2.4.1. Implication of new mobility to road network operation

<table>
<thead>
<tr>
<th>Strategies / Objectives</th>
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<tbody>
<tr>
<td>• Investigate new mobility forms (connected and autonomous vehicles, zero-emission vehicles, sharing cars,…) and MaaS concept and its applications around the world in order to explore its critical role and how effective road network management and operations contribute to ensuring mobility.</td>
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<tr>
<td>• Highlight risks challenges and opportunities of new mobility and MaaS.</td>
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<td>• Investigate MaaS business model, which the clear aim of address how big the model should to be attractive and viable for road agencies and road users, with a specific focus on:</td>
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<td>o Who should it serve.</td>
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<td>o How to manage the demand?</td>
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<td>o How to integrate the choices and focus clearly on the operational aspects?</td>
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<tr>
<td>• Provide guidance at the right stage of development to assist the industry in implementation and decisions.</td>
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<td>• Encourage coordination with other TCs and TFs, such as T.C. 1.1 Performance of Transport Administration, T.F. B.2 - Automated vehicles – Challenges and opportunities for road operators and authorities, T.C.2.1 – Mobility in Urban Areas, T.F.2.1 – New mobility and its impact on Road Infrastructure and Transport, and T.C.3.1 – Road Safety</td>
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Mobility as a Service (MaaS) is still a fairly new concept as a tool of Intelligent Transport Solutions.

MaaS tools have been launched in several countries such as:

• Finland, where this idea was born. Through the website https://whimapp.com/, users are allowed to access various modes of transport through a single app.

• Vienna (Austria) with its SMILE project-pilot. Smart Mobility Info & Ticketing System Leading the Way for Effective E-Mobility Services, which offers a unique mobility solution for users. The pilot allowed 1,000 users access to a smart app to make transport choices with 16 different service providers. The results of the pilot study are shown here http://smile-einfachmobil.at/index.html.

• Hannover (Germany), where the world’s first example of Mobility-as-a-Service has been launched. GVH’s (Greater Hanover Transport Association) ‘Mobility Shop,’ https://www.gvh.de/, the very first fully operational example of MaaS in Germany.

One last example has been developed in order to understand the concept of MaaS. KPMG has created an innovative MaaS requirements Index to help authorities gain a deeper understanding of their platforms and where risks and opportunities lie.

This topic still needs further exploration especially in regard to its effect on road infrastructure management and operations and is quickly evolving.

Where single public transport offerings i.e. rail, bus etc. have failed to entice the private car user, MaaS offers an integrated approach to satisfy all types of users. In a highly connected society, MaaS delivers tailored solutions to fit a user’s need.

It represents a convergence of public and private transportation to provide a single integrated solution for individual users needs all while still attempting to address congestion, safety and convenience.

The MaaS concept is still in a developmental stage with various countries implementing pilot projects. As with all developing concepts, there may be many benefits, but risks and challenges need to be considered.

From a demand side, the user expects a myriad of transport choices, however the back end would require multiple private and public service providers to collaborate and provide the best offers of transport. Private partners whilst integrating into such a system will still need to protect their business model whilst partnering with public agencies.

From a supply side, it would require effective operations of road and infrastructure in ensuring that the journey combinations are reliable. This concept however places great emphasis on the reliability and accuracy of traveler information systems. Users will require real time data to make the relevant mode choices. The transportation network needs to understand travel patterns, optimize the network, and calibrate demand and supply.

The front end is where the user will interact with the system and should not only provide modal offerings but transport information that can affect their journey plans i.e. construction activity, traffic alerts etc. with a simple and easy to use interface.
The concept in itself is promising with the potential to transform the way mobility and technology relate to each other however the implementation and operations is complicated where multiple parties with differing needs to cooperate and manage their risks.

In addition, the emergence of autonomous vehicles is the subject of much works and studies within and outside PIARC. In most cases, the approach is vehicle-centered, forgetting the necessary evolution of the infrastructure. Nowadays, the higher the level of automation (from 1 to 5), needs the higher the performances requirements of the infrastructure. This subject has been briefly addressed (Routes/Roads No. 373) under the acronym HQoSH (High Quality of Service Highway).

The objective is to further develop this concept. This will include identifying all the characteristics of the road that are significant for the autonomous vehicle to be able to travel safely. For each of these characteristics, it may be necessary to define a metric in order to quantify the level of quality offered by the road. This quality level could be related to the level of automation required (for example, for autonomous driving at level n (n between 1 and 5), an infrastructure offering a level of quality at level p (p values to be defined) is required). The issue of the digital infrastructure (definition, condition for updating) needs also to be addressed. Beyond the technical aspect, business aspects, stakeholder’s role and underlying value chain could also be addressed. Finally, investigating how private and public sectors should direct their trades and skills to meet these new challenges would be very valuable.

Definitely, the aim of this task is to explore the critical role effective network management and operations contribute to ensuring MaaS is an attractive solution to enable the shift from car ownership to usership for transport, taking in account all the new mobility technologies. It is to address the risks and challenges and the opportunities to mitigate and manage these challenges.

So, firstly it is necessary to make a review of the work carried out so far by different organizations, and to collect and analyze different experiences. Based on them, a briefing note addresses:

- How big the model should be for it to be attractive and viable?
- Who should it serve?
- How do you manage the demand and how would you integrate the choices and focus clearly on the operational aspects?

A briefing note of this nature will therefore not only benefit the public sector but the private sector that wants to cooperate and operate in this space.

Finally, with this concept still in its early stage, this report can provide guidance at the right stage of the development to assist the industry in implementation and decisions. This contribution from PIARC will be relevant and useful if completed early enough for consumption by the industry.

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<tr>
<th>Outputs</th>
<th>Expected Deadlines</th>
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<tbody>
<tr>
<td>Literature review</td>
<td>November 2020</td>
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<tr>
<td>Collection of case studies.</td>
<td>December 2021</td>
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<td></td>
<td>March 2023</td>
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<tr>
<td>Briefing note</td>
<td>June 2021</td>
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### 2.4.2. Optimizing road operations and performances through new technologies and digitalization

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<th>Strategies / Objectives</th>
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<tr>
<td>Identify best practices related to the application of Big Data and data driven decision-making in order to increase the productivity and performance of the road network.</td>
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<tr>
<td>Investigate the role of new technologies and digital tools within the transportation sector, underlining how they can enhance road network operations and enable efficiency.</td>
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<tr>
<td>Investigate traffic management strategies and techniques, including off-line (e.g. traffic signal review) and online (e.g. balancing traffic density or gating) approaches related to ITS systems.</td>
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<tr>
<td>Study the current values of KPI’s of the performance of operations and maintenance within RNO and ITS systems in order to enable the comparison thanks to the new tools and processes of optimization.</td>
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<td>Take in account the work carried out by the T.C. B.1. Road Network Operations/Intelligent Transportation Systems, in particular on “Big data in Road transport” and develop it more to promote knowledge sharing.</td>
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<td>Encourage coordination with other TCs and TFs, such as T.C.1.5 – Disaster Management, T.C.2.1 – Mobility in Urban Areas, T.C. 2.2 – Accessibility and Mobility in Rural Areas, T.C.2.3 – Freight, T.F.2.1 – New mobility and its impact on Road Infrastructure and Transport, T.C.3.1 – Road Safety, , T.C. 3.2 – Winter Service and T.C.3.3 – Asset Management.</td>
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As far as “Optimizing the operation and performance of existing facilities” concerns, this topic needs to be studied more deeply because of the fast changes in technology, concepts and processes.
Road network capacity is not fully utilized, as traffic demand is concentrated on only small proportion of the road network (i.e. bottlenecks) and time-of-the day (i.e. peak periods). A balanced operation of the road network has the potential to unlock untapped productivity of the road network resulting in less congestion delay and more reliable travel times.

In the several emerging countries, a lot of road operators and governmental agencies do not have enough knowledge and funds to optimize the performance of operation and maintenance due to different reasons (political, social, legal, technical and economical and/ or lack of knowledge, goals, objectives, will, management, analysis of risks and so on).

This aim of this topic seeks to optimize the performance of operation and maintenance with a systemic and transversal point of view, involving road operators, universities, NGO’s and, urban, interurban and regional Governments.

On the other hand, other topics such as optimizing mobility and education, jobs, welfare, health, industry with their KPI’s and their contribution to the growth of the country, have been taken into account. Another topic considered is the added value or transference of technology of the developed countries to the emerging countries. That process should be developed creating strengths into the local market and in the local engineers. Indeed, emerging countries need to develop their own technologies so that they can get out of the dependence on foreign technologies. In relation to this issue, studying the transition of technology between the existing facilities and the news and the use of the drones, Big Data, electric infrastructure and vehicles, V2V and I2V communications and AI (artificial intelligence) technologies to the process of optimization should be considered too.

In addition, data is the basis for road network operations. While in the past only data generated by own resources (sensor data) has been considered for road network operations, currently, several data sources can be used for a highly improved road network operation in all areas: planning, management and maintenance. Procedures and processes within road network operator need to be improved in order to enable road network operators to use data from different sources efficiently.

Within the new cycle, best practice examples for data driven decision making need to be collected and discussed. This includes how to collect data from vehicles (or vehicle fleets), how to use this data, how to merge data from vehicle sensors with own sensor data and data from 3rd parties, and how to improve existing services with these improved data sets.

Based on the experts’ discussions, the future need of a road sensor network should be evaluated. Where road network operators will still need to invest in own sensors in the future, and under which conditions data from other sources might be able to replace own sensor data.

Furthermore, the emergence of more data on road network performance (i.e. Big Data for Road Network Operations) has opened new possibilities in managing and controlling road traffic. For example, ramp signals have taken advantage of data from high density detectors on motorways to prevent flow breakdown on motorways. Similar approaches can be developed for the whole road network, particularly for the arterial road network by employing emerging data on the road network, such as Bluetooth, more detectors, probe vehicle data, etc.

The research objective would be to identify best practice in increasing the productivity of the road network through the application of Big Data and data driven decision-making. The focus would be on the traffic management strategies and techniques, including off-line (e.g. traffic signal review) and on-line (e.g. balancing traffic density or gating) approaches.

By last, we know that data-driven decision making is highly important as soon it comes to connected and automated vehicles using the road infrastructure. Therefore, a clear approach needs to be given.

Besides, almost all technical committees are dealing with data-driven decision-making. The challenge of this cycle should be how to concentrate the knowledge. Ideally, more flexible committee meetings are needed, where committees start working closer or somehow coordinate with each other than to work isolated.

The output of the research work would be a best practice review and a collection of examples case studies. The research would also identify the scale of the impacts, where available. In addition, a Seminar and a Conference/Workshop carried out within the 2020-2023 Cycle have been part of the preparation of the report.

Over the last couple of decades, governments around the world have been seeking policy and investment solutions to meet the ever increasing demand for access and mobility as the world population continues to grow. Rather than focusing on building extra capacity, more efficient solutions can sometimes be found by using existing capacity, where possible and appropriate.

There are at least two aspects to the Smart Use of Roads theme, as defined above:

- How to apply Big Data to extract additional capacities from a congested road network?
- How to balance the various demand for road space from different road users (cars, freight, public transport, cyclist and pedestrians) in a congested network?

Both topics are considerable broad themes by themselves. Both are important but the nature of expertise and application are not the same. The first topic focuses strictly on optimizing vehicular throughput, while the second topic aims to incorporate people throughput, place-making and mode share policies.

Given that within 2016-2019 cycle groundworks on Big Data have been carried out, it appears logical to consider focusing on research on the application of Big Data to optimize vehicular traffic throughput, as it extends from the groundwork already
done on Big Data for Road Network Operations. It is also more in-line with the nature of the RNO/ITS technical committee’s scope and expertise.

Within the 2016-2019 cycle, a report on Big Data for Road Network Operations examined the potential for the application of Big Data to Road Network Operations. The main core of the report was the framework and benefits of Big Data. It did not examine in detail the traffic operation strategies and techniques that can translate the potential of Big Data to improved road network capacity. Therefore, the topic is a novelty and timely to be studied in this cycle.

To conclude, an expected output consists in a deep report of the current values of KPI’s of the performance of operation and maintenance and the comparison with the achieved values with the new tools and processes of optimization. It is necessary to analyse and describe the different processes in several countries and to compare them with specific KPI’s.

<table>
<thead>
<tr>
<th>Outputs</th>
<th>Expected Deadlines</th>
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<tbody>
<tr>
<td>• Collection of case studies.</td>
<td>• June 2022</td>
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<tr>
<td>• Full report.</td>
<td>• December 2022</td>
</tr>
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</table>

### 2.4.3. Update of the RNO/ITS Manual

#### Strategies / Objectives

- Provide a medium-level overview / insight into RNO-ITS for decision-makers, middle managers and young professionals,
- Provide technical advice relevant to countries and regions that have not developed any ITS project yet,
- Exchange knowledge and techniques on RNO-ITS.
- Regular work to:
  - Identify articles that are not relevant (obsolescence, etc.).
  - Update the articles (including a research work to illustrate them with images, videos, case studies, references, etc.)
- A survey will be carried out regularly in order to ensure that the content of the website is relevant for its users.
- Encourage coordination with other TCs and TFs, such as T.C.2.1 Mobility in Urban Areas, T.C.2.3 Freight, T.C.3.1 Road Safety, T.C.3.3 Asset Management and T.C.4.4 Tunnels.

The Road Network Operation (RNO) and ITS online manual is one of the few thematic online resource of PIARC. It has been developed thanks to USDOT funds and ITS America expertise and was open to public after a huge work at the end of the cycle 2012-2015 in English, and afterwards in Spanish and French.

The focus of the RNO-ITS website is the role of ITS in Road Network Operations, not the entire scope of ITS. The website is a handbook for people who are not already ITS specialists. The target of the manual is therefore not the experts, but senior staff such as decision-makers or middle managers in road authorities. The website also has value for young professionals who are learning about RNO and ITS and RNO. Many road authorities in developing countries are new to road network operations and look to PIARC for advice and guidance. The RNO-ITS website addresses this need very well, but goes well beyond in trying to keep pace with the latest developments in ITS – such as ITS-based user services and connected and automated driving.

During the 2016-2019 PIARC work cycle, the objective was to maintain and to update the RNO and ITS online manual. In order to achieve this objective, a preliminary task was to create and to edit a monitoring file describing the content of each article: author, date of last change, associated case studies and videos, etc. This file has been consolidated in late 2018 and will be one deliverable of the work of the workgroup in charge of the maintenance and of the update of the website, however it may be an unexpected deliverable.

The main objectives of the development and the update of the Road Network Operations and ITS online manual are:

- Provide a medium-level overview / insight into RNO-ITS for decision-makers, middle managers and young professionals,
- Provide technical advice relevant to countries and regions that have not developed any ITS project yet,
- Exchange knowledge and techniques on RNO-ITS.

This resource is not meant to be an academic resource.

The website is currently composed of 4 themes:

- Basics of RNO and ITS,
- Road network operations,
- Building blocks,
• Emerging economies.

Some figures (2018) about the RNO-ITS online manual give an insight about the content:

• about 350 articles, making the equivalent of 1,050 pages if the whole manual was to be converted as a A4-page report,
• 72 case studies, aiming at increasing with the new case studies written down during the 2016-2019 cycle,
• 53 videos,
• references to PIARC reports from previous cycles.

To achieve the objectives, the website needs to be:

• technically maintained in the three languages: the content, especially the content that is not hosted on the website such as medias and external links, needs to be always accessible,
• reviewed: since PIARC stands for high-quality, out-of-date content is not welcome on this website. The review will ensure that the content is still up-to-date or will suggest articles that needs to be updated. This is particularly true for technologies within RNO and ITS, which evolve quickly,
• updated: to get the latest content, either when content is not up-to-date anymore, or if a new topic has to be tackled with, such as connected vehicles, autonomous driving, etc,

<table>
<thead>
<tr>
<th>Outputs</th>
<th>Expected Deadlines</th>
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</thead>
<tbody>
<tr>
<td>Update of the RNO/ITS Manual</td>
<td>Up to June 2023</td>
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