This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824269.

Project Acronym:	**infra4Dfuture**
Project Title:	**Infrastructure for the Future**
Project Number:	**824269**
Topic:	**MG-2-4-2018 – Coordinating national efforts in modernizing transport infrastructure and provide innovative mobility services**
Type of Action:	**Coordination and Support Action (CSA)**

D1.1 – Stakeholder map for transport infrastructure innovation

Version 1.0

Deliverable:	D1.1 Stakeholder map for transport infrastructure innovation
Work Package:	WP1: Strengthening transport infrastructure partnerships and alliances
Due Date:	M4
Submission Date:	31/03/2019
Start Date of Project:	01/10/2018
Duration of Project:	24 Months
Organisation Responsible of Deliverable:	Rijkswaterstaat (RWS)
Version:	1.0
Status:	Final
Author name(s):	Ruud Smit (Rijkswaterstaat) Johan Jonsson (Trafikverket) Bernard Gyergyay (BASt)
Reviewer(s):	
Nature:	☒ R – Report ☐ P – Prototype ☐ D – Demonstrator ☐ O - Other
Dissemination level:	☒ PU - Public ☐ CO - Confidential, only for members of the consortium (including the Commission) ☐ RE - Restricted to a group specified by the consortium (including the Commission Services)

Contents

1 Executive summary

The original delivery date of deliverable D1.1 was 31 January 2019. But in agreement with the project officer from EC-INEA, this due date was extended to 31 March in order to accommodate a full cycle of comments with all relevant Stakeholders.

The initiative focuses on (commonalities in) the management of tangible infrastructure networks for surface transport in which 'infrastructure' is defined as the physical ('hard') and organisational ('soft') structures and facilities needed for the operation of the transport network. This includes the linear links and intersections, the corresponding buildings, the power and data/communication supplies and interconnections to all internal and external stakeholders and end users, as well as the governance and management structures and procedures across the line of sight from ministry to market.

The objective is to drive demand driven innovation, spanning the entire process of research and deployment towards larger network scales.

In the fall of 2018, the strategic documents of a wide selection of transport related stakeholders in the European arena were assessed on the relevance to the infra4Dfuture (i4Df) initiative.

From this assessment, the i4Df initiative selected three infrastructure capabilities that infrastructure owners should have in the future. For each of the capabilities, guiding objectives for 2040 were drafted as well as the innovation focus areas that are key to achieving these guiding objectives.

The initial suggestions for the three infrastructure capabilities were discussed during the 1st i4Df stakeholder conference on 11 December (Brussels, Belgium) in a setting of strategic representatives from the national transport infrastructure authorities (NTIA) and the European Commission.

After processing their comments, an updated draft formed the foundation for discussions at the 1st i4Df Expert Workshop on 25-26 February (Bergisch Gladbach, Germany), in a setting of senior experts across the four stakeholder groups (NTIAs, industry, research and European Commission).

Building on the input of these two events, the deliverable D1.1 was drafted and submitted. It presents following items:

- **Overview of the relevant stakeholders to the i4Df initiative** as the foundation on which the invitations to the following Stakeholder Conferences will be sent.
- **Initial description of the three infrastructure capabilities for 2040**, including guiding objectives
- **Initial overview of corresponding innovation focus areas** that are key to develop towards the guiding objectives
- **Key notions on professional competence development** as a starting point for further elaboration
- **Initial references to strategic agendas and positions** for the various stakeholders

This deliverable D1.1 will serve as a reference for the other activities in the i4Df initiative. Also the contents presented here will evolve over time following the insights built from the structured dialogue with the relevant stakeholders.

2 Introduction

2.1 Purpose of the document

2.1.1 Task description for D1.1

D1.1 : Stakeholder map for transport infrastructure innovation

Map providing a first ever consolidated overview of all cross-modal stakeholder bodies in the European arena as well as a joint vision on infrastructure capabilities until 2040. Deliverable refers to Task 1.1.

The document is a reference for the project activities. It guides engagements with the stakeholder environment for WP1, WP2, WP3 and WP4.

The document is related to Task 1.1: Defining the stakeholders and their joint vision on infrastructure capabilities. The aim of this task is to define the relevant stakeholder arena to infrastructure innovation from each of the four groups as well as to map the joint vision of the national transport infrastructure authorities (NTIA) on infrastructure capabilities until 2040 and the related professional competences required.

In a first step, the relevant stakeholders will be identified for each of the four stakeholder groups: issue owners, innovation programme owners, industrial lead suppliers and research providers. Documentation on the joint missions, visions, aims and strategies of these groups will be collected from their well-known representing European bodies and assessed on cross-cutting commonalities. The decision making levels from each of the representing bodies will be invited to attend a first of four strategic stakeholder conferences.

In this first stakeholder conference (M2) the invited decision makers of the stakeholder bodies will be informed on infra4Dfuture and the timeline for completion. Also they will be consulted on completeness of a draft stakeholder map that will have been prepared by the core partners of this task in advance. Furthermore, they will be consulted on a draft joint vision on infrastructure capabilities until 2040 describing the challenges to be addressed, outlining the respective scope and expected impacts, and indicating the expected time lines for implementation/ deployment. This sets the reference for further tasks in this WP as well as in WP 2 (structures to coordinate a portfolio of programmes) and WP3 (professional competence building).

Key issues from this task description are:

- Identification of **relevant stakeholders** to consult
- Assessment of (their) missions, visions, aims and strategies on cross cutting **commonalities**
- Draft **joint vision** on infrastructure capabilities **for 2040** describing challenges, scope and expected impacts as well as time line for implementation/deployment
- Related **professional competences**

This deliverable D1.1 will serve as a reference for the other activities in the i4Df initiative. Also, the contents presented here will evolve over time following the insights built from the structured dialogue with the relevant stakeholders.

2.1.2 Deviations in process, timing and content

- **Process:** In deviation with the task description, the 1st i4Df Stakeholder Conference was limited to the national transport infrastructure authorities (NTIAs) and the European Commission. This was decided in order to first enable a common understanding and support on the scope of 'infrastructure management' and related key issues before engaging with the wider stakeholder setting.
- **Timing:** The original delivery date of deliverable D1.1 was 31 January 2019. But in agreement with the project officer from EC-INEA, this date was postponed in order to be able to have a better consolidated view following a full cycle of comments with all relevant Stakeholders.
- **Content:** The description of (specific) challenges, scope and expected impacts as well as time line for implementation/deployment are not described in this document. This requires further consultation of the stakeholders.

2.2 Intended audience and aim

The intended audience for this document are primarily the members of the i4Df project consortium as it serves as a reference for following activities in the i4Df initiative. This document:

- **Identifies the key stakeholders** to engage for delivering the project results over the runtime of the i4Df initiative
- **Presents a consolidated view on future infrastructure capabilities** , supported by guiding objectives for 2040
- **Presents an overview of infrastructure innovation focus areas** from a common vision on the infrastructure capabilities for 2040
- **Presents key notions for professional competence development** respective of the future infrastructure capabilities

2.3 Interrelations with other WPs of the project

- **Relation with WP 2:** presentation of a joint vision of the infrastructure managers on future capabilities (for 2040) as well as outlines the corresponding innovation focus areas.
- **Relation with WP3:** outline of the required competence development respective to the identified innovation focus areas.
- **Relation with WP4:** provision of the references for communication and dissemination with relevant stakeholders for infrastructure innovation and implementation.

3 Relevant stakeholders to infrastructure innovation.

The i4Df initiative focuses on establishing a coordination mechanism for demand driven infrastructure innovation in a European setting, including associated countries from the wider European research area.

As the intended coordination mechanism will not imply centralised or even collective management, but rather voluntary alignment/concertation of national, regional and European activities according to the required scale and respecting the principles of subsidiarity, its foundation is a structured dialogue between all relevant stakeholders (see figure).

This dialogue builds from achieving a set of common objectives of the various NTIAs as **public issue owners** that have an urgent need to a common agenda for infrastructure innovation and implementation. This common agenda serves as a guiding actionable perspective for the other stakeholders, notably:

- the public **innovation programme owners** that from a shared interest may fund items from that common agenda. Examples of bilateral, multilateral and European cooperation are: the European Commission, from well-known programmes such as Horizon-Europe, CEF; CEDR, from its transnational research programme; and other EU-regional cooperation such as the Nordic Council on the Nord-FU programme, and Germany, Austria and Switzerland on the DACH initiative.
- the **industrial lead suppliers** of innovative solutions.
- the supporting **research providers** (including education and training).

Overleaf the table presents the stakeholders, distinguished in those at the demand side of infrastructure innovation and implementation (pubic issue owners and innovation programme owners) and those at the supply side (industrial lead suppliers and research providers). The overview presents platforms and associations in which the various organisations and firms are organised towards the European arena. It should be noted that the structured dialogue within the coordination mechanism is primarily focussed on the exchange with individual members. This ensures the direct relations required for achieving support for developing the mechanism and its roll-out. However, the platforms identified serve as efficient access points to the specific stakeholder groups, for example when concerned with dissemination and knowledge transfer of research results.

Table: Relevant stakeholders to infrastructure innovation.

DEMAND SIDE • **Public Issue Owners** • **Innovation Programme owners**		**SUPPLY SIDE** • **Industrial lead suppliers** • **Research Providers**	
From i4Df consortium	Annex 1	Construction Industry	ENCORD
Other Road infrastructure authorities (non-i4Df)	CEDR	Automotive Manufacturers Europe	ACEA
Rail infrastructure authorities (non-i4Df)	EIM	Automotive Suppliers	CLEPA
Other National Transport Infrastructure Authorities from EU	Romania, Bulgaria, Slovakia, Croatia	Rail Manufacturers	UNIFE
Inland waterways	INE	Operators of Toll Road Infrastructures	ASECAP
Sea port authorities	ESPO	Logistics, freight forwarding and customs services	CLECAT
Inland port authorities	EFIP	Telecoms providers	ETNO
Airport authorities	ACI-Europe	Energy providers	ENTO-E
Regional and municipal authorities	Polis Eurocities	Automotive research and development	EUCAR EARPA
Public transport authorities	EMTA	Building Research Institutes	ENBRI
		ETRA: National Road Research Centres	FEHRL
		ETRA: Transport Research Institutes and Universities	ECTRI
		ETRA: Road Safety Research Institutes	FERSI
		ETRA: Rail Research Institutes	EURNEX
		ETRA: Human oriented Research Institutes, and Universities	HUMANIST
		ETP on Airborne Transport	ACARE
		ETP on Logistics	ALICE
		ETP on Construction	ECTP
		ETP on Rail Transport	ERRAC
		ETP on Road Transport	ERTRAC
		ETP on Waterborne Transport	Waterborne
World Rail authorities	UIC	European Railway sector	CER
World Road authorities	PIARC	World Public transport	UITP

4 Infrastructure capabilities for 2040

4.1 Demarcation of infrastructure

4.1.1 General aspects

In the i4Df initiative, the focus is put on transport infrastructure innovation and implementation for road, rail, waterborne and airborne transport of passengers and goods from origin to destination.

The initiative focuses on (commonalities in) the management of tangible infrastructure networks for surface transport in which 'infrastructure' is defined as the physical ('hard') and organisational ('soft') structures and facilities needed for the operation of the transport network. This includes the linear links and intersections, the corresponding buildings, the power and data/communication supplies and interconnections to all internal and external stakeholders and end users, as well as the governance and management structures and procedures across the line of sight from ministry to market.

4.1.2 Respective of the other components in the transport system

From this perspective, any demarcation of infrastructure management should be considered with appropriate flexibility. From this, a priority is on understanding these interdependencies and corresponding cross-cooperation and collaboration with the other stakeholders.

As a consequence, any demarcation of infrastructure (management) should be considered with appropriate flexibility. From this, a priority is on understanding these interdependencies and corresponding cross-cooperation and collaboration with the other actors.

4.1.3 Geographical setting

In the context of the i4Df initiative, transportation networks are a spatial framework of routes linking locations, enabling transport of people and goods from origin to destination. The routes can be tangible such as is the case with roads, rails, waterways, or less tangible such as is the case with air and sea corridors.

In terms of geographical setting and functionality, the initiative focuses on the TEN-T comprehensive networks, including relevant supporting sections of the non-TEN-T networks, that carry most of the traffic and are strategically most important (e.g. also in the context 'military mobility'). With a focus on the links, municipal networks, airports and waterborne ports are regarded as singular nodes in the network for which the key issues to address are: accessibility, availability and reliability of the (inter) links.

These urban and economical nodes have an essential role in enabling effective and efficient distribution of transport flows of freight and passenger transport across the multimodal European transport area. They can be of different scale and organisation, but are typically set in the densely populated areas and economic centres of Europe. Their utilisation typically is to the maximum service capacity *i.e.* they are typically highly congested.

The end user of the infrastructure network includes the direct user of the network and stakeholders who provide energy, data, information, transport and mobility services to the end users.

4.2 Key trends, drivers and enablers for infrastructure innovation

Infrastructure managers provide a broad range of services to the end users. Currently, the European mobility system is in rapid transition towards the provision of higher service quality to the end user from the perspective of an increasingly integrated system, enabling seamless and well informed movement of passengers and freight from origin to destination across different modes. Key challenges to this service provision are: the requirements of construction, replacement and renewal; the intense competition for space and fiscal budget; demands and opportunities from new mobility business models, and digitalisation for economy and society, such as mobility as a service; the sensitivity to economic and social pressures from disruption (e.g. end of life cycle, natural and man-made events); liveability and sustainability; adaptation to climate change; and the opportunities to synergise with data and energy network management (e.g. with TEN-E, the Trans-European Networks for Energy, in greening/decarbonising the transport energy pool); the security of the infrastructure service provision to the end-user, regarding man-made attacks and natural hazards; safety of infrastructure workers and end users.

The manifestation of these trends will be particularly noticeable on the 'soft' side of infrastructure as about 90% of the future physical infrastructures already exist today whereas this is only the case for approximately 10% of the organisational structures. For example, the impact of digitalisation will be a game changer throughout the current infrastructure management and operation as the rapid ingress of data will affect every aspect in the operational processes. On top, digitalisation will drive new, currently unknown business models which subsequently will drive profound changes in societal attitudes and behaviour, in turn affecting the current role and position of infrastructure managers.

4.3 Key infrastructure capabilities and guiding objectives for 2040

In order to coordinate innovation infrastructure innovation and implementation actions across a portfolio of EU and national programmes and initiatives, a common reference is needed to future 'capabilities' that infrastructure managers expect to provide to the end user and society as a whole. Although presented here as independent entities, the following set of three capabilities work interdependently:

- ***Infrastructure optimally meeting end user needs.*** *The ability to provide optimal transport infrastructure network capacity in order to accommodate increasing transport needs, and balancing cost, performance, safety and risk to provide infrastructure as a high quality service to end users.*
- ***Infrastructure meeting environmental and social sustainability needs.*** *The ability to embed transport infrastructure networks in their immediate surroundings, optimally balancing interests from economy, society, and environment.*
- ***Infrastructure achieving added value from digitalisation.*** *The ability to harvest the benefits from digitalisation in internal processes of transport infrastructure management (e.g. planning, design, construction, operation, end-of-life) as well as in the relation between transport infrastructure management and its end user (smart mobility and logistical services, individual end users).Use digitalisation to support the achievement of sustainability targets and provide a better service to infrastructure end users.*

Each capability is spanned by a set of guiding objectives that set the agenda for the infrastructure innovation demand, as is presented in the table overleaf.

Table: Guiding objectives for 2040.

CAPABILITY: Infrastructure optimally meeting end-user needs	CAPABILITY: Infrastructure meeting environmental and social sustainability needs	CAPABILITY: Infrastructure achieving added value from digitalisation
Providing optimal transport infrastructure capacity. • Full accommodation of the anticipated development in transport demand across the network, achieving effective alignment between the surface infrastructure networks through interoperability and seamless integration between modes at every stage.. • Effective ownership throughout the whole infrastructure life cycle, from planning and design, to end of life. • Effective adaptive integration and implementation of innovations across the delivery process chain. • Resilience to natural and manmade hazards, including adaptation to climate change. **Enabling significant improvement in (societal) Performance-Cost ratio.** • Significant reduction of total cost of ownership (TCO) e.g. reduction of TCO by 30% for infrastructure managers. • Achievement of zero fatalities and severe injuries of infrastructure workers and end users. • Low cost, affordable high capacity infrastructure that supports end users' service combinations of mobility and logistics.	**Optimal contribution to climate change mitigation.** • Facilitate the energy transition of the surface transport system. This concerns the transition in the energy pool of the transport modes and supporting measures to improve energy-efficiency of mobility services (passengers, freight). • Minimise carbon footprint of the whole service-life of infrastructure, including the infrastructure delivery process chain. • Achieve energy neutrality of the infrastructure management process. This concerns overall energy balance of the daily operational processes, e.g. lighting/signalling, data/information provision, lifting, ventilation. **Optimal contribution to liveability.** • Collaborate on the minimisation of the impact of noise/vibration, and pollutant emissions. This concerns the share of the impact that is contributable to infrastructure management. • Collaborate on the optimal net benefit from embedding infrastructure in the spatial setting. This concerns the 'how' in infrastructure governance, balancing benefits for the economy, society and environment in the planning and approval stage. • Compliance with COP21 and Agenda 2030/UN targets for sustainable development in the context of European objectives and targets.	**Full accommodation of connected and automated mobility, maintenance and construction concepts on transport infrastructure** • Facilitate the transition towards smart mobility concepts (freight and passenger) for emerging concepts for automated mobility, e.g. CCAM for road and ATO for rail. • Use automated, semi-automated and remote-piloted solutions for infrastructure maintenance and construction to improve safety for workers and reduce costs. • Proactively define the capabilities of infrastructure in the accommodation of automated and connected mobility, maintenance and construction solutions. **Optimal position in evolving data-driven infrastructure management processes** • Proactive position of the infrastructure manager within the infrastructure related data-driven ecosystem, incl. clearly defined data flows between multimodal, -national and -sectoral stakeholders. • Ability to process internal and external raw data into smart data that can optimize infrastructure management processes, incl. maintenance and construction of infrastructure. • Provide seamless data and information use and provision across the transport infrastructure network and logistic chain to the end user. **Physical, digital and virtual infrastructure aligned with data networks and energy grids.** • Facilitation of the alignment of TEN-T core network with data and energy networks that can cater for future digital needs, e.g. internet of things (IoT) and smart grid based electric mobility. • A clear business model and case for investment and maintenance of digital and virtual infrastructure.

5 Innovation Focus Areas

Building on the strategic agendas, position papers and other references from the various stakeholders, a first list of innovation focus areas (IFAs)was derived, that are key in achieving the guiding objectives for 2040.This list was discussed in the first i4Df Stakeholder Conference (11 December 2019) and the first i4Df Expert Workshop (25-26 February 2019). Each IFA represents an independent entity that can have strong links and complementarities to other IFAs.

It is expected that this list will further evolve, following the further stakeholder engagement events scheduled. The aim is to finalise the list of IFAs in autumn-winter 2019.

Table: Innovation Focus Areas for 2040.

CAPABILITY: Infrastructure optimally meeting end-user needs	**CAPABILITY: Infrastructure meeting environmental and social sustainability needs**	**CAPABILITY: Infrastructure achieving added value from digitalisation**
1-1: Guaranteed asset health and availability	2-1: Resource efficient manufacturing, construction and operations	3-1: Managing the transition towards the accommodation of automated transport on road, rail, air and waterways infrastructure
1-2: Integrated infrastructure life-cycle management	2-2: Advanced strategies and approaches for accommodation of the energy transition in transport	3-2: Advanced approaches and strategies for automated construction and maintenance of infrastructure with support of artificial intelligence
1-3: Service timed to the second	2-3: Advanced strategies and approaches to minimize the impact of noise/vibration, and pollutant emissions.	3-3: Secure and resilient data and information provision across the multimodal, transnational network (road, rail, water, air) for all users.
1-4: Responsible procurement fostering strong innovation delivery mechanisms	2-4: Advanced approaches and strategies for the integration of (urban) nodes in the TEN-T networks - multimodal, multi-scalar, and multi-objective	3-4: Data-driven and digitalised asset management
1-5: Key Performance Indicators to meet the end user's mobility and logistic needs		
1-6: Strategies and approaches for ensuring optimal safety, security and resilience of the infrastructure network		

6 Professional competence development

6.1 The need improving professional competences

In the first i4Df Stakeholder Conference on 11 December 2018, which focused on the future infrastructure capabilities, the conclusion was that alongside with the continuous need for well-known 'hard' infrastructure knowledge, the human capital of the NTIAs should increasingly put emphasis on the 'soft knowledge aspects' of infrastructure management; the people behind the operations. Already the infrastructure managers at the table indicated a clear and urgent need for new, additional skills (competences and knowledge) in order to enable effective collaboration with other infrastructure authorities, and industry in increasingly complex settings. They include abilities to function in multidisciplinary and collaborative teams.
Following on the first Stakeholder Conference, the expert attending the first Expert Workshop on 25-26 February 2010 were consulted with a request to elaborate on these initial strategic notions. Following paragraph presents the headlines from that session.

6.2 Captures from the first Expert Workshop

During the first Expert Workshop in Bergisch Gladbach (25-26 February 2019) following key notions were captured from the attending experts:

6.2.1 Key trends, developments, changes for your organization in the next 10-20 years

- **Digital transformation**. Key trends are the emergence of automated transport, the ingress of digitalisation of work and processes (i.e. 'big data'), and the related security issues.
- **Human development**. Key trends are the persistent loss of technical knowledge in the workforce (both with NTIAs and industry) due to ageing/retirement and shifting preferences of students. Also the innovation issues extend beyond pure technological knowledge, and include organizational aspects as well as social aspects (end-user orientation). Next to technological knowledge, softer skills should have emphasis.
- **Environment**. Key trends are on sustainability, adaptation to and mitigation of climate change, and the availability of (natural) resources.
- **Organisation**. Key trends are on multi-sectoral and multidisciplinary cooperation (across the networks, across the modes and across the -organizational and geographical- borders; globalization. Organisations need to be more flexible to cope with the ongoing change, and understand increasingly complex business casing.
- **Assets**.Key trends are on management/organisation and on optimisation and replacement of (ageing) infrastructure structures.
- **Energy transition**. Key trends are on the greening of the energy pool for the transport system, such as through electrification and hydrogenisation of vehicle propulsion.

6.2.2 Impact of these trends/challenge on human capital

- **Hard skills**. Next to adequate replacement of the outflowing employees with basic knowledge, there is an urgent need for inflow of employees with new knowledge (e.g. big data, ICT, organizational, social).

- **Multidisciplinary (soft skills).** In view of the increasing integrated systems approach of infrastructure management, there is a need for adequate ability to work in multidisciplinary and multi-stakeholder teams.
- **Innovation/change/adaptation (soft skills).** As constant change is the new standard in infrastructure management, there is a need for task and job flexibility and continuous reskilling of the workforce..
- **New curricula (formal education):** The current curriculums of education and training should evolve to reflect the mentioned trends (multi-disciplinary, multi-stakeholder setting, new knowledge fields; soft skills).
- **New talent.** The infrastructure sector should live the fact that it is competing for talent. This requires new approaches and structures to attract and bind personnel.

6.2.3 Bridging the gap

- One of the main conclusions of the expert discussions was that the **human factor is central** in the innovation implementation.
- Also it was acknowledged that **human resources management** should become **pro-active** - with a focus on flexibility, change and adaptation.
- **Organisations** should consider to adapt flexibility in the organizational structure – silos vs dynamic teams.
- **Training and retraining**. Concepts, such as lifelong learning, should be brought to practice effectively.
- **Education.** The curricula of universities should evolve to match the identified infrastructure capabilities

7 REFERENCES

In the running up to this deliverable, a variety of references were assessed in order to identify commonalities from the stakeholders strategic agenda's. Following overviews present the documents that were assessed. Over the course of the initiative it is expected that this list will evolve.

7.1 Reference from the demand side of innovation

Label	Reference
CEDR 2016	CEDR strategy 2016; 2016; http://www.cedr.eu/td-strategy-2016-warsaw/
CEDR 2017	CEDR Action Plan 2018-2020; 2017; http://www.cedr.eu/strategic-plan-tasks/action-plan-2018-2020/
EIM 2018	Position paper on MFF-A sufficient EU budget for the best Rail System in Europe;February 2018; http://www.eimrail.org/publications/news/eim-cer-position-paper-on-mff
CER 2018	Postion paper – Commission proposal on Connecting Europe facility COM (2018) 438 final; September 2018; http://www.cer.be/publications/latest-publications/cer-position-paper-commission-proposal-connecting-europe-facility
STRIA Energy	Low-emission alternative energy for transport – Roadmap; https://ec.europa.eu/jrc/en/publication/brochures-leaflets/strategic-transport-research-and-innovation-agenda-stria-roadmap-factsheets
STRIA TM	Network and traffic management systems – Roadmap; https://ec.europa.eu/jrc/en/publication/brochures-leaflets/strategic-transport-research-and-innovation-agenda-stria-roadmap-factsheets
STRIA CCAM	Cooperative, connected and automated transport – Roadmap; https://ec.europa.eu/jrc/en/publication/brochures-leaflets/strategic-transport-research-and-innovation-agenda-stria-roadmap-factsheets
STRIA INFRA	Transport infrastructure – Roadmap; https://ec.europa.eu/jrc/en/publication/brochures-leaflets/strategic-transport-research-and-innovation-agenda-stria-roadmap-factsheets
STRIA SMART	Smart mobility and services- Roadmap; https://ec.europa.eu/jrc/en/publication/brochures-leaflets/strategic-transport-research-and-innovation-agenda-stria-roadmap-factsheets
I&W 2016	Questions for the day after tomorrow – Strategic knowledge and innovation agenda Infrastructure and the environment; June 2016; https://www.rijksoverheid.nl/documenten/rapporten/2016/12/07/vragen-voor-overmorgen
NOVI 2017	Nationale Omgevingsvisie – The Netherlands national strategy on a liveable environment; February 2017; https://www.denationaleomgevingsvisie.nl/publicaties/default.aspx#folder=937064
RWS 2017	Innovation agenda 2015-2020 – Reviewed; January 2017; https://staticresources.rijkswaterstaat.nl/binaries/Innovatieagenda_herijking_2016_tcm21-100461.pdf
HbR 2017	Response of the Port of Rotterdam to the draft report of the committee on transport and tourism on a European strategy for low-emission mobility; July 2017; https://www.portofrotterdam.com/sites/default/files/position_paper_low_emission_strategy_port_of_rotterdam.pdf?token=K_jxA11I
BMVI 2016A	The BMVI Network of Experts- Knowledge- Ability-Action; May 2016; https://www.bmvi-expertennetzwerk.de/EN/Home/home_node.html;jsessionid=FFB1E339CCCE5142A3B063BB3286CB73.live21303
BMVI 2016B	The research strategie of the BMVI Network of Experts- Knowledge- Ability-Action; May 2016?; https://www.bmvi-expertennetzwerk.de/DE/Publikationen/Medien/Forschungsstrategie.pdf?__blob=publicationFile&v=2
BMVI 2013	Roads in the 21st century. Innovative Road Construction in Germany. Federal Ministry of Transport, Building and Urban Development. June 2013. https://www.bmvi.de/SharedDocs/DE/Anlage/VerkehrUndMobilitaet/Strasse/strasse-im-21-Jahrhundert-englisch.html

BMVI 2015	Phased introduction of Building Information Modelling (BIM) until 2020. Federal Ministry of Transport and Digital Infrastructure. Dec 2015. https://www.bmvi.de/SharedDocs/DE/Publikationen/DG/stufenplan-digitales-bauen.html

7.2 References for the supply side of innovation

Label	Reference
ACEA 2018	ACEA position paper – The European Commission's action plan on Iternative fuels infrastructure; February 2018; https://www.acea.be/publications/article/position-paper-the-european-commissions-action-plan-on-alternative-fuels-in
ETNO	Telecom operators' priorities for Horizon Europe; February 2019: see also: https://etno.eu/library/positionpapers/391-telecom-operators-priorities-for-horizon-europe.html
CLECAT	Various position papers on related matters; continuous; see also: https://www.clecat.org/positions/all
SETRIS 2018	Towards fully integrated transport system- Summary of the SETRIS Project Outcomes and Results; April 2018; http://www.waterborne.eu/media/35583/31022_setris_publication_web_final.pdf
JETP 2013	Roadmap for cross-modal transport infrastructyureinnovatyion – towards a performing infrastructure; ERTRAC-ERRAC-Waterborne-ACARE-ECTP; 30 June 2013; https://ec.europa.eu/growth/tools-databases/eip-raw-materials/en/community/document/etp-roadmap-cross-modal-transport-infrastructure-innovation-towards-performing
ESPO 2018	The infrastructure investment needs and financing challenge of European ports; March 2018; https://www.espo.be/publications/the-infrastructure-investment-needs-and-financing-
ESPO 2017	More EU budget for transport - The best Investment Plan for Europe; October 2017;https://www.espo.be/media/2017.09.21%20Flyer_Transport_Organisations_CEF_2017_09_19.pdf
ALICE 2018	Corridors, hubs and synchro-modality – research and innovation roadmap;http://www.etp-logistics.eu/?page_id=79
ECTP 2018	ECTP Infrastructure and mobility-FP9 2021-2027 position paper; March 2018; http://www.ectp.org/fileadmin/user_upload/documents/I_M/ECTP_I_M_Committee_Position_Paper_v2018-03-14.pdf
ERTRAC 2018	ERTRAC Strategic Research Agenda – Input to 9th EU Framework Programme; March 2018; https://www.ertrac.org/uploads/documentsearch/id52/ERTRAC-Strategic-Research-Agenda-SRA-2018.pdf
ACARE 2017	Strategic Research & Innovation Agenda - Delivering Europe's Vision for Aviation – update 2017; 2017; https://www.acare4europe.org/documents/delivering-europe%E2%80%99s-vision-aviation-sria-2017-update
ERRAC 2017	RAIL 2050 VISION document – Rail, the backbone of Europe's mobility; 2017; http://www.errac.org/wp-content/uploads/2018/01/122017_ERRAC-RAIL-2050.pdf
WATER 2019	Strategic Research Agenda for the waterborne sector; January 2019; https://www.waterborne.eu/media/35860/190121-waterborne_sra_web_final.pdf

7.3 Other references

Label	Reference
OECD 2011	Strategic transport infrastructure needs to 2030 – Main findings; 2011; https://www.oecd.org/futures/infrastructureto2030/49094448.pdf
IEA 2013	Global land transport infrastructure requirements – Estimating road and railway infrastructure capacity and costs to 2050; 2013; https://www.iea.org/publications/freepublications/publication/TransportInfrastructureInsights_FINAL_WEB.pdf
SHELL 2018	Sky -SHELL SCENARIOS MEETING THE GOALS OF THE PARIS AGREEMENT; 2018; https://www.waterborne.eu/media/35584/shell-scenarios-sky.pdf
ITF 2013	Understanding the value of transport infrastructure – guidelines for macro-level measurement of spending and assets; 2013; https://www.itf-oecd.org/sites/default/files/docs/13value.pdf
GOTS 2017	The Geography of Transport Systems - The spatial organization of transportation and mobility; 2017; https://transportgeography.org/

ANNEX 1. National transport infrastructure authorities in the i4Df consortium

Name	Short name	Country
MINISTERIE VAN INFRASTRUCTUUREN WATERSTAAT	RWS	NETHERLANS
NETIVEI ISRAEL – NATIONALTRANSPORT INFRASTRUCTURECOMPANY LTD	NTIC	ISRAEL
MINISTERE DE L'ENVIRONNEMENT, DEL'ENERGIE ET DE LA MER	MEEM	FRANCE
LIIKENNEVIRASTO	LIIKENNEVIRASTO	FINLAND
MINISTERSTWO INFRASTRUKTURY	MI PL	POLAND
INFRAESTRUTURAS DE PORTUGAL SA	IP	PORTUGAL
MINISTERIO DE FOMENTO	FOMENTO	SPAIN
VLAAMS GEWEST	AWV	BELGIUM
VALSTS AKCIJU SABIEDRIBA LATVIJASVALSTS CELI	LSR	LATVIA
KARAYOLLARI GENEL MUDURLUGU	KGM	TURKEY
MINISTERSTWO GOSPODARKI MORSKIEJ I ZEGLUGI SRODLADOWEJ	MMEIN	POLAND
DANISH ROAD DIRECTORATE	DRD	DENMARK
TRAFIKVERKET - TRV	TRV	SWEDEN
STATENS VEGVESEN	NPRA	NORWAY
BUNDESMINISTERIUM FUER VERKEHRUND DIGITALE INFRASTRUKTUR DIG	BMVI	GERMANY
ANAS SPA	ANAS SPA	ITALY
BUNDESMINISTERIUM FUERVERKEHR, INNOVATION UNDTECHNOLOGIE	BMVIT	AUSTRIA
HELLENIC MINISTRY OF INFRASTRUCTURE, TRANSPORTS AND NETWORKS	HMI	GREECE