The COVID-19 pandemic: the challenge of managing it as a crisis and harnessing it as a chance for sustainable mobility and transport

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Abstract. The COVID-19 pandemic comprises a “milestone” for multiple aspects of social, economic, and technological life. Trips and movements were placed at the center of attention to control the virus’ transmission since the diffusion may occur both during the trip, while people are on-board, and after they arrive at the final destination, in the context of their activities. Public Transport Authorities (PTA), providers of mobility services, and commuters have faced various challenges that require from them a change or adaptation of their practices and behavior. In the framework of the European project “PE4Trans”, which concerns citizens’ engagement in the planning of sustainable mobility policies, a multidisciplinary three-session virtual event took place. Its aim was to address all challenges posed by the pandemic related to mobility and transport by involving researchers, executive officers, decision-makers, and policymakers in an organized dialogue. This paper systematizes and synthesizes the findings of this discussion, covering aspects related to the nature of the pandemic, the measures of personal protection along the whole mobility chain, the structural business changes for the case of mobility providers, the exploitation of technology, the people with disability, and the role of the local authorities. The pandemic reveals itself as a two-sided coin: its first side is related to the public health crisis that needs proper handling within the transport system, while its second side is related to the chance of accelerating the transition towards sustainable mobility and the opportunity of promoting reforms within the transport business sector.

1. Introduction

By the emergence of the COVID-19 pandemic, especially during its first wave, movements and trips of citizens in Greece (and other areas of the world) were drastically influenced. A huge reduction of traffic and trips was observed, reaching almost zero passengers in various urban or interurban (long-distance) modes of “collective transport” (e.g., on the inter-urban coach/bus lines). The attitude of people towards the use of public transport became negative since they considered it a risky mobility behavior. As a consequence of passengers’ concerns, mobility restrictions, encouragement of teleworking, and shift to private vehicles and individual modes of transport, mobility decreased, and revenues of transport operators declined dramatically.
As noted in the letter of the International Association for Public Transport (L'Union Internationale des Transports Publics [UITP]), “the entire ecosystem of the sector will have to fight to survive this crisis; to rebuild trust in public transport in the post-COVID-19 period and, ultimately, to come out the other side stronger.” [1]. The continuation of normality in the economic and social life of people, even partially, with the selective, e.g., temporal, spatial, population-based, or sectorial, implementation of measures of social distancing, led to the need for both the use of public transport during the pandemic and the proper management of mobility and travel demand. With the emergence of the pandemic, a number of crucial needs arose, particularly for public transport. First, there was a need to ensure the provision of the services by all means of transportation, minimizing the health risks for all involved parties throughout the mobility chain, especially for users and employees. Second, the need to regain the general public’s trust in the use of public transport arose. Third, there was a need to ensure the financial viability of transport providers, both public and private ones, and to reduce -as much as possible- deficits, while maintaining an adequate level of service. Fourth, the need to facilitate individual urban mobility by means other than cars, such as walking, cycling, and micro-mobility, had emerged. Dealing with the problems related to the issue of “COVID-19 and transport systems” has to be based on an interdisciplinary approach, involving many specializations and backgrounds, such as transport planners, infectious disease specialists, public health experts, nano-material engineers, etc. Of course, the incomplete existing knowledge and the absence of valid answers to several queries regarding the nature of the new coronavirus and the pandemic remains a challenge, which was particularly intense when the new coronavirus appeared.

2. The paper’s approach
This paper is based primarily on the findings and outcomes derived or emerged through the online interdisciplinary conference entitled “Mobility and coronavirus: a crisis or an opportunity?”. The conference took place on June 18, 2020. It was organized in the frame of the “Public Engagement for Sustainable Public Transport” (PE4Trans) Interreg Europe project, co-funded by the European Regional Development Fund.

Table 1. Breakdown of the objectives and participants’ background for all conference sessions.

| Sessions | Session’s goals and objectives | Field of work or expertise |
|----------|--------------------------------|-----------------------------|
| Providing advice and recommendations to the public to travel in a health-safe way by collective transport modes | • Identify risks and opportunities derived from behavior change  
• Indicate personal protection practices to be applied along the mobility chain  
• Understand transport policy suggestions  
• Understand structural changes and challenges for transport operators  
• Recognize the role of intelligent transport and the value of big data in managing trips during the pandemic  
• Recognize the potential contribution of local governance in changing travel behavior | • Medical support and biosafety  
• Transport sector executives  
• Economics, transportation, information technologies  
• Transport management |
| The impact of the pandemic, ways to respond and seize opportunities by exploiting science and technology | | |
| Encouraging sustainable mobility, the role of local governance and civil society in the era of coronavirus | • Identify challenges for pedestrians, cyclists, and people with disability  
• Understand the critical aspects of the mobility infrastructure in the broader area of Thessaloniki | • Local governance and decision takers  
• Representatives of civil society and users’ clubs |
As the pandemic posed various challenges related to the project, facilitating a discussion with scientists, policymakers, and transport professionals was considered as necessary to address issues such as i) mobility changes, ii) passengers’ trust in health safety in public transport, iii) transport operators’ sustainability, iv) crisis management in transport systems, v) promotion of active and individual sustainable mobility, etc.

The discussion was structured in three distinct sessions: i) the first session was about how citizens should behave in a health-safe way when traveling on public transport, ii) the second session dealt with the impact of the pandemic on operators, and how should respond and seize opportunities with the support of technology and scientific knowledge, and at last iii) the third session addressed the issue of encouraging sustainable mobility by the local governments and the civil society in the “era of coronavirus.” For each session, its goals and objectives were defined at the very beginning, enabling us to determine the required key interventions, the selection of panelists to be invited, the desired scientific and professional background of the speakers, and the process of moderating the discussion in real-time. The following table summarizes the titles of the sessions, their goals and objectives, and the participants’ field of work or expertise.

In the next section, we try to present a comprehensive presentation and analysis of the findings and outcomes derived through the conference (June 2020) by composing creatively and coherently information and opinions provided by the invited speakers and participants and filtering them through our point of view.

3. Conference’s conclusions: key findings and outcomes
The management of the pandemic in the transport sector has a multidimensional character. Mobility and transport influence the pandemic and vice versa. The interactive relationship between the pandemic and transport is determined by the trip attributes.

![Figure 1: The pandemic management on transport.](image)

Regarding the key stakeholders involved in the process of managing this relationship, there are three categories: i) the population groups, ii) the providers of transport services, and iii) the public authorities. The main “tools” used to manage the pandemic’s impact on transport are the following: i) technology and intelligent transport; ii) user mobility behavior and personal hygiene measures; iii) organizational interventions, reengineering, and operations management; iv) creation of sustainable mobility infrastructure; v) the regulatory framework.
The conference’s conclusions are analyzed below, while key findings and outcomes are discussed, reflecting various aspects of the multidimensional nature of the pandemic management on transport, as shown in Figure 1.

3.1. The nature of the pandemic and mobility

The prevention of any contagious disease is mainly associated with the avoidance of transmission, as the new coronavirus is transmitted through inhalation and contact with infected droplets. The main ways to avoid transmission are i) avoidance of crowded places, ii) personal protective equipment, and iii) proper and frequent hand washing (hygiene). These measures require a radical change in behavior. The distance of not less than 1.5 to 2 meters, the use of protective equipment and especially a mask, the avoidance of close physical socializing, and the proper hand hygiene comprise the main measures to interrupt the spread of the coronavirus.

The coronavirus pandemic comprises an opportunity to shape attitudes in people that will remain after the end, making the transmission of infectious diseases in the future more difficult. Besides, changing behavior regarding the daily use of clean water in the past helped to reduce certain infections drastically. Constant social distancing and the use of a mask are difficult to be maintained forever. However, proper hand hygiene, simple habits of covering the mouth during coughing and sneezing, as well as good ventilation of the premises are very important measures that can become citizens’ routine. Oblivion and the success of dealing with the pandemic itself are the great dangers that can lead to complacency or lack of awareness of the role of protective measures to reduce the spreading of the pandemic. Since the pandemic still exists, people and travelers should be careful, not ignoring its existence.

Mobility is not just a transition from point A to point B, but a complex process that can be realized by different means (walking, wheelchair, walking stick, bicycle, public transport, etc.) and has multiple aspects (environmental, aesthetic, cultural, and social). In the era of the coronavirus, new challenges and requirements have been added, which differ depending on the group of users and the transport mode to which they are addressed. The behavioral aspects of transport and mobility are changing, and it seems that there is a shift towards more personalized means of transportation. Since there is continuous and dynamic development in our knowledge of the nature of the coronavirus and the evolution of the pandemic, preventive measures throughout the mobility chain should be constantly monitored and, if necessary, adjusted. Similarly, appropriate adjustments to the aspects of the travel behavior may be needed, as shown through the shift of people to more individual modes of transport, at least for those who have such an option.

3.2. Main measures recommended by competent bodies and additional protection measures

The pandemic was an unprecedented condition for public transport operators, which had to be managed appropriately. The aim was to create an environment not favoring the spread of the coronavirus and to secure the provision of transport services. It was also a kind of real experiment testing both the readiness of transport operators to respond to the new circumstances and the resilience of transport systems.

In the case of public transport (in June 2020), various rules and measures came into force, which were imposed mainly by ministerial decisions, such as i) a maximum number of passengers per vehicle based on its maximum capacity to ensure social distancing, ii) prohibition of getting on the vehicle through the front door (next to the driver), iii) non-operation of air-conditions, iv) personal hygiene, such as the mandatory use of a mask for employees and passengers, imposing fines for non-use, etc.

Apart from encouraging the application of personal hygiene measures, recommendations from the competent bodies were communicated related to the reasonable use of public transport, such as avoiding its use when there are suspicious symptoms similar to those of the disease and avoiding its use during peak hours when the purpose of traveling is not important enough, e.g., except for going to work.
In addition to the measures recommended by the competent bodies that must be obeyed, there are other measures that anyone should take for their protection throughout the entire transport chain, given the high number of surfaces that the passenger may touch. These measures can be grouped into two categories:

1. Main general measures of personal protection: i) avoidance of congested and crowded spaces, ii) frequent and meticulous hand washing, and iii) use of personal protective equipment, such as masks and gloves, especially indoors.
2. Additional measures of personal protection: i) avoidance of placing shoes and clothes in the house after their usage outdoors (they can be placed, e.g., on the balcony, in the hallway, etc.); ii) daily clothes to be stored in a special closet; iii) frequent disinfection of the mobile phone and bags; and iv) in case of any trip outside the house everyone can choose a hand to touch surfaces and the other one for not touching them, following, thus, a “code” to control their exposure to infectious surfaces.

3.3. Structural changes in the market and transport operators
The effects on the economy are very damaging, covering many business activities, and they are expected to be significant, as the changes seem to have a permanent effect. Individuals and businesses have passed through the five “stages of denial”: initial denial, anger, negotiation, depression, and acceptance. Currently, they are in the phase of “accepting” the crisis after the initial “denial.” Of course, there was, and there is still huge uncertainty about the future and an inability to do predictions and forecasts. The system is by definition multi-factorial, and the crisis affects both supply and demand for transport services.

In the general context of the economy, business models face many changes in terms of corporate governance and corporate structure. Corporate values are degraded. Problems regarding bank loans provision and financial liquidity arise. In addition, the operation of the market itself is affected. The market and the competition cannot operate freely since the rules and restrictions are set by third parties, such as the governments. The nature of the services itself is being questioned, and the restructuring of the whole market’s organization takes place. Thus, negative processes are in progress for the major parts of entrepreneurship, such as the need to reduce costs, financial liquidity problems for businesses, etc. The way services are organized is being completely restructured, and the importance of stocks is being revised. As business models change, companies are interested in setting up and securing financial capital, drastically reducing operating costs. As the sectors of the economy are intertwined with one another, several problems arise through this interaction. For example, service problems and requirements in tourist accommodation limit their available capacity affecting the demand and pricing of transport services.

Transport agencies face unique situations to which they must respond immediately, and these influence all levels: management, personnel, and passengers. The agencies have been called upon to adapt themselves and modify their operations to the extent that they have not done any time before. The pandemic enhanced the individual transportation means compared to those of public transportation. Especially with regard to the “sharing economy,” actors in the field of mobility (e.g., electric scooters) were significantly affected during the first phase of the pandemic in terms of services’ demand. Reviews and updates of regulatory frameworks are required to cover the aspects such as hygiene and safety in addition to mobility and transportation. Transport operators and distribution companies will need to change their operating models. In addition, the required optimal new policy of organizing the supply chain while reducing the time and cost of providing transport services comprises a great challenge for the scientific community and every stakeholder involved.

New challenges emerge in the field of research on new technologies and new ways of organizing transportation and logistics in order to reduce costs, time, and overcrowding. Great challenges and opportunities are created in the field of research, innovation, and the utilization of new possibilities that offer technological developments, such as the Internet of Things (IoT), cloud computing, blockchain, big data, artificial intelligence, etc.
3.4. **Technological applications and safe transport**

The technology has already offered valuable solutions for the treatment and management of the pandemic, while there are great possibilities for the development or adoption of new applications. Pandemic is an opportunity for further promotion of Intelligent Transport Systems (ITS) as well as for the utilization of big data and artificial intelligence in the fields of health and the reduction of the spread of the coronavirus, e.g., in the cases of China and Taiwan.

E-ticketing systems, the automatic recording of the passengers getting on board (e.g., sensors at doors), and the provision of information via ITS systems are important technologies useful for the transport operators during the management of the pandemic. E-ticketing systems allow, among others, the intact transaction (no need to touch and get into contact with potentially contaminated surfaces), as well as for the recording and management of the passengers and the travel demand (e.g., identification of passengers’/customers’ groups, such as students, people with disability, users of cards of multiple trips, etc.). Automatic passenger recording systems may enable the notification of a bus driver about reaching the defined allowed maximum occupancy so that other passengers do not board. In addition, this information can be forwarded to users, e.g., through a mobile phone application, so that they can plan their trip by seeking alternative travel options (transport mean, time of the trip, etc.).

Big and qualitative data already exist and are still being collected. Their use can contribute substantially to the better management of the impacts of the pandemic. Indeed, the size of data is increasing daily and rapidly; indicatively, approximately 90% of the data worldwide has been generated during the period 2018-2020. Actually, in the case of the pandemic, Google provided data on mobility during the pandemic. These are aggregated, anonymous user data (per day, country, and region) during the period of the pandemic, based on the location history of any user of mobile phone that has activated it. Data could help countries to evaluate public health policies that have been implemented, drawing conclusions about the planning of the response actions and the necessary plan for a future outbreak of a pandemic. Data can help in the evaluation of implemented public health policies in order to draw conclusions for the planning and response to a future pandemic outbreak. Also, data allow monitoring of the changes in travel behavior. Although the use of data has helped societies to manage the pandemic, it is noted that there is always the risk of privacy violations and their misuse.

3.5. **People with disability in the era of coronavirus**

People with disability should be considered at the top of the priority setting concerning mobility planning and road safety measures. Whatever facilitates and makes easier the mobility of the people with disability facilitates and enables all citizens.

Any measure designed by public authorities or transport operators in order to serve the mobility (e.g., municipality buses, transport services providers, taxis, etc.) should first take into account the needs of people with disability, not adding more problems in their mobility. For example, the placement of tables and seats by the restaurants and cafes in public, open-air spaces of a city center in order to enable them to maintain bigger physical distances among their customers should not be against the safe and smooth mobility of wheelchair users, people with other kinds of disability, and the rest of the population.

Nevertheless, pedestrian routes and ramps’ design have many problems in the area of Thessaloniki. It is estimated that only 1% of the ramps are perfectly accessible, adhering to the specifications, ensuring comfortable, smooth, and safe movements. In addition, visually impaired people face many difficulties accessing vehicles, mainly due to overcrowding and their inability to communicate with the bus driver through the front door (since boarding from the front door is prohibited during the pandemic). With regard to public transport vehicles, appropriate protocols should be established and implemented by all actors who are running vehicles of public use.
3.6. Mobility, pandemic, and local authorities

The role of local authorities in promoting the necessary adjustments is crucial in various aspects, such as i) the provision of the appropriate required infrastructure to people with disability, pedestrians, public transport users, and cyclists; ii) the provision of adequate public space of high quality, properly redistributed among the various users; iii) the provision of transport services to groups of citizens, such as people with disability, the elderly, students, etc.; iv) the promotion of sustainable mobility and the health and safety of citizens; v) the promotion of travel behavior change and the adoption of practices to stay safe and remain healthy.

Local governments should take the opportunity now offered by the new legislation and proceed with pilot applications of infrastructure projects or management measures that enhance sustainable mobility. After all, even before the pandemic in many European cities, the target set is instead of simply achieving sustainable mobility by promoting soft and active mobility, the fully “car-free cities,” especially regarding their historic urban centers. In order for any proposed planning measure to be successful, a consultation process should take place by engaging all the stakeholders and interested parties, regardless of the final political decision on the matter under discussion. Interventions, to be effective and last for long, must be part of a comprehensive, holistic plan and not be fragmented. In addition, by ensuring their public acceptance, a long-term operation of the pilot applications due to coronavirus will be secured, avoiding potential setbacks.

In terms of urban planning, it should be highlighted that Greek cities are extremely compact, densely built, and with mixed land use. Although the concept of “compact cities” was promoted as a model for urban planning, the pandemic, at least for the time being, calls it into question. Regarding urban governance and traffic management at the city level, it is pointed out the bad past practice of conducting traffic studies for the municipalities of the wider urban area of Thessaloniki, in isolation to each other, without any comprehensive, integrated, and holistic consideration of the entire metropolitan complex. The concept of metropolitan planning is crucial for any project or initiative related to urban mobility. Today, this should be ensured in the way in which the (municipal) Sustainable Urban Mobility Plans (SUMPs) are prepared and implemented. The danger of repeating the former errors today in the case of SUMPs should be avoided.

Given that Greek municipalities cooperate with various citizens’ networks (organizations of civil society) and have direct contact with services and structures/agencies, and face to face communication with citizens coming from local associations and specific population groups (e.g., municipal kindergartens, special facilities for the elderly in Greece, service for the support of independent living called “Help at Home,” schools, etc.). These groups include vulnerable individuals whose travel behavior can be influenced with the aim of adopting “safer” mobility practices. Through these networks, structures, and contacts, municipalities could form a crucial factor in influencing behaviors and reach almost the entire population, with the aim of educating people to adopt health-safe mobility practices.

3.7. Managing trips during the pandemic: the example of the metropolitan area of Thessaloniki

The initial goal set for public transport in Thessaloniki was to ensure the ability to continue the services’ provision. The initial plan concerning the management of the new situation included actions, such as i) protecting staff and planning certain operations, taking into account some limitations; ii) informing providers, identifying critical operations, determining available back-ups or replacements, recording, and controlling sources in stock, etc.; and iii) protecting the users of public transport. It is worth noting that a crucial challenge that was (and is) related to the above refers to the inability of operators to control the boarding of passengers infected by SARS-CoV-2 effectively.

With regard to the pandemic management by the public transport operators, they followed the instructions and recommendations given by the Greek Government, the National Agency for Public Health (in Greece), the European Union, and the UITP to create a comprehensive and effective policy to be implemented in the public transport system of Thessaloniki.
4. Conclusions
The health crisis of the COVID-19 pandemic had multiple impacts on all aspects of individuals’ social and economic life, affecting mobility and movements. In a relatively fast way, after the emergence of the outbreak, it was realized that the pandemic could be seen as a “catalyst” towards a faster transition to a sustainable urban mobility paradigm, as an accelerator of the already existing trends or as a factor of triggering public transport innovation [2][3].

The decline in passengers’ traffic volumes and the collapse of providers’ revenues throughout Europe have challenged their financial viability and ability to continue the uninterrupted provision of transport services to all. Through the pandemic, it was made clear that effective public health management should not be considered as a standalone strategy for the protection against a virus spread; instead, it should be seen in a wider context in combination with policies on smart pricing and marketing. Given that transport operators’ responsibilities on financial issues, revenues’ control, recovery of passenger demand, etc., are crucial for their viability, a comprehensive public health strategy emerges as an integral part of their integrated financial management during the outbreak of the pandemic and even after its end.

The successful management of the pandemic during its first wave in Greece (in the spring of 2020) and the poorer management during its second wave (in the autumn of 2020) by both citizens and public officials underlined the risk of the reduced concern, which was highlighted during the conference. Individuals should be constantly aware of the important role of the protection measures, being dedicated to apply them or comply with them in a meticulous way until the end of the pandemic.

Even after one year since the COVID-19 outbreak, there is still some uncertainty on how social and economic life in cities will be normalized, in parallel with the gradual vaccination of the population. During the upcoming period, the various vaccines will be tested in real conditions, cures for the disease will be applied, and market actors will try to regain the confidence of people, alleviating their worries and hesitations. Measuring the impact on public transport usage and estimations on its possible long-term duration will be possible after some months, as also seen in other research [4].

The pandemic reminded people of the various dangers and risks that exist, urging the importance of designing emergency response strategies to ensure the “resilience” of urban life and urban systems.

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