Impacts of COVID-19 on the transport sector and measures as well as recommendations of policies and future research: Analyses based on a world-wide expert survey

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Abstract†

Impacts of coronavirus disease 2019 (COVID-19) on the transport sector and the corresponding policy measures have been investigated by more and more researchers and organizations. Considering the various uncertainties and unknowns about this virus and its impacts (especially long-term impacts), it is necessary and important to hear the opinions and suggestions from experts in the transport and related sectors. However, to date, there is no study from the perspective of experts in the field of transport and related disciplines. This study attempts to address this gap through a questionnaire survey of experts in the field of transportation and other relevant fields. The survey was conducted worldwide between the end of April and late May 2020, taking into account the need for balance between geographic regions, type of workplace and working duration, and so on. In particular, experts were requested to provide their opinions and suggestions as well as concerns via free answers. Based on extensive analyses of the survey results, this study first reveals the realities of lockdowns, restrictions of out-of-home activities and other physical distancing requirements, as well as modal shifts. Experts’ agreements and disagreements to the structural questions about changes in lifestyles and society are then discussed. Furthermore, a qualitative analysis of the free answers from experts was conducted. Finally, findings are summarized and important research issues are extensively discussed.

Keywords: COVID-19, Public health, Pandemics, Expert survey, Transport Sector, Impacts, Measures, Lifestyles, Society

1. Introduction

Both the number of confirmed infection cases and deaths caused by coronavirus disease 2019 (COVID-19) are still growing rapidly across the whole world. This trend has continued since the end of March 2020. As of May 24, 20202 (https://coronavirus.jhu.edu/map.html), the total infection cases stood at 5,335,868 and total deaths at 341,549. Only within 10 days, more than 1.0 million infection cases were newly confirmed and deaths increased by about 50,000 persons. The USA is still suffering most, but the recent increase in Brazil is also remarkable. While some countries have shown a declining trend of both new cases and deaths, a second wave is expected.3 A third wave may also come because the virus will remain in the

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1 This research is a part of the activities initiated by the WCTRS COVID-19 Task Force. Hereafter, comments from experts who participated in the survey are directly cited in italic type.
2 This date was the end of this expert survey.
population and may resurge, if given the opportunity.\textsuperscript{4} Thus, both short-term measures and long-term strategies are required for all countries in the world.

Similar public health crises have repeatedly occurred in recent human history, including pandemics such as the 1918 Spanish Flu. Recent examples include the Ebola outbreak in 2019, the Ebola haemorrhagic fever in 2014, the H1N1 influenza virus in 2009, the 2005-2016 Zika fever, and SARS in 2003. Unfortunately, it seems that we have not learnt lessons from the past, as evidenced by the above facts about COVID-19.

COVID-19 is expected to significantly affect the global society in various ways, from both short-term and long-term perspectives.

For example, the impact of the current pandemic is most pronounced in megacities. If more people are properly concerned about the high risks of infection in megacities, the current growing trend of megacities over the whole world may slow down, and within a particular country, the regional distribution of the population may become more balanced. For example, in Japan, young people’s migration is the main driver for the over-concentration of the population in the three megacity regions (Tokyo, Nagoya and Osaka). The pandemic may encourage more young people to move back to local cities. Transport policy making should pay more attention to local cities within a well-coordinated regional planning framework with industrial policymaking and other public policies, which can, for example, attract new leading industries to local cities.

The current pandemic has also resulted in the rapid diffusion of various online businesses. This trend is likely to continue and consequently more delivery-based services will replace people’s shopping at stores and online working styles will become more popular. Once the economy is re-opened, a rapid growth of automation may also be expected. Such trends mean that not only transportation systems, but also our life-styles as well as our economies will become much “smarter”. It is worth exploring whether the development of a “smart” society will help transport systems and services to work in a more sustainable way.

At the same time, physical distancing practices may encourage more people to rely on cars in their daily lives. It would then be natural to expect an increase in traffic accidents, especially for young people, assuming that no policy interventions are made. Just-in-time requirements for deliveries coming from growing online businesses may induce traffic accidents, too. More research efforts are required to clarify these potential effects.

According to IEA, the drop in energy demand (including transport energy demand) during the COVID-19 pandemic may result in a record annual decline in carbon emissions of almost 8%.\textsuperscript{5} On the other hand, a third of the global population has to stay at home because of the lockdown.\textsuperscript{6} A continuous observation by the Renewable Energy World with respect to 113 homes in Austin, Texas (79 with solar and 34 without solar; 50 having Level 2 Electric Vehicle, or EV, chargers) found a maximum 20% increase in residential energy consumption in March 2020, in comparison with previous months of March (since 2017). In contrast, EV charging dropped dramatically. After the pandemic, a ‘new normal’ is anticipated, which is expected to be accompanied by dramatic changes in people’s lifestyles. The current experience with more blue skies may trigger people’s pro-environmental attitudes. If this is the case, energy consumption from both in-home and out-of-home activities will decrease. It is still to be seen, however, whether such dramatically changed lifestyles will result in more or less energy consumption, either in-home or out-of-home.

Because of long stays at home, people have been advised via various channels about

\textsuperscript{4} https://www.nationalgeographic.com/science/2020/05/anthony-fauci-no-scientific-evidence-the-coronavirus-was-made-in-a-chinese-lab-cvd/ [Assessed on May 12, 2020] Here, Dr. Anthony Fauci, the White House coronavirus response coordinator, was interviewed.


\textsuperscript{6} https://www.businessinsider.com/countries-on-lockdown-coronavirus-italy-2020-3 [Assessed on May 2, 2020]
how to keep healthy, especially how to do physical exercise at home and eat in a healthy way. And there seem to be more and more people following instructions about healthy lifestyles. Related to travel behavior, active travel has been attracting more and more attention, while an increase in car dependency is expected to occur at the same time. Thus, it is unclear whether people’s health conditions can be improved via active travel or not. This needs more research.

For some people, long periods at home during the COVID-19 pandemic has brought about a lot of stress. Such stress may be released suddenly after the pandemic is over, in the form of travel and tourism for relaxation. On the other hand, physical distancing practices may continue for a while, even after the pandemic is announced to be over. Such long-lasting practices may change people’s social networking styles remarkably: face-to-face communications have been dramatically reduced. Related to travel behavior, the expected increase of online social networking will be beneficial in terms of a reduction of transport demand. Thus, there is a trade-off relationship between time use and social networking.

More online working and flexible working arrangements are expected. This will allow people to work at home and at the same time to take care of children, without seriously affecting their work and fears of virus infection during travel and at workplaces. This also helps to substantially reduce the crowdedness inside public transport vehicles.

Transportation plays extremely important roles in sustainable development. The current COVID-19 pandemic has highlighted the various roles of transport, again. Because of lockdowns, restrictions on out-of-home activities, and other physical distancing requirements, many cities in the world have seen air pollution drop, bringing back blue skies and cleaner air. Even though this may be “unfortunately (only) short-term good news”\(^7\), it is accompanied by significant economic damage, particularly for socially-vulnerable population groups. The Economist Intelligence Unit predicts that the global economy will contract by 2.5%\(^8\). The United Nations states that the COVID-19 pandemic affects low-income people, older persons, persons with disabilities, youth, and indigenous peoples.\(^9\) Putting these negative impacts aside, this is the first time in human history that we can empirically prove at the global level that behavioral changes in different life domains can contribute to improvements in environmental sustainability, even though many changes are not voluntary.

Impacts of COVID-19 on the transport sector and corresponding measures have been widely investigated by more and more researchers and organizations (e.g., aviation\(^10,11\), maritime\(^12,13\), railway\(^14,15\), urban transport\(^16,17\)).

All of the above concerns need to be better addressed in a scientific way. Considering the existence of various uncertainties and unknowns about this virus, particularly those about its impacts, it is necessary and important to hear the opinions and suggestions of experts in the

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transport and related sectors. However, there is no study to date from the perspective of experts in the field of transportation. Therefore, this study makes an initial attempt through the implementation of a world-wide questionnaire survey of experts in the field of transportation and other relevant research fields. The survey was implemented between the end of April and late May, 2020. More specifically, the survey aims to investigate the following contents related to the transport sector:

1. Impacts: to investigate the impacts of COVID-19
2. Preparedness: how our society had prepared for such a pandemic
3. During-pandemic measures: what measures are being taken by our society to fight against this pandemic
4. After-pandemic recovery measures: to suggest what our society should do after this pandemic
5. Long-term strategies: to explore how to generalize findings from the above actions to tackle other public health threats.

In the remaining part of this article, the survey design and contents are first described and then data collection and then profiles of experts participating in the survey are explained. After these two sections, countries’ preparedness before the COVID-19 pandemic, as reported by experts, is revealed, and measures during the pandemic, together with modal shift observed by experts, are analyzed. Furthermore, experts’ opinions from the structured questionnaire about long-term changes in people’s lifestyles and society are given, followed by a qualitative analysis based on experts’ free answers. Finally, this study summarizes the findings and discusses future research issues.

2. SURVEY CONTENTS

The expert survey was designed to solicit views about impacts of COVID-19 on the transport sector, how countries of the world prepared for the occurrence of such public health threats (or pandemics), what kinds of measures were taken during the COVID-19 pandemic, how people’s lives and our society were expected to change, how to make an effective recovery after the pandemic, and how to address the afore-mentioned changes in the future. As for the impacts of COVID-19, it is not possible to collect accurate, data-backed analyses based on such a questionnaire survey. Instead of asking experts to report the impacts, which needs careful investigation and takes a long time, experts were asked to report what kinds of activities were being prohibited, restricted, and recommended. Experts’ opinions about the ongoing pandemic, future changes in life and the society, and the corresponding measures are captured by pre-specified questionnaire items, based on intensive discussions by several core members of the WCTRS COVID-19 Task Force.

Main survey contents are shown below (for details, refer to Appendix A).
- Preparedness: the existence of guidelines and/or contingency plans for different transport modes/facilities
- During-pandemic measures: Associated with the impacts
  - Lockdown and its timings (start and end dates) of residence city/town and in the case of lockdown, the type of restrictions being put on mobilities.
  - Declaration of a state of emergency and its timings: both residence country and city/town
  - Activities/facilities prohibited to perform/use under the current COVID-19 pandemic in residence city/town
  - Measures taken in residence city/town against COVID-19
Recommendations to the public in your city/town against COVID-19

- Significant modal shifts in residence city/town during the pandemic
- Expected long-term changes in people’s lifestyles and the society in residence country, caused by the influence of COVID-19
- Experts’ additional suggestions about the ongoing measures and the post-COVID-19 pandemic policies for recovery of the transport and logistics sector as well as long-term transport/logistics policies, and/or important information sources that experts want to share. This part was very important because experts were invited to provide additional information about what was happening in their countries and cities/towns, and to share opinions about future changes and measures/policies that could not be fully reflected in the above questions.
- Finally, experts were also asked to report on their type of workplace, major research fields, academic affiliations, duration of professional experience, and city and country of residence countries and cities/towns.

3. Data collection and profiles of experts

This world-wide survey was initiated by the Chair and Co-chairs of the WCTRS COVID-19 Task Force. The WCTRS (World Conference on Transport Research Society) is a platform for the exchange of ideas among transport researchers, managers, policy makers, and educators from all over the world, from a perspective which is multi-modal, multi-disciplinary, and multi-sectoral. Its members come from more than 60 countries and areas. WCTRS has various collaborations with other academic associations, international and domestic organizations/associations across the world. The survey was implemented online and the survey webpage was distributed to members of WCTRS and its collaborative networks.

Because of the time limitation, we collected questionnaires from 357 experts, of whom 284 provided valid answers (79.6%). It should be noted that with the exception of their place of residence, experts were allowed to select multiple choices for other attributes. The place of residence of the experts were China (21.5%), Europe (17.6%), Northern America (13.4%), Japan (10.9%), India (9.9%), South Korea (6.3%), other Asian countries (11.6%), Middle East (2.5%), Africa (2.5%), and Latin America (2.1%), and Oceania (1.8%). As for types of workplaces, experts from universities and colleges account for 69.7%, followed by experts from research institutes and think tanks (19.0%) and firms (14.4%), governments (11.6%), and NGO/NPO, and international organizations, and others (7.4%). Regarding professional experience, 38.0% of experts have worked for more than 20 years, which is the highest, followed by 15-20 years (16.2%), 10-15 years (13.4%), 5-10 years (15.8%), and less than 5 years (16.5%). Concerning research and/or professional fields, the top five are transport planning and policy (56.0%), passenger transport (44.4%), urban and regional planning (31.7%), traffic management, operation and safety (30.3%) as well as transport and land use (30.3%). Other fields include transport, climate change and environment (21.5%), transport in developing and emerging countries (19.7%), transport economics and finance (18.3%), freight transport and logistics (16.9%), transport infrastructure design and maintenance (9.9%), tourism (9.2%), energy policy (5.3%), and public health (3.2%).

4. Preparedness

Experts reported that the percentages of cities/towns with guidelines of transport systems for public health threats prepared before the COVID-19 pandemic are 33.5% for bus systems,
27.1% for rail transit systems, 26.8% for aviation systems, and 21.8% for taxi (Figure 1(a)). The percentages for other transport modes/facilities are less than 15%: 13.4% for expressways/motorways/highways, 10.9% for maritime systems for passenger transport, 9.9% for logistics facilities, 8.5% for paratransit modes, 8.1% for maritime systems for freight transport, and 6.7% for river/canal transport systems.

Among the experts participating in the survey, 13.9% of experts reported that none of the above systems in their cities/towns had such guidelines, and 33.8% did not know or were not sure about the existence of such guidelines.

Comparisons across countries/regions (Figure 1(b)(c)) found that for both guidelines and contingency plans, China shows the highest shares for all transport modes and facilities, followed by South Korea. Each of these two countries’ shares is much higher than other countries/regions. They are followed by India and other Asian countries, meaning that they are higher even than Europe and USA/Canada (mainly USA). What do these shares mean? During the COVID-19 pandemic, to date, Europe and USA have suffered more seriously than other countries/regions. Do the higher numbers of infected cases and deaths coincide with these lower preparation ratios of guidelines and contingency plans or are there any inherent causalities? This is worth exploring in detail.

When the transport and logistics services are interrupted by a public health pandemic, the daily life activities of millions of individuals are affected. Therefore, contingency planning to respond to such disruptions is required. However, the largest share (44.7%) of experts reported that they did not know about the existence of such contingency plans, while 31.3% reported no such plans existed in their residence cities. The percentages of cities/towns with such contingency plans were 21.1% for bus systems, 18.3% for rail transit systems, 14.8% for aviation systems, 11.3% for taxi, 8.5% for expressways/motorways/highways, 8.5% for logistics facilities, 7.7% for maritime systems for passenger transport, 4.9% for maritime systems for freight transport, 4.2% for paratransit modes, and 3.5% for river/canal transport systems.

In summary, there are more guidelines than contingency plans, with notable differences across countries/regions. However, even taking the availability of transport systems into account, the existence of guidelines and contingency plans for public health threats are still very low. Policymakers should take such low percentages seriously and examine why there was a lack of preparations, considering that several pandemics had already occurred in the past. For the current COVID-19 pandemic, when some countries are suffering from many damages (losing many valuable lives and observing rapid increases in cases), why are other countries just waiting and watching, like watching a fire on the opposite bank of a river? This is an era of globalization: airlines can transport infected passengers from one side of the world to the other, within half a day. Even with no guidelines or contingency plans, the developed countries could have been more prepared given current advanced technologies. Politicians should spend more time learning lessons from the past and from each other, rather than complaining or blaming. They could urge and assist policymakers in different sectors to take more effective measures. The current crisis has shown that time is invaluable for saving lives.

(a) Guidelines and contingency plans: Overall comparisons

(b) Guidelines: Comparisons across countries/regions
5. Measures taken during the COVID-19 pandemic

It was found that 48.6% of experts reported an ongoing lockdown in their residence cities/towns, 17.6% reported a terminated lockdown, and the remaining answered no lockdown. As for the declaration of a state of emergency, 56.1% reported a declaration at the country level and 61.5% at the city/town level. Thus, the reported lockdown share is very high (66.2%, in total). Some participating experts commented on the issue of how to define lockdown. According to statista.com, by the late April, a third of the world population was on some forms of lockdown, where lockdown was defined as a situation whereby “governments ordered their citizens to stay at home and only take a minimum of necessary trips outside, while announcing police enforcements and/or fines for people failing to meet the requirements”. Because different experts may not have the same understanding about lockdown, we did not provide any definition. Instead, we asked experts to report on the following two sets of questions, i.e., activities restricted and prohibited.

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Activities restricted during lockdown
As shown in Figure 2(a), many facilities are closed: schools (64.1%), offices (46.5%), factories (44.7%), and stores (34.2%), while restrictions are put on people who can make a trip (40.1%) and on trip frequency (15.1%). In 17.6% of cities/towns, no physical exercise or walking dogs outside houses/apartments is allowed, while medical emergencies (56.3%), medical retrieval (50.7%), and shopping of daily necessities (55.3%) are allowed. As for country/region comparisons (Figure 2(b)), South Korea, Japan and China had much lower shares of restricted activities, while the shares in USA/Canada, Europe, India, other Asian countries, and other countries are extremely high. By the end of the survey period, China and South Korea had already reduced the numbers of infections and deaths dramatically. Because of this, their lower shares are understandable. However, Japan’s lower share is surprising, considering a state of emergency was in place across the whole country. Paradoxically, the USA had the highest shares of closures of offices and stores, but few limits on people who could go outside. This troubling observation is consistent with the following comment from a transportation consultant in the USA, who have worked for 40 years as a professional.

- In most of the US, the social distancing measures aren’t really mandated or enforced - some types of businesses are required to close, and also some parks and beaches, but otherwise there are no rules about where people can and can’t go.

Activities prohibited during COVID-19 pandemic
As displayed in Figure 3(a), by the end of the survey period, major prohibited activities are cultural events (e.g., music concert, exhibition, festival) (in 92.8% of cities/towns), going to school (92.8%), sports events (92.3%), amusement venues (e.g., casino, bar, night club) (86.5%), libraries (84.5%), gastronomical services (e.g., restaurant, barbecue at park) (66.7%), offices (54.1%), factories (43.5%), and retail shops (35.3%). In 23.7% of cities/towns, physical exercise or walking dogs outside houses/apartments are prohibited. Compared with the above restricted activities, the shares of prohibitions are much higher and the country/region differences are smaller for most cases (Figure 3(b)).

Protective and supportive measures
Looking at Figure 4(a), it is found that the top three measures are 1) stay-at-home campaigns (89.1%); 2) physical-distancing-friendly goods delivery has been widely practiced (62.7%); and 3) physical distancing measures have been taken in public transport and their stations/stops (e.g., bus passengers use only rear doors to avoid close contact with the driver, bus/rail open windows during operation) (62.0%). Remarkable features from the country/region comparisons (Figure 4(b)) are that India uses more drones and/or robots to inform people to keep physical distances and wear masks, and other Asian countries (excluding China, Japan, South Korea and India) use more military forces for transporting/delivering emergency goods and medical services, and take protection measures by tracing people’s behavioral trajectories via high tech. The shares of physical distancing measures are higher in USA/Canada and Europe, which have the highest shares of economic stimulus measures taken for recovery of industries. The use of high-tech measures against COVID-19 is not popular in USA/Canada and Europe.

The above measures are followed by the following economic measures: “monetary compensations have been paid to citizens for income reduction, medical treatment, etc.” (56.0%), “economic stimulus measures have been taken for recovery of industries” (54.6%), and “monetary compensations have been paid to transport and logistics firms suffering from economic losses” (27.8%).

<table>
<thead>
<tr>
<th>Activity</th>
<th>Average Percentage</th>
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<tbody>
<tr>
<td>Others</td>
<td>9.5%</td>
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<tr>
<td>Limit on trip frequency</td>
<td>15.1%</td>
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<tr>
<td>No physical exercise or walking dogs outside house/apartment</td>
<td>17.6%</td>
</tr>
<tr>
<td>Closure of stores</td>
<td>34.2%</td>
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<tr>
<td>Limit on people who can go outside</td>
<td>40.1%</td>
</tr>
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<td>Closure of factories</td>
<td>44.7%</td>
</tr>
<tr>
<td>Closure of offices</td>
<td>46.5%</td>
</tr>
<tr>
<td>Medicine retrieval allowed</td>
<td>50.7%</td>
</tr>
<tr>
<td>Shopping of daily necessities allowed</td>
<td>55.3%</td>
</tr>
<tr>
<td>Medical emergencies allowed</td>
<td>56.3%</td>
</tr>
<tr>
<td>Closure of schools</td>
<td>64.1%</td>
</tr>
</tbody>
</table>

(a) Average percentages for overall samples

(b) Average percentages by country/region

(1) Others (25) - South Korea (18) - India (28) - Japan (31)
(2) Other Asia (33) - USA/Canada (38) - Europe (50) - China (61)

Figure 2. Activities restricted during lockdown (multiple choices)
Figure 3. Activities prohibited during COVID-19 pandemic (multiple choices)

Figure 4. Protective and supportive measures (multiple choices)

(a) Average percentages for overall samples

(b) Average percentages by country/region
Finally, 46.5% of experts reported that protection measures for physical distancing are being taken based on information collected by tracing behavior trajectories via mobile phone, security video camera, credit card and/or other high-tech media, while 13.4% reported that drones and/or robots are being used to inform people to keep physical distances and wear masks, etc. Military forces were dispatched to take care of emergency medical services in 15.8% of cities/towns and to transport emergency logistics materials in 12.0% of cities/towns.

**Recommended activities during COVID-19 pandemic**

As seen from Figure 5(a), the most recommended activities during COVID-19 pandemic are online meetings (in 94.0% of cities/towns), avoiding gatherings (90.5%), telework or online work (88.7%), online lectures (88.4%), and avoiding eating out (76.4%).

Important, in 54.6% of cities/towns, it is recommended to restrict passengers on public transport (e.g., train, subway, bus), and in 22.2% of cities/towns, it is recommended to make an online booking before using a public transport mode (e.g., train, subway, bus). These measures are useful for keeping physical distance when using public transport, and it is therefore important to deploy such measures in more cities.

Looking at differences across countries/regions (Figure 5(b)), “other countries” have the largest share of restricting the number of passengers to board public transport vehicles, followed by Europe. Considering the effectiveness as a physical distancing measure, transport demand control should be promoted; however, for example, it is not popular in Japan, which was still facing an increasing number of infections and deaths. One more feature is that the share recommending physical exercise alone or with few people is the highest in Europe.

**Modal shifts: Subjective observations by experts**

It is observed from Figure 6(a) that as expected, a large share of modal shift from public transport to other modes was observed based on experts’ subjective observations: the largest shift to car (64.8%), followed by walking (42.3%), bicycle (35.6%), and motorcycle (19.7%).

Among the 22.5% of other answers (64 answers), 16 answers are about the decline of all trips due to lockdown and other restrictions, 14 did not know or were not sure, 14 did not observe any of the above major shifts, and 7 said that more walking and cycling were used. Thus, while public transport should be further improved, the current crisis should be regarded as a chance to significantly increase the share of walking and bicycle.

As seen in Figure 6(b), the shift from public transport to car in South Korea and China is most remarkable. In contrast, European people show a more environmentally sustainable and healthy travel style, i.e., shift from public transport to walking and bicycle. In India and other Asian countries, the shift from public transport to motorcycle is much higher than other countries/regions. India shows the second largest shift from public transport to walking, following Europe.

**6. Experts’ opinions on long-term changes**

Here, 21 structured questions were shown to experts: 11 are about long-term changes in lifestyles, and the remaining are about long-term changes in the society.

**Long-term changes in lifestyles**

As for changes in lifestyles (Figure 7(a)), 77.8% of experts fully agreed or agreed to “online working (working at home, neighboring satellite offices, cafes, etc.) will become popular”, followed by agreement on “the car dependence will become more obvious due to adverse reactions to crowded public transport during the COVID-19 pandemic.” (63.0%: fully agreed

(a) Average percentages for overall samples

(b) Average percentages by country/region

Figure 5. Recommended activities during COVID-19 pandemic (multiple choices)
or agreed) and “online shopping will become the most popular shopping activity” (60.9%: fully agreed or agreed). Many experts argue that online working and shopping will become more dominant in people’s future lives.

Regarding car usage, 14.8% of experts disagreed or fully disagreed that car dependence would increase. Such disagreement may be reasonable, for example, if people change their activity patterns without using more cars. Related to this, two young experts who participated in the survey made the following interesting comments.

• The car dependence will become more obvious due to adverse reactions to crowded public transport during the COVID-19 pandemic. I think this is hard to say because it can be balanced by a willingness to purchase more locally, in reason of new habits. There can be interesting dynamics about new habits of consumptions (avoiding supermarkets), going back to locally produced commodities. (young expert from a research institute/think tank in Belgium)

The car dependence will become more obvious due to adverse reactions to crowded public transport during the COVID-19 pandemic

Family bonds will be enhanced significantly

The society will become more isolated due to the progress of online activities and smart technologies (AI, IoT, robotics, etc.)

Online education will be a standard model of education

Online shopping will become the most popular shopping activity

More and more people will choose to live far from the city center

More and more people will out-migrate from populated cities

Working hours will become longer

More and more people will choose a job allowing them to mainly work at home

Online working (working at home, neighboring satellite offices, cafes, etc.) will become popular

Infection risk level of a job will determine job choices

<table>
<thead>
<tr>
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<th>Fully agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Fully disagree</th>
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<td>The car dependence will become more obvious due to adverse reactions to crowded public transport during the COVID-19 pandemic</td>
<td>12.3%</td>
<td>50.7%</td>
<td>22.2%</td>
<td>10.2%</td>
<td>4.6%</td>
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<tr>
<td>Family bonds will be enhanced significantly</td>
<td>9.5%</td>
<td>37.3%</td>
<td>39.1%</td>
<td>10.9%</td>
<td>3.2%</td>
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<tr>
<td>The society will become more isolated due to the progress of online activities and smart technologies (AI, IoT, robotics, etc.)</td>
<td>16.0%</td>
<td>41.2%</td>
<td>23.9%</td>
<td>20.8%</td>
<td>3.5%</td>
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<td>Online education will be a standard model of education</td>
<td>7.7%</td>
<td>26.4%</td>
<td>32.7%</td>
<td>23.6%</td>
<td>9.5%</td>
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<td>Online shopping will become the most popular shopping activity</td>
<td>20.4%</td>
<td>40.5%</td>
<td>21.1%</td>
<td>14.8%</td>
<td>3.2%</td>
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<td>More and more people will choose to live far from the city center</td>
<td>3.9%</td>
<td>31.3%</td>
<td>36.3%</td>
<td>12.0%</td>
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<td>More and more people will out-migrate from populated cities</td>
<td>2.8%</td>
<td>31.7%</td>
<td>31.7%</td>
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<td>Working hours will become longer</td>
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<td>37.0%</td>
<td>28.2%</td>
<td>8.8%</td>
<td></td>
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<tr>
<td>More and more people will choose a job allowing them to mainly work at home</td>
<td>3.9%</td>
<td>34.9%</td>
<td>26.1%</td>
<td>4.5%</td>
<td></td>
</tr>
<tr>
<td>Online working (working at home, neighboring satellite offices, cafes, etc.) will become popular</td>
<td>26.8%</td>
<td>51.1%</td>
<td>13.4%</td>
<td>3.2%</td>
<td></td>
</tr>
<tr>
<td>Infection risk level of a job will determine job choices</td>
<td>3.2%</td>
<td>30.6%</td>
<td>25.0%</td>
<td>8.5%</td>
<td></td>
</tr>
</tbody>
</table>

Figure 7. Changes in people’s lifestyles expected by experts
I expect attitudes to shift substantially; even if we can assume public transport health risks are no greater than pre-COVID19, perceptions will shift, leaving transit more vulnerable than ever. However, at the same time we face worsening car congestion all over the world, and perhaps we will see greater use of ICT, but we will also likely see transport systems become even more polarized, where those that can afford to use auto modes, and others are forced to use other modes despite the new/perceived risks. (young expert from a university in the USA)

Related to jobs, 35.9% of experts thought that the infection risk level of a job will determine job choices, 34.2% expected that more and more people will choose a job allowing to mainly work at home, and 26.1% stated that working hours will become longer.

Because of fear about virus infection, we expected a significant number of people would out-migrate from populated cities and live far from city centers. This expectation is supported by about 20% of experts, respectively: out-migration from populated cities (22.2%) and living far from city centers (20.4%).

Even though many students are taking online lectures, only about 30% of experts agree that online education will be a standard model of education.

More than 50% of experts think that the society will become more isolated due to the progress of online activities and smart technologies (AI, IoT, robotics, etc.). Due to long stays at home together with family members, family bonds are expected to be significantly enhanced. This argument is supported by 46.8% of experts.

Figure 7(b) shows differences across countries/regions, in experts’ opinions about changes in lifestyles. Based on the shares of “fully agree” and “agree”, experts who expect that the car dependence will become more obvious had the highest share in the USA, followed by India. Experts in India report that online shopping and working is expected to become more preferred, but also show the highest share who believe that society will become more isolated due to the progress of online activities and smart technologies. Online shopping will become more popular in South Korea. Surprisingly, the popularity of online shopping in Europe and USA/Canada as well as Japan is evaluated by experts to be lower than that in other countries/regions, by experts. Working hours will become longer in India and other Asian countries. Interestingly, the top three countries with the highest agreement to the statement “infection risk level of a job will determine job choices” are Japan, India and other Asian countries (excluding China and South Korea). A serious problem which has emerged in Japan has been the refusal of hospitals and other medical facilities to admit patients with fever due to concerns over infection risks, and there seems to be a problem needing to be paid serious attention to choices of medical jobs in the future.

In summary, the experts’ opinions above suggest that policymakers should make efforts to prevent increased car dependence due to adverse reactions to public transport services after the pandemic. Such a trend may be further strengthened by more living outside of city centers and in suburbs. More out-migration from megacities may lead to more car users in local cities. Even though the ever-increasing popularity of online activities will mitigate such a pressure to some extent, policymakers should learn from historical experiences of policy efforts against car dependence and prepare for the prevention of more car use by further improving public transport services and promoting more active transport (bicycle and walking). Note that the above expected trends vary across countries/regions.

Long-term changes in the society
In contrast to the responses on expected changes in lifestyles, there are more experts who
support our assumed changes in society after the COVID-19 pandemic (see Figure 8(a)). More than 60% (up to about 82%) of experts support (fully agree or agree) the following statements about changes in society.

- (81.7%) More and more inter-city business trips for meetings will be replaced by online meetings.
- (73.6%) Online services of government, bank, ticket purchase, etc. will become a standard service.
- (70.1%) More and more intra-city business trips for meetings will be replaced by online meetings.
- (66.5%) Smart technologies (e.g., AI, IoT, robotics) will be the key to detect and sound the alarm on the occurrence of future public health threats.
- (64.8%) Significant changes will occur, within 5 years, in transport and logistics policymaking due to lessons from COVID-19.
- (63.7%) The cost structure of the transport and logistics sector may be altered dramatically to prepare for future public health threats.

Related to inter-city business trips, similar replacements by online meetings may also be observed with respect to intercontinental travel, as argued by an expert from a university in the Netherlands (with 29 years of professional experience): “Intercontinental travel will decrease dramatically and flying will become much less popular, due to risks and price increases.” More online meetings and other online activities, together with other changes in lifestyles, provide us with an unprecedented opportunity to make changes toward truly improved sustainable development.

Meanwhile, 56.3% of experts think that the intervention of governments to transport/logistics industries will be strengthened after COVID-19. As for government interventions, to address the impacts of COVID-19, private hospitals have been nationalized in Spain, various modes of transport in the UK may possibly be nationalized, and France is ready to nationalize large businesses.21

Many international organizations are arguing about the coming ‘new normal’.22,23,24,25 Related to this, we asked experts about whether social and economic systems will return to the previous ones before COVID-19 or not. It was found that while 51.1% of experts support this argument, 48.9% expressed their neutral opinions (22.2%) or showed a disagreement or a full disagreement.

About 60% of experts think that the expected changes will contribute to improving resilience and sustainability of the transport and logistics sector. Needless to say, these changes are necessary to improve resilience and sustainability, but not sufficient, as argued by an expert working at a firm in the USA (with 11 years of professional experience): “Resilience and sustainability of systems will only increase if governments make an intentional effort to increase these. If they are not careful they may more deeply entrench unsustainable practices because they seem most effective in the short-run.”

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The expected changes will contribute to improving resilience and sustainability of the transport and logistics sector.

Significant changes will occur, within five years, in transport and logistics policymaking due to lessons from COVID-19.

The intervention of governments to transport/logistics industries will be strengthened after COVID-19.

The cost structure of the transport and logistics sector may be altered dramatically to prepare for future public health threats.

The induced growth of online business and automation will lead to more unemployment.

More and more intra-city business trips for meetings will be replaced by online meetings.

More and more inter-city business trips for meetings will be replaced by online meetings.

Smart technologies (e.g., AI, IoT, robotics) will be the key to detect and sound the alarm on the occurrence of future public health threats.

Online services of government, bank, ticket purchase, etc. will become a standard service.

Social and economic systems will not return to the previous ones before COVID-19.

(a) Average percentages for overall samples

(b) Average percentages by country/region

Figure 8. Changes in our society expected by experts
Comparisons across countries/regions (Figure 8(b)) found obvious differences across countries/regions. However, the differences are not as remarkable as those of changes in lifestyles. The featured differences are summarized here. First, governmental interventions to transport and logistics industries will become most obvious in India. This is consistent with the observation in India that the highest share of experts are worried that the induced growth of online business and automation will lead to more unemployment. As for online services of government, Japan shows the highest share. This can be partially explained by the following comments from an expert in a university of Japan, who has worked for more than 30 years.

- The unique Japanese seal stamp system will be computerized, which will enable remote work, so the way people work may change.

Europe will see most replacements of inter-city trips by online meetings, followed by USA/Canada; meanwhile, USA/Canada is expected to see more replacements of intra-city trips (even higher than Europe). Other Asian countries (excluding China, Japan, South Korea, and India) are expected to have more changes in all aspects related to society. Using smart technologies to detect and sound the alarm on the occurrence of future public health threats is not that welcome in USA/Canada and Europe, but it is well welcome in India, South Korea and other Asian countries as well as other countries. Interestingly, Japan has a similar higher agreement on use of smart technologies as China. For the cost structure change in the transport and logistics sector, experts in Japan and other Asian countries showed higher expectations. India and USA/Canada are the top two countries that see significant changes in transport and logistics policymaking due to lessons from COVID-19. Other countries show the highest agreement on the statement “social and economic systems will not return to the previous one before COVID-19”.

The many changes observed are expected to improve resilience and sustainability of the transport and logistics sector, especially in other Asian countries and China, while South Korea and USA/Canada are the two countries with the lowest expectation in this respect.

7. Experts’ opinions selected from free answers

More than 100 experts gave additional comments on potential changes in people’s lifestyles and society, suggestions about immediate measures and the post-COVID-19 policies for the recovery of the transport and logistics sector as well as long-term policies. These comments and suggestions are summarized below.

Uncertainties and unknowns

Experts point out uncertainties and unknowns about the COVID-19 pandemic. These undermine the ability of transport experts to evaluate what will happen in the transport sector.

- The only additional thing I would say is - this is all UNCERTAIN. Who knows. Things could return to some semblance of "normal". (local government officer in the USA: 28 years of professional experience)
- It is still too early to judge. (expert from a university in China: 30 years of professional experience)
- It is too soon to say what the longer term effects of the coronavirus will be on the transport sector. (expert from a university in Japan: 10 years of professional experience)
- People have short memories. London tube patronage recovered in a year after the terrorist bombs. (expert from a university in the UK: 40 years of professional experience)
- There's so much unknown right now. The real issue is when and whether there is a "cure" or vaccine. I think if that happens (and it needs to happen quickly), I think things go back to normal fairly fast. If it doesn't happen or if it takes a long time, then the world economy will
become a Shamble and who knows what will happen. (transport consultant in the USA: 25 years of professional experience)

For the unknowns about COVID-19, for example, the Business Insider raised “11 critical, unanswered questions about the coronavirus and COVID-19, the diseases it causes: (1) how did the new coronavirus get into people? (2) how many people have actually gotten COVID-19? (3) what makes the coronavirus so good at spreading? (4) what drives mortality in people infected by the coronavirus? (5) what percent of people infected by the coronavirus die? (6) why do young people face the least risk of dying? (7) can you get reinfected? (8) how seasonal is the coronavirus? (9) are there any safe and effective drugs to treat COVID-19? (10) will there be a vaccine for the coronavirus, and when? (11) what are the long-term consequences for those who survive COVID-19?”

For the transport sector, the unknowns are what are the impacts of COVID-19 and how to address the impacts, from both immediate, short-term and long-term perspectives. Treating uncertainties and unknowns is surely a fundamental requirement for policymakers, including transport policymakers (e.g., Lyons and Davidson, 2016; Workman et al. 2020). However, this requires cross-disciplinary collaboration. For the current pandemic, it is necessary and important to promote collaboration between public health, transport and supply chain experts to inform policymakers’ decisions about lockdowns, for example. Unfortunately, even for the current pandemic, cross-disciplinary collaborations have not been commonly observed and poor coordination across sectors/organizations has been noted.

**Mindsets of policy makers**

Being confronted with the above uncertainties and unknowns, experts suggest changes in policymakers’ mindsets, as shown below.

[1] *The response to Covid-19 is likely to be as long lasting and as drastic as the response to the Spanish Flu.* (local government officer in the USA: 32 years of professional experience)

[2] *Lesson learned will assure a similar outbreak in the future will be handled such that mitigation will not crash western world economies as it has this time around.* (expert of MPO in the USA: 20 years of professional experience)

[3] *I see this crisis as a great opportunity to change and improve current mobility systems towards more sustainability. Dealing right with the outcomes of this crisis could also help us to better deal with the climate crisis. At the same time resilience of the transportation sector towards crisis could improve.* (expert from a university in Finland: 8 years of professional experience)

[4] *There need to be clear, unambiguous, messages to the public. People in authority must avoid setting bad examples of behaviour.* (expert from a university in the UK: 50 years of professional experience)

[5] *The current lockdowns in various cities should allow policy-makers to plan and even improve their public transport systems, but unfortunately they are probably too preoccupied with managing the public health crisis to turn their attention to other issues. Academics could play a part in highlighting some of these critical issues through their research activities before things return to how they were before these lockdowns.* (expert from a university in Japan: 11 years of professional experience)

[6] *Supply chains need cooperation, not barriers.* (young expert from a university in China)

[7] *Any policy should take into account climate change stakes, in particular solo driving should be discouraged.* (expert from a research institute / think tank in France: 32 years of professional experience)

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[8] I think Covid-19 pandemic is the result of our increasingly unsustainable kinds of human interactions with the environment and with each other to name a few: environmental degradation, pollution, nutrition intake deficiencies and unhealthy eating habits, social-cultural and psychological selfish behaviors and lack of response-receptivity, wars, unsustainable urban planning such as building multi stories housings, high raising flats and units, deforestation and land degradation, etc. As a result, pathogens can now mute faster, travel further and with greater diversity while our immune system gets weaker. Otherwise, more viruses to come and with greater numbers. So, I think, long term policies strategies should really incorporate all of these factors and plan for a coherent global response. The structures needed for this coherence needs to be encoded within our transport, logistics and urban planning and regulated by global world government institutes such as the world Parliament of cultural festival states, UN and humanitarian hubs where every person, every culture and every nation participate to their best and play a vital role. (Expert from a university in Australia: 16 years of professional experience)

[9] Identifying the beneficiaries of compensation measures, and under which conditions, will be interesting. There are some discussions on whether the aviation sector should receive compensation in light of climate change. How will this affect trade. The COVID pandemic is currently used as an excuse to justify why cars manufacturers should be waived from their emissions targets, while there is no direct link (they wrote a letter to European institutions). (young expert in a research institute or think tank in Belgium)

[10] In the context of pandemic, we need to think of a new land use and transport policy where walkability is given higher priority in planning and operation infrastructure so that essential services such as medical services and daily needs can be delivered/accessed without relying on public transport. (expert from an international organization in Bangladesh: 20 years of professional experience)

The comments [1][2] suggest the necessity of looking back on human history to learn more lessons. The comment [3] proposes to make better use of the current crisis to further improve the transport sector. The comment [4] points out the importance of better communication by governments with the public: to be a role model for the public. The comment [5] recommends that policymakers should work together with academics, by allowing more academics to be involved in policymaking. The comment [6] raises a critical question to our global society: how to promote globalization via cross-border economic activities after the COVID-19 pandemic. Should we reduce cross-border economic activities by pulling those transnational corporations back to their home countries, via strong economic measures or institutional regulations? Should each country in the world conduct self-sufficient economic activities, or is it possible for each country to realize such a self-sufficient economy? The comments [7][8][9] argue the importance of climate change considerations, even under the current pandemic. It is true that the transport sectors all over the world are suffering from losses and damages from COVID-19, and they must by strongly supported. However, it is also a big challenge for policymakers to balance the short-term bailout and the long-term policy goals of sustainable transportation development. The last comment [10] actually raises a dilemma for policymakers. In reality, many people have to reply on public transport, because our cities are too big to walk. At the same time, making cities more walkable is surely beneficial to health and the environment.

A chance to make great changes: This will never come again
Various behavioral changes have been observed during the pandemic. Some changes may continue and new changes may be expected after the pandemic. In either case, sustainable behavioral changes must be promoted. Some experts emphasize the importance of making use of this pandemic to realize more improved sustainability. Among them, the following long
statements given by an expert from a university in New Zealand, who worked for 54 years as a professional, are impressive.

- There will be pressure on globalisation trade policies with encouragement to purchase more goods made locally. For trading nations like New Zealand, this will impact free trade and our economy. International tourism will take a long time to recover and will be managed more for quality than quantity. Aviation will remain highly constrained and many airlines will likely disappear from servicing international travel. Regional zones that have the virus well contained collectively will allow international travel within their region to resume earlier.

- Direct non-stop flights enable better tracing of contacts. Multi-stop tourism will be inhibited by quarantine regulations at national borders requiring 14 day isolation periods upon arrival. Travellers will not wish to waste holiday time in successive lockdown mode. For freight, there will be a return to more localised warehousing and less emphasis on just in time delivery from distant storage locations. The experience of traffic thinning during lockdown and the clean air benefits that were realised will mean the pressure will be on to green vehicle fleets to reduce emissions. That will be encouraged by both stick and carrot policies. A positive for climate change measures, but countries that think business as usual must come before health and safety, will need to change their thinking and actions. Pandemics do not distinguish between nations, leaders, race or religion. Their global impact is greater than any bilateral or multilateral trading deal. We will respect our natural environment more after pandemic shocks. Where we live, work and recreate becomes a habitat to conserve rather than abuse in the search for wealth. We will see a decline in the mining and transport of minerals that contribute to greenhouse gas production, and more renewable clean energy developments. As in war time, innovation in the cause of survival will flourish. Our connectedness will be boosted by electronic means, with physical contact constrained. Information technology that enhances collaboration will be sought after. Fake information will not be tolerated. Monopolies on the provision of information will need to be challenged and tested. Political and commercial analysis needs an unfettered reportage, but distribution cannot rely upon advertising revenue. Whether the pandemic will help us to reassess our love of consumerism to purchase things we do not need and to throw away without thought of downstream consequences, is a matter that will be watched closely. It is said, never waste a crisis. This COVID-19 virus is a lever to make changes.

Other experts point out changes in urban forms together with increase in car trips, more green mobility and logistics, and substitution of activities in physical spaces with those in virtual spaces. Transport systems with shared spaces (public transport, shared mobility, paratransit) are expected to become less popular, which are closely linked with the increase in car trips.

- Car use and urban sprawl may grow, and this requires accelerate reduction of emission by cars, that in turn make more feasible improvements of the road network. Staggering hours and days of work and study may remain, reducing congestion for road transport and costs of production for public transport. (expert from a research institute / think tank / NGO / NPO in Italy: 40 years of professional experience)

- The importance of healthy transport mode such as walk and cycle, and living near workplace will be more evaluated by citizens. It will be a good chance to promote them. (expert from a university in Japan: 20 years of professional experience)

- COVID-19 may push development of soft-mobility and micro-mobility in cities. May also help development of green mobility and logistics in cities, people having experienced a low pollution world during lockdown. (expert from a firm in France: 19 years of professional experience)

- I suppose we will change our working styles, not the way using transportation. For example, instead of working at a fixed time, adopt flextime. I suppose that this will eliminate congestion and rushing to work on a full train. But I don't think we'll work online without direct communication or AI will replace essential workers. (an expert at a research institute / think tank in Japan: 35 years of professional experience)
The crisis has also demonstrated the risk associated with the lack of independent mobility, and may therefore lead to more people wanting their own vehicle. This can lead to an increase in both motorized transport (e.g. cars) and non-motorized transport (e.g. bicycles). Delivery services are also likely to grow as people become accustomed to ordering food and other goods online. (an expert in Japan with 11 years of professional experience)

"Too early to see if the behavioural changes will persist, but measures are needed to protect the public transport operation. The only positive mobility aspect we noticed is the increase in active travel." (expert from a university in Australia: 24 years of professional experience)

Hygiene standards will get higher priority in transport, more freight distributing goods from e-shops and local farmers with local vegetables, fruits and other local food items to be distributed in a coordinated way on short distances and under hygiene prescriptions (expert from a university in Czech Republic: 22 years of professional experience)

Shared autonomous vehicles, paratransit will be less popular (expert from a university of Canada: 40 years of professional experience)

Immediate measures for surviving COVID-19
Immediate measures have been taken worldwide, including general measures for avoiding any infection by wearing masks, washing hands, keeping physical distance from each other, and disinfection of public transport vehicles and public spaces. Experts in this survey further make the following suggestions.

- Robust systems for getting essential items such as food and medication to highly vulnerable people need to be set up. (a British expert in university, 50 years of professional experience)
- Avoiding crowded places and crowded buses, trains and planes. (consultant in New Zealand: 30 years of professional experience)
- People should wear masks when moving in crowded public places and travelling in public transport. (a local government officer in India: 25 years of professional experience)
- Allowing free bike sharing use for essential workers, and operating buses and subways with higher frequency than usual. (young expert of NGO/NPO in South Korea)
- Setting different out-of-home activity levels depending on the level of infection risks. (expert from a university in Japan: 10 years of professional experience)

As stated by the World Bank, panic buying has been one of the top headlines of the COVID-19 (coronavirus) pandemic. Why the World Bank emphasizes panic buying is because it may seriously worsen global health supply chains. One expert participating in the survey pointed out the issue of limited capacity of production systems within short timeframes. For this, emergency laws and institutional design should be established as soon as possible, allowing emergency goods to be produced and delivered on a large scale and in a timely way.

Supply shortages are, partly the result of very limited capacity of manufacturing systems to produce more on short notice (i.e., working at economic efficiency and capacity) (a consultant in the USA: 37 years of professional experience)

To keep sufficient physical distance, it is very understandable that people try to avoid crowded places and crowded buses, trains and planes. If transport demand keeps unchanged, public transport has to be operated with higher frequency than usual, by properly reducing the number of passengers inside each vehicle. To make such an operation possible, online booking of public transport should be promoted, as already practiced in 22.2% of cities/towns observed by experts (see Figure 5).

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Measures for the ‘new normal’ period of the COVID-19 pandemic

Experts’ opinions suggest that measures for the ‘new normal’ period of the COVID-19 pandemic should be taken in a comprehensive way, from upstream to downstream.

Upstream measures: Public health, social and economic systems

To make sure the transport sector plays its own “should-be” roles, public health, social and economic systems should be established in a well-coordinated manner. Cross-sectoral policymaking will be the key for successfully conquering COVID-19 and addressing its impacts.

• Improving public health infrastructure (a local government officer in India: 25 years of professional experience): This will be a top-priority, among all measures/policies, for successful fight against public health threats. While prevention of the occurrence of epidemics and immunity building are important, it is also necessary to guarantee emergency medical logistics and humanitarian logistics (or transport of essential goods and services) during pandemics. Immunity building also requires joint efforts from public health and other sectors, including the transport sector.
  - Epidemic prevention and control, transportation support for emergency materials and key production and living materials, support key areas for epidemic prevention and control, strictly prevent the import of overseas epidemic, and resolutely block the spread of cross infection through passenger stations and transportation vehicles. (young expert from a university in China)

• Preparation of disaster management plan (a local government officer in India: 25 years of professional experience):
  This measure has similar features as the anti-pandemic measures. Both types of measures should be integrated as joint responses to catastrophic events, in general. For example, in summer, urban flooding often occurs. In the summer of 2020, urban flooding will occur here and there. This means that policy makers have to prepare for the co-occurrence of COVID-19 and urban planning threats. Therefore, from now on, disaster management and anti-pandemic measures have to be taken simultaneously. Immediate preparation is required: for example, how to keep physical distance at evacuation sites, which are usually crowded.

• Re-organization of social and economic systems as well as urban and transport systems
  - I think that the way to contain the huge losses of revenues of public transport systems is the change of life times to smooth peak hours, allowing less crowded vehicles. Only a widely shared organization of the times of the city (offices, schools, industrial plants, etc.) could allow to better address people mobility and not lose confidence on public transport. This would have another important side-effect, allowing to decrease congestion and pollutant emissions. Finally, creating a sense of community, spurring a conscience of effects of our mobility, thanks to bottom-up social oriented mobility tools could help. (expert from a university in Italy: 30 years of professional experience)

• Urban and regional forms and land use (a local government officer in India: 25 years of professional experience)
  - Population density should be reduced through better land use management.
  - Work from home should be encouraged
  - The need for travel long distances for work or other essential activities should be reduced.
  - Education can be moved online to a great extent

Downstream measures: Transport and logistics measures
Experts made various proposals from the perspectives of both transport service providers and users, covering service operation, technological development, monetary measures, and enlightenment. Furthermore, these measures need to be conveyed to the public and various stakeholders to avoid non-compliance. The followings are the major proposals from experts.

- **To transport users and the society** (expert from a university in Japan: 40 years of professional experience)
  - release workers from the fixed offices, fixed working time
  - introduce strong congestion charge in public transport and road systems

- **To transport operators** (expert from a university in Japan: 40 years of professional experience; a local government officer in India: 25 years of professional experience)
  - Sanitizing public transport regularly (a local government officer in India: 25 years of professional experience)
  - Public Transport - improve level of service and overcrowding (a local government officer in India: 25 years of professional experience)
  - strengthen the performance of ventilation in cars of public transport (expert from a university in Japan: 40 years of professional experience)
  - segregate the immigration check lines for the passengers of flights coming from high infection countries/regions and much stricter thermometer check and health check should be applied (e.g. airlines) (expert from a university in Japan: 40 years of professional experience)
  - Airports should be equipped with more facilities for screening and testing and quarantining (a local government officer in India: 25 years of professional experience)
  - New guidelines for public transport need to be designed abiding by the social distancing rules applicable to the region. This might drastically reduce the capacity of current available transit system. This gap needs to be filled with reducing the headway and introduction of additional transit resources. Incentives must be provided to the staff working during this vital situation to ensure the economic security of the employees. Regularization of Transportation Network Companies to incorporate shared mobility services in the mainstream transit system must be encouraged. (young expert from a university in India)

- **Financial support**
  - To provide immediate financial support to the industries which operations are strictly regulated (e.g. airlines) (expert from a university in Japan: 40 years of professional experience)
  - Subsidies for public transport sectors are highly needed to maintain the public transport service. (expert from a university in Japan: 12 years of professional experience)
  - More public investment in public transport (expert from a university in China: 30+ years of professional experience)
  - Restructuring of salary/wage structures for "front line" workers such as bus and train operators, grocery store workers (state government officer in the USA: 30 years of professional experience)

- **Measures based on technologies**
  - The development of autonomous car and drone logistics should be accelerated (a consultant in Japan: 18 years of professional experience)
  - More public investment in automation ventilation, touchless technologies (expert from a university in China: 30+ years of professional experience)
  - MaaS the like should be realized as soon as possible (expert from a university in Indonesia: 30 years of professional experience)
  - [Opportunities and concerns] Logistics information should be provided and coordinated using SNS. (consultant in Japan: 30+ years of professional experience), and devices such as drone, robots, automatic drive system have to be more exploited. (a consultant in Japan: 35 years of professional experience). However, Japan has a high awareness of
privacy and the spread of electronic money systems has not progressed, so it is not possible to sufficiently track and manage personal information using ICT compared to Korea and Taiwan. The response to COVID-19 this time may be a catalyst for ICT reform, but since there are few experts in the political world, I think that the pace of reform may not be as fast as expected. (expert from a university in Japan: 30+ years of professional experience)

- No doubt, world will never be the same as before COVID-19. If we structure our responses to address core issues related to tele-mobility and collective mobility systems, we may be able provide better mobility choices/alternatives for people. That does not necessarily mean less mobility. But this would definitely mean better health and quality of life. (Expert from a university in India: 37 years of professional experience)

**Measures for developing countries**

More attention should be paid to the growth of COVID-19 infection in developing countries, which has shown a much more rapid growth rate in recent months. Including the USA, all developed countries have shown a diminishing trend of growth in both infections and deaths. However, more and more developing countries are showing a remarkable increase. For example, within the last month (April 24 – May 24), the number of infections in India increased by 5.1 times, Brazil by 4.6 times, Mexico by 3.1 times, and Pakistan by 2.5 times. It is expected to become worse especially considering dense and poorly-equipped buses, informal transport (e.g., paratransit), and over-concentration of population in large-sized developing cities, particularly in slums. More and more low-income and vulnerable people in developing countries will be at risk of being infected, because they cannot keep proper physical distances and have no available medical services.

Issues in developing countries have been seriously pointed out by the experts participating in the survey.

- The crowding of public transport is very common in developing or emerging countries. However, now onwards social distancing is going to be an integral part of our life - so, it will be necessary to redesign the public transport services in every sense to promote social distancing. Travel demand management measures such as staggered working hours, variable working hours, etc. may be needed as the capacity of public transport will be limited when public transport has to operate with due regard to social distancing. A complete guideline needs to be prepared for travel demand management and public transport operation in the post COVID-19 scenarios. It is not only the capacity of public transport but also other measures such as disinfecting vehicles after every trip need to be done for public transport and common carrier modes. Various travel demand management strategies need to be formulated and social acceptance need to be judged, Travel behavior research is going to be important in the overall context. (expert from a university in India: 20+ years of professional experience)

- The measures and post-COVID policies for recovery of transport and logistic sector is dependent on the Nation’s type. Not all nations are same. They vary by population, geography, climate, food habits, cultural habits, economy, natural resources, governance, administration, traffic and travel patterns and behaviour etc. and therefore, the solutions that one nation adopts, not necessary that those can work for other. A country like India which is 2nd most populated, having high number of unorganised sector, high number of people who are yet not able to use IoT and ICT technologies even though having smart phones, weak IT security infrastructure, such country cannot adopt to changes quickly. and therefore, in order to revive its economy, it will have to eventually reach to the place from where it stranded during COVID. In order to recover the transport and logistics sector, the national government will have to provide stimulus package, promote and safeguard public transport, increase tax on fuel and control vehicle ownership, increase taxes on personal vehicles, promote infrastructure that would help people choose more cycling and public transport rather than adopt personal vehicles. (Central government officer in India: 12 years of professional experience)
The quality of personal protective equipment for passengers and drivers needs to be increased. It should be made available even to those who cannot afford it since this is a public health issue rather than an individual health issue alone. Since the physical distancing plus personal protective equipment will be a norm - there is a need to clearly specify the standards for this so that the transition can be made by transport service operators immediately. (expert from a university in Philippines: 22 years of professional experience)

Food security is another concern for many poor transport workers in developing countries as they are not earning due to lockdown. (expert in a university of Bangladesh, 20 years of professional experience)

The disruptions are not uniform in LMICs (low- and medium-income countries). So, how a government of LMIC going to come up with the policies will be different from the HICs (high-income countries) policies? The political priority in LMICs is hardly going to get affected by this pandemic in the long run. (a young expert in an Indian university)

A lot of care and guidance to be taken. However, unfortunately, countries specially developing countries, are more serious about their political benefit than the people of the country or world as a whole. (expert from a university in Sri Lanka: 15 years of professional experience)

Taxi, bus, paratransit and motorcycle (Grab & Gojek) are the most transport mode that affected by Covid-19 case. They did not support financially by the government to cover operational cost or when they are idle. (expert from a university in Indonesia: 30 years of professional experience)

For extreme conditions, transit units could be used for isolation units in poor countries. For moderate to low risk emergencies, only few essential service providers should be allowed to use public transit. (expert from a university in India: 10 years of professional experience)

Exception: Qatar has a very special situation. Most of the transportation system is very new. The metro network was opened last year (2019) October. Thus, the main, most dominant, transport mode is private cars. That's why there were no major risks with the public transport system since it is still new and not popular. (expert from a university in Qatar: 10 years of professional experience)

Massive public transport augmentation may be needed as the capacities go down due to distancing norms. Highway infrastructure cannot provide required capacities, especially in urban areas. (expert from a university in India: 30 years of professional experience)

The recovery period post lockdown is going to bring several challenges to government and transportation organizations which include managing the rising inter-city and intra-city travel demand, maintaining smooth uninterrupted flow of medical resources, food, and essential amenities. Public transit agencies have to ensure that they regain the trust of public by ensuring all safety protocols such as social distancing to be followed in transit. These measures are crucial to deter people from using private vehicles which can be addressed through the following (A central government officer in India, 27 years of professional experience):

- Opportunity for achieving a sustainable transportation system
- Improvement in disaster resiliency of transportation system
- Need for regaining the trust of the common public in safe movement available in public transport system

Maintain social distance, neat and clean service, sitting bus etc. are become popular (expert from a university in Bangladesh: 10 years of professional experience)

Social Distancing is not being practiced by many. People are not wearing masks. Children are not taken into consideration. (expert from a university in Nigeria: 40 years of professional experience)
8. Conclusions and future research issues

Recognizing the existence of various uncertainties and unknowns about COVID-19 and its impacts (especially long-term impacts), a world-wide questionnaire survey was conducted of experts in the fields of transport and other relevant disciplines, between the end of April and late May, 2020, when global daily new cases showed a relatively stable fluctuation pattern (85,000 – 100,000 cases). For experts, this period must have been a very busy time, because many were involved in government work, education, handling of business operations and so on, in response to COVID-19. Nevertheless, 357 experts participated in the survey and 284 provided valid answers. In addition, more than 100 experts gave their professional opinions on potential changes in people’s live and our society and various “should-be” measures. These 284 experts had a balanced profile in terms of countries of residence, professional fields, and duration of professional experience.

8.1. Findings

Analyses of survey results revealed serious impacts of COVID-19 on transport, logistics, and daily life, in terms of prohibited and restricted activities. Major findings can be summarized as follows.

· The maximal percentage of cities/towns with guidelines and/or contingency plans in the transport sector against public health threats is only about 30%, on average. This low percentage is extremely problematic, considering that many countries have suffered serious pandemics in the past. Coincidently or expectedly, this low percentage is especially remarkable in those countries/regions with more infected cases and deaths.
· Nearly 70% of cities/towns, where experts were living, experienced or are still experiencing lockdown.
· Stay-at-home campaigns, physical distancing measures in public transport and goods delivery, economic measures, avoidance of face-to-face social contacts, and online activities are the predominant measures against COVID-19 in the transport sector.
· Probably due to fear of infection inside public transport vehicles, declines in public transport usage were reported, with shifts in trip demand to car, walking and bicycle. In other words, remarkable modal shifts away from public transport were observed. Even though total modal shifts in all surveyed countries/regions to active transport (walking and bicycle; especially in Europe) are higher than the shift to car, a greater than 60% shift from public transport to car (especially in South Korea and China) is a serious concern for sustainable transport development. In India and other Asian countries, the shift from public transport to motorcycle is much higher than other countries/regions.
· Concerning long-term changes in people’s lifestyles, experts showed great concern about the potentially increasing car dependence on one hand, balanced by the expectation that there will be more shifts of activity participation from physical spaces to virtual spaces on the other.
· In the case of long-term changes in society, there are more experts who expect changes toward improved sustainability than those showing opposite opinions.
· Various issues in developing countries are pointed out by experts: e.g., problematic political governance, balance between travel demand management and public transport operation, promoting and safeguarding public transport via taxation and infrastructure improvements, standards for personal protective equipment for transit passengers and drivers, and enlightenments about physical distancing measures.

Recognizing the existence of uncertainties and unknowns, experts suggested that policymakers should change their mindsets to effectively address the impacts of COVID-19, and policies should be made across sectors in a well-coordinated way.

8.2. Future research issues

Even though more and more evidence on the impacts of COVID-19 has been accumulating, there are still many unknowns. Experts suggest that more research efforts should be made, including the improvements of the present expert survey research. Some areas for improvement were also suggested.

Further improvements to the present expert survey
According to the comments from participant experts, definitions of lockdown differ across countries/regions. In this sense, the term “lockdown” is not really useful to capture actual situations. Because policies/measures are highly time-dependent and conditional on available budgets, it is necessary to better phrase relevant questions and to further make sure tradeoffs between policies/measures. To minimize the infection risks, cross-sectoral joint efforts are required. Even for trip making, because it is a derived demand from activity participation, to minimize the infection risks related to trip makers (being infected by others or infecting others), policies/measures should be taken from both transport and activity destination perspectives. Focusing on transport, more detailed types of transport modes (including smart and shared mobility: e.g., bike sharing, car sharing, MaaS, autonomous vehicles) should be investigated. Various online activities are expected to boom in the very near future. It is necessary to measure the market size of each type of online activity to estimate their mitigating effects on transportation issues. Such booming online activities may be associated with life arrangements or lifestyles. The life-oriented approach (Zhang, 2017) may be useful to capture the whole picture of changes in life. Due to the changing situations about COVID-19 and differences across countries/regions, it is worth implementing a follow-up survey to participant experts by providing feedback on the present survey. Based on the survey results, in-depth discussions among selected experts may be helpful to derive more effective policies/measures at different levels (e.g., global, national, regional, and city/town).

Interdisciplinary research on transport, urban planning, and public health measures
After experiencing such a serious pandemic, people will become sensitive to public health threats in the future, though it is unclear how long such a tendency will last. To better address the impacts of public health threats in the future, more interdisciplinary research on transport and public health measures should be conducted, as suggested by participant experts.

- The effects of COVID-19 affect people's movements and logistics. Currently, in Korea, goods needed by individuals are delivered through on-line, so on-line logistics is increasing. However, even after COVID-19, it is judged that people's hygiene will be sensitive. Therefore, in the operation of transportation, I think it is necessary to study the system structure and spatial structure of the hygiene check part. (expert from a university in South Korea: 28 years of professional experience)

- More research is required focusing on integration of personal safety in public transport systems including aviation. (expert from a university in Saudi Arabia: 30 years of professional experience)

Related to safety, recently, IATA has just declared its following five principles for industry re-start (related to safety and security, flexible responses to the progress of the
pandemic, environmental targets, the role in the economic recovery, global and national standards) and a roadmap to “Safely Restarting Aviation”. In making the road map, IATA emphasized that “all measures should be outcome based, supported by scientific evidence and a robust fact-based risk assessment, and all measures should be aimed at minimizing the risk of transmission at airports (both landside & airside) and onboard aircraft…”. For this, what kinds of scientific evidence do we have for the aviation industry? This has to be answered as soon as possible.

In the urban context, current physical distancing practices require urban planners, transport planners and community designers to reconsider current designs of public spaces, spaces of public transport vehicles and platforms, and building spaces, etc., to prevent infection of viruses, and to re-plan current cities and transportation systems for the coming “new normal”. For such a reorientation, decision makers and planners of cities and transportation systems must work together with the public health sector. For this, new ways of thinking are required for policymaking and planning of cities and transportation systems, where pandemics will have to become an unavoidable consideration.

Citizen participation and risk communication
For the current pandemic, a study in Japan revealed that bad communication between governments and the public may be associated with the spread of COVID-19 at its early stages (Zhang, 2020). General speaking, successful interventions and effective policy measures require better citizen participation or public involvement. Various lessons could be learned from public health threats in the past; however, the current experience suggests that not all lessons were adopted. Then, the questions to be asked are: should there be any differences of public involvement in response to COVID-19 and other public health threats, and why weren’t the historical lessons utilized in the fight against the current pandemic?

Revolutionary approach for resolving complex issues caused by pandemics
Because of diverse and serious impacts of COVID-19 on the transport sector, huge amounts of budgets are required to compensate for damages caused by lockdown, to support re-opening and recovery of the economy, and to address long-term impacts of COVID-19. Then the question is: how much should be invested in the transport sector, how to take climate change into account under such a pandemic, how to invest? Related to this, the following comments from participant experts suggest that it is necessary to develop a revolutionary approach to resolve complex issues caused by pandemics.

- The question appears to be a bit fuzzy in that both the transport/logistics sectors and policies are destined to be parts of the general economic theory. And the last one, with its mainstream structure and working, is one of the main factors (to be blamed) to contribute to the present dilemma by being indifferent to the destruction of nature by the working of the present economic system, dragging the 'transport & logistics activities' into the battle-ground at the wrong side. Therefore, unless a 'revolutionary' change happens to occur within the economic theory itself, I do not expect any workable (and reliable) approach to the solution(s) to our (global) problems ahead. (expert from a university in Turkey: 40+ years of professional experience)
- It is important but critically hard to quantitatively identify tradeoff between economy and public health measures. (expert from a university in USA: 25 years of professional experience)
- You have not mentioned active transport (bikes and walking), neither have you talked about the environment, and I think that the latter should be the most pressing problem/challenge for

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To make economic measures work in an expected way, effective institutional design cannot be ignored: how to involve different stakeholders and what their roles should be (especially how governments should be involved in the operation of large-scale private businesses), what are policy instruments, how to enhance the efficiency of policy implementation, and how to better communicate with the public. All these issues need careful investigation from a comprehensive and cross-disciplinary perspective.

The ongoing experience of the COVID-19 pandemic, once again, reminds us of the importance of transforming the current market-oriented society to a life-oriented society. Our society has used its resources to maximize the economy, but not to maximize life, as evidenced by what has happened during the current pandemic: the loss of too many valuable lives are largely due to unsuccessful measures taken here and there. Evidence is emerging that more low-income people have been infected and have died than high-income people, for example, “in New York, the ZIP codes in the bottom 25% of average incomes represent 36% of all cases of the disease, while the wealthiest 25% account for under 10%. In Michigan, for example, African Americans make up 14% of the population but account for a third of infections and 40% of deaths”. Again, in the USA, more than 20 million people applied for unemployment benefits in April 2020. For this, protective economic measures are required, but it needs to be taken from a different angle from traditional ones. In line with such considerations, the World Economic Forum is arguing that “Coronavirus has shown us why we urgently need to make a basic income a reality”. This is because the labor income share in GDP has been declining year by year, since the global financial crisis in 2008. Another trend needs to receive more attention. The nationalization trend of lifeline business in Spain, the UK, and France has re-emphasized the importance and necessity of protecting lifeline businesses and their employees. Furthermore, the various sustainable lifestyles have been practiced (some have been forced, but some are due to voluntary behavioral changes).

Research on the potential rise in car dependence after the COVID-19 pandemic
Even though more than 60% of participant experts agreed that there is a potential for increasing car dependence after the current pandemic, such a trend will not occur on its own. It will depend on various policies after the pandemic: industrial policies, anti-car measures via pricing, pro-car measures via new technologies (e.g., autonomous vehicles), the intensity of public transport improvement measures, active transport measures, changes in lifestyles and attitudes and so on. All these should be better addressed in the future.

8.3. Call for world-wide, interdisciplinary and cross-sectoral collaborations

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The COVID-19 pandemic is an unprecedented global crisis and similar crises will occur in future. Now is the time when our human society needs to take collective actions by breaking borders of countries, sectors, laws, and disciplines. To design effective measures against public health pandemics, information sharing (governments, firms, experts, and individuals, etc.) is extremely crucial, because we have to uncover the unknowns in terms of COVID-19 and its consequences as much as possible. Such information should be regarded as global public goods. For effective information sharing, consensus building is essential, but it must be speedy. To make this possible, preparedness drawing on lessons from history, and mutual learning among countries of the world, are key. To prepare well for future public health pandemics, world-wide, interdisciplinary and across-sectoral collaborations are urgently required.

Acknowledgements
We would like to especially appreciate all those experts who participated in the survey and provided valuable suggestions and opinions (see the italic parts in the main text). This research is supported by the WCTRS COVID-19 Task Force. Our sincere thanks also go to other members in the Task Force, students in Mobilities and Urban Policy Lab, Hiroshima University, who provided valuable comments, and Ms. Fuyo (Jenny) Yamamoto for her English proofing of the manuscript.

References
Appendix A: Major contents of the expert survey

<table>
<thead>
<tr>
<th>Categories</th>
<th>Detailed question items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparedness</td>
<td>Which of the following transport modes or systems in your city/town had guidelines for public health threats that were already prepared before the COVID-19 pandemic [multiple choices]?</td>
</tr>
<tr>
<td></td>
<td>◦ Aviation system</td>
</tr>
<tr>
<td></td>
<td>◦ Maritime system: Passenger</td>
</tr>
<tr>
<td></td>
<td>◦ Maritime system: Freight</td>
</tr>
<tr>
<td></td>
<td>◦ River/canal transport system</td>
</tr>
<tr>
<td></td>
<td>◦ Rail transit system (e.g., railway, subway, street car)</td>
</tr>
<tr>
<td></td>
<td>◦ Bus system</td>
</tr>
<tr>
<td></td>
<td>◦ Expressway, motorway, highway</td>
</tr>
<tr>
<td></td>
<td>◦ Logistics facilities</td>
</tr>
<tr>
<td></td>
<td>◦ Taxis</td>
</tr>
<tr>
<td></td>
<td>◦ Paratransit mode: auto rickshaw, Jeepney, tuk, etc.</td>
</tr>
<tr>
<td></td>
<td>◦ No guidelines for the above systems</td>
</tr>
<tr>
<td></td>
<td>◦ Do not know</td>
</tr>
<tr>
<td></td>
<td>◦ Others</td>
</tr>
</tbody>
</table>

When the transport and logistics services are interrupted by a public health pandemic, the daily life activities of millions of individuals are affected. Therefore, contingency planning to respond to such disruptions is required. In your city/town, which of the following transport modes or systems had contingency plans that were already prepared before the COVID-19 pandemic [multiple choices]?

|                             | ◦ Aviation system                                                                                                                                                                                                                                                                                                                                           |
|                             | ◦ Maritime system: Passenger                                                                                                                                                                                                                                                                                                                                 |
|                             | ◦ Maritime system: Freight                                                                                                                                                                                                                                                                                                                                |
|                             | ◦ River/canal transport system                                                                                                                                                                                                                                                                                                                          |
|                             | ◦ Rail transit system (railway, subway, street car)                                                                                                                                                                                                                                                                                                       |
|                             | ◦ Bus system                                                                                                                                                                                                                                                                                                                                            |
|                             | ◦ Expressway, motorway, highway                                                                                                                                                                                                                                                                                                                          |
|                             | ◦ Logistics facilities                                                                                                                                                                                                                                                                                                                                  |
|                             | ◦ Taxis                                                                                                                                                                                                                                                                                                                                                  |
|                             | ◦ Paratransit mode: auto rickshaw, Jeepney, tuk, etc.                                                                                                                                                                                                                                                                                                      |
|                             | ◦ No contingency plan for the above systems                                                                                                                                                                                                                                                                                                               |
|                             | ◦ Do not know                                                                                                                                                                                                                                                                                                                                           |
|                             | ◦ Others                                                                                                                                                                                                                                                                                                                                                  |

During-pandemic measures: Associated with the impacts

|                             | • Was your city/town locked down, is it currently locked down, or will it be locked down, because of the spread of COVID-19?                                                                                                                                                                                                                                     |
|                             | ◦ It was locked down                                                                                                                                                                                                                                                                                                                                     |
|                             | ◦ It is currently locked down                                                                                                                                                                                                                                                                                                                           |
|                             | ◦ It will be locked down                                                                                                                                                                                                                                                                                                                                |
|                             | ◦ No lockdown                                                                                                                                                                                                                                                                                                                                           |
|                             | • Lockdown and its timings (start and end dates)                                                                                                                                                                                                                                                                                                         |
|                             | • In the case of lockdown, what type of restrictions are put on mobilities?                                                                                                                                                                                                                                                                               |
|                             | ◦ limit on people who can go outside                                                                                                                                                                                                                                                                                                                      |
|                             | ◦ limit on number of times to go out                                                                                                                                                                                                                                                                                                                     |
|                             | ◦ no physical exercise or walking dogs outside house/apartment                                                                                                                                                                                                                                                                                            |
|                             | ◦ medical emergencies allowed                                                                                                                                                                                                                                                                                                                            |
|                             | ◦ medicine retrieval allowed                                                                                                                                                                                                                                                                                                                             |
|                             | ◦ shopping of daily necessities allowed                                                                                                                                                                                                                                                                                                                   |
|                             | ◦ closure of schools                                                                                                                                                                                                                                                                                                                                     |
|                             | ◦ closure of factories                                                                                                                                                                                                                                                                                                                                   |
|                             | ◦ closure of offices                                                                                                                                                                                                                                                                                                                                     |
|                             | ◦ closure of stores                                                                                                                                                                                                                                                                                                                                     |
|                             | ◦ others                                                                                                                                                                                                                                                                                                                                                 |

Declaration of a state of emergency and its timings:

|                             | • residence country                                                                                                                                                                                                                                                                                                                                       |
|                             | • residence city/town                                                                                                                                                                                                                                                                                                                                   |

Activities/facilities prohibited to perform/use under the current COVID-19 pandemic in residence city/town

|                             | ◦ gastronomical services: e.g., restaurant, barbecue at a park                                                                                                                                                                                                                                                                                            |
|                             | ◦ cultural events: e.g., concert, exhibition, festival                                                                                                                                                                                                                                                                                                     |
|                             | ◦ sports events                                                                                                                                                                                                                                                                                                                                        |
|                             | ◦ amusements: e.g., casino, bar, night club                                                                                                                                                                                                                                                                                                             |
|                             | ◦ retail shops                                                                                                                                                                                                                                                                                                                                         |

<table>
<thead>
<tr>
<th>Measures taken in residence city/town against COVID-19</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ Military forces were or have been dispatched to transport emergency logistics materials.</td>
</tr>
<tr>
<td>○ Military forces were or have been dispatched to take care of emergency medical services.</td>
</tr>
<tr>
<td>○ Stay-at-home campaign has been propagated across the whole city/town.</td>
</tr>
<tr>
<td>○ Monetary compensations have been paid to citizens for income reduction, medical treatment, etc.</td>
</tr>
<tr>
<td>○ Monetary compensations have been paid to transport and logistics firms suffering from economic losses.</td>
</tr>
<tr>
<td>○ Economic stimulus measures have been taken for recovery of industries.</td>
</tr>
<tr>
<td>○ Protection measures for physical distancing have been taken based on information collected by tracing behavior trajectories via mobile phone, security video camera, credit card and/or other high-tech media.</td>
</tr>
<tr>
<td>○ Drones and/or robots have been used to inform people to keep physical distances and wear masks, etc.</td>
</tr>
<tr>
<td>○ Physical distancing measures have been taken in public transport and their stations/stops (e.g., bus passengers use only rear doors to avoid close contact with the driver, bus/rail opens windows during operation).</td>
</tr>
<tr>
<td>○ Physical-distancing-friendly goods delivery has been widely practiced.</td>
</tr>
<tr>
<td>○ Others</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommendations to the public in your city/town against COVID-19</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ Telework (or online working)</td>
</tr>
<tr>
<td>○ Online meeting</td>
</tr>
<tr>
<td>○ Online lecture</td>
</tr>
<tr>
<td>○ Restrict the passengers to get into public transport (e.g., train, subway, bus)</td>
</tr>
<tr>
<td>○ Make an online booking before using a public transport (e.g., train, subway, bus)</td>
</tr>
<tr>
<td>○ Avoid having a gathering event (e.g., park, square/plaza, church)</td>
</tr>
<tr>
<td>○ Avoid eating out</td>
</tr>
<tr>
<td>○ Physical exercise alone or with few people</td>
</tr>
<tr>
<td>○ Others</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modal shifts in residence city/town during the pandemic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you observe significant modal shifts in your city/town [multiple choices]?</td>
</tr>
<tr>
<td>○ from public transport to car</td>
</tr>
<tr>
<td>○ from public transport to motorcycle</td>
</tr>
<tr>
<td>○ from public transport to bicycle</td>
</tr>
<tr>
<td>○ from public transport to walk</td>
</tr>
<tr>
<td>○ others</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expected long-term changes in people’s lifestyles in residence country</th>
</tr>
</thead>
<tbody>
<tr>
<td>How much do you agree to each of the following statements about long-term changes in people’s lifestyles in your residence country, caused by the influence of COVID-19? [fully disagree, disagree, neutral, agree, fully agree]</td>
</tr>
<tr>
<td>○ Online working (working at home, neighboring satellite offices, cafes, etc.) will become popular.</td>
</tr>
<tr>
<td>○ Online shopping will become the most popular shopping activity.</td>
</tr>
<tr>
<td>○ Online services of government, bank, ticket purchase, etc. will become a standard service.</td>
</tr>
<tr>
<td>○ Online education will be a standard model of education.</td>
</tr>
<tr>
<td>○ Working hours will become longer.</td>
</tr>
<tr>
<td>○ The society will become more isolated due to the progress of online activities and smart technologies (AI, IoT, robotics, etc.).</td>
</tr>
<tr>
<td>○ Family bonds will be enhanced significantly.</td>
</tr>
<tr>
<td>○ Infection risk level of a job will determine job choices.</td>
</tr>
<tr>
<td>○ More and more people will choose a job allowing them to mainly work at home.</td>
</tr>
<tr>
<td>○ More and more people will choose to live far from the city center.</td>
</tr>
<tr>
<td>○ More and more people will out-migrate from populated cities.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expected long-term changes in the society in residence country</th>
</tr>
</thead>
<tbody>
<tr>
<td>How much do you agree to each of the following statements about long-term changes in the society of your residence country, caused by the influence of COVID-19? [fully disagree, disagree, neutral, agree, fully agree]</td>
</tr>
<tr>
<td>○ More and more inter-city business trips for meetings will be replaced by online meetings.</td>
</tr>
<tr>
<td>○ More and more intra-city business trips for meetings will be replaced by online meetings.</td>
</tr>
<tr>
<td>○ Smart technologies (e.g., AI, IoT, robotics) will be the key to detect and sound the alarm about the occurrence of future public health threats.</td>
</tr>
</tbody>
</table>

- Social and economic systems will not return to the previous ones before COVID-19.
- The above changes will contribute to improving resilience and sustainability of the transport and logistics sector.
- The cost structure of the transport and logistics sector may be altered dramatically to prepare for future public health threats.
- The intervention of governments to transport/logistics industries will be strengthened after COVID-19.
- The car dependence will become more obvious due to adverse reactions to crowded public transport during the COVID-19 pandemic.
- Significant changes will occur, within 5 years, in transport and logistics policymaking due to lessons from COVID-19.
- The induced growth of online business and automation will lead to more unemployment.

**Experts’ additional suggestions, opinions, etc.**

We would like to highly appreciate it if you could kindly give additional suggestions about the ongoing measures and the post-COVID-19 pandemic policies for recovery of the transport and logistics sector as well as long-term transport/logistics policies, and/or provide us important information sources that you want to share with us.

**Individual attributes**

Your research or professional field(s) [multiple choices]
- Passenger Transport
- Freight Transport and Logistics
- Traffic Management, Operations and Safety
- Transport Economics and Finance
- Transport and Land Use
- Transport, Climate Change and Environment
- Transport Planning and Policy
- Transport in Developing and Emerging Countries
- Transport Infrastructure Design and Maintenance
- Urban and Regional Planning
- Tourism
- Energy Policy
- Public Health
- Others

Residence country, city/town

Your main occupation(s) [multiple choices]
- Education: university, school, college, etc.
- Central government
- Local government
- International organization
- Research institute / think tank
- Private firm: consultancy / engineering
- Private firm: transport/logistics service provider
- Private firm: transport-related manufacturer
- NGO / NPO
- Other

How many years have you worked in your expertise? [unit: years]