8, 2020. DOI: 10.1016/j.trip.2020.100273.
- EIT Urban Mobility. (2021). EIT KIC Urban Mobility S.L.Torre Glories, Diagonal 21108018 Barcelona, Spain. Date of access: 25.05.2021, https://www.eiturbanmobility.eu/wp-content/uploads/2021/03/Urban-mobility-strategies-during-COVID-19_long-2.pdf.
- Fatmi, M.R. (2020). COVID-19 impact on urban mobility. *Journal of Urban Management*, 9 (3), 270–275. DOI: 10.1016/j.jum.2020.08.002.
- Gao, S., Rao, J., Kang, Y., Liang, Y., Kruse, J., Dopfer, D., Patz, J.A. (2020). Association of mobile phone location data indications of travel and stay-at-home mandates with COVID-19 infection rates in the US. *JAMA Network Open*, 3 (9). Retrieved from <https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2770249>.
- Information website “Monitor”. (2021) https://monitor-odessa.com/odesskiy_gorsovvet/samyj-velosipednyj-gorod-ukrainy-jeto-lvov-a-odessa-autsajder-po-protjazhennosti-velodorozhek/.
- McKinsey. (2020). McKinsey Center for Future Mobility.
- SDG Tracker. (2021). Measuring Progress towards the Sustainable Development Goals. Date of access: 25.05.2021, <https://sdg-tracker.org>.
- Sharifi, A., Khavarian-Garmsir A.R. (2020). The COVID-19 pandemic: Impacts on cities and major lessons for urban planning, design, and management. *Science of The Total Environment*, 749. DOI: 10.1016/j.scitotenv.2020.142391.
- Teixeira, J.F., Lopes, M. (2020). The link between bike sharing and subway use during the COVID-19 pandemic: The case-study of New York's Citi Bike. *Transportation Research Interdisciplinary Perspectives*, 6, 2020. DOI: 10.1016/j.trip.2020.100166.

- TomTom. (2020). Historical Traffic Stats. <https://www.tomtom.com/products/historical-traffic-stats>.
- United Nations Development Programme. (2021). Біла книга мікромобільності [White Book of Micromobility]. Retrieved from https://www.ua.undp.org/content/dam/ukraine/docs/EE/EU-4Climate/WhiteBook_fin.pdf.
- Verchovna Rada of Ukraine (2020). Про внесення змін до деяких законодавчих актів України щодо удосконалення правового регулювання дистанційної, надомної роботи та роботи із застосуванням гнучкого режиму робочого часу [About the modification of some legislative Ukrainian acts concerning improvement of legal regulation of remote, remote working and work with application of a flexible mode of working hours]. Retrieved from <https://zakon.rada.gov.ua/laws/show/1213-20?lang=en#Text>.
- Verchovna Rada of Ukraine. (2020). Проект Закону про внесення змін до деяких законодавчих актів щодо вдосконалення регулювання відносин у сфері забезпечення безпеки окремих категорій учасників дорожнього руху (користувачів персонального легкого електротранспорту, велосипедистів та пішоходів) [Draft law to introduce amendments to certain legislative acts to improve the regulation of relations in the sphere of ensuring the safety of certain road participant categories (users of personal light electric vehicles, cyclists, and pedestrians)]. Retrieved from https://w1.c1.rada.gov.ua/pls/zweb2/webproc4_1?pf3511=68074.
- Verchovna Rada of Ukraine. (2021). Про внесення змін до статті 19 Закону України “Про лікарські засоби” щодо здійснення електронної роздрібної торгівлі лікарськими засобами [About the Law 19 modification of Ukrainian article “About medicines” concerning implementation of electronic retail trade in medicines]. Retrieved from <https://zakon.rada.gov.ua/laws/show/904-IX#Text>.