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Editorial

Transportation Planning, Mobility Habits and Sustainable Development in the Era of COVID-19 Pandemic

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1. Introduction

Starting from December 2019, the world has faced an unprecedented health crisis caused by the new coronavirus (COVID-19) due to SARS-CoV-2. The global spread was so rapid that the World Health Organization, on 12 March 2020, officially declared a global pandemic, which today, two years later, still remains the cause of numerous deaths every day. Concerning this issue, it is important to understand how to design the most appropriate short-, medium- and long-term strategies/policies to minimize the huge economic and social impact of this crisis. The lockdown of cities and regions and specific mobility restrictions have been common practices implemented worldwide to contain and delay the spread of the COVID-19 epidemic. Furthermore, mobility habits and some environmental factors have played a central role in the spread of the virus.

The coronavirus has deeply affected the population globally, as people have become more reluctant to perform "unnecessary" activities (trips) and have become wary (fearful) of social interactions. Social distancing became mandatory at first and then desirable, with significant consequences for the quality of life and for the global economy. In this context, the transportation system (both passenger and freight) was also impacted (e.g., limitation in passenger capacity for public services; reluctance towards crowded transport services), with still has unknown consequences in the medium and long term. However, this crisis could also be considered as an opportunity for relaunching social and welfare policies in addition to sustainable development. In this context, the development of new technologies (e.g., autonomous vehicles and smart roads) could be a driver for relaunching cities from a sustainable perspective while also addressing both the ethical and the acceptability problems concerned with them (e.g., [1]).

For these reasons, advancement in related scientific knowledge is crucial to support all public and private actors across the globe that are facing this crisis. In these two years, studies worldwide have mainly focused on both the main causes of spreading the virus and the possible impacts produced by the coronavirus. While the scientific community has focused mainly on health issues to defeat this virus, other key topics addressed in the literature seek to correlate the cases (deaths) of COVID-19 to meteorological (e.g., temperature and relative humidity, [2–5]), air quality (e.g., PM pollution, [6,7]), and transportation (e.g., transport accessibility and mobility habits, [8,9]) variables. By contrast, other research has focused on the impacts produced by COVID-19 on, for example, the transport sector (e.g., travel behavior and transport mode perception, [10–13]) and the possible trend scenarios, which could characterize the "new normal" in the post-coronavirus era (e.g., development of sustainable mobility and improvement in urban quality of life, [14–17]).

Despite these efforts, significant work is still needed to advance knowledge in this area, and this Special Issue aims to contribute to bridging this gap.

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2. Synopsis of the Contributions

This Special Issue of Sustainability provides an opportunity to investigate transportation planning, mobility habits, and sustainable development in the era of the COVID-19 pandemic. The papers published constitute an original discussion including, but not limited to, the following topics from a sustainable perspective:

- Influences of air quality and mobility habits on the spread of the virus;
- Changes in mobility and activity habits (e.g., behavioral variation, modal share modification) and impacts on transport sector (e.g., transport modes usage);
- Urban and street regeneration from a sustainable perspective.

With respect to the influences of air quality and mobility habits on the spread of the coronavirus, Cartenì et al. (A) investigated the conjecture, according to which the daily number of certified cases of COVID-19 is directly correlated to the average particular matter (PM) concentrations observed several days before the contagions occurred (short-term effect), and this correlation is higher for areas with a higher average seasonal PM concentration, as a measure of prolonged exposure to a polluted environment (long-term effect). Furthermore, the correlations between the daily COVID-19 new cases and mobility trips and those between the daily PM concentrations and mobility trips were also investigated. Correlation analyses were performed for the application case study, consisting of 13 of the main Italian cities, through the national air quality and mobility monitoring systems. Data analyses showed that the mobility restrictions performed during the lockdown produced a significant improvement in air quality with an average PM concentrations reduction of about 15%, with maximum variations ranging between 25% and 42%. Estimation results show a positive correlation (stronger for the more highly polluted cities) between the daily COVID-19 cases and both the daily PM concentrations and mobility trips as measured about three weeks before, when the contagion most likely occurred. The findings highlighted in this research, which are also supported by the evidence in the literature [2,6,9], allow us to reach the conclusion that PM concentrations and mobility habits could be considered as potential early indicators of COVID-19 circulation in outdoor environments. However, the obtained results pose significant ethical questions about proper urban and transportation planning; the most-polluted cities do not only have the worst welfare for their citizens but, as highlighted in this research, are at a greater risk of spreading current and future respiratory and/or pulmonary health emergencies.

Within this issue, Cartenì et al. (H) underlined that lockdown policies applied worldwide to limit the spread of COVID-19, which are mainly based on health considerations, have negatively impacted public transport (PT) usage, which is suspected as a means for the virus to spread due to difficulties ensuring social distancing. This resulted in a setback to sustainable mobility and impacted equity and social exclusion issues (e.g., [18–22]. The research performed by these authors investigated the conjecture that the spread of the coronavirus is directly correlated to PT usage. A correlation analysis among the daily number of certified coronavirus cases and the PT trips measured for the day on which the contagions occurred was performed during the second wave in Italy. The estimation results show a high correlation (up to 0.87) between the COVID-19 contagion and PT trips performed 22 days before. This threshold indicates that quarantine measures, which are commonly set for two weeks and based only on incubation considerations, were inadequate as a containment strategy and may have produced a possible slowdown in identifying new cases and hence in adopting mitigation policies. A cause–effect test was also implemented, concluding that there is a strong causal link between COVID-19 and PT trips. The obtained results could yield significant insights into the context variables that influence the spread of the virus, also helping policymakers to enact appropriate policies (e.g., [23]) and assessment analyses (e.g., [24–27]), thereby ensuring the sustainable recovery and development of urban areas in the postpandemic era. With this aim, Keyong et al. (M) conducted a comprehensive evaluation of the vehicle routing problem (VRP) from a sustainable viewpoint during the pandemic and explored viable delivery solutions that may aid in the containment of the COVID-19 pandemic. Through a systematic review of the selected

articles, the authors identified four broad themes of pandemic containment measures from the delivery aspect: contactless distribution, efficient pharmaceutical delivery strategy, sustainable waste transportation strategy, and isolated and quarantine vehicle scheduling.

With respect to the changes in mobility and activity habits, Ceccato et al. (B) underlined how the diffusion of the COVID-19 pandemic has induced fundamental changes in travel habits. The SARS-CoV-2 coronavirus pandemic has significantly affected the way passenger transport services are provided, mainly due to sanitary restrictions imposed by epidemiological services. At the same time, the communication behavior of travelers has also changed, which in turn has influenced the demand for these services. Although many previous authors have analyzed factors affecting observed variations in travel demand [28–31], only a few works have focused on predictions of future new normal conditions, in which people will be allowed to decide whether to travel or not, although risk mitigation measures will still be enforced on vehicles, and innovative mobility services will be implemented. In addition, few authors have considered future mandatory trips of students that constitute a great part of everyday travel and are fundamental to the development of society. In this paper, logistic regression models were calibrated by using data from a revealed and stated-preference mobility survey distributed to students and employees at the University of Padova (Italy) to predict variables impacting their decisions to perform educational and working trips in the new normal phase. The results highlight that these factors are different between students and employees; furthermore, available travel alternatives and specific risk mitigation measures on vehicles were found to be significant. Moreover, the promotion of the use of bikes, as well as bike sharing, carpooling, and micromobility among students can effectively foster sustainable mobility habits. On the other hand, countermeasures in studying/working places resulted in a slight effect on travel decisions.

Within this topic, Cieśla et al. (G) presented a prediction regarding the development of passenger transport services, considering random factors related to the COVID-19 pandemic situation based on scenario methods. The authors investigated transport service future development issues from multiple perspectives, including demand analysis, the selection of major factors influencing the development of passenger transport for individual Polish passengers using an online questionnaire, and scenario designs. The main purpose of this article was to propose various scenarios for the development of passenger transport, considering changes in the demand for these services and factors related to their perception by the users of the different transport modes. The results obtained are useful, for example, in supporting the planning process [32–34] in decision making [35–38] based on future behavioral trends.

Furthermore, Dias et al. (K) highlighted how the COVID-19 pandemic has resulted in new postpandemic travel patterns as a result of the stay-at-home policies and restricted movement orders imposed by the governments. In particular, the authors investigated the changes in individual travel behavior after the Malaysian government imposed a series of lockdowns, also known as movement control orders (MCO). From March to April 2021, a questionnaire survey was distributed throughout Malaysia, and 435 complete responses were collected. The results indicate that during the pandemic, the respondents predominantly chose private cars for various purposes, such as, for example, cleanliness, infection concern, social distance, and wearing face masks. Binary logistic regression models were developed to estimate individuals' propensity to make trips for different purposes, i.e., work/study, social activities, recreational activities, and religious activities. The results indicate that essential workers were nearly three times more likely than the general population to make a work trip during the pandemic. Regarding social and recreational trips, males were more likely to make such types of trips as compared to females. Furthermore, those who perceived a higher risk of infection were less likely to make social and recreational trips. Regarding religious trips, males were significantly more likely to make such trips during the pandemic as compared to females.

With respect to the impacts induced by the coronavirus on user activities, Ghodsi et al. (I) observed changes in people's shopping behavior from face-to-face experiences to online shopping during the COVID-19 pandemic, leading to reduced shopping trips, and this decrease has directly affected traffic congestion and air pollution. Identifying the factors influencing the increase in online shopping behavior during the pandemic can be helpful for policymakers in the post-COVID-19 era. The study proposed by these authors aimed to discover the effect of factors related to the COVID-19 pandemic and demographic characteristics on shopping attitudes and, consequently, on shopping trips. Based on the interviews of ten experts, factors associated with COVID-19 and demographic characteristics were selected as influential factors for shopping attitude and shopping trips. The relationship between all factors was examined using interpretive structural modeling (ISM) and microscopic–macroscopic (MICMAC) analysis. The results obtained underline five levels of influential factors affecting shopping attitude and shopping trips: age and gender; income and education; the household size and COVID-19 awareness; attitude towards COVID-19 and infection-avoidance practices; and the norm subject and shopping personal control.

With respect to the impacts induced by the coronavirus on transport users, Politis et al. (J) aimed to examine the effect of the pandemic on the users of the public transport system of London through analyzing tweets before (2019) and during (2020) the outbreak. Overall, almost 250,000 tweets were collected and used to examine the word clouds of the tweets expressing negative sentiment and, by applying the latent Dirichlet allocation method, the most prevalent topics in both analysis periods were investigated. The results obtained by the authors indicate an increase in negative sentiment on dates when stricter restrictions against the pandemic were imposed. Furthermore, topic analysis results highlight that although users focused on the operational conditions of the public transport network during the prepandemic period, they tended to refer more to the effect of the pandemic on public transport during the outbreak. Additionally, according to correlations between ridership data and the frequency of pandemic-related terms, the authors also found that during 2020, the public transport demand decreased, while tweets with negative sentiment were increasing at the same time.

Furthermore, Lucchesi et al. (L) assessed the impact of COVID-19 pandemic on urban public transport. The authors used a hybrid choice model to identify the new barriers and potential solutions to increasing users' perception of safety, considering pre-existent perceptions of public transportation quality [39–42]. Data from an online survey at an urban scale in southern Brazil were used. The results underline that the main barriers to using public transport during the virus transmissions are related to the system characteristics that force constant interaction with other passengers. Countermeasures that limit the number of passengers and increase offers are possible solutions to make users feel safe while riding and may reduce evasion and migration to more unsustainable transport mode.

Focusing on the impacts induced on transport modes, Bliš'anová et al. (D) investigated air transport. In particular, during the pandemic, airlines mainly stopped flying altogether and were forced to ground hundreds of planes worldwide involuntarily. Airports had to close their terminals for a long time and wholly suspend operations, and its resumption required significant organizational changes. This article summarizes the measures related to the COVID-19 pandemic adopted by airports to minimize the risk of spreading the disease. The study developed by these authors focuses on countermeasures and their implementation at selected airports in a specific time frame and airports' behavior during a pandemic, which varies depending on the country and time of the year. The results demonstrate that steps being taken at airports include the use of face coverings or masks, social distancing, enhanced cleaning and disinfection activities, temperature and/or symptoms checks (fever, loss of smell, chills, cough, shortness of breath), and RT-PCR (reverse transcription–polymerase chain reaction) screening and data collection with health declarations. These measures have now become an essential standard for the operation of airports and can, therefore, be used to assess the level of airport safety

achieved. Furthermore, the authors also investigated the level of achieved airport safety based on the proposed scoring method.

With respect to the air mobility impact, Sun et al. (F) performed a cross-comparison through time series analysis of the impact COVID-19 has had on three aviation centers of the world—the United States, Europe, and China. The authors found that the peak of the COVID-19 impact was around April/May 2020, followed by a strong recovery mostly in domestic subsystems. A homogeneous impact on the United States was observed, while a strong heterogeneous impact was underlined in Europe, followed by a rather short-term impact in China. Domestic flight connectivity recovered much faster than international flight connectivity, particularly for the Chinese air transportation system.

With respect to the impacts on rail transport, Vichiensan et al. (E) investigated the rail sector, underlining how this transport mode around the world has been suffering from heavily reduced ridership due to a reduced capacity for social distancing and passengers' concern over the risk of COVID-19 infection. Various countermeasures were implemented to reduce the COVID-19 risk so that passengers felt safe to travel by rail. The study performed aimed to evaluate COVID-19 countermeasures on Bangkok's urban rail transport from passengers' viewpoints and examine its influence on passenger's confidence. The data were obtained from an interview survey of 1105 railway passengers conducted at the stations during the second wave of the pandemic. Factor analyses and structural equation modeling were conducted. The results reveal that social distancing was not satisfied by the passengers but adversely caused inconvenience and increased infection risk when the station or rail were congested. On the other hand, the passenger temperature check, face mask enforcement, and hand sanitization countermeasures were found to highly and positively contribute to passengers' confidence. Contact tracing applications were also found to raise awareness and confidence. The findings provide insights for rail authorities and related agencies to effectively implement the countermeasures that would be practically and financially sustainable.

Finally, with respect to the impact on urban and street regeneration from a sustainable perspective (e.g., [43–45]), Valente et al. (C) discussed the role of public spaces and street networks within the urban quality of life framework [39]. The advent of the COVID-19 pandemic has focused their crucial importance in the reorganization of places that are "safe" because they allow movement through cities with minimal risk of contagion. While addressing the need for social distancing, open-air exercise, and mobility without the use of public transport, these measures resulted in other environmental and social benefits. Living with the coronavirus pandemic has produced a series of adaptative actions, such as barring or limiting automobile traffic, thereby expanding street space for pedestrians and bicyclists, whose impact is, as yet, difficult to fathom because of their contingent, temporary nature. In this context, the authors proposed a case study in Italy based on a street redesign from a sustainable perspective. Based on topographic, morphologic, and climatic data, it evaluated a series of contiguous road sections, defining redesign capacities and critical conditions to implement sustainable interventions to manage urban runoff, mitigate extreme heat events, expand pedestrian paths, and provide a bicycle network. This holistic approach to sustainable urban design evaluation, supported by reproducible data and parameters, serves as a replicable model for the sustainable redesign of roads in other urban settings.

3. List of Contributions in this Special Issue

A. Cartenì, A.; Cascetta, F.; Di Francesco, L.; Palermo, F. Particulate Matter Short-Term Exposition, Mobility Trips and COVID-19 Diffusion: A Correlation Analyses for the Italian Case Study at Urban Scale. *Sustainability* **2021**, *13*, 4553. https://doi.org/10.3390/su13084553.

B. Ceccato, R.; Rossi, R.; Gastaldi, M. Travel Demand Prediction during COVID-19 Pandemic: Educational and Working Trips at the University of Padova. *Sustainability* **2021**, *13*, 6596. https://doi.org/10.3390/su13126596.

C. Valente, R.; Mozingo, L.; Bosco, R.; Cappelli, E.; Donadio, C. Environmental Regeneration Integrating Soft Mobility and Green Street Networks: A Case Study in the Metropolitan Periphery of Naples. *Sustainability* **2021**, *13*, 8195. https://doi.org/10.3390/su13158195.
D. Blišťanová, M.; Tirpáková, M.; Brůnová, L. Overview of Safety Measures at Selected Airports during the COVID-19 Pandemic. *Sustainability* **2021**, *13*, 8499. https://doi.org/10.3390/su13158499.
E. Vichiensan, V.; Hayashi, Y.; Kamnerdsap, S. COVID-19 Countermeasures and Passengers' Confidence of Urban Rail Travel in Bangkok. *Sustainability* **2021**, *13*, 9377. https://doi.org/10.3390/su13169377.
F. Sun, X.; Wandelt, S.; Fricke, H.; Rosenow, J. The Impact of COVID-19 on Air Transportation Network in the United States, Europe, and China. *Sustainability* **2021**, *13*, 9656. https://doi.org/10.3390/su13179656.
G. Cieśla, M.; Kuśnierz, S.; Modrzik, O.; Niedośpiał, S.; Sosna, P. Scenarios for the Development of Polish Passenger Transport Services in Pandemic Conditions. *Sustainability* **2021**, *13*, 10278. https://doi.org/10.3390/su131810278.
H. Cartenì, A.; Di Francesco, L.; Henke, I.; Marino, T.; Falanga, A. The Role of Public Transport during the Second COVID-19 Wave in Italy. *Sustainability* **2021**, *13*, 11905. https://doi.org/10.3390/su132111905.
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K. Dias, C.; Abd Rahman, N.; Abdullah, M.; Sukor, N. Influence of COVID-19 Mobility-Restricting Policies on Individual Travel Behavior in Malaysia. *Sustainability* **2021**, *13*, 13960. https://doi.org/10.3390/su132413960.
L. Lucchesi, S.T.; Tavares, V.B.; Rocha, M.K.; Larranaga, A.M. Public Transport COVID-19-Safe: New Barriers and Policies to Implement Effective Countermeasures under User's Safety Perspective. *Sustainability* **2022**, *14*. 2945. https://doi.org/10.3390/su14052945.
M. Lin Keyong, S.; Musa, N.; Yap, H. Pandemic Containment and Vehicle Routing Problems: A Systematic Review. *Sustainability* **2022**, *14*, 2053. https://doi.org/10.3390/su14042053.

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