Advanced traffic management solutions for synchronized and resilient multimodal transport services

SYNCHROMODE

D1.1: Project & Innovation Management plan

Responsible author: E. Mitsakis
Contributing authors: A. Kotsi, D. Tzanis
Date: 30/06/23

This project has received funding from the European Union's Horizon Europe research and innovation program under grant agreement No 10110471

Legal disclaimer: The information in this document is provided “as is”, and no guarantee or warranty is given that the information is fit for any particular purpose. The above referenced consortium members shall have no liability to third parties for damages of any kind including without limitation direct, special, indirect, or consequential damages that may result from the use of these materials subject to any liability which is mandatory due to applicable law.
© 2023 by SYNCHROMODE Consortium.

This report is subject to a disclaimer and copyright. This report has been carried out under a contract awarded by the European Commission, contract number: 101104171. The content of this publication is the sole responsibility of the SYNCHROMODE project.

This document has been prepared for the European Commission however it reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Table of Contents

Executive Summary 6
Summary sheet 7
Project partners 8
Document history 9
List of Figures 10
List of Tables 11
List of acronyms 12
1. Introduction 13
1.1. Purpose of the document 13
1.2. Intended audience 13
1.3. Document structure 14
2. Project organization 15
2.1. Consortium 15
2.2. Management structure and procedures 16
2.2.1. Decision making bodies 17
2.2.1.1. General Assembly (GA) 17
2.2.1.2. Steering Committee 18
2.2.1.3. Project Coordinator 18
2.2.2. Operational bodies 19
2.2.2.1. Technical Management Board 19
2.2.2.2. Work Package Leaders 19
2.2.2.3. Task Leaders 20
2.2.2.4. Case Study Leaders 20
2.2.2.5. Advisory Board 21
2.2.2.6. Innovation Manager 21
2.2.2.7. Work Management 21
3. Time management 23
3.1. Project timeline 23
3.2. Person Months distribution per Work Package 23
3.3. Milestones 25

Copyright © 2023 by SYNCHROMODE

3.4. Deliverable tracking 26
4. Finances 28
4.1. Administrative and financial management 28
4.2. Pre-financing 28
4.3. Interim payment 28
4.4. Final payment 28
5. Internal communication 29
5.1. SYNCHROMODE SharePoint 29
5.2. Mailing lists 29
5.3. Planning and performance meetings 30
5.3.1. Types of meetings 31
5.3.2. Planning and documenting of meetings 33
6. Change management 35
6.1. Procedures for changes requests 35
6.2. Conflict resolution process 37
7. Innovation management 38
7.1. Foreword on Innovation 38
7.2. Innovation management strategy 38
7.2.1. Multimodal network and traffic management landscape analysis in Europe 40
7.2.1.1. Challenges 40
7.2.1.2. Current state-of-the-art: System solutions 41
7.2.1.3. Current state-of-the-art: Data fusion for multimodal network management 41
7.2.1.4. Current state-of-the-art: Supply-Demand modelling, simulation, prediction 42
7.2.1.5. Current state-of-the-art: Transport Network Optimization 43
7.2.1.6. Current state-of-the-art: Related Horizon Europe R&D projects 44
7.2.2. Key Innovation Elements in SYNCHROMODE 47
7.2.3. Deliverables with high innovation potential 49
7.3. SYNCHROMODE Innovation Assessment Framework 51
7.3.1. Assessment Framework 51
7.3.2. Innovation Metrics 53
8. Conclusions 55
9. References 56

Copyright © 2023 by SYNCHROMODE

Annex I: Innovation definitions 58

Copyright © 2023 by SYNCHROMODE

Executive Summary

The present document is the Project & Innovation Management plan, which is prepared within the context of WP1: Project Management of the SYNCHROMODE project.

Concerning the SYNCHROMODE project, the Grant Agreement (GA) and the Consortium Agreement (CA) are the legally binding sources describing the framework for project organization, responsibilities, and rights of the project beneficiaries. The current Project Management plan relies on the management content of these documents and provides detailed information on procedures and agreements among partners. The document elaborates on the essential aspects of project management, such as management structure, time management, finances, internal communication, and change management, and describes in detail the practical procedures to be followed by all consortium members, to establish rules for cooperation and communication between the beneficiaries.

With regards to the Innovation Management plan, the objective is to establish a structured, yet flexible mechanism and related processes, which will penetrate all project's activities throughout the entire project's lifetime, to ensure that high levels of innovation are maintained. To ensure that innovation is maintained that the project activities are well connected, that project-external developments are monitored, and that the innovation goals of SYNCHROMODE do not lose relevance, clear definitions, targets, indicators, methods of monitoring and re-orienting in case of deviations or course changes influenced by project external factors (e.g., changes in technologies or policies not controlled by project partners) are required. The Innovation Management plan describes the innovation strategy, that be a detailed analysis of previous and ongoing research and innovation activities in the related field at EU level, the Key Innovation Elements (KIEs) in SYNCHROMODE, as well as the deliverables of the project that have a high innovation potential and will be closely monitored during the project. The plan concludes with the framework for assessing innovation throughout the course of the project, which sets specific Innovation Metrics (IMs), related to the KIEs of the project.

Copyright © 2023 by SYNCHROMODE

Summary sheet

Deliverable No.	1.1
Project Acronym	SYCHROMODE
Full Title	D1.1 – Project & Innovation Management plan
Grant Agreement No.	101104171
Responsible Author(s)	E. Mitsakis
Contributing Author(s)	A. Kotsi, D. Tzanis
Peer Review	Leire Serrano (DEUSTO) Antonio Masegosa (DEUSTO)
Date	30/06/2023
Status	Final
Dissemination level	Public
Version	1.0
Work Package No.	WP1
Work Package Title	Project management
Work Package Leader	ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS (CERTH)
Project Coordinator	ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS (CERTH)
Website	https://synchromode.eu

Copyright © 2023 by SYNCHROMODE

Project partners

Organisation	Country	Abbreviation
ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS	Greece	CERTH
UNIVERSIDAD DE LA IGLESIA DE DEUSTO ENTIDAD RELIGIOSA	Spain	DEUSTO
NOMMON SOLUTIONS AND TECHNOLOGIES SL	Spain	NOMMON
YUNEX GMBH	Germany	YUNEX
MAP TRAFFIC MANAGEMENT BV	Netherlands	MAPTM
AIMSUN SLU	Spain	AIMSUN
BE-MOBILE	Belgium	BE-MOBILE
VMZ BERLIN N BETREIBERGESELLSCHAFT MBH	Germany	VMZ
ARRIVA PERSONENVERVOER NEDERLAND BV	Netherlands	ARRIVA
RUPPRECHT CONSULT-FORSCHUNG & BERATUNG GMBH	Germany	Rupprecht
POLIS NETWORK	Belgium	POLIS
PNO INNOVATION SL	Spain	PNO
REGION OF CENTRAL MACEDONIA	Greece	RCM
CITYLOGIN IBERICA SL	Spain	CITYLOGIN
PROVINCIE ZUID-HOLLAND	Netherlands	PZH
UNIVERSITY COLLEGE LONDON	United Kingdom	UCL

Copyright © 2023 by SYNCHROMODE

Document history

Version	Date	Organisation	Main area of changes	Comments
Version 0.1	22.05.2023	CERTH-HIT	First version	Internal
Version 0.2	19.06.2023	DEUSTO	Internal review	To be reviewed
Version 1.0	30.06.2023	CERTH-HIT	Final version for submission	

Copyright © 2023 by SYNCHROMODE

List of Figures

Figure 1: SYNCHROMODE Management structure and governing bodies. 17
Figure 2: SYNCHROMODE's revised Deliverables tracking chart 27
Figure 3: Screenshot of the SYNCHROMODE SharePoint. 29
Figure 4: Schema of the SYNCHROMODE Innovation Management Strategy activities. 39
Figure 5: SYNCHROMODE Innovation Management Strategy. 52

Copyright © 2023 by SYNCHROMODE

List of Tables

Table 1: List of SYNCHROMODE partners 15
Table 2: Steering Committee members. 18
Table 3: Detailed list of SYNCHROMODE Work Packages. 20
Table 4: Detailed information of SYNCHROMODE Case Studies. 21
Table 5: SYNCHROMODE hierarchy 22
Table 6: PMs overview per partner. 23
Table 7: SYNCHROMODE revised Milestones 25
Table 8: SYNCHROMODE meetings 31
Table 9: Procedures for changes requests 35
Table 10: SYNCHROMODE Expected Results 47
Table 11: SYNCHROMODE Project Outcomes 48
Table 12: List of SYNCHROMODE Deliverables with high innovation potential in chronological order 49
Table 13: SYNCHROMODE Innovation Metrics 53

Copyright © 2023 by SYNCHROMODE

List of acronyms

AB	Advisory Board
CA	Consortium Agreement
CSL	Case Study Leader
DoA	Description of Action
EC	European Commission
ER	Expected Results
GA	Grant Agreement
IM	Innovation Manager
IM	Innovation Metric
KIEs	Key Innovation Element
MS	Milestone
PC	Project Coordinator
PM	Person Month
PO	Project Outcomes
SC	Steering Committee
WP	Work Package
WPL	Work Package Leader

Copyright © 2023 by SYNCHROMODE

1. Introduction

The SYNCHROMODE project aims to develop a data driven ICT toolbox for improving the management of transport operations from a multimodal perspective, to manage the transport network. SYNCHROMODE will provide transport managers with new predictive and network optimization capabilities for balancing the transport supply and demand, enabling efficient reaction to different types of events. SYNCHROMODE will demonstrate via well-chosen Case Studies the effectiveness of integrated multimodal and multi-actor traffic and transport management solutions and the SYNCHROMODE toolbox, able to balance the demand load of both people and goods and at the same time reduce individual journey times.

Concerning project management processes, the SYNCHROMODE WP1: Project management aims to ensure the successful execution of the project through effective and efficient management and coordination, towards the achievement of the project objectives. WP1 focuses on all the technical and administration-related project management activities, including the overall consortium and project coordination. The specific tasks of WP1, which are related to this document, include:

- Task 1.1: Administrative and financial project management.
- Task 1.2: Technical project management.
- Task 1.3: Internal & external innovation monitoring and management.

1.1. Purpose of the document

D1.1 elaborates on the following aspects:

- Project organization.
- Project management.
- Work processes between the members of the tasks, Work Packages, and consortium bodies.
- Documents/ Deliverables management.
- Project dissemination rules.
- Finance and administration management.
- Innovation management.
- Other support processes.

The deliverable aims at ensuring an effective organization and execution that will allow the project to achieve its objectives. The overall management plan of the project described in the deliverable is based on the Consortium Agreement (CA) and Description of Action (DoA) (as per Grant Agreement number 101104171) of SYNCHROMODE.

1.2. Intended audience

The dissemination level of D1.1 is public, and the document intends to serve as a guideline for the appropriate management of the SYNCHROMODE project. The deliverable targets are to introduce

Copyright © 2023 by SYNCHROMODE

the management procedures to all projects' participants of the consortium. The document is particularly important for Task, Work Package (WP) and Case Study leaders, as well as the Steering Committee (SC) and Advisory Board (AB) members due to their participation in the management bodies. Participants leading or contributing to the preparation of deliverables must read and apply all the procedures related to the preparation of the deliverables.

1.3. Document structure

This document is organized as follows:

- Chapter 1: Executive Summary
- Chapter 2: Introduction
- Chapter 3: Project organization including the different roles within the structure and some procedures that must be followed in terms of work management.
- Chapter 4: Time management focuses on the aspects of timeline of the whole project, deliverables, and milestones deliveries.
- Chapter 5: Administrative and financial management aspects.
- Chapter 6: Internal communication processes.
- Chapter 7: Management of procedures related to requests for changes and resolution of conflicts.
- Chapter 8: Innovation Management and strategy for achieving innovation-oriented project goals.
- Chapter 9: Conclusions of the document.

Copyright © 2023 by SYNCHROMODE

2. Project organization

The SYNCHROMODE management organization aims to manage properly project partners, resources, and tasks in terms of communication and coordination among them. The overall work has been divided accordingly amongst partners, making them responsible for Work Packages and Tasks depending on their expertise to reach high quality and a fluid workflow avoiding bottlenecks.

This section describes the management of the project, including the structure of the partners and documents. The structures, roles, responsibilities, and mutual obligations of the partners described have been specified in the CA agreed upon before the start of the project.

2.1. Consortium

The SYNCHROMODE consortium brings together stakeholders from different disciplines reaching from governmental, research, user associations and industry. The consortium consists of well-known key players in transport from different European countries and includes substantial knowledge, skills, and experience to make the project a success.

The SYNCHROMODE community is made up of key players from each area. The consortium consists of 16 beneficiaries from 7 different countries, including 3 Case Studies locations. The list of SYNCHROMODE partners is presented in the table below, as from the signature of the Grant Agreement.

Table 1: List of SYNCHROMODE partners

No.	Beneficiary name	Short name	Country
1	ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS	CERTH	Greece
2	UNIVERSIDAD DE LA IGLESIA DE DEUSTO ENTIDAD RELIGIOSA	DEUSTO	Spain
3	NOMMON SOLUTIONS AND TECHNOLOGIES SL	NOMMON	Spain
4	YUNEX GMBH	YUNEX	Germany
5	MAP TRAFFIC MANAGEMENT BV	MAPTM	Netherlands
6	AIMSUN SLU	AIMSUN	Spain
7	BE-MOBILE	BE-MOBILE	Belgium

Copyright © 2023 by SYNCHROMODE

No.	Beneficiary name	Short name	Country
8	VMZ BERLIN BETREIBERGESELLSCHAFT MBH	VMZ	Germany
9	ARRIVA PERSONENVERVOER NEDERLAND BV	ARRIVA	Netherlands
10	RUPPRECHT CONSULT-FORSCHUNG & BERATUNG GMBH	Rupprecht	Germany
11	POLIS	POLIS	Belgium
12	PNO INNOVATION SL	PNO	Spain
13	REGION OF CENTRAL MACEDONIA	RCM	Greece
14	CITYLOGIN IBERICA SL	CITYLOGIN	Spain
15	Provincie Zuid-Holland	PZH	Netherlands
16	UNIVERSITY COLLEGE LONDON	UCL	United Kingdom

2.2. Management structure and procedures

Preparation and completion of Deliverables is a key indicator of project progress. The Deliverables preparation starts as soon as the task work begins, and progress must be periodically reported to Task and Work Package leaders that will report to the Project Coordinator.

All the deliverables in SYNCHROMODE must use the official template available created for the project. The Deliverables must pass through some steps before the final submission as presented in the table below.

The management structure described in this section establishes the leadership processes to successfully achieve the project's objectives, supervising and coordinating activities, to ensure that the work performed is fulfilling the expectations of the project in terms of quality and time.
The challenge of SYNCHROMODE management relies on the multiple necessary interactions within WPs, Tasks, and Case Studies, each one involving partners with a horizontal role linked to specific tasks and/ or partners involved in specific Case Studies activities with local stakeholders.

The good functioning of partnerships within the Case Studies and the actual commitment of both private and public stakeholders are key factors as this is crucial for the successful development of the SYNCHROMODE services and the implementation of the SYNCHROMODE toolbox. For such complex activities the distribution of responsibilities and the flow of information are of particular importance to create the necessary transparency and trust for a close collaboration between both

Copyright © 2023 by SYNCHROMODE

consortium partners. Moreover, SYNCHROMODE requires an organization able to balance the interests of the multiple stakeholders and handle conflicts effectively. This is to ensure a fast and acceptable resolution of issues or disputes that would otherwise delay or affect the work plan or the fulfilment of project objectives, but also to reduce the risk of escalations.

A particular focus needs to be put on the synchronization of major milestones and the proactive monitoring of deviations. Finally, the overall management processes depend on the experience of the people involved. For SYNCHROMODE, the main management positions (such as WP and Task leaders) are filled with senior experts from the fields of traffic management, connected and automated mobility, ITS and C-ITS, and computer science with a long-time experience in managing large research projects.

SYNCHROMODE management bodies are of two types:

- The operational bodies with the Coordinator and the Technical Manager, in charge of the project controlling, the planning, steering, and controlling of the work progress and the quality of results.
  The decision-making bodies are comprised of the Coordinator, the General Assembly (GA), and the Steering Committee (SC), responsible for strategic decisions concerning the work plan, risk management and conflicts. Major changes regarding objectives and partners are to be discussed and prepared for the final decision making of the general assembly.

In the following sections, the Organizational and Management Structure is described in detail following the overall illustration in Figure 1.

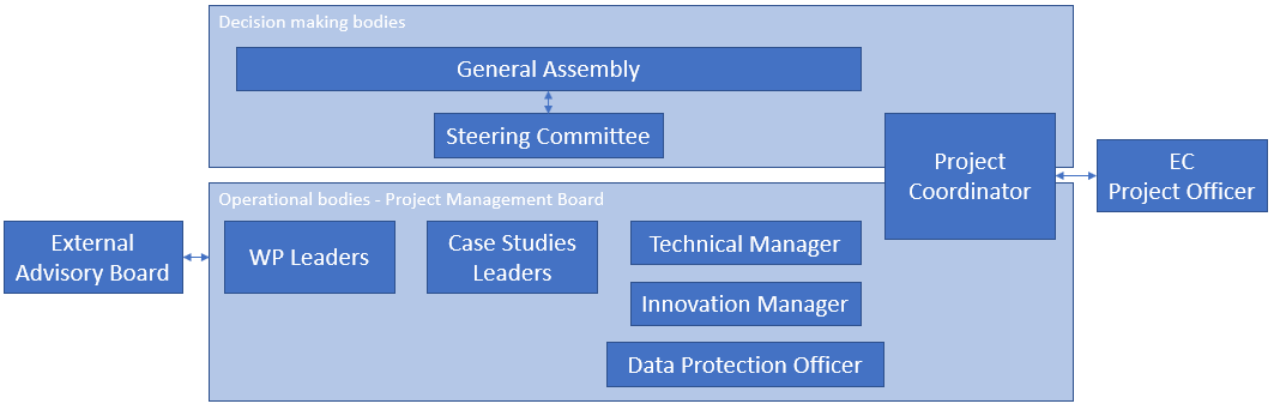

Figure 1: SYNCHROMODE Management structure and governing bodies.

2.2.1. Decision making bodies

2.2.1.1. General Assembly (GA)

The General Assembly (GA) is the highest decision-making body of SYNCHROMODE, where all the partners of the project consortium are represented. More specifically, each partner will nominate a

Copyright © 2023 by SYNCHROMODE

representative of their organization, to serve as a member of the board. Upon recommendations from the Steering Committee and/ or the Coordinator, the GA takes final decisions on the overall policy of the project, on proposals for modifications or extensions of the Consortium Agreement or of the objectives of the project. The Coordinator and the Steering Committee keep the GA informed about progress and achievements. The Project Coordinator (PC) chairs the GA. The GA meets according to the defined work plan, at least every six months for the bi-annual status meetings.

2.2.1.2. Steering Committee

The Steering Committee is the overall responsible body for major strategic decisions within SYNCHROMODE. Like the GA approach, with regards to partners' engagement, each partner will nominate a representative of their organization to serve as a member of the board. It monitors the work progress and evaluates the achievements regarding the work programme. The Steering Committee is the escalation level for conflicts that cannot be solved on the working level WP or by the Technical Manager. Decisions of the Steering Committee are binding and can only be overturned by an explicit alternative decision of the General Assembly. The decision-making aims at achieving consensus. The Steering Committee meets at least every six months and when needed. The meetings are chaired by the Project Coordinator. The members of the Steering Committee are senior experts with management experience from the different partner organizations, representing different consortium member types and are not directly involved in the project work. The table below presents the members of the Steering Committee as approved during the first GA during the Kick-off meeting; appointed persons shall be assigned by the beneficiaries.

Table 2: Steering Committee members.

Stakeholder type	Beneficiary
Coordinator	CERTH
Technical coordinator	DEUSTO
Industry	YUNEX
Public authority	PZH
Research - academia	UCL

2.2.1.3. Project Coordinator

The Project Coordinator (PC) is CERTH. The PC is responsible for the successful and smooth running of the project. The PC is directly involved in resolving conflicts and attending all meetings and events, as needed. The PC is also responsible for the project progress monitoring; tasks of the PC

Copyright © 2023 by SYNCHROMODE

are the administrative and financial reporting and the delivery of the project results to the European Commission (EC). Furthermore, the PC is responsible for the correct execution of all the rules of the Horizon Europe Programme, as established in the Grant Agreement. The PC is the only contact point to the European Commission on all project related issues. The PC chairs the decision-making bodies of SYNCHROMODE. The WP1 describes in detail the management tasks. The activities to be carried by CERTH in relation with the EC are the following:

- Inform the EC about events likely to significantly affect or delay the implementation of the action or the EU's financial interests and inform the EC of circumstances affecting the decision to award the grant or the compliance with requirements under the Agreement.
- Submit deliverables and reports (periodic and final) to the EC.
- Coordinate reviews of the EC to the project.
- Receive the payments of the EU funding from the EC and distribute them to the beneficiaries.

In relation with the Consortium, the role, and responsibilities of CERTH include (but not limited) the following:

- Overall coordination of the technical activities, including monitoring of their compliance with the Grant Agreement, project advancement and use of resources, quality control, and overall risk management.
- Organization and chairing of the consortium bodies' meetings, including the preparation, distribution, and recording of the meetings documentation (agenda and minutes).

The PC is Dr. Evangelos Mitsakis, Research Director (Researcher A) at CERTH - HIT (Hellenic Institute of Transport), having led and contributed to several funded projects in the field of connected and automated mobility and traffic management.

2.2.2. Operational bodies

2.2.2.1. Technical Management Board

The Technical Management Board is responsible for the technical management of the project and covers all main technical management responsibilities. The Technical Management Board is led by the Technical Manager, which is DEUSTO, and it is supported by the Project Coordinator and the Innovation Manager.

The Technical Management Board meets according to the defined work plan, at least every six months.

2.2.2.2. Work Package Leaders

The Work Package Leader (WPL) is responsible for the technical management of the individual Work Packages. The WPL is supported by the Task leaders, who report to the WPL on a regular basis. For

Copyright © 2023 by SYNCHROMODE

all technical matters, the WPL reports to the Technical Management Board. For progress reporting (e.g., interim/ periodic reports and financial reporting), the WPL reports directly to the PC (always keeping the Technical Management Board informed). The WPLs (appointed persons) are listed in the table below.

Table 3: Detailed list of SYNCHROMODE Work Packages.

Work Package	Lead participant short name	Appointed person
WP1	CERTH	Evangelos Mitsakis
WP2	RUPPRECHT	Wolfgang Backhaus
WP3	NOMMON	Jaime Pizarroso
WP4	UCL	Manos Chaniotakis
WP5	DEUSTO	Antonio Masegosa
WP6	YUNEX	Diego Salzillo Arriaga
WP7	POLIS	Zsofia Jakoi

2.2.2.3. Task Leaders

Task Leaders are responsible for the coordination of the work at Task level. The Task Leaders are responsible for the actual execution and coordination of the work inside the task, reporting of the progress of the work to the WPLs, as well as the preparation and quality control of the deliverables the Task shall produce.

2.2.2.4. Case Study Leaders

The Case Study Leader (CSL) is the interface between the project and the Case Study. The CSL is responsible for the close linkage of the SYNCHROMODE activities to the Case Studies. The CSL is responsible on behalf of the respective Case Study to:

- Plan and monitor the progress of the Case Study, its partners, and local stakeholders, to ensure that it is aligned with the work plan agreed at WP and overall project level.
- Coordinate the Case Study work across WPs.
- Anticipate, assess, register, and inform of the risks that may rise in the Case Study and find solutions or mitigation actions for those.
- Coordinate and control the Case Study progress and achievements.

Copyright © 2023 by SYNCHROMODE

The exchange of SYNCHROMODE Case Studies responsibilities with the local authorities and project representatives on a regular basis are necessary to ensure the commitment of both public and private stakeholders in each Case Study and ensure a functioning partnership.

Table 4: Detailed information of SYNCHROMODE Case Studies.

Case Study	Lead participant short name	Appointed person
1. Multimodal traffic management for urban and peri-urban transport networks - Thessaloniki, Greece	CERTH	Evangelos Mitsakis
2. Traffic management for large duration events management – Netherlands	MAPTM	Steven Boerma
3. Enhancing collaboration between mobility and logistic operators - Madrid Region, Spain	NOMMON	Jaime Pizarroso

2.2.2.5. Advisory Board

The Advisory Board (AB) has an external reviewer role, providing external expertise on topics relevant to SYNCHROMODE. The Advisory Board will be open to other stakeholders from the global multimodal traffic management domain and other areas of expertise related to the project. The members of the Advisory Board will be selected by the Steering Committee and formally invited. Members shall first sign a Non-Disclosure Agreement (NDA) before they are granted access to any background and foreground as well as any confidential information.

2.2.2.6. Innovation Manager

The Innovation Manager (IM) establishes processes to maximize exploitation of the results by SYNCHROMODE partners. The IM is responsible for the Innovation Management process, from identification of SYNCHROMODE innovations, and for taking together with the Technical Management Board necessary actions to ensure favorable conditions for innovation and for the effective exploitation of innovations during and after the end of project. The IM is Areti Kotsi of CERTH, having the necessary experience in research and technology innovation.

2.2.2.7. Work Management

Distributed execution and management tiers have been established to manage and document the results of the project results efficiently. The tiers, classified from the lesser to the higher level, are linked to an entity of the SYNCHROMODE project structure as follows:

Copyright © 2023 by SYNCHROMODE

Table 5: SYNCHROMODE hierarchy

Level	Entity
1	Task
2	Work Packages and Case Studies
3	Technical Management team
4	Steering Committee
5	General Assembly

WPLs must deal with the technical developments and overall coherence and technical implementation of project outputs. A summary of their tasks is:

- Ensuring completion of Work Package activities and Deliverables on time, within budget and with high quality.
- Coordinating activities within the Work Package.
- Meeting the operational, functional, documentation and data, planning and financial requirements for Deliverables according to the contract and EC requirements.
- Reviewing and approving all formal Work Package Deliverables.
- Managing risk within the Work Package.
- Formal and informal reporting on Work Package progress, quality, and risk status to the coordinator.

All partners working on a Task must periodically report progress and achievements of their corresponding deliverables to the Task leaders every 6 months. The information report will include the following:

- Objectives of the period.
- Progress towards objectives in the covered period, including milestones (i.e., specific goals, activities, deliverables) achieved.
- Justification and impact of delays and objectives not achieved.
- Corrective measures to reverse the unplanned issues of last point.

At the same time, all the Tasks' work is overseen by Work Package and Case Study leaders, who must report the situation to the Technical Management Board. The Project Coordinator, as a representative of the Technical Management Board, must share the updates with the Steering Committee, to take actions at that level if it is needed. Finally, the General Assembly is responsible for the management of Consortium level issues.

Copyright © 2023 by SYNCHROMODE

3. Time management

3.1. Project timeline

The project implementation has a duration of 36 months and officially starts in May 2023. The latest version of the SYNCHROMODE Gantt Chart is available on the EC's ECAS platform.

3.2. Person Months distribution per Work Package

The table below shows the distribution of the planned Person Months (PMs) in each WP per project partner for the total project's duration. A PM gives an overview of the estimated effort that needs to be spent by each partner to achieve the goals in each WP.

Table 6: PMs overview per partner.

Beneficiary	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total
CERTH	23	3	8	18	12	34	11	**109**
DEUSTO	4.5	5	8	6	55	12	4.5	**95**
NOMMON	0.5	5	15	10	8	8	1	**47.5**
YUNEX	0.5	3	0	0	0	13	2.5	**19**
MAPTM	0.5	5	5	0	8	17	3.5	**39**
AIMSUN	0.5	1	1	21	2	10	1.5	**37**
Be-MOBILE	0.5	4	4	0	0	14	2.5	**25**
VMZ	0.5	3	6	0	0	18	1.5	**29**
ARRIVA	0.5	4	4	0	0	10	3.5	**22**
RUPCON	0.5	19	0	0	0	0	3	**22.5**
POLIS	0.5	1	0	0	0	0	17.5	**19**
PNO	0.5	0	0	0	0	0	20.5	**21**
RCM	0.5	2	0	0	0	14	3.5	**20**
CITYLOGIN	0.5	2	0	0	0	17	1.5	**21**

Copyright © 2023 by SYNCHROMODE

Beneficiary	WP1	WP2	WP3	WP4	WP5	WP6	WP7	Total
PZH	0.5	1	0	0	0	5	1.5	**8**
UCL	0.5	0	0	34	4	4	1	**43.5**
Total	**34.5**	**58**	**51**	**89**	**89**	**176**	**80**	**577.5**

Copyright © 2023 by SYNCHROMODE

3.3. Milestones

The SYNCHROMODE project has 8 Milestones (MSs) that are defined to monitor the achievements of the project; they are listed in the table below. The Project Coordinator will continuously check the project work against the Milestones to identify risks and deviations from the original plan. Each Milestone has a lead beneficiary who is responsible for achieving the Milestone together with all partners involved in the related Work Packages. If said lead beneficiary becomes aware of a deviation from the original Milestone plan, he/ she needs to inform the Project Coordinator as soon as possible and to follow the change management process for any change requests from the original time plan.

Table 7: SYNCHROMODE revised Milestones

MS No.	MS Name	WP No.	Leader	Means of verification
MS1	User needs and SYNCHROMODE system requirements defined based on a multi-stakeholder's approach. Initial stakeholder analysis finalized for the exploitation activities.	WP2, WP7	Rupprecht	D2.1., D7.4[1] (first release in M4)
MS2	System architecture defined; Case studies scope defined.	WP2, WP6	YUNEX	D2.3, D6.1
MS3	First release of API for data harmonization and fusion ready. The market analysis is finalized and ready for use in the exploitation activities.	WP3, WP7	CERTH	D3.2, D7.2
MS4	First release of subsystems ready: Transport network optimization module. Application of the transport state estimation models. Methodologies and Algorithms for mobility patterns	WP5, WP3, WP4	DEUSTO	D3.3, D4.5, D5.4

[1] According to the Grant Agreement, D7.2: Exploitation & Business Modelling Plan was used as a means of verification. However, the current version for verification is D7.4: Exploitation & Business Modelling Plan due to the versioning of D7.1: Dissemination and Communication Strategy Plan (including dissemination material).

Copyright © 2023 by SYNCHROMODE

MS No.	MS Name	WP No.	Leader	Means of verification
	reconstruction and identification of bottlenecks and disruptions.			
MS5	Final release of API for data harmonization and fusion ready.	WP3	CERTH	D3.2
MS6	Final release of subsystems ready: API for data harmonization and fusion; travel behavior models; transport prediction models; Optimization models for transport network management. First release of the SYNCHROMODE tool integrated.	WP5, WP3, WP4	DEUSTO	D3.3, D4.5, D5.4
MS7	Final release of the SYNCHROMODE tool integrated.	WP6	VMZ	D6.3
MS8	SYNCHROMODE tool tested and validated.	WP6	CERTH	D6.4

3.4. Deliverable tracking

In addition to monitoring Milestones, the submission of Deliverables is also rigorously tracked each month. This results in a graph like the one shown in the figure below, which shows the planned cumulative number of Deliverables submitted at each month (blue curve), in comparison with the actual cumulative number (orange curve). Any deviations will be immediately visible.

Copyright © 2023 by SYNCHROMODE

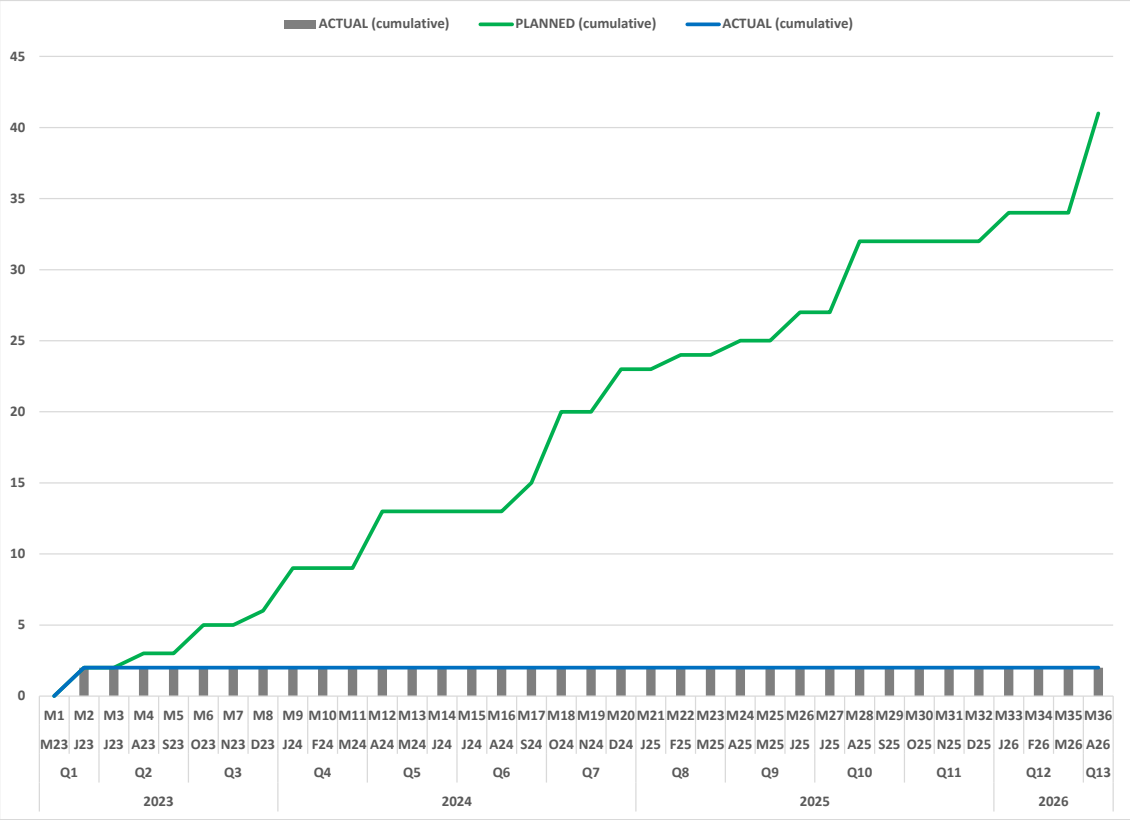

Figure 2: SYNCHROMODE's revised Deliverables tracking chart

Copyright © 2023 by SYNCHROMODE

4. Finances

4.1. Administrative and financial management

The Project Coordinator is responsible for coordinating and supervising all financial, legal, and contractual aspects including the reporting. Corresponding progress reviews and reports including cost statements and budgetary overviews will be performed to verify the planned activities from an administrative and financial point of view. These will occur at the set reporting period deadlines (Month 18 and Month 36). The cost statements will be collected and checked by the Project Coordinator based on the scheduled work plan and sent to the EC. In addition, intermediate six-monthly management reports are foreseen. These six-monthly intermediate management reports will be requested by the Project Coordinator for all partners, and will include:

- The person-months spent during the last six months.
- The other costs spent (e.g., travel, equipment, etc.).
- A narrative report on the technical activities of each partner.

4.2. Pre-financing

With the start of the project, CERTH as the coordinator received the pre-financing from the EC, which is 80% of the total budget minus the 5% guarantee fund. All partners agreed to receive their part of the total budget as part of the pre-financing. In May 2023 the Project Coordinator distributed the amount received from the EC to all partners, in proportion to each partner's share in the budget.

4.3. Interim payment

If a partner spends more budget until Month 18 than the pre-financing received from the EC (based on the partner's submitted cost statements), then the partner can request an interim payment. The interim payment will be managed by the EC via the Project Coordinator.

4.4. Final payment

The final payment request will be made by the Project Coordinator at the end of the project. This is submitted by the Project Coordinator, but the financial claim and grant request is done by each partner through the financial statements.

Copyright © 2023 by SYNCHROMODE

5. Internal communication

Communication plays a central role in the success of the SYNCHROMODE project. The Project Coordinator ensures that all information is communicated to all partners as required. This guarantees a shared view on the project progress, developed results, and encountered problems.

The Project Coordinator works with extensive use of e-mail and tele-, video- and web-conferences as often as necessary to coordinate the work between the WPs.

In the following sections an overview of the SYNCHROMODE communication tools and procedures is presented.

5.1. SYNCHROMODE SharePoint

All project information, technical and management, is accessible via the Internet-based collaboration platform "SYNCHROMODE SharePoint" for internal communication. All partners have access to this and can download and upload all files and data. Access to SharePoint is regulated by the Project Coordinator. The SharePoint can be found at https://imetbgr.sharepoint.com/sites/SYNCHROMODE. An indicative screenshot of the home page is shown in the figure below.

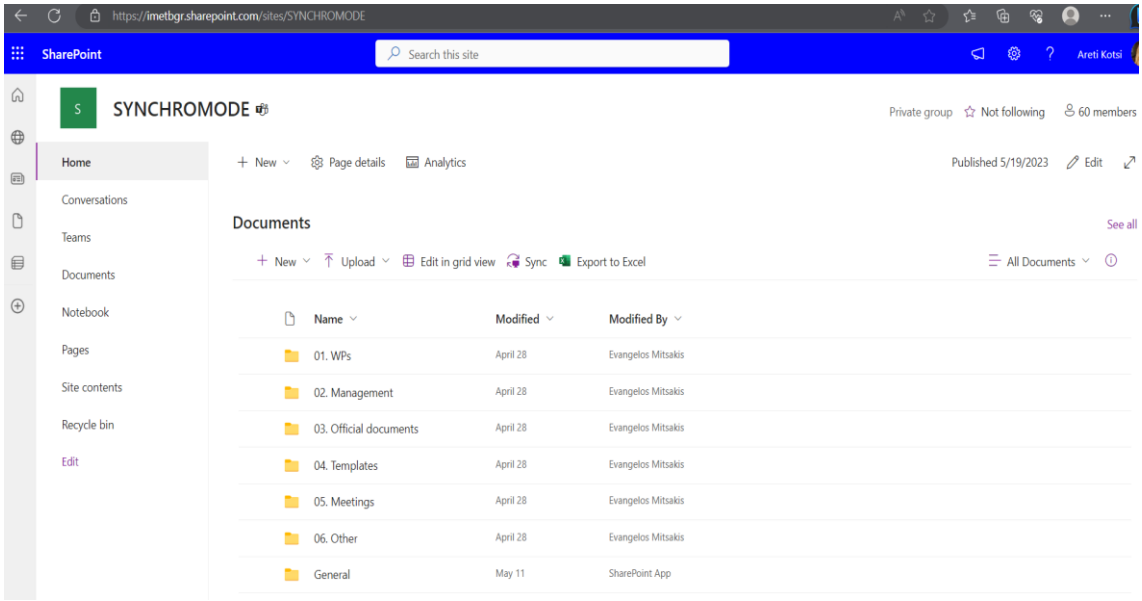

Figure 3: Screenshot of the SYNCHROMODE SharePoint.

5.2. Mailing lists

Copyright © 2023 by SYNCHROMODE

In addition to discussion in documents, emails are used to exchange ideas and viewpoints. Emails should be sent additionally on the following occasions:

- When new material relevant for a certain Task or Deliverable is uploaded to or modified on SharePoint, all partners involved in the Task or Deliverable should be informed via email. It should contain a link to the material to facilitate navigation.
- If a response/ action from partners is required, it should be announced via email to that partner.
- When an action has started that requires others to deliver input, the action should be announced by sending an email to the involved partners (typically in conjunction with a conference call).
- Shortly before the deadline of an action, an email should be sent reminding the partners who have not yet provided their input.

For best performance, all emails should contain the text "SYNCHROMODE" at the start of their subject line, plus additional keywords, to help everybody to easily assess the project relation and the topic. Within the SYNCHROMODE project the following mailing lists will be set up:

- WP1: wp1@synchromode.eu
- WP2: wp2@synchromode.eu
- WP3: wp3@synchromode.eu
- WP4: wp4@synchromode.eu
- WP5: wp5@synchromode.eu
- WP6: wp6@synchromode.eu
- WP7: wp7@synchromode.eu
- All Partners: all@synchromode.eu
- WP leaders: wp@synchromode.eu
- CS leaders: cs@synchromode.eu
- Dutch CS: dutchcs@synchromode.eu

These mailing lists will be continuously updated by the Project Coordinator. In case any new colleague needs to be included in specific mailing lists, or to be removed, a request should be sent to the Project Coordinator. The Project Coordinator also distributes and actively maintains a list containing all contact information for the individual people working on the project (e.g., e-mail addresses, phone numbers).

5.3. Planning and performance meetings

This section describes the types of meetings within SYNCHROMODE and the process that will be followed to plan and hold meetings.

Copyright © 2023 by SYNCHROMODE

5.3.1. Types of meetings

To ensure successful collaborations within the project, regular meetings in different formats and with different frequencies will be arranged. All types of meetings and the related details are included in the table below.

Table 8: SYNCHROMODE meetings

Type of meeting	Responsible	Frequency	Participants	Physical - Online	Short description
Cross-WP & project management meetings: led by project coordinator, incl. overview of all technical activities for all WPs and admin/project management	Project Coordinator	Monthly	• Project Coordinator • Technical Manager • WPLs	Online	Reporting and monitoring on project management issues and WPs progress, workplan, risks, deviations, and mitigation actions
WP meetings: led by each WP, technical and management if needed	WPLs	Biweekly/ Monthly (to be defined by the WPL)	• Project Coordinator • Technical Manager • WPLs • Task Leaders • Project Coordinator • Technical Manager	Online (physical to be defined when necessary, by the WPL)	Reporting and monitoring on the WP and internal Tasks progress, workplan, risks, deviations, and mitigation actions

Copyright © 2023 by SYNCHROMODE

Type of meeting	Responsible	Frequency	Participants	Physical - Online	Short description
General Assembly	Project Coordinator	Every 6 months	SYNCHROMODE consortium (all partners)	Physical	Reporting and monitoring on project management issues, overall project progress, workplan, risks, deviations, and mitigation actions
Project meeting	Project Coordinator	Every 6 months (combined with the GA)	SYNCHROMODE consortium (all partners)	Physical	Reporting and monitoring on project management issues, overall project progress, workplan, risks, deviations, and mitigation actions
EC review meeting	Project Coordinator in alignment with the Project Officer	M18 and M36	• Project Coordinator • Technical Manager • WPLS • Project Officer • EC Reviewers	Physical	Reporting to the EC the project progress, workplan, risks, deviations, and mitigation

Copyright © 2023 by SYNCHROMODE

Type of meeting	Responsible	Frequency	Participants	Physical - Online	Short description
					actions - EC feedback
Workshops	WPLs	According to the related workplan timing as stated in the GA	• Project Coordinator • Technical Manager • WPLs • Task Leaders • Other (e.g., external stakeholders)	Physical and Online (to be defined by the WPL)	The objectives will be aligned with the related workplan

5.3.2. Planning and documenting of meetings

The following process will be followed to plan and document meetings:

- If it is a regular GA meeting, then the Project Coordinator invites all partners.
- If the meeting is specific to a certain WP, then the WP Leader is responsible for inviting the involved partners.
- The chairperson of each meeting starts a process to fix a date using either a related conference call or via the respective mailing list. The chairperson shall give notice in writing of the meeting to each partner as soon as possible and no later than 14 calendar days preceding an ordinary meeting and 7 calendar days preceding an urgent meeting.
- The chairperson shall prepare and send each partner a written original agenda no later than 14 calendar days preceding the meeting, or 7 calendar days before an urgent meeting
- If the meeting is physical, the inviting person provides travel information via email.
- Any partners may add an item to the original agenda by written notification to all the other members no later than 7 calendar days preceding the meeting.
- If the meeting is physical, all partners indicate the people that will attend.
- The chairperson shall produce written minutes of each meeting which shall be the formal record of all decisions taken. He/ she shall send draft minutes to all members within 10 calendar days of the meeting. These minutes shall be considered as accepted if, within 15 calendar days from sending, no partner has sent an objection in writing to the chairperson with respect to the accuracy of the draft of the minutes.

Copyright © 2023 by SYNCHROMODE

- The minutes will also be stored in SharePoint, as well as all information regarding the agenda, the signed attendance list(s) (physical meetings), presentations, and photos (physical meetings).

Copyright © 2023 by SYNCHROMODE

6. Change management

Throughout SYNCHROMODE's project duration of 36 months it may become necessary to update the work and the implementation plan. Guiding principles for any update are the project objectives and official agreements with the EC as well as the agreements of those beneficiaries affected by the respective changes.

Given the complexity and diversity of a research project such as SYNCHROMODE, the following changes could happen during the project:

- Changes to the technical work plan (DoA).
- Changes and shifts of partner resources.
- Beneficiaries entering or leaving the consortium.

Such changes to SYNCHROMODE will be handled via change requests and contract amendments with the EC. The change requests are SYNCHROMODE's internal procedures to introduce and agree upon requested changes. All minor changes (not influencing the overall objectives of the project) will be handled informally and will be reported in the minutes of the related meetings. Major changes will result in a contract amendment to be submitted to the EC. Once accepted by the EC, the amended contract version will be legally binding.

The process of the contract amendment usually requires several months to be finalized. However, in most cases it is necessary to continue the project throughout this period. In those cases, a formless agreement with the respective EC officer should be settled in advance.

6.1. Procedures for changes requests

In the Table 8 below the relevant steps in the case of changes and/ or contract amendments are explained.

Table 9: Procedures for changes requests

Type of change request	Procedural steps
WP level actions	Step 1: The partner identifies the reason and amount of any change.

Copyright © 2023 by SYNCHROMODE

Type of change request	Procedural steps
	Step 2: The partner asks involved partners in the WP for their consent to the change in writing and asks the WP Leader for acceptance.
	Step 3: The WP Leader decides whether the changes are accepted. This decision is documented in the meeting minutes.
	Step 4: The WP Leader submits the change request and states the reasons for necessity to the project coordinator.
	Step 5: Minor changes are accepted at management-level and no further approval is needed. Proceed with Step 1 of "Contract amendments".
High-level actions	Step 1: If changes are significant and have a high impact on the work of the project, the Project Coordinator asks the General Assembly for a decision.
	Step 2: The General Assembly decides on the change request. This decision is documented in the meeting minutes.
	Step 3: If the request has been approved, the Project Coordinator informs the EC officer.
	Step 4: The EC officer agrees to modify the requested changes or asks for further detailed information.
Contract amendments	Step 1: The partner or the WP Leader changes the WP description accordingly in the WP part of the DoA and sends it to the Project Coordinator. A short explanation should be provided indicating that the relevant partner(s) identify the need to update the WP.
	Step 2: The Project Coordinator updates the overall DoA, the resource database and the project description.
	Step 3: The project coordinator sends the contract amendment documents to the EC for signature. Contract amendment documents include formal contract amendment request, the updated DoA, and the list with detailed changes.

Copyright © 2023 by SYNCHROMODE

Type of change request	Procedural steps
	Step 4: If necessary, the project coordinator updates the consortium agreement, and all partners sign it.

6.2. Conflict resolution process

SYNCHROMODE is a collaborative project and disagreements or problems might arise during the performance of project tasks. A clear decision-making procedure will allow for a lean conflict resolution. The Consortium Agreement defines specific rules for the settlement of disputes. This agreement, which is signed by all partners, encourages settling possible disputes amicably and, in case a solution cannot be found, by eventual arbitration. The rules for arbitration are specified in the Consortium Agreement.

SYNCHROMODE promotes a collaborative approach by all partners as well as an attitude which avoids hiding any technical or financial difficulty that could affect the downstream workflow of the other participants. In case of difficulties, partners should provide detailed information about the issue and positively support the establishment of suitable recovery actions.

Conflict resolution is considered at different levels. At the level of a Work Package, only a verbal consensus is necessary, with regular communication as needed; this will escalate if no consensus is reached. For straightforward project management issues, a verbal consensus is sufficient, and a voting is done if necessary (with a simple majority rule); this escalates if no decision could be reached, or an appropriate decision cannot be taken because of the voting.

Copyright © 2023 by SYNCHROMODE

7. Innovation management

7.1. Foreword on Innovation

For the benefit of all partners, with varying backgrounds as well as different objectives within the SYNCHROMODE project, as well as for the benefit of a structured approach towards Effective Innovation Management at project level, a clear definition for innovation is needed and provided hereafter.

The definition of innovation adopted herein is based to a large extent upon the one provided by Melissa Shilling (New York University). The definition of innovation adopted in the present report is "*The act of introducing a new device, product, or method for application to commercial or practical objectives. Invention may or may not be needed since innovation may include the introduction and use of known ideas and solutions in a new context*".

There is a wealth of various other definitions regarding innovation management. These are included in Annex I of the present report, for informative purposes.

7.2. Innovation management strategy

As per the definition of Innovation Management adopted in SYNCHROMODE, Innovation Management includes processes and structures for monitoring and controlling of innovation within the SYNCHROMODE project.

Innovation Management includes processes and structures, as referred to also in the respective definition provided at the beginning of this report, to manage and control activities that, starting from end users' needs, aim to continuously identify and check new ideas with the final objective of developing new products or services which can satisfy these needs.

The activities of the Innovation management strategy within SYNCHROMODE will include the following processes:

- Identification and dynamic management of the Innovation Management approach.
- Understanding of the landscape, including market, key stakeholders, trends, technologies, needs and opportunities.
- Continuous monitoring of the landscape.
- Assessment of the innovation potential of research results.
- Liaise with project management and take corrective measures if needed, to ensure that market needs are best met.

Copyright © 2023 by SYNCHROMODE

The Innovation Management strategy will be implemented through activities, which are planned in a way that allows their execution in iterations, to allow being continuously in line with ongoing evolution at market, technological and non-technological level.
Having defined the Innovation Management strategy, the activities to implement it include a very good understanding and continuous (throughout the whole lifetime of the project) monitoring of the multimodal traffic management landscape/ domain, in terms of market needs developments and opportunities. This monitoring of project-external activities allows making comparative assessment between these and the project-internal activities, to ensure that all project internal activities remain relevant within the global context and always preserve a high degree of innovation. In case of major changes or problems faced either at project-external or at project-internal level, the Innovation Management process foresees interactions with the SYNCHROMODE project management team, to adopt the project plans as necessary.

The activities of the SYNCHROMODE Innovation Management strategy are schematically presented in the figure below.

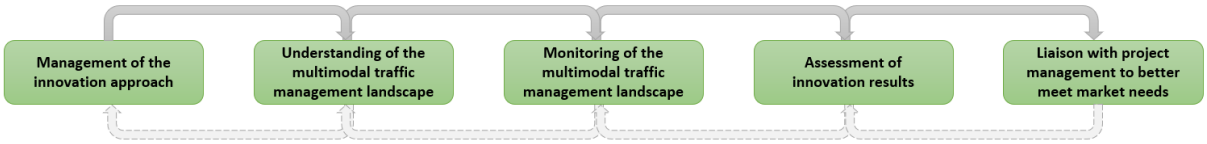

Figure 4: Schema of the SYNCHROMODE Innovation Management Strategy activities.

Innovation Management within SYNCHROMODE is the primary responsibility of the Innovation Manager, that be Areti Kotsi (CERTH). According to the SYNCHROMODE Grant Agreement, the responsibilities of the Innovation Manager include:

- Establishment of processes to maximize exploitation of the results by SYNCHROMODE partners.
- Responsible for the identification of SYNCHROMODE innovations.
- Responsible for taking together with the Technical Management Board actions to ensure favorable conditions for innovation and for the effective exploitation of innovations during and after the end of the project.

To achieve these goals and fulfil the responsibilities, the Innovation Manager of the SYNCHROMODE project will:

- Define the Innovation Management strategy approach, plan all related activities, and inform all project partners accordingly.
- Continuously monitor market, technology, and policy trends in the multimodal network and traffic management domain.

Copyright © 2023 by SYNCHROMODE

- Inform at a regular basis the SYNCHROMODE consortium partners about emerging trends on the above.
- Continuously monitor all major project activities related to the deliverables with high innovation potential.
- Continuously liaise with Work Package Leaders to assess the innovation level of the activities executed therein against the Innovation Management plan (present report). This will also be done collectively for all Work Packages, due to the high degree of interconnectivity and interdependency of the project activities.
- Assess the level of innovation at project level, utilizing Innovation Metrics (IMs), a set of performance indicators, which are related to the Key Innovation Elements (KIEs) of the project.
- Report at M36 on the Innovation Management activities undertaken as well as on the major achievements related to innovation at project level within the framework of the Final Report.
- Report about Innovation Management activities undertaken as well as about the major achievements related to innovation at project level during the GA/ Project meetings during a dedicated session.
- Ensure the innovation level during all meetings, workshops and consultations that will take place during the project.
- Provide support during potential introductions of SYNCHROMODE commercially exploitable results to third parties or candidates for technology transfer.

7.2.1. Multimodal network and traffic management landscape analysis in Europe

7.2.1.1. Challenges

Transport plays a vital role in EU society and the economy: 10 million people are employed in related positions, accounting for 5% of the GDP1. Furthermore, effective transport systems are essential for European companies to increase their competitiveness in the global economy and impose a strong impact on people's quality of life. The technological advances (including automation and electrification) and the new modes and schemes of transport and mobility (e.g., CAVs and micro-mobility), are generating a revolution in mobility, transport network and traffic management. Peoples' mobility and the transport of goods are expected to continuously increase dramatically. In the case of freight transport with respect to 2005, by around 40% in 2030 and over 80% by 2050. Passenger traffic is expected to grow 34% by 2030 and 51% by 2050, causing a substantial pressure on the existing traffic infrastructure, further increasing air pollution and traffic jams. Traffic congestion costs in Europe are EUR 100 billion, 1% of GDP each year3, with road and air traffic congestion being a major concern.

Copyright © 2023 by SYNCHROMODE

In 2018, 28 % of total EU-28 greenhouse gas emissions came from the transport sector. Road transport is by far the biggest emitter accounting for more than 70% of all GHG emissions from transport. Overall, by 2050, the EU needs to reduce emissions by 80-95%, below 1990 levels, and has set the goal of limiting climate change to 2º C increase. Besides, the introduction of new modes of transport (CAVs) and the abundance of micro mobility solutions (scooters, e-bikes, skateboards, shared bicycles, etc.) is causing traffic increase due to the unregulated landscape of operations. Traffic management is becoming more complex, and unexpected circumstances such as the COVID-19 pandemic have shown that unplanned events have huge impacts on the transport network. During the COVID -19 pandemic the public transport users decreased by 80% in some EU cities compared to pre-crisis levels (before March 2020)5. Besides, several transport authorities limited the capacity of the vehicles, to guarantee safe distances between people (for example Milan and Barcelona reduced occupancy to a maximum of 25% and 50%, respectively, Ireland to 20%, Portugal to 2/3, etc.) and comply with the national regulation in force. Even though transport network management has benefited from the latest technological advances, current traffic and transport management solutions pertain to local, or limited to small areas, and traffic management strategies are based on aggregated variables (e.g., total flows, average speeds). This allows to deploy solutions that seek a compromise in terms of efficiency but cannot address the heterogeneity and variety of the mobility needs.

7.2.1.2. Current state-of-the-art: System solutions

There is an evident lack of integrated frameworks of measures and indicators for assessing the performance of multimodal transport systems. Current assessment frameworks often fail to account for the complex relationships between indicators at leg and trip level [1]. Safety indicators are another example that does not follow a linear relation. These exhibit the “weakest link” phenomenon: the safety factor of the trip is determined by the factor of the worst link regardless of factors of the other modes [2]. Most of the indicators used to measure the performance of multimodal systems oversee these relations [1]. Recently, the SESAR2020-ER4 TRANSIT project has proposed a set of multimodal indicators for long distance trips. This can be extended for the case of urban and peri-urban trips. Existing Key Performance Indicators also show limitations concerning the evaluation of the system performance in terms of social welfare (e.g., accessibility, inclusiveness, safety, security, health).

7.2.1.3. Current state-of-the-art: Data fusion for multimodal network management

A multimodal management of transport networks requires reliable, comprehensive, and updated data on the demand to be met. In the last 10 years, the exploitation of geolocated traces generated by personal mobile devices (smartphones, public transport

Copyright © 2023 by SYNCHROMODE

smart cards, etc.) and both fleet and private vehicles have risen the attention of researchers and practitioners [3], [4], [5]. These sources enable a continuous collection of mobility data with a high level of spatio-temporal resolution, overcoming some of the limitations of traditional travel surveys (e.g., small sample sizes, incorrect and imprecise answers, high cost). Mobile network data is particularly relevant for multimodal network management since it allows the reconstruction of users' door-to-door trips [6]. Since these devices were not originally thought to generate data for mobility analyses, it is necessary to develop data analysis and fusion algorithms to transform raw data into meaningful travel demand information. There are examples of successful identification of mode and route in long distance trips by its fusion with supply data [7] and mode estimation with survey data aided by machine learning methods [11]. However, there is still room for further exploiting these data sources for demand characterization [11] and developing data standards that consider fusion and analysis needs. In contrast with the case of people's mobility patterns reconstruction and analysis from non-conventional data sources, the case of good's travel demand has hardly been explored. There is still limited availability of freight demand data, as companies and stakeholders are reluctant to share this. In this context, the analysis of goods' travel demand could be highly benefited by the exploitation of geolocated big data sources. The identification and prediction of non-recurrent events (bottlenecks, disruptions, etc.) and their effects on network demand patterns can also benefit from the fusion of data generated in the context of smart cities (network sensors, IoT, connected and autonomous vehicles, etc.). Recent studies have shown promising results for both identification [8],[9] and prediction of incidents [9], [10], [11] based on data fusion and machine learning techniques. However, the practical application of these methodologies for traffic management is hindered by several reasons [8]: lack of sufficient data, lack of automated fusion processes and the need for maintenance of data integrity in real-time.

7.2.1.4. Current state-of-the-art: Supply-Demand modelling, simulation, prediction

Estimation and prediction of travel demand and interaction with supply is central to traffic management as all related operations require knowledge about the spatial and temporal distribution of the demand. The demand patterns are commonly expressed as dynamic (time-dependent) origin-destination matrices. Traffic models are used to study various complex and large-scale problems, from transport planning to evaluation of traffic management strategies as well as for the estimation and prediction of the transport network traffic state [12], [13], [14]. Demand is a key input to traffic simulators and Dynamic Traffic Assignment models, to estimate and predict the network performance and capture the travel behaviour. A research gap is identified regarding operational, hybrid (ML-driven and simulation) approaches for the demand estimation and prediction problems, that can increase estimation and prediction accuracy as well as reduce computation time. The estimation of dynamic demand for simulation based DTA models is computationally expensive. Recent studies focus on developing

Copyright © 2023 by SYNCHROMODE

metamodel-based methods for the calibration of dynamic OD demand in large-scale networks [15], [16] propose a metamodel approach that optimizes the demand using the network-wide Macroscopic Fundamental Diagram (MFD), using multiple data sources to derive empirical bi-modal MFDs. Finally, representation of behaviorally informed multimodal demand and supply remains a significant research gap limiting the applicability of solutions for multimodal transport management. A shift from collective to individual actions should also be considered, in focus on traffic management of individual vehicles, still considering all the interactions among the various modes. This could be also enhanced with cooperative and competitive coordination of transport modes both at decision making and operations level, as well as the development of models for traffic management based on social innovation, where solutions rely on an ecosystem approach integrating the needs and requirements of various actors and vendors in all steps of planning, execution, and evaluation. Considering CAVs' and CCAM capabilities, decentralized traffic management, relying on decentralized CCAM agents that could utilize high performance computing and edge computing, could be further developed, and include traffic management plans and processes accounting also for advanced forecasting techniques. Although efforts towards this direction exist (e.g., HARMONY H2020 project for transport planning), solutions are still being implemented in silos with little information exchange between different modes and not on an operational level, ignoring users' behavior.

7.2.1.5. Current state-of-the-art: Transport Network Optimization

Transport network management requires orchestrating and coordinating current and future transport modes. In this context, the following areas are relevant to optimize mobility flows of passengers and freights at a network level:

1. Synchronization of people and goods transport for efficient use of the transport network and its resources.
2. Synchronization of on-demand and shared mobility with public transport to improve mobility in peri-urban areas or areas with limited access to public transport.
3. Signalized vehicle coupled control with CAVs for a better exploitation of CAVs potential not only as a means of transport, but as a new technological tool to optimize network load balance; and
4. Optimization of response plans for bottlenecks and events management.

However, the design of systems for these three areas implies solving complex optimization problems. Such complex problems are characterized by having multiple objectives (e.g., total travel time by mode, emissions), a high number of constraints (e.g., transport system-wide capacity, digital infrastructure maturity), and a diversity of scenarios (e.g., transport in urban areas, freeways, intersections, etc.). Such challenges are usually addressed in the state-of-the-art with optimal control, online feedback

Copyright © 2023 by SYNCHROMODE

techniques and bio-inspired algorithms. Although the latter represents progress, these optimization approaches suffer the following issues:

1. Low scalability because of high computational cost and sub-optimality.
2. Limited robustness to deal with the great variety of transportation scenarios.
3. They are static in the sense of the reaction when congestion or other traffic events have been detected.

7.2.1.6. Current state-of-the-art: Related Horizon Europe R&D projects

The FRONTIER project [17] aims to provide the network and integrated traffic management strategies of the future, considering new types and modes of transport automated vehicles, towards the minimization of pollution and capacity bottlenecks, the reduction of accidents, and the need to reduce the cost of mobility for all users (both citizens, public authorities, and businesses). The project facilitates the transition towards resilient multimodal autonomous mobility by establishing the processes of collaboration and arbitration among stakeholders while developing the business models that will address the commercial viability of the identified solutions. It will develop, apply, and test autonomous management systems, secured by design, that will constantly evolve using data generated from real-time monitoring of the transportation system, knowledge generated by operators and decision makers, and simulation models providing system optimal solutions accounting for new mobility services and technologies. The project will be validated in three pilot sites (Oxfordshire UK, Athens GR, and Antwerp BE) focusing on three main themes: Smart Infrastructures and CAVs integration; Multimodal mobility for passengers and freight cross-stakeholders collaboration; Network performance analysis for planning and policy making. To materialize this concept, FRONTIER follows an efficient multidisciplinary approach bringing together a multidisciplinary list of partners from 5 universities and research institutes, 7 companies, 5 transport authorities from three diverse European countries, one testbed for traffic management and one international road federation.

In the DIT4TraM project [18], twenty knowledge institutions, companies, and governments are investigating and testing for the first time whether this “swarm intelligence” approach is feasible for traffic and transport. Our focus is on individual travelers, connected cars, smart bicycles, and intelligent traffic control systems. Simply put, we are exploring how we can get these agents to communicate and interact locally in such a way that they automatically contribute to the greater goal of a smooth and safe traffic flow. DIT4TraM runs from 1 September 2021 to 1 September 2024. Our goal is to develop control concepts and algorithms based on swarm intelligence for the widest possible range of applications during this project period. We’re including different modalities, from pedestrians to cars to subsystems. And we focus on different use cases, from local traffic control to regional traffic and mobility management. We

Copyright © 2023 by SYNCHROMODE

are, of course, looking at fully decentralized solutions with one hundred percent self-organization, drawn up according to the so-called 'mechanism design' concept. But we also include solutions with distributed intelligence: solutions that are local where possible and centralized where necessary. In this case, central intelligence, such as a traffic management system at the traffic center, monitors the situation in general and only interferes if the local intelligence falls short. To test and develop all new knowledge and insights in practice, six pilot studies in four EU countries are organized: in France (Bordeaux), Greece (Glyfada and Athens), the Netherlands (Amsterdam and Utrecht), and Spain (AP-7 freeway). With these pilots we test the gains to be achieved for traffic flow, safety and liveability and look at the effects on reliability and resilience. With these results, we create a better understanding of which principles of swarm intelligence can be used for traffic and transport. And this knowledge is expected to lay the foundation for a 180-degree paradigm shift in our traffic and mobility management.

The ORCHESTRA project [19] will establish a common understanding of multimodal traffic management concepts and solutions, with and across modes, for various stakeholders and multiple contexts. It will define a Multimodal Traffic Management Ecosystem (MTME) where traffic managements in different modes and areas (rural and urban) are coordinated to contribute to a more balanced and resilient transport system, bridging current barriers and silos. Support MTME realization and deployments through the provision of tools, models, and guidelines – including support for connected and automated vehicles and vessels (CAVs) ORCHESTRA aims to provide European policymakers, public authorities, transport providers, and citizens with both new knowledge and technical and organizational solutions to enhance collaboration and synchronizing of operations within and across transport modes, enhancing safety and reducing emissions. The project requires insight and knowledge from a multidisciplinary perspective, from different transport domains, of diverse representatives from transport operators, industry to policymakers, including citizens, communities, and scientists. Therefore, for the project to help achieve its goals and share the results, ORCHESTRA has engaged various Community of Practice (CoP) Experts within their domain. The CoP was established to support and advise the project by participating in meetings, workshops, and interviews. The CoP will get first-hand information about the project's result and can relay these elements to their network if they wish. SEA Aeroporto di Milano manages the Malpensa and Linate airports in Milan. It represents the second largest airport group in Italy with 29 million of passengers in 2016, and with near 550,000 tons of goods passing through its cargo terminals last year it confirmed its place as the leader for cargo aviation in Italy. Herøya Industrial Park is one of the biggest industrial parks in Norway and is situated in the municipality of Porsgrunn in Telemark, 150 km south of Oslo. With its strategic location on the coast in the far south of Norway, Herøya Industrial Park is the best choice for export companies and anyone who needs fast, efficient links with Europe and the rest of the world. About 80 businesses with approx. 2.500 employees have established themselves at Herøya Industrial Park which is at the forefront of testing the autonomous transport solutions of the future. The industrial park has been chosen as Living Lab, a living test area, in the EU's large-scale

Copyright © 2023 by SYNCHROMODE

investment in intelligent intermodal transport. Here, on behalf of the EU, test drive an autonomous escort service for freight transport. The goal of the EU project ORCHESTRA is to realize the digital and green intermodal transport solutions of the future. Critical test operations will be carried out in a fully operational gateway for freight transport on Herøya for the next three years. A robotic escort service and a digital traffic system that unloads goods transport safely in and out will be used.

TANGENT [20] is a project funded by the European Commission under the Research and Innovation Programme, which started in September 2021 and will end in August 2024. The project is coordinated by the University of Deusto, based in Bilbao, Spain. TANGENT will lead to the development of new complementary tools for optimizing traffic operations in a coordinated and dynamic way from a multimodal perspective and considering automated / non-automated vehicles, passengers, and freight transport. TANGENT is developing new complementary tools for optimizing traffic operations in a coordinated and dynamic way from a multimodal perspective and considering automated / non-automated vehicles, passengers, and freight transport. TANGENT is a project funded by the European Commission under the Research and Innovation Programme, which started in September 2021 and will end in August 2024. TANGENT is coordinated by the University of Deusto, based in Bilbao, Spain. The pilot cities involved are Lisbon, Great Manchester, Rennes, and Athens. TANGENT is improving knowledge and management of mobility flows among a range of transport modes. In addition, it enables the implementation and integration of innovative mobility solutions, services, and business models. The project is contributing to more efficient traffic management, facilitating multimodal networks, accelerating the transition towards connected and automated mobility, reducing pollutant emissions and congestion, improving safety and security, and reducing the cost of mobility for all. TANGENT is helping the pilot cities achieve a 10% reduction in travel time, 8-10% reduction in CO2 emissions, 5% reduction of accidents, 10-15% increase in use of public transport.

The CONDUCTOR [21] project's main goal is to design, integrate and demonstrate advanced, high-level traffic and fleet management that will allow efficient and globally optimal transport of passengers and goods, while ensuring seamless multimodality and interoperability. Using innovative dynamic balancing and priority-based management of vehicles (automated and conventional) CONDUCTOR will build upon state-of-the-art fleet and traffic management solutions in the CCAM ecosystem and develop next generation simulation models and tools enabled by machine learning and data fusion, enhancing the capabilities of transport authorities and operators, allowing them to become "conductors" of future mobility networks. We will upgrade existing technologies to place autonomous vehicles at the center of future cities, allowing heightened safety and flexible, responsive, centralized control able to conduct traffic and fleets at a high level. These innovations will lead to less urban traffic and congestion, lowered pollution, and a higher quality of life. Project innovations will be integrated into a common, open platform, and validated in three use cases, testing the interoperability of traffic management systems and integration of different transportation means for

Copyright © 2023 by SYNCHROMODE

both people and goods. Use case UC1 integrates traffic management with intermodality, UC2 tests demand-response transport, and UC3 urban logistics. In each use case and its demonstrations, simulations will be validated through real-life data.

7.2.2. Key Innovation Elements in SYNCHROMODE

The Key Innovative Elements (KIEs) of SYNCHROMODE are expressed through the Expected Results and Outcomes of the project. The Expected Results (ER) are aligned with the project objectives and integrated future exploitation potential perspectives. The ERs produce quantifiable Project Outcomes (PO) that highlight the significance of the project's contributions to innovation aspects. The tables below present the ERs and POs.

Table 10: SYNCHROMODE Expected Results

Expected Result (ER)	Description
ER1.1	User needs & system requirements definition through co-creation process approach with stakeholders
ER1.2	New governance models for transport management
ER2.1	Transport & mobility management data inventory
ER2.2	Adapted and new data standards for multimodal network management
ER2.3	Algorithms for the analysis and reconstruction of mobility patterns
ER2.4	Algorithms for the identification of bottlenecks and disruptions in multimodal networks
ER 3.1	Travelers' behavior modelling
ER 3.2	Transport demand and supply modelling simulation suite
ER 3.3	Prediction capabilities for bottlenecks management
ER 4.1	Traffic management strategies for balancing demand across transport modes
ER 4.2	Traffic management strategies for cooperation of freight and passenger transport

Copyright © 2023 by SYNCHROMODE

Expected Result (ER)	Description
ER5.1	Mobility data space for traffic data management
ER 5.2	Dashboard for real-time monitoring and prediction of network-wide multimodal transport & traffic
ER 5.3	Decision-making support tool for multimodal traffic management operations
ER 6.1	SYNCHROMODE system tested and validated in real scenario (Madrid, Thessaloniki, Netherlands)
ER7.1	Dissemination strategy for impact creation
ER7.2	Lessons learned and policy recommendation measures
ER7.3	Exploitation plan & business models

Table 11: SYNCHROMODE Project Outcomes

Project Outcome (PO)	Description
PO1.1	Advanced artificial intelligence and transport simulation models for an efficient door to door mobility combining 6 different modes of transport and reducing in a 15-20% the oversupply/ overdemand
PO2.1	At least 15 transport management stakeholders using new and expanded data standards for better data management
PO2.2	At least 15 transport management stakeholders using new algorithms for multimodal demand and bottleneck/disruption analysis.
PO3.1	Adoption of response plans in the light of disruption in a 75% by the transport agents, such as trip alternatives, reducing the time loses in a 35-45%
PO4.2	Reduction of journey times in a 15-20% by delivering alternative/ adapted transport response plans in the light of events

Copyright © 2023 by SYNCHROMODE

Project Outcome (PO)	Description
PO4.3	Decrease of empty kms travelled by vehicles (passenger, freight) in a 15-25%
PO4.4	10-20% decrease polluting emissions generated by transport
PO5.1	Acceptance of governance models by 15 stakeholders
PO5.2	Involvement of at least 10 policymakers
PO6.1	SYNCHROMODE system is adopted in 6 cities/ regions as supporting tool for transport & traffic operations management
PO6.2	High use of the scientific and technological research published in the framework of SYNCHROMODE, an average of > 15 citations per paper

7.2.3. Deliverables with high innovation potential

The SYNCHROMODE project deliverables, which have a high potential for innovation, are listed in the table below. These deliverables will be monitored with particular attention at all stages of their development by the Innovation Manager, to ensure that the level of innovation is maintained at a high level.

Table 12: List of SYNCHROMODE Deliverables with high innovation potential in chronological order

Del. No	Deliverable title	Task No
D2.5	Case Studies description	T2.3
D2.1	Report on user needs and system requirements definition for each case study	T2.1
D5.1	Analysis of current and future mobility approaches in optimization of transport network management	T5.1
D2.2	Multi-actor cooperation and governance models for integrated multimodal transport systems - version 1	T2.2

Copyright © 2023 by SYNCHROMODE

Del. No	Deliverable title	Task No
D3.1	Data requirements and inventory	T3.1
D4.2	Conceptual Architecture	T4.1
D6.1	Reference architecture and its applications - version 1	T6.1
D6.3	SYNCHROMODE toolbox functional specifications document - version 1	T6.3
D4.3	Transport Simulation report	T4.3
D5.2	Optimization models for transport network management	T5.2
D2.3	Multi-actor cooperation and governance models for integrated multimodal transport systems - updated version 2	T2.2
D3.2	API for data harmonisation and fusion - version 1	T3.1
D3.4	Methodologies and Algorithms for mobility patterns reconstruction and identification of bottle necks and disruptions - version 1	T3.3
D4.5	Application of the transport state estimation models - version 1	T4.5
D5.4	Transport network optimization module - version 1	T5.4
D6.2	Reference architecture and its applications - final version 2	T6.1
D6.4	SYNCHROMODE toolbox functional specifications document - final version 2	T6.3
D5.3	Optimization techniques for transport network management	T5.3
D3.3	API for data harmonisation and fusion - final version 2	T3.1
D4.4	Operational hybrid models	T4.4
D3.5	Methodologies and Algorithms for mobility patterns reconstruction and identification of bottle necks and disruptions - final version 2	T2.2
D4.6	Application of the transport state estimation models - final version 2	T4.5
D5.5	Transport network optimization module - final version 2	T5.4

Copyright © 2023 by SYNCHROMODE

Del. No	Deliverable title	Task No
D6.5	SYNCHROMODE toolbox demonstrator - version 1	T6.3
D6.6	SYNCHROMODE toolbox demonstrator - final version 2	T6.3
D2.4	Multi-actor cooperation and governance models for integrated multimodal transport systems - final version 3	T2.2
D6.7	Impact assessment results	T6.4
D7.4	Exploitation & Business Modelling Plan	T7.3
D7.7	Policy recommendations and lessons learnt	T7.4

Further to the above-listed deliverables, the Innovation Manager will place particular attention on the level of innovation during all meetings, workshops and consultations that will take place during the project.

7.3. SYNCHROMODE Innovation Assessment Framework

7.3.1. Assessment Framework

The objective of assessment of innovation throughout the entire lifetime of the SYNCHROMODE project is to have means of verification that the SYNCHROMODE research and innovation activities are of consistently high level of innovation, valid, relevant within the broader landscape and context and of course aligned with the objectives of the project with respect to innovation. To do so, the framework for the assessment of innovation in SYNCHROMODE will include a set of KIEs (as described in the previous section), which will be continuously monitored throughout the project's duration. Monitoring these KIEs will allow to have an overview of the impacts of SYNCHROMODE at technological and market level. It will also allow taking corrective measures, in case of deviations from strategic objectives and innovation related goals.

This approach relies upon the innovation management strategy defined herein and it is schematically depicted next.

Copyright © 2023 by SYNCHROMODE

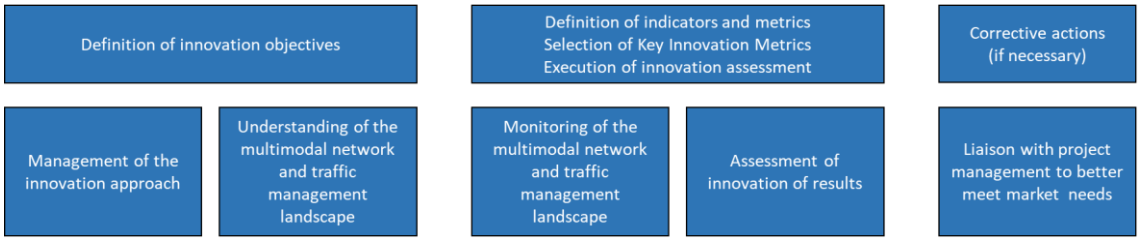

Figure 5: SYNCHROMODE Innovation Management Strategy.

The list of actions to be undertaken during the project includes the following list of activities. This list is dynamic by nature and will be adjusted as needed during the project.

- Define the Innovation Management strategy approach, plan all related activities and inform all project partners accordingly.
- Continuously monitor market, technology and policy trends in the multimodal network and traffic management domain.
- Liaise with end user groups (from the Case Studies) to acquire their feedback on the usability of the services to be offered.
- Inform at a regular basis the SYNCHROMODE consortium partners about emerging trends on the above.
- Continuously monitor all major project activities related to the deliverables with high innovation potential.
- Continuously liaise with Work Package Leaders to assess the innovation level of the activities executed therein against the Innovation Management plan (present report). This will also be done collectively for all Work Packages, due to the high degree of interconnectivity and interdependency of the project activities.
- Propose corrective actions, based on the analysis of Innovation Metrics to the project management team.
- Report at M18 on the Innovation Management activities undertaken as well as on the major achievements related to innovation at project level, within the framework of the First Period Report.
- Report at M36 on the Innovation Management activities undertaken as well as on the major achievements related to innovation at project level, within the framework of the Second Period Report.
- Report about Innovation Management activities undertaken as well as about the major achievements related to innovation at project level during the project meetings during a dedicated session.
- Ensure the innovation level during all meetings, workshops and consultations that will take place during the project.
- Provide support during potential introductions of SYNCHROMODE commercially exploitable results to third parties or candidates for technology transfer.

Copyright © 2023 by SYNCHROMODE

7.3.2. Innovation Metrics

A list of innovation performance indicators, herein named Innovation Metrics (IM), has been defined and will be utilized during the SYNCHROMODE project. These IMs are presented in the following table.

Table 13: SYNCHROMODE Innovation Metrics

IM ID	Innovation Metrics description	IM category	IM target value	Relation to SYNCHROMODE results
IM1	Number of scientific publications and conference/ congress presentations	Science	≥15	Scientific results of all technical WPs
IM2	Number of new methods, tools, systems, services, and processes	Technology	≥4	3 SYNCHROMODE services, 1 SYNCHROMODE toolbox
IM3	Number of new architectures and services toolkits	Technology	≥1	SYNCHROMODE toolbox architecture
IM4	Number of commonly accepted methods and tools for impact assessment the SYNCHROMODE services	Science	≥1	WP6 impact assessment methodology
IM5	Number of established and functional stakeholders' partnerships	Policy	≥3	One per Case Study
IM6	Contributions to standards (new standards, enhanced/ revised existing standards)	Standardization	≥1	

Copyright © 2023 by SYNCHROMODE

IM ID	Innovation Metrics description	IM category	IM target value	Relation to SYNCHROMODE results
IM7	Number of new business models developed and adopted	Business	≥1	Results of WP7
IM8	Number of new commercially available and exploitable products	Business	≥1	SYNCHROMODE toolbox
IM9	Number of events organized to promote the use of SYNCHROMODE solutions to third parties	Business & Technology	≥3	SYNCHROMODE final event At least two international related events promoting the project's results

Copyright © 2023 by SYNCHROMODE

8. Conclusions

D1.1 Project & Innovation Management plan, serves as the guide for the management of the project as it includes the project organization in detail as well as the innovation management part. The first part of the document presents the project organization aspects including all the roles managing the project, which are key for the correct development of the whole project. This part is the reference point for project management procedures and provides the SYNCHROMODE management bodies with detailed steps to success in the achievement of the project objectives. All essential management aspects are presented and described, i.e., project management structure, time management, finances, internal communication, and change management. The second part of the document is comprised of the innovation management plan which objective is to establish a structured, yet flexible mechanism and related processes, that will monitor all project's activities throughout the entire project's lifetime, to ensure that high levels of innovation are maintained. The innovation management plan includes a strategy plan, Key Innovation Elements, and a framework for the assessment of innovation throughout the lifetime of SYNCHROMODE.

Copyright © 2023 by SYNCHROMODE

9. References

[1] Dixit, M. K., Venkatraj, V., Ostadalimakhmalbaf, M., Pariafsai, F., & Lavy, S. (2019). Integration of facility management and Building Information Modeling (BIM). Facilities, 37(7/8), 455–483. https://doi.org/10.1108/f-03-2018-0043

[2] Kanafani, A., & Wang, R. (2010). Measuring Multimodal Transport Level of Service. UC Berkeley: University of California Transportation Center. Retrieved from https://escholarship.org/uc/item/9k74n1b5.

[3] Lenormand M, Picornell M, Cantú-Ros OG, Tugores A, Louail T, Herranz R, et al. (2014) Cross-Checking Different Sources of Mobility Information. PLoS ONE 9(8): e105184. https://doi.org/10.1371/journal.pone.0105184.

[4] Picornell, M., Ruiz, T., Lenormand, M., Ramasco, J. J., Dubernet, T., & Frías-Martínez, E. (2015). Exploring the potential of phone call data to characterize the relationship between social network and travel behavior. Transportation, 42(4), 647–668. https://doi.org/10.1007/s11116-015-9594-1.

[5] Yabiku, S. T., Glick, J. E., Wentz, E. A., Ghimire, D., & Zhao, Q. (2017). Comparing Paper and Tablet Modes of Retrospective Activity Space Data Collection. Survey research methods, 11(3), 329–344. https://doi.org/10.18148/srm/2017.v11i3.6741

[6] García-Albertos, P., Cantú Ros, O.G., & Herranz, R. (2020). Analyzing door-to-door travel times through mobile phone data. CEAS Aeronautical Journal, 11, 345-354.

[7] Burrieza-Galán, J., Jordá, R., Gregg, A., Ruiz, P., Rodríguez, R., Sala, M. J., Torres, J., García-Albertos, P., Cantú Ros, O. G., & Herranz, R. (2022). A methodology for understanding passenger flows combining mobile phone records and airport surveys: Application to Madrid-Barajas Airport after the COVID-19 outbreak. Journal of Air Transport Management, 100, 102163. https://doi.org/10.1016/j.jairtraman.2021.102163.

[8] El Faouzi, N. E., & Klein, L. A. (2016). Data fusion for ITS: techniques and research needs. Transportation Research Procedia, 15, 495-512.

[9] Lana, I., Del Ser, J., Velez, M., & Vlahogianni, E. I. (2018). Road traffic forecasting: Recent advances and new challenges. IEEE Intelligent Transportation Systems Magazine, 10(2), 93-109.

[10] Torre-Bastida, A. I., Del Ser, J., Laña, I., Ilardia, M., Bilbao, M. N., & Campos-Cordobés, S. (2018). Big Data for transportation and mobility: recent advances, trends and challenges. IET Intelligent Transport Systems, 12(8), 742-755.

[11] Kashinath, S. A., Mostafa, S. A., Mustapha, A., Mahdin, H., Lim, D., Mahmoud, M. A., ... & Yang, T. J. (2021). Review of data fusion methods for real-time and multi-sensor traffic flow analysis. IEEE Access, 9, 51258-51276.

Copyright © 2023 by SYNCHROMODE

[12] Ben-Akiva, M., Koutsopoulos, H. N., & Walker, J. (2001, February). Dynamit-p: dynamic assignment model system for transportation planning. In WCTR Conference Seoul, Korea.

[13] Mahmassani, H. S., Abdelfatah, A., Tavana, H., Chiu, Y-C., Abdelghany, A., Huynh, N., & Zhou, X. (2001). DYNASMART-P: Intelligent Transportation Network Planning Tool – Calibration and Evaluation Plan for DYNASMART-P. Unknown Publisher.

[14] Tampère, C., Viti, F., & Immers, L. (2009). Traffic state estimation and prediction in urban networks through online modeling. In proceedings of the 1st Conference on Models and Technologies fot ITS.

[15] Osorio, C. (2019). Dynamic origin-destination matrix calibration for large-scale network simulators. Transportation Research Part C: Emerging Technologies, 98, 186–206. https://doi.org/10.1016/j.trc.2018.09.023.

[16] Dantsuji, T., Hoang, N. H., Zheng, N., & Vu, H. L. (2022). A novel metamodel-based framework for large-scale dynamic origin–destination demand calibration. Transportation Research Part C: Emerging Technologies, 136, 103545. https://doi.org/10.1016/j.trc.2021.103545.

[17] FRONTIER project. http://www.frontier-project.eu/.

[18] DIT4TRAM project. https://dit4tram.eu/.

[19] ORCHESTRA project. https://orchestra2020.eu/.

[20] TANGENT project. https://tangent-h2020.eu/.

[21] CONDUCTOR project. https://conductor-project.eu/index.php

Copyright © 2023 by SYNCHROMODE

Annex I: Innovation definitions

Most probably due to the diverse background of all those (persons and sectors) where the development of innovative solutions, products or technologies is an important target, no clear and commonly acceptable definition of innovation exists. The nature of this report does not provide a commonly agreed definition. However, it is important to have some definitions that provide a setting and a starting point. The following list contains a variety of definitions for innovation (retrieved by Eric Shaver, The many definitions of innovation).

- "…the successful conversion of new concepts and knowledge into new products, services, or processes that deliver new customer value in the marketplace."
- "Something different that has impact."
- "Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace."
- "Innovation is significant positive change."
- "Innovation represents the core renewal process in any organization. Unless it changes what, it offers the world (product/service innovation) and the ways in which it creates and delivers those offerings (process innovation) it risks its survival and growth prospects."
- "…the development and intentional introduction of new and useful ideas by individuals, teams, and organizations…".
- "…the creation of a new product-market-technology-organization-combination."
- "…is the creation and capture of new value in new ways."
- "…innovation is the process that turns an idea into value for the customer and results in sustainable profit for the enterprise."
- "A change in a product offering, service, business model or operations which meaningfully improves the experience of a large number of stakeholders".
- "…the art of applying creative ingenuity to either solving business problems or creating material value through a product, service or experience."
- "…production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems. It is both a process and an outcome."
- "…adoption of an internally generated or purchased device, system, policy, program, process, product, or service that is new to the adopting organization."
- "…the search for, and the discovery, experimentation, development, imitation, and adoption of new products, new production processes and new organizational set-ups."
- "Innovation is change that creates a new dimension of performance."
- "Innovation is creativity with a job to do."
- "…new ideas that are implemented to create business value."

Copyright © 2023 by SYNCHROMODE

- "…a product, process or service new to the firm, not only new to the world or marketplace."
- "The design, invention, development and/or implementation of new or altered products, services, processes, systems, organizational structures, or business models for the purpose of creating new value for customers and financial returns for the firm.''
- "People implementing ideas that create new value."
- "Innovation is the creation of a new product, service, or process that provides value for customers and/or other stakeholders."
- "Innovation is an invention that has demonstrated its' ability to create value."
- "A new idea, method, or device. The act of creating a new product or process, which includes invention and the work required to bring an idea or concept to final form."
- "Innovation is the set of capabilities (individual, company, societal) that allows the continuous realization of a desired future by transforming what is possible into what is valuable for many."
- "Innovation is executing new ideas to create value."
- "Innovation transforms the useful seeds of invention into solutions valued above every existing alternative – and widely adopted."

Copyright © 2023 by SYNCHROMODE