Deliverable D 8.2
Advisory Board Final Technical Recommendations

Project acronym:	OPEUS
Starting date:	01/11/2016
Duration (in months):	36
Call (part) identifier:	H2020-S2R-OC-CCA-2015-02
Grant agreement no:	730827
Due date of deliverable:	Month 36
Actual re-submission date:	10-07-2020
Responsible/Author:	UIC / Christine Hassoun
Dissemination level:	PU
Status:	Final v2

Reviewed: (**yes**/~~no~~)

The OPEUS project has received funding from the European Union's Horizon2020 research and innovation programme under grant agreement number 730827

Document history		
Revision	***Date***	***Description***
Draft_v1	October 2019	Document initiated, initial content created
Draft_v2	December 2019	Content updated
Draft_v3	January 2020	Content updated, issued for review
Final	12th February 2020	Update following review, formatting to finalise
Final v2	June 2020	Update following final external review

Report contributors		
Name	**Beneficiary Short Name**	**Details of contribution**
Christine Hassoun	UIC	Initiation, iterations, partner contributions collations
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1. Executive Summary

This document has been prepared as a result of the OPEUS project (Grant Agreement 730827), which has been delivered with funding from Horizon 2020, EU Research and Innovation programme (2014-2020). OPEUS - "Modelling and strategies for the assessment and OPtimisation of Energy USage aspects of rail innovation" - addresses topic S2R-OC-CCA-02-2015 "Energy usage, generation and saving approaches" (call identifier H2020-S2RJU-2015-01) as part of the Shift2Rail Joint Undertaking first open call, and aimed to develop a simulation methodology and accompanying modelling tool to evaluate, improve and optimise the energy consumption of rail systems with a particular focus on in-vehicle innovation.

This report constitutes OPEUS deliverable D8.2 "Advisory Board Final Technical Recommendations", developed as a result of the delivery of WP8, specifically Task 8.2, and facilitated by all the activities undertaken during delivery of all the other OPEUS WPs. It illustrates the activities undertaken by the project beneficiaries in establishing and developing the project's Advisory Board membership, its contribution to project delivery, and the recommendations coming about at the project end.

The role of the Advisory Board is considered, including its link to the complementary S2R Member's project "Future Improvement for Energy and Noise" (FINE1), (Grant Agreement number 730818). Then, the activities undertaken with AB members throughout the project's duration are explored, including the evolution of the group's membership to encompass the FINE1 Energy Group representatives, their inputs to the OPEUS Project delivery and development of the simulation Tool and their views on the future dissemination and exploitation of the OPEUS Tool resulting from the project successful conclusion.

The report concludes that the input of the AB members and their technical recommendations have been integral to the success of the project, such that the OPEUS Tool is intended for use within subsequent project "FINE2", thereby paving the way for additional stakeholders in the railway sector including operators, manufacturers, and research institutions to use the approved Tool to run detailed analyses themselves of new technologies and concepts.

2. Abbreviations and acronyms

Abbreviation / Acronyms	Description
AB	Advisory Board
DoA	Description of Action
Dx.x	Deliverable x.x
EC	European Commission
FINE1	Shift2Rail partner project: Future Improvement for Energy and Noise – Grant Agreement number: 730818
H2020	Horizon 2020
Mx	Month x
OC	Open Call
OPEUS	Modelling and strategies for the assessment of OPtimisation of Energy Usage aspects of rail innovation – Grant Agreement number: 730827
S2R	Shift2Rail
Tx.x	Task x.x
WPx	Work Package x
Project Participant Short Name:	Project Participant:
UNEW	University of Newcastle upon Tyne (project beneficiary No.1, Project Coordinator)
UIC	International Union of Railways (project beneficiary No.2)
UITP	International Union of Public Transport (project beneficiary No.3)
SAFT	SAFT Technologies (project beneficiary No.4)
UROS	University of Rostock (project beneficiary No.5)
STAV	Stadler Rail Valencia SAU (project beneficiary No.6)

3. Background / context

The OPEUS project received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement number 730827.

The aim of the project was to develop a simulation methodology and accompanying modelling tool to evaluate, improve and optimise the energy consumption of rail systems, with a focus on in-vehicle innovation.

The main objectives of the OPEUS project comprised:

- Defining a simplified but universal energy requirements outlook for European urban rail systems
- Developing a comprehensive rail energy usage simulation methodology
- Developing an energy consumption simulation modelling tool for assessment purposes and which was applicable to urban, regional, high speed and freight duty cycles
- The further assessment of the role and optimisation potential of driver advisory systems (DAS) in relation to control strategies for different representative duty cycles and traction types
- The further assessment of the potential for energy usage optimisation of novel technologies (e.g. next generation ESSs) and strategies (e.g. engine power-off at low loads)
- Providing a critique of the energy consumption outlook for railway systems.

Comprising 9 Work Packages (WP) in total, the focus of Work Package 8 (WP8) has been "Engagement". Its objective was "to establish a clear and fruitful communication platform between the OPEUS activities and those outside the consortium focusing in particular on the essential relationship with the Shift2Rail (S2R) founding members and associates and their innovation activities related to OPEUS".

4. Objective / aim of this report

This document has been developed as a result of the delivery of WP8, specifically Task 8.2, and facilitated by all the activities undertaken during delivery of all the other OPEUS WPs.

This deliverable report aims to explain the reason for the development of an Advisory Board (AB) for the OPEUS project, the origins and evolution of its composition, its engagement with the project as per the DoA, and the technical recommendations coming about at the project end.

5. The role of the Advisory Board

To assist in the fulfilment of the above objectives and achievement of the project's aim, it was planned at the project's development stage that an AB would be established as an instrument to maximise project impact. It was to act as a sounding board providing feedback on the approach being taken and the progress of the project, and to also facilitate engagement, dissemination, exploitation and adoption of the OPEUS project results (specifically the OPEUS Tool) by the wider railway community.

The AB's composition was considered carefully so as to include personnel with relevant expertise and an active interest in energy optimisation from a variety of aspects; industry stakeholders, S2R representatives and a representative of the S2R Member's project "Future Improvement for Energy and Noise" (FINE1), Grant Agreement number 730818.

6. Advisory Board activity and technical recommendations

The original membership of the AB was defined at the stage of the project being developed. The finer detail of the personnel targeted and engaged at this point are set out in the DoA Annex 1 Part B (Section 2.2.3). To summarise, the group was to comprise 6 individuals from different industry organisations, one of who was nominated as Chair for the occurrence of any specific AB meetings that might be undertaken. UNEW had contacted the intended AB members to introduce them to the project and explain how their engagement was to be facilitated, including practical items such as confirmation that their travel costs for OPEUS meetings would be covered by a specific budget.

Since the AB was established, several the originally-engaged members have unfortunately moved on from their roles and have therefore not been available to OPEUS. UNEW attempted on two occasions to organise a physical meeting alongside a project Plenary but, due to incompatibility of dates, it was not possible to meet. However, two individual members of the AB (namely Mr Bart Van der Spiegel and Mr Laurent Dauby) have been available for project activity consultation on an as-and-when needed basis, some of which was undertaken 'remotely'. There was no negative impact on the progression of the project stemming from this.

As there had been the desire originally to also include representation from the FINE1 project in the composition of the AB, the opportunity was seized to engage more meaningfully with the FINE1 Partners, especially those within their Energy Group, to reinforce the OPEUS AB composition to fulfil the role of the group as per the DoA, whilst maintaining the required varied and relevant stakeholder and industry composition.

The high level objective within the S2R Energy topic is to systematically assess and benchmark the impact of innovative technologies on energy demand and costs in European railway systems, and as both OPEUS and FINE1 worked towards this they have enjoyed a close and fruitful working

relationship throughout project delivery. Personnel from both project Partners have participated in several of each other's working groups to assist the collaborative working, assessment and evaluation of key performance indicators and the production of deliverable reports and meaningful project results. To illustrate, UROS, STAV and UNEW have participated in collaborative meetings with FINE1 numerous times, both face to face and online via teleconference facility and a list of these meetings is included as Annex 1 (this is also included as appropriate to the OPEUS project's 1st and 2nd Periodic Technical Reports) These meetings were, in-part, AB update meetings with the sharing of progress on the development of the Tool and discussion regarding the ideas and advice for the process development and testing of the Tool (i.e. the main objective of the OPEUS project) but also looked into the establishment of the next steps for exploitation of the Tool in the context of the railways sector (as defined through the work conducted in Del 9.2). As such, the specific OPEUS partners participating in the different groups/ meetings were aligned with the owners of the action being conducted, e.g. for the energy storage system it was SAFT and SNCF, for calculation of energy KPI and tool improvement it was UROS and DLR.

Throughout the involvement of FINE1 members as OPEUS AB resource, original AB members were also included to this dialogue wherever possible; by way of example, the OPEUS Plenary meetings benefitted greatly from the involvement of Mr Laurent Dauby (UITP) on numerous occasions. These meetings provided the means by which to discuss the finer points of the OPEUS Tool technical development, its targeted credibility within the sector as a meaningful offer, and the associated plans for exploitation after the project timeline.

From the FINE1 Energy Group as end users of the Tool, continuous feedback about the requirements, capabilities and functionality of the OPEUS Tool as it was under development resulted in a number of incremental improvements as the versions progressed from v1 to the final release. In this way, the AB has not only assisted the development of tool, but also the validation of its functionality, for example SNCF's involvement in the WP6 activity that concluded in deliverable D6.2, the simulation based assessment to derive the innovative technologies influence on energy usage assessment.

The above interactions with AB members ensured that the planning, development and production of the OPEUS Tool has been inclusive of the thoughts, views and opinions of leading industry players and stakeholders regarding both the development of a simulation methodology and the modelling tool. The resulting OPEUS Tool will be an appropriate and effective tool for industry use when considering ways to improve and optimise energy consumption in the sector.

Near the end of the OPEUS project timescale, advice from the AB was helpful in the coordination of development of the scope, content and outreach of the joint Shift2Rail CCA OPEUS and FINE1 Final Event that was held at UIC in Paris on 17th October 2019. This was particularly relevant for the setting up of a specific session on the proposed future development, enhancement and exploitation of the OPEUS Tool, out of which came some key messages and ideas:

- Distribution, handling, publication of the Tool - covering the development of the graphical user interface as well as possibilities for a simpler use of the Tool

- Extension of the functionalities of the Tool – consideration of a wide scope of possible enhancements to add further capability to improve scope and accuracy e.g. machine learning algorithms for energy optimized operating strategies, assessment of thermal aspects, extension of the model topologies (e.g. include fuel cells) as well as extensions to cover further infrastructure parameters
- The presented possibilities for the enhancement were discussed afterwards, which results in further enhancement suggestions, e.g. an inclusion of a detailed HVAC (heating-ventilation-air-conditioning) model.

An important result from OPEUS is the draft position paper on the energy outlook for railway systems which was developed with input of AB members and presented at the October 2019 Final Event with FINE1, covering areas such as potential actions underpinned by the Avoid-Shift-Improve approach, contribution of the work of OPEUS to the objectives of S2R and a set of recommendations to support addressing energy related aspects of railway systems. These can be summarised as the need to have a holistic approach to energy efficiency that will deliver substantial benefits towards decarbonisation. The position paper, in this sense, turned out to be aligned with EC policy towards decarbonisation and climate change actions.

7. Conclusions

The arrangement with the FINE1 Energy Group and the positive, productive and continuous collaborative nature of this has proven to be the most effective away to seek, discuss and implement external advice on the core issues related to the technical and practical implementation of the work in OPEUS.

The FINE1 Energy Group has satisfactorily fulfilled the role envisaged for the original Advisory Board. Specifically, the technical recommendations of the AB have had a significant positive impact in the following areas:

- Removing the use of gradients from representative synthetic duty cycle profiles based on the current prEN50591 standard “Specification and verification of energy consumption for railway rolling stock” to facilitate a valid comparison of energy estimations for research purposes;
- Development of a representative synthetic duty cycle profiles for metro services, currently not included in prEN50591;
- Core areas for tool enhancement beyond OPEUS including expanding the functionalities of the tool to add further capability to improve scope and accuracy e.g. machine learning algorithms for energy optimised operating strategies, assessment of thermal aspects, extension of the model topologies (e.g. include fuel cells) as well as extensions to cover further infrastructure parameters.

Other key contributions have included active participation of the AB members in the validation of the tool and review of the OPEUS' position paper. These inputs have been instrumental in the success of the project.

The OPEUS Tool was also intended for use within subsequent project "FINE2", having been standardised against preliminary standard prEN50591, the development group within which FINE1 closely cooperated. This paves the way for additional stakeholders in the railway sector including operators, manufacturers, and research institutions) to use the approved Tool to run detailed analyses themselves of new technologies and concepts.

Annex 1 – List of OPEUS-FINE1 collaborative meetings

Meeting category/Title	Linked WP / Activity	Date	Location	Participants (beneficiaries short name)
OPEUS + FINE1 preparatory meeting	All	7.10.2016	Via telco	UNEW
FINE1 kick-off meeting	WP1 – WP9	1.12.2016	Brussels	UNEW
FINE1 + OPEUS project collaboration meeting	WP2, WP3	3.3.2017	Via telco	UNEW, UROS, STAV
FINE1 + OPEUS project collaboration meeting	WP2, WP3	22.3.2017	Brussels	UROS, STAV
CCA energy meetings	All	31.3.2017 + quarterly, subsequently	Via telco	UNEW
FINE1 + OPEUS project collaboration meetings	WP2, WP3	21.4.2017 5.5.2017 2.6.2017 7.7.2017 8.9.2017 19.10.2017 16.11.2017 14.12.2017 8.2.2018	Via telco	UNEW, UROS, STAV
FINE1 + OPEUS project collaboration meeting	WP2, WP3	14.3.2018	Munich	UNEW, UROS, STAV
FINE1 + OPEUS project collaboration meetings	WP2, WP3	5.4.2018 4.5.2018 6.6.2018	Via telco	UROS, STAV
Joint Shift2Rail CCA OPEUS and FINE1 Final Event	All	17.10.2019	UIC, Paris	All