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D2.3 – Effective collaborative structures and schemes for cross-modal, transnational information transfer and cross-fertilisation between innovation programmes and initiatives Nr.2

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Abbreviations

ACARE	Advisory Council for Aeronautics Research in Europe
AI	Artificial Intelligence
BIM	Building Information Modelling
BMVI	Federal Ministry for Transport and Digital Infrastructure, Germany
BMVIT	Federal Ministry for Transport, Innovation and Technology, Austria
BRA	Baltic Road Association
C2I	Car to Infrastructure
CBA	Cost-benefit-analysis
CCUS	Carbon capture, utilisation and storage
CEDR	Conference of European Directors of Roads
CEF	Connecting Europe Facility
CoT	City of Things
D-A-CH	Germany – Austria – Switzerland
DuLO	Duurzame leefomgeving
EIM	European Rail Infrastructure Managers
FA	Focus Area
FEREC	Fondation d'entreprise recherche collective pour la construction et les infrastructures
FFI	Strategic Vehicle Research and Innovation
FoPS	Forschungsprogramm Stadtverkehr *(Research Programme Urban Transport)*
i4Df	Infrastructure for the future
IDRRIM	Institut des Routes, des Rues et des Infrastructures pour la Mobilité, France
IFA	Innovation Focus Area
ITS	Intelligent Transport Systems
MAAS	Mobility as a service
MINnD	Modélisation des INformations INteropérables pour les Infrastructures Durables

MOTF	Mobility of the Future
NGInfra	Next Generation Infrastructures
NTIA	National Transport Infrastructure Authority
R&I	Research and Innovation
RMMS	Road Markings Management System
S2R	Shift to Rail
SERA	Single European Railway Area
STRIA	Strategic Transport Research and Innovation Agenda
TEN-T	Trans-European Transport Network
TRIMIS	Transport Research and Innovation Monitoring and Information System

Executive Summary

This document builds on deliverable D2.2 "*Effective collaborative structures and schemes for cross-modal, transnational information transfer and cross-fertilisation between innovation programmes and initiatives Nr.1*" and presents the base structure for a rolling cross-modal and transnational portfolio of existing and future innovation and research programmes and initiatives. This deliverable is one of the elements of the "toolbox for IFA collaboration groups" of the i4Df coordination mechanism that is explained in detail in D1.4 "Ready to implement, supported coordination mechanism".

A total of 27 national, transnational and Europe research and innovation programmes and initiatives have been collected through structured desktop research (e.g. TRIMIS database) and a stakeholder consultation process (e.g. four i4Df regional outreach events). The portfolio analysis illustrates that there are many potential thematic links between the seven IFA collaboration groups and the 27 identified programmes and initiatives. Further, the portfolio analysis shows that the majority of programmes and initiatives either address multiple modes or roads. It is acknowledged that the presented portfolio of programmes and initiatives and the analysis in this deliverable provide only a snapshot of the duration of the i4Df initiative.

This deliverable concludes by recommending that the i4Df portfolio of innovation programmes and initiatives needs to be updated and analysed in regular intervals by the National Transport Infrastructure Authorities in the IFA collaboration groups. The "IFA Continuous Collaboration Life Cycle" is suggested as an approach IFA collaboration groups might use to structure their activities.

1 Introduction

1.1 Purpose of this document

The overall aim of this deliverable is to set up the basis for a structure for a cross-modal and transnational portfolio of existing and future innovation and research programmes and initiatives. It was created to determine an appropriate generic level for potential demand driven coordination and collaboration activities between national transport infrastructure authorities (NTIAs), such as:

- Selective alignment of national innovation agendas on national networks;
- Joint research and innovation activities across borders, sectors and modes.

This deliverable is one of the elements of the "toolbox" of the i4Df coordination mechanism that is explained in detail in D1.4 "Ready to implement, supported coordination mechanism" for the concerted rolling portfolio of relevant innovation programmes and initiatives until 2025 and 2030 and the key coordination structures and instruments. This toolbox is derived from the results from relevant i4Df deliverables (D1.1, D1.2, D1.3, D1.4, D2.1, D2.2, D3.1, D3.2) and contains elements that are meant to assist the IFA groups in their collaborative work. The IFA coordination ecosystems are free to select from the toolbox those elements they consider to be important and useful for their work (cf. D1.3 "Joint innovation pathways until 2040").

D2.3 aims to enable the NTIAs to achieve the best possible benefit for their common research and innovation activities in the frame of the future cooperation based on the initiation through the i4Df project. This approach will result in the achievement of synergies both between the NTIAs but also across the different modes and across different infrastructures.

In order to achieve the approach described above, the following objectives were completed in D2.2 and D2.3:

a) Explanation of the portfolio and other key terms.

b) Identification of suitable innovation and research programmes and initiatives to be included in the portfolio.

c) Development of a suitable methodology to conduct a portfolio analysis with the following foci:

   i. Development of the thematic links between identified programmes and initiatives, and the seven i4Df IFAs (cf. D1.2 "Joint vision on transport infrastructure innovation until 2040" and D1.3);

   ii. Identification of basic characteristics to describe and compare identified programmes and initiatives.

d) The elaboration of the portfolio analysis and the development of suitable recommendations for the operationalisation of the IFA collaboration groups.

e) Provide best practice examples of existing models for collaboration and the transfer of results applied by the identified programmes and initiatives (see D3.1 for details).

Deliverable D2.2 (M16) suggested approaches for objectives a), b) and c) to the i4Df consortium and the key stakeholders of this initiative. Deliverable D2.3 builds upon D2.2 to achieve all the stated objectives apart from e), which was completed in D3.1. The completion of D2.2, D2.3 and D3.1 was conducted in close coordination. This resulted in the decision that objective e) is best addressed in D3.1, due to the detailed analysis of best practice examples.

So far, the experts collaborating in the IFAs have identified the priority topics to cooperate on (see D1.3). In the next step, the IFAs should aim to link to existing structure and stakeholders in their ecosystem to start the IFA Continuous Collaboration Life Cycle described in Chapter 5 “Recommendations and Conclusion”. The full i4Df coordination mechanism will be described in D1.4 “Ready to implement, supported coordination mechanism (M24).

1.2 Deviations

The submission of D2.3 and completion of MS6 was delayed due to the cancelation of the 2nd Expert Workshop. The 2nd Expert Workshop was intended to be held in March 2020 (M18) but had to be cancelled due to the corona virus crisis. Instead, in June 2020 (M21) digital meetings of the seven IFA collaboration groups have been conducted aiming at having a final consultation for the i4Df consortium members concluding the several consultation rounds to agree on the structure and scope of the IFAs. The event was conducted in the form of six successive webinars, each dedicated to one of the identified IFAs. No digital meeting was held for IFA 1.3 “Responsible and innovative procurement and finance”, because the role of IFA coordinator was vacant at the time.

In order to allow the results of this important final consultation of the NTIAs to be considered in D2.3, the Project Officer kindly agreed to shift the due date of D2.3, originally intended for M17, to M22. During the webinars the pilot mechanism for exchange of knowledge and information between programmes and initiatives (MS6) was presented.

1.3 Approach

The process of the work for developing, selecting and conducting the work in Task 2.2 is briefly described in the following. All activities were conducted in close collaboration with the other technical tasks of the i4Df consortium resulting in setting a sophisticated scope to cover the needs of all work packages accordingly. With respect to the limited time of high-level participants and experienced senior experts participating at the i4Df events, it was achieved to get a broad input for the different needs of the i4Df project in a structured and concise way, resulting in a close interaction of the different technical tasks of this project.

The work completed in D2.2 was taken as a basis to extend the list of national, regional and European programmes and initiatives most relevant for the work of the IFA collaboration

groups. In total, 16 national and 11 transnational programmes and initiatives were identified from the sources described in Chapter three. These sources were evaluated regarding the strategic and scientific aspects related to the framework for successful cooperation, the benefits and challenges and how to solve possible difficulties.

It has to be noted that some IFA coordinators could not provide national programmes because of the fact that some NTIA have sensitivities about sharing this information. In addition to the listed programmes and initiatives, there might be further (smaller) national initiatives that have not been listed explicitly. Further, only programmes and initiatives that are providing funding were considered in this deliverable and projects were excluded due to their very large number.

2 The i4Df cross-modal and transnational portfolio of existing and future innovation and research programmes and initiatives

The i4Df cross-modal and transnational portfolio of existing and future innovation and research programmes and initiatives, abbreviated as “the i4Df portfolio of innovation programmes and initiatives”, is an attempt to provide a suitable tool that can be used by IFA collaboration groups to determine the most appropriate generic level for demand driven coordination and collaboration activities. Due to the difference in each of the seven IFA innovation ecosystems, each IFA collaboration group has a unique thematic focus and ecosystem setup. Hence, it is neither possible nor wanted to develop and suggest a “one-size fits all” approach for coordination and collaboration activities of the IFAs. The i4Df portfolio of innovation programmes and initiatives rather aims to illustrate the multitude of the different cooperations and collaborations that currently exist in Europe and match them thematically with the eight IFAs. This illustration can be used by the IFA collaboration groups for inspiration to set up the most suitable approach to the unique setup of their IFA collaboration ecosystem.

For further clarification the key terms for the i4Df portfolio of innovation programmes and initiatives are explained as follows:

i. Cross-modal: i4Df is an initiative that aims to identify common research and innovation needs across the transport modes. This is not to be confused with the term “multi-modal”, which is a research and innovation theme in its own focusing on the organisational interchanges between modes. In order to identify cross-modal research themes/challenges, the i4Df portfolio of innovation programmes and initiatives needs to be open to all transport modes, incl. road, rail, waterways, ports and airports.

ii. Transnational: the i4Df portfolio needs to look equally at national, regional and European programmes in order to enable the potential alignment of national innovation agendas and joint transnational research and innovation activities.

iii. Innovation and research programmes: the i4Df portfolio needs to identify innovation and research programmes that are suitable for the needs of the NTIAs. Research and

innovation programmes that show no added benefit to NTIAs will be excluded from the portfolio.

iv. Current and future research and innovation programmes: The European landscape of research and innovation programmes is very diverse and changing regularly. Hence, it is necessary to regularly update the portfolio to ensure that it becomes a “rolling portfolio”.

The end-users of this portfolio will be the IFA collaboration groups. It should be noted that they are at different stages of their development – some of them have already reached a mature stage allowing to constructively collaborate. Other IFAs are yet in the stage of developing their ideas and asking the respective experts from the NTIAs for contributions.

3 Identification of innovation and research programmes and initiatives

Annex A provides an overview of the identified innovation and research programmes and initiatives that were identified by the approach of D2.3 (cf. chapter 1.3).The identified innovation and research programmes were categorised on their relevance to the IFAs, taking into consideration the following aspects:

- Name, abbreviation and initiator/owner
- Link to website
- Funding country
- Background and policy objectives
- Affected transport mode(s)
- Frequency and duration
- Underlying strategy
- Funding and budget
- Matching i4Df Innovation Focus Areas

Chapters 3.1 to 3.6 describe the sources that were considered in the identification of programmes and initiatives.

3.1 EU regional events (MS10)

In autumn 2019, the following four regional outreach events were organised by the i4Df consortium in the frame of Task 2.2, considering the scope of WP1, WP2 and WP3:

- Riga: 10/11 September 2019; host: Latvijas Valsts ceļi (LVC) / Latvia

- Paris: 30 September/1 October 2019; host: Ministère de l'environment, del'energie et de la mer (MEME) / France
- Warsaw: 16 October 2019; host: Ministry of Infrastructure (MI) / Poland
- Thessaloniki: 5/6 November 2019; host: Ethniko Kentro Erevnas Kai Technologikis Anaptyxis (CERTH/HIT) / Greece

Aim of the i4Df regional outreach events was on the one hand to promote the awareness of the i4Df project and to have participants' feedback on regional priorities in infrastructure innovations. On the other hand, best practice examples for regional collaboration as well as the identification of potential hindrances were collected. The participants were senior experts and managers from transport agencies, European Commission, universities, and industry, both from the hosting country and its' neighboring countries. The number of mainly high-level representatives of the different stakeholder groups ranged from 25 to about 50.

The participants were invited to bring in their knowledge in parallel sessions. They presented their vision of the transport infrastructure from regional perspectives, focusing on their country's infrastructure capabilities, developments and potentials and sharing their perspectives on the future of multimodal coordination of infrastructure innovation and implementation. The following questions were raised:

1. What should IFAs cooperate on?
2. How should they cooperate?
3. What are benefits and challenges to cooperation?
4. How can challenges be overcome?

For this deliverable only the answers to questions no. 2. to 4. are relevant, in this chapter the findings of all four regional outreach events related to these three questions are summarised below. The views and opinions expressed in the summary of the i4Df regional outreach events do not necessarily represent the view of the i4Df initiative. Responses and findings related to question no. 1, i.e. specific recommendations for common future innovative transport themes, have been implemented to the IFA descriptions in the deliverable D1.3 in case they had not been considered so far in D1.2.

It should be mentioned that there are several challenges that are not of interest to all European countries due to the existing regional differences. These differences are caused by e.g. the surface area of the country and distances between regional centres and related costs for construction and maintenance; density of population resulting in the rate of return on capital for investments in transport infrastructure; state of development and age of the existing transport network. These individual needs and challenges will result in common research coordinated by only few countries. It is expected that the existing structures for collaborative research will be used for these research tasks and that there is no need for the development of new structures. The deliverables of the i4Df project may help to boost also these regional networks.

- **How should IFAs cooperate?**

Communication between stakeholders: Technology can overcome many challenges apart from human error; misleading communication between the stakeholders is a major challenge. Example is the difficult communication in the digitalisation process. The cooperation should focus on formulating and understanding the needs of different stakeholders, “translators” may help to facilitate the cooperation between them. Further, clear data ontology needs to be created that enables a common understanding across Europe.

Stakeholders’ interests: The interests of a large number of players/stakeholders (politicians, infrastructure managers, local governments, individuals, etc.) in the field of transport infrastructure have to be taken into account. The existing experiences (benefits and disadvantages) of single transport administrations with these stakeholders should be taken into consideration.

Decision making procedures need to be reviewed with the intention to save time. Automated collection of data and digitalisation of planning in decision making may be shown as a proof that decisions on priorities are unbiased, reducing the human factors in decision making.

Quick reaction on new developments. It is important to not only focus on the long-term, but also the short-term needs. Although the development until 2040 is discussed, new developments in terms of IT technology will come much faster, therefore there is no possibility to make predictions for the far future. It will be necessary to quickly react or adapt to new developments.

Implementation of innovation: The TEN-T is an instrument that should be taken into consideration for the implementation of innovative project results. This might help to speed up the implementation as well as to increase the perception of the innovation across borders.

- **What are benefits and challenges to cooperation?**

Agreement on the use of the same techniques: It is necessary that countries would agree on the same technique to allow a consistent evaluation. This is relevant e.g. for the collection and application of data via C2I-technique to cope with the increasing traffic flow and safety.

Differences between NTIAs: The needs of the NTIAs across Europe differ quite much from each other. The same applies for the interests of the NTIAs and industrial lead suppliers and companies.

An example for these differences at present is the different age of infrastructure and the equipment for the collection of information between the European countries. It is necessary to identify possibilities to synchronise digital elements with physical components of infrastructure in order to guarantee seamless transport on a comparable level of quality all over Europe.

National policy: The decision to join a cooperation is a political decision and depends on the actual political situation and development. Although technical experts might be interested to

join and are convinced by the benefits of a cross-modal cooperation, it might be difficult to reach for the decision makers to ask for their interest to join a cooperation.

Destabilisation of the competences of NTIAs: Players like Google and the AliBaba (Chinese shopping application) have indicated their ability to deliver traffic management activities based on their experience with data and logistics. This may cause problems for NTIAs in the future.

Cross-border implementation of innovation: National procurement law and regulations are a difficulty for the wider implementation of innovations across borders.

Risk aversion: There is a resistance to change existing well-functioning techniques and technologies. One of the reasons for this are the high risks linked to the implementation of innovations.

Costs: The implementation of European regulations and directives causes high costs for NTIAs.

Handling of data: The key challenge for existing infrastructure is how to obtain reliable data and process the data. It is noticed that there is shortage of skills to fully extract value from data. As already multiple BIM approaches exist on national level, it is necessary to solve these problems first before a cross-border cooperation can start.

- **How can challenges be overcome?**

Increased cooperation: Improved dissemination and sharing of good experiences and innovations can be achieved through the support of adequate websites and conferences. This might also support the exchange of knowledge on expert level and enable and strengthen bottom-up support between NTIAs

Costs of innovations: Infrastructure managers should know and accept that innovative measures that need to be taken, i.e. the reduction of CO_2 emissions, may cost more compared to conventional approaches. Test tracks should receive external funding.

At times of shortages and recession, any financing decision is important and critical. Innovative technologies should be screened through a CBA process, in terms of life-cycle of road assets. Social and environmental aspects, regarding the impact of these innovative technologies, should be also taken into consideration.

Raising of awareness: In order to convince decision makers to support research and innovation, additional efforts are necessary.

End users / clients need to be better informed about the already existing digital solutions that can be procured today. Especially smaller cities were stated to be a feasible environment to try out new approaches.

It is essential to communicate the key challenges that national transport infrastructure authorities are facing with regard to their stakeholders. A suitable example for communication with stakeholders is the strategic document from Portugal which states the 50 innovations challenges “Infraestruturas de Portugal” is facing currently.

Synergies of different infrastructure systems. As large transport infrastructure projects are expensive, it is necessary to create synergies with other types of infrastructures such as energy or telecommunication sectors to create shared networks and grids. Simultaneous construction of multiple infrastructure types in one corridor or by sharing physical components of structures allows to develop projects in a more efficient manner compared to a separate construction.

The increase of energy consumption for all new means and pieces of equipment for communication should be taken into regard. It will be necessary that not only all transport modes will collaborate across the borders but also the transport infrastructure owners will collaborate with the energy and telecommunication sector. A reduction of the silos between the modes will enable better co-modal cooperation.

The MINnD (www.minnd.fr) initiative was stated as a good example of how cross-sectoral cooperation for digitalisation in the infrastructure sector can be set up on a national level.

Mobility should change into service thinking. There is a public unawareness of possible alternative means of transportation that is caused by incoherence and lack of intermodality between different transport systems. Currently, all mobility options are not forged together and are not seen as one service. In order to support the envisaged behavioural changes of transport users, psychologists should come in handy to provide advice on coming about these changes.

In summary, the following results can be noted in the context of this deliverable from the events:

- Through the events, the structure of eight IFAs was confirmed by regional stakeholders and a regional feedback for the eight topics was gathered (note: the number of eight IFAs was later reduced to seven IFAs by combining the original IFAs 1.1 “Network performance” and 1.2 “Integrated infrastructure network management” to “Integrated network performance management”, cf. D1.3).
- At the events, additional research and innovation programmes were collected that are included for analysis in D2.3. For example, additional information was collected from the following research and innovation programmes: Baltic Road Association (www.balticroads.org), NordFoU (www.nordfou.org), FEREC (https://fondation-ferec.fr/) and IDRRIM (www.idrrim.com).
- Further findings in the context of the cooperation structure are described in chapter 5 of this deliverable.

3.2 TRIMIS

The Transport Research and Innovation Monitoring and Information System (TRIMIS) monitors the implementation and effectiveness of the roadmaps developed by the Strategic Transport Research and Innovation Agenda (STRIA) in 2017. TRIMIS analyses technology trends, research and innovation capacities and developments in the European transport sector, providing open-access information. In the database (https://trimis.ec.europa.eu/) of

programmes related to transport infrastructure currently 81 programmes are listed. After an initial screening (see Annex B), 11 programmes from the database were considered relevant and selected for the innovation and research programmes and initiatives.

3.3 Strategic Transport Research and Innovation Agenda 2019[1]

As part of the First Mobility Package of the Commission of 31 May 2017, the European Commission prepared a Staff Working Document[2] which focused on the definition of a Strategic Transport Research and Innovation Agenda (STRIA). That document includes a forward-looking agenda for research and innovation in transport, in particular addressing seven priority areas in the form of roadmaps.

As part of these roadmaps, the first STRIA roadmap on Transport Infrastructure published in 2017 assessed the requirements for changes to infrastructure to meet the environmental policy objectives and, for this purpose, sought to identify the areas where the next generation of research and innovation are likely to be of greatest benefit. This roadmap focused on the areas of governance; pricing, taxation and finance; intermodality, interoperability and integration of transport systems; life cycle optimisation; and infrastructure operation and digitalisation.

During 2019, the European Commission has updated several STRIA Roadmaps, transport infrastructure being one of them. While during 2016-2017 the development of the first STRIA Roadmap on Transport Infrastructure was mainly concerned with decarbonization as the key goal, this updated version shows a wider approach. Decarbonization is still an objective, but other aspects are herein being considered too, such as a) Governance; b) Life cycle and asset management; c) Financing, pricing and charging; d) Technology and digitalisation; e) Multimodality, interoperability and interconnectivity; f) Safety and security; g) Sustainability, environment and resilience; and h) Logistics. A total number of 101 actions are described for the above themes, covering policy, management and technological actions.

The final version of the STRIA 2019 Infrastructure Roadmap is not published yet, but a draft version was given to the i4Df consortium for review as part of a wider consultation process.

3.4 Horizon Europe

The purpose of the document “Orientations towards the first Strategic Plan implementing the research and innovation framework programme Horizon Europe” (European Commission,

[1]STRIA 2019 was created by the European Commission and has not been published officially until the submission of this deliverable.

[2] Commission Staff Working Document. Towards clean, competitive and connected mobility: the contribution of Transport Research and Innovation to the Mobility Package. 2017 https://ec.europa.eu/transport/sites/transport/files/swd20170223-transportresearchandinnovationtomobilitypackage.pdf

2019)[3] is to inform and stimulate a co-design process that will prepare the first Strategic Plan for Horizon Europe, the European Union Framework Programme for Research and Innovation 2021 – 2027. The document presents six focus clusters for Horizon Europe, which are currently going through a wider consultation process. Within the context of i4Df Cluster 4, 'Digital, Industry and Space', Cluster 5, 'Climate, Energy and Mobility' will be considered for further analysis, and Cluster 6, 'Food, Bioeconomy, Natural Resources, Agriculture and Environment'. The result of matching the initial Horizon Europe structure to the i4Df IFAs can be found in Annex D. From this comparison it can be seen that IFAs 2.1 "Decarbonisation of Infrastructure Management", 3.1 "Smart Data and Information Ecosystem for Accommodating Automated and Connected Transport" and 3.2 "Information Provision for Process Optimisation in Infrastructure Management" have the most matches and IFAs in Capability 1 "Infrastructure Optimally Meeting End User Needs" the least.

3.5 Connecting Europe Facility

The Multi-Annual Work Programme for financial assistance in the field of Connecting Europe Facility (CEF) - Transport sector for the period 2014-2020 - provides an overview of specific objectives that are used as criteria for funding. The 15 specific objectives in the 2014-2020 programme will be considered in the context of i4Df.

3.6 Consultation i4Df Consortium and IFA collaboration groups

In the frame of several activities inside the i4Df project, the project consortium was contacted in order to collect the relevant information for Task 2.2. This was conducted at the meetings of the Governance Board (GB) and at the 2nd and 3rd Stakeholder meeting where in addition to the members of the i4Df consortium also the stakeholders from the other innovation programme owners (e.g.EC, CEDR, EIM), industry and research participated.

The objective of the 1st i4Df Expert Workshop (M5; MS4.1) was to fix, develop and describe the IFAs for a common vision on road and rail infrastructure innovation and implementation needs until 2040. The definition of IFAs was highly important to setting the direction of cooperation, both from a cross-modal as well as from a cross-border and cross-sectoral perspective. The distribution of the IFAs, at that time 14, was prepared and presented to the experts of the workshop who further developed and refined the scopes of the IFAs regarding their strategic context and challenges, the expected impacts in 2030, and their innovation and implementation (D1.2).

In the dedicated discussions of the single IFAs, the participants brought in their knowledge of national, regional and European programmes and initiatives that was considered in the initial list in D2.2.

[3] Available on: https://ec.europa.eu/research/pdf/horizon-europe/ec_rtd_orientations-towards-the-strategic-planning.pdf

The 2nd Expert Workshop (M18; MS 4.3) that was originally intended to be held in March 2020 in Copenhagen/Malmö had to be cancelled due to the corona virus crisis. Instead, for the final consultation of the consortium members virtual meetings of the IFA collaboration groups have been conducted in June 2020 (M21). The event was held digitally, in the form of six successive webinars, each dedicated to one of the identified Innovation Focus Areas (IFA).

The objective was to consolidate the need for infrastructure innovation and implementation from the NTIAs that 'own the societal issues' for which innovative solutions are needed. The participants were consulted on the key challenges to be addressed, the impacts to be expected for 2030, and the scope aiming at refining the draft D1.3. In addition, there was a consultation on opportunities for synergies between the various national and transnational programmes and initiatives on the respective IFA. These findings were used to finalise the list developed in D2.2, resulting in Annex A: "Identified innovation and research programmes and initiatives".

3.7 Conclusion for the identification of innovation and research programmes and initiatives

In summary it can be said that i4Df is not starting from a blank sheet to provide an overview of programmes and initiatives; the STRIA and TRIMIS activities have contributed significantly to the identification and monitoring of the innovation and research programmes in the field of transport infrastructure. In the context of i4Df an additional identification process was successfully completed in order to ensure that identified programmes match the needs of the NTIAs and their ambition to collaborate. Through the consultation process with the i4Df consortium and the IFA collaboration groups, additional national and transnational innovation and research initiatives were identified that could be used for cross-fertilisation within the IFA collaboration groups. Chapter 5 provides recommendations for a process how the identification of innovation and research programmes and initiatives can be continued in future. Annex A provides an overview of all the innovation and research programmes that were considered for the analysis within the i4Df portfolio of innovation and research programmes.

4 Methodological approach for portfolio analysis

Even though there is a wide range of literature available on the evaluation of the innovation and research programmes), there is no concept available that exactly focuses on the context of the i4Df approach and the needs of the NTIAs and their ambition to collaborate. The i4Df portfolio of innovation programme is an attempt to provide a suitable tool that can be used by IFA collaboration groups to determine the most appropriate generic level for demand driven coordination and collaboration activities and match them thematically according to the seven IFAs. Hence, the following aspects are considered in the methodological approach for the portfolio analysis.

4.1 Thematic links with seven i4Df IFAs

Deliverable 1.2 “Joint vision on transport infrastructure innovation until 2040” defines the eight innovation focus areas for innovation and implementation relevant to the joint infrastructure capabilities that provide the thematic structure for the eight IFA collaboration groups:

Capability 1: **Infrastructure optimally meeting end user needs**

- IFA 1.1 & 1.2: Integrated network performance management
- IFA 1.3: Responsible and innovative procurement and finance

Capability 2: **Infrastructure meeting environmental and social sustainability needs**

- IFA 2.1: Decarbonisation of infrastructure management
- IFA 2.2: Preserving the environment
- IFA 2.3: Integrating multi-layer networks and nodes

Capability 3: **Infrastructure achieving added value from digitalisation**

- IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport
- IFA 3.2: Information provision for process optimisation in infrastructure management

These seven IFAs provide the thematic core of the i4Df coordination mechanism. Hence, it is suggested that all of the identified innovation and research programmes and initiatives will be screened according to their thematic foci and overlaps with the seven i4Df IFAs.

4.2 Identification of characteristics to describe and compare identified programmes and initiatives

The i4Df coordination mechanism describes the approach of collaboration of the different stakeholders and the collaboration inside the IFAs as well as the interaction between the IFAs. This coordination mechanism has not been finalised and agreed upon by the consortium members at the stage of writing this deliverable D2.3. The finalisation and the endorsement by the i4Df governance board will take place during the i4Df final virtual event 9-10 September 2020. Hence it is not possible at this stage to determine the exact “added value” of the identified innovation and research programmes to the coordination mechanism. However, through the previous stakeholder conferences and the regional outreach events, the following aspects were identified as important characteristics for the i4Df coordination mechanism to ensure that it provides “added value to existing structures and programmes”:

- **LIGHT** – Indication about the size and extent of the background structure of the programme

FLEXIBLE – The ability to accommodate relevant developments in changing themes and cooperation approaches

OPEN – Ability to accommodate relevant new stakeholders (e.g. from different modes) and programmes

The characteristics “flexible” and “open” can be considered as pre-conditions for the identified research and innovation programmes and initiatives to potentially collaborate with the IFA collaboration groups. The characteristic “light” is not considered as an important characteristic for the analysis of the portfolio and the collaboration potential.

Further characteristics to assess the collaboration potential of IFA collaboration groups with the research and innovation programmes and initiatives are the following:

TRL – Which TRL does the programme and initiative focus on?

Mode – Which mode(s) does the programme and initiative focus on?

4.3 Results from the portfolio analysis of identified programmes and initiatives

Annex B presents the results of the links between IFAs and the identified programmes and initiatives. In summary, it can be stated that IFA 3.2 has the most identified links.

Table 1: Overview of matches between IFAs and identified programmes and initiatives

Programmes and Initiatives	IFA 1.1/ IFA 1.2	IFA 1.3	IFA 2.1	IFA 2.2	IFA 2.3	IFA 3.1	IFA 3.2
National	11	8	11	11	7	11	12
Transnational	8	8	9	8	7	9	9
Total	**19**	**16**	**20**	**19**	**14**	**20**	**21**

The identified programmes and initiatives focus mainly on the following modes:

11 road, 11 multiple modes, 1 rail,1 air, 1 road/rail, 1 road/water 1 road/rail/water.

Deliverable 1.3 identifies three successive stages time to illustrate the TRL

Stage 1: Research and development (spanning TRL 4 to 7)

Stage 2: Demonstration and validation spanning TRL 8 and 9)

Stage 3: Market uptake (stage III, spanning deployment up to larger network scales).

Most identified programmes and initiatives focused on the Stage 1 and Stage 2 of the innovation process.

It was considered impractical to attempt an ex-ante assessment of whether the identified research and innovation programmes and initiatives encompass the characteristics of "flexible" and "open". Most of the identified research and innovation programmes and initiatives were not designed in such a way that they have interfaces to facilitate collaboration with other programmes and initiatives. Even without designated interfaces collaboration is theoretically possible and, therefore, should be attempted by the IFA collaboration groups if it suits their activities. The following two recommendations are given:

- IFA collaboration groups should review their collaboration with innovation and research programmes and initiatives to share "success stories" with other IFAs.
- Managers of innovation and research programmes and initiatives could include interfaces to IFAs from the beginning on to facilitate collaboration at later stages.

5 Recommendations and Conclusion

This deliverable has confirmed that:

- There is a multitude of research and innovation programmes and initiatives on national, transnational and European level that IFA collaboration groups can link to, exchange with and/or learn from.
- The thematic scope of the IFAs was selected studiously and the identified topics are also addressed in depth on European, transnational and national level.
- The applied methodology in this deliverable has proven to be successful in collecting, filtering and processing information from a wide range of thematic areas, modes, sectors and geographic levels. Especially the national knowledge and experiences of the NTIAs in the IFA collaboration groups has proven to be valuable. This is due to the unique position of NTIAs enabling them to gather information and to decide which information is most relevant to share in the context of the IFA collaboration groups.
- There is a multitude of existing collaboration activities across Europe that provide useful insights and inspiration for the development of the i4Df coordination mechanism (see D1.4 for further information).
- This portfolio overview can feed into the operationalisation of the IFA collaboration groups, to identify common research and innovation goals and to initiate joint activities in this field.

However, the expiry date of the information contained in this deliverable will be reached rather soon. The "half-life of knowledge", the amount of time that elapses before half of the knowledge in a particular area is superseded, in the context of this very fast moving policy and research area of transport infrastructure research is constantly accelerating. It must therefore be acknowledged that the i4Df portfolio of innovation programmes and initiatives and the analysis in this deliverable provide only a snapshot of the duration of the i4Df

initiative. An updated i4Df portfolio of innovation programmes and initiatives might change the results of this analysis in the near future.

Based on this very likely development, this deliverable concludes therefore by recommending that the i4Df portfolio of innovation programmes and initiatives needs to be updated and analysed in regular intervals by the NTIAs in the IFA collaboration groups. This recommendation is shown in the “IFA Continuous Collaboration Life Cycle” (figure 1):

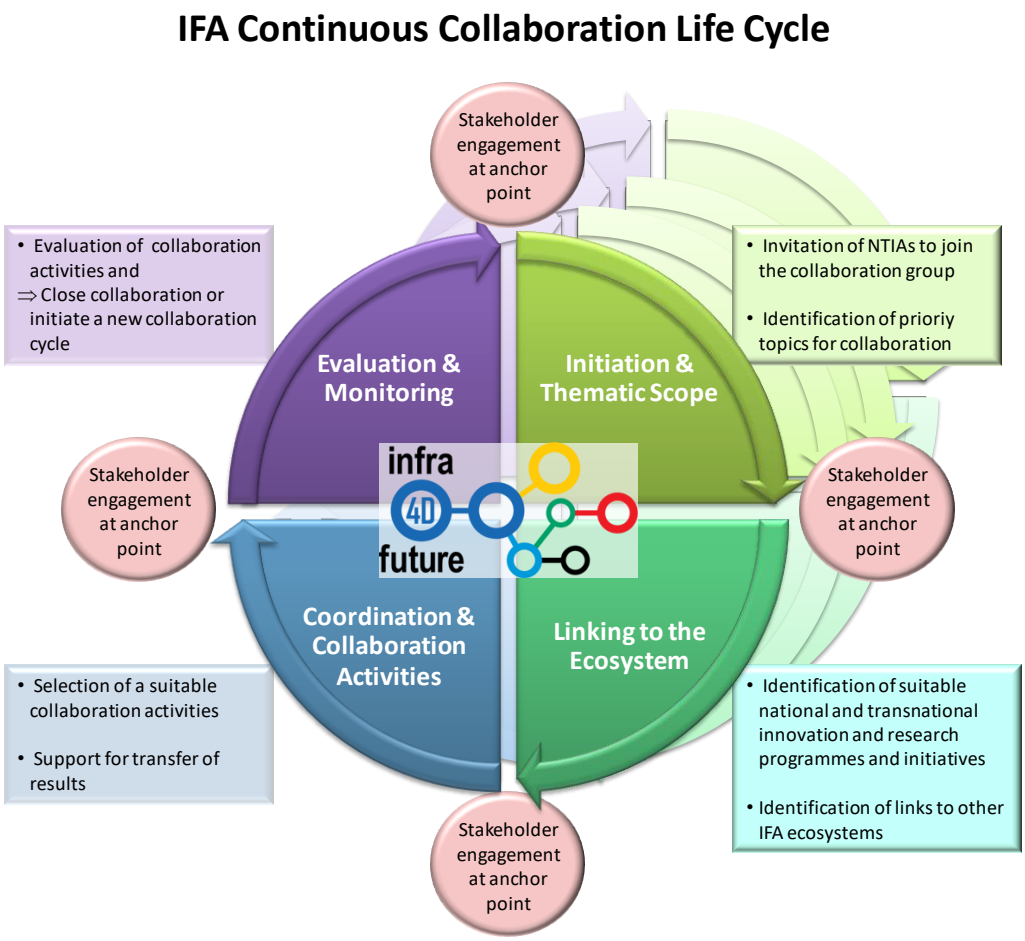

Figure 1: IFA Continuous Collaboration Life Cycle

The IFA Continuous Collaboration Life Cycle illustrates the steps IFA collaboration groups will have to complete in order to successfully collaborate on the selected IFA topics. Each IFA collaboration group can use the life cycle as inspiration to structure their activities and to adapt it to their specific needs. The length of time to complete a full cycle highly depends on the maturity of the IFA ecosystem; here differences between the IFAs can be noted. For example, new IFA ecosystems might take longer time for the step “Initiation and Thematic Scope” compared to more mature ecosystems that have already completed several life cycles, building up on already existing structures of collaboration. Further, it is recommended that after each step in the cycle the wider stakeholder ecosystem is consulted, for example at European anchor points (e.g. TRA and TEN-T days) or other relevant events.

The four steps in the IFA Continuous Collaboration Life Cycle can be described as follows:

a) Initiation and Thematic Scope:

A group of NTIAs comes together to initiate an IFA on a broader topic heading. Through an iterative exchange the thematic scope of the IFA activities is sharpened by identifying the priority topics that are most suitable for collaboration activities. Through the process additional NTIAs are invited to participate in the IFA collaboration group.

b) Linking to the ecosystem:

Based on the thematic scope the IFA should aim to link to existing structures and stakeholders in their ecosystem. This can for example include further national, transnational and European innovation and research programmes and initiatives, stakeholder platforms and the collaboration and exchange with other IFA collaboration groups.

c) Coordination and collaboration activities:

Each of the i4Df IFAs encompasses a coordination ecosystem in which a collaboration group of public issue owners (NTIAs) and a community of experts from industry, education and research engage in a structured dialogue with the objective to establish a supported demand driven agenda for infrastructure innovation and implementation. This structured dialogue can result, among others, in linking innovation agendas and joint research and innovation activities.

d) Evaluation and monitoring:

The final step is to review the activities of the IFA collaboration group and to decide whether a new cycle should be initiated. The IFA collaboration groups are not working groups that have a continuous mandate to exist, but should dissolve if the identified innovation and research needs are answered or continue if there is a need for a continuation of the activities.

In conclusion, this IFA Continuous Collaboration Life Cycle should facilitate and guide the operationalisation of the IFA collaboration groups.

Annex A: Identified innovation and research programmes and initiatives

Overview of national innovation and research programmes and initiatives

1) Aktionspaket Automatisierte Mobilität 2019 – 2022 / Action plan automated mobility 2019 - 2022 (AT)
2) BMVI Network of Experts (DE)
3) CoT - City of Things - smart cities and municipalities. Flanders Innovation and Entrepreneurship (VLAIO; BE-FL)
4) DuLo programme (NL) which would translate to “sustainable living environment”
5) FEREC (FR)
6) FFI - Strategic Vehicle Research and Innovation (SE)
7) FoPS - Research Programm Urban Transport (DE)
8) Framework for BIM implementation in design and construction phase of road life cycle (LV)
9) Future Mobility (AT)
10) IDRRIM (FR)
11) NGInfra (NL)
12) Platform WOW (NL)
13) PON RESEARCH AND INNOVATION (IT)
14) Sustainable transportation (CH)
15) TakeOff, BMVIT (AT)
16) V&R programme (NL) “replacing and renewing of transport infrastructures”

Overview of transnational innovation and research programmes and initiatives

17) Horizon Europe (European)
18) Connecting Europe Facility – CEF (European)
19) LIFE (2.2) (European)
20) Shift2Rail (European)
21) Benelux Union (BE, NL, LU)
22) BRA - Baltic Road Association (EE, LT, LV) http://www.balticroads.org/

23) CEDR (transnational)

24) CHARM (NL, BE-Flanders, GB) http://charmprogramme.com/

25) Demonstration and Validation Trajectory Benelux (BE, NL, LU)

26) D-A-CH (DE, AT, CH)

27) NordFoU (DK, FI, FO, IS, NO, SE)

Table 2: Thematic links between National Programmes and Initiatives and i4Df IFAs

	National Programmes and Initiatives	**IFA 1.1/ IFA 1.2**	**IFA 1.3**	**IFA 2.1**	**IFA 2.2**	**IFA 2.3**	**IFA 3.1**	**IFA 3.2**
1)	Action plan automated mobility (AT)						X	
2)	BMVI Network of Experts (DE)	X		X	X		X	X
3)	CoT - City of Things - smart cities and municipalities (BE-FL)	X		X	X			X
4)	DuLo Programme (NL)			X	X	X		
5)	FEREC (FR)	X		X	X		X	X
6)	FFI - Strategic Vehicle Research and Innovation (SE)			X	X		X	X
7)	FoPS Research Programm Urban Transport (DE)	X	X					
8)	Framework for BIM implementation (LV)							X
9)	MOTF (AT)	X	X	X	X	X	X	X
10)	IDRRIM (FR)	X		X	X		X	X
11)	NGInfra (NL)	X	X	X	X	X	X	X
12)	Platform WOW (NL)	X	X	X	X	X	X	X
13)	PON Research and Innovation (IT)	X	X	X	X	X	X	X
14)	Sustainable transportation (CH)	X	X			X	X	X
15)	TakeOff		X	X	X	X	X	X

	National Programmes and Initiatives	IFA 1.1/ IFA 1.2	IFA 1.3	IFA 2.1	IFA 2.2	IFA 2.3	IFA 3.1	IFA 3.2
	Federal Ministry for Transport, Innovation and Technology (AT)							
16)	V&R Programme (NL)	X	X					

1) Initiative: Action plan automated mobility 2019 - 2022

- **Website**

www.bmk.gv.at/themen/alternative_verkehrskonzepte/automatisiertesFahren/publikationen/aktionspaket.html

- **Funding country**

Austria

- **Background and policy objectives**

In addition to overcoming technical challenges the action plan also aims to address the necessary development of digital infrastructure, social and legal framework conditions for the deployment of automated mobility. It is therefore important for the public sector to use resources in a targeted manner to benefit society. An important focus in Austria is therefore already learning from tests and pilot projects within the framework of clearly defined use cases or areas of application and the development of new forms of mobility. Accordingly, the government programme 2017-2022 aims to develop Austria into a pioneering country and thus also a research, development and production location for automated driving in close cooperation with the automotive industry and research. In particular, the Ministry will continue to promote test tracks and related research projects.

- **Affected transport mode(s)**

Road

- **Frequency and duration**

N/A

- **Underlying strategy**

Yes

- **Funding & budget**

Budget: N/A. Coverage: Austria

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

2) Initiative: BMVI Network of Experts

- **Website**

www.bmvi-expertennetzwerk.de/EN/

- **Funding country**

Germany

- **Background and policy objectives**

BMVI Network of Experts is a new format of departmental research. Under the guiding theme of Knowledge – Ability – Action, seven departmental research facilities and executive agencies of the Federal Ministry of Transport and Digital Infrastructure (BMVI) formed a Network of Experts in 2016. Their objective is to address urgent transport questions of the future through innovations in the areas of adapting to climate change, environmental protection and risk management. In doing so, the Network of Experts builds directly on the guiding principles of the Federal Government and its sustainability and high-tech strategy.

- **Affected transport mode(s)**

Road, Waterways and Rail

- **Frequency and duration**

Since 2016

- **Underlying strategy**

Yes,

- **Funding & budget**

Budget: N/A. Coverage: France (primarily), international participation possible

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

3) Initiative: CoT - City of Things - smart cities and municipalities; Flanders Innovation and Entrepreneurship (VLAIO)

- **Website**

https://www.imeccityofthings.be/en/blog/smart-cities-in-vlaanderen-en-daarbuiten

- **Funding country**

Belgium

- **Background and policy objectives**

In a smart city, governments, companies, research institutions and citizens create solutions for urban challenges. More and more physical objects are connected to the internet (Internet of Things). This allows for real-time collection of data and quicker monitoring of parameters. This programme supports cities and communities in the implementation of smart city applications using the Internet of Things to support economic growth or improve services to citizens. These applications can address transport and infrastructure topics, such as the reduction of congestion, sustainable inner-city distribution and optimisation of parking spaces.

- **Affected transport mode(s)**

Multiple modes

- **Frequency and duration**

2017 – 2019

- **Underlying strategy**

Yes

- **Funding & budget**

Public (national/regional/local). Budget: 4 Mio €.

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 3.2: Information provision for process optimisation in infrastructure management

4) Initiative: DuLo Programme

- **Website**

www.rijkswaterstaat.nl/zakelijk/duurzame-leefomgeving

- **Funding country**

Netherlands

- **Background and policy objectives**

The programme focuses on a number of aspects to achieve carbon neutrality by 2030.

- **Affected transport mode(s)**

Multiple modes

- **Frequency and duration**

N/A

- **Underlying strategy**

N/A

- **Funding & budget**

Budget: N/A. Coverage: Netherlands

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 2.3: Integrating multi-layer networks and nodes

5) Initiative: FEREC

- **Website**

https://fondation-ferec.fr/

- **Funding country**

France (Industry)

- **Background and policy objectives**

French players in the infrastructure sector have certain know-how, acquired over a long period of time as part of a process involving companies, engineers and contracting authorities, including the State, which has long been the dominant client. This know-how is

also widely recognized abroad and has helped French players to rank among the best in the world. To promote the strengthening of this collaborative research, five players (Colas, Eiffage, Eurovia, SNCF-Reseau, Vinci) have decided to combine their resources to create the foundation FEREC to support collective research for construction and infrastructure.

- **Affected transport mode(s)**

Road and Rail

- **Frequency and duration**

Since 2018 (Yearly)

- **Underlying strategy**

No

- **Funding & budget**

Budget: N/A. Coverage: France (primarily), international participation possible

- **Matching infra4Dfuture Innovation Focus Areas:**

IFA 1.1/1.2: Integrated network performance management

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

6) Initiative: FFI - Strategic Vehicle Research and Innovation

- **Website**

https://www.vinnova.se/en/m/strategic-vehicle-research-and-innovation/

- **Funder**

Sweden

- **Background and policy objectives**

FFI is a partnership between the Swedish government and automotive industry for joint funding of research, innovation and development concentrating on Climate & Environment and Safety. Initially set to run from 2009-2012 with no definite ending year.

Currently there are five collaboration programs:

- Energy and Environment
- Traffic Safety and Automated Vehicles
- Electronics, Software and Communication
- Sustainable Production
- Efficient and Connected Transport systems

➢ **Affected transport mode(s)**

Road

➢ **Frequency and duration**

2009 – 2015

➢ **Underlying strategy**

Yes

➢ **Funding & budget**

100 Mio. €/year, of which half is governmental funding.

➢ **Matching infra4Dfuture Innovation Focus Areas**

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

7) Initiative: FoPS Forschungsprogramm Stadtverkehr– Research Programme Urban Transport 2019/2020

➢ **Website**

http://mobilitaet21.de/wp-content/uploads/2019/08/Projektliste_FOPS_2019-2020.pdf

➢ **Funding country**

Germany

➢ **Background and policy objectives**

The Research Programme Urban Transport (FoPS) is a funding programme of the Federal Ministry for Transport and Digital Infrastructures (BMVI) for improving transportation conditions in communities.

Objectives of FoPS are to elaborate and assemble application oriented, scientific and practical knowledge for decision makers in urban and regional transport.

Core of the programme is the application-driven investigation of specific questions, which shall ensure transferability to regions all over Germany. Basic research is accepted insofar it serves the application-based research. Planning tasks are considered research elements if they are designed as transferrable examples.

- **Affected transport modes**

Multiple modes

- **Frequency and duration**

Annual Call since 1967

- **Underlying strategy**

Mobilität des 21. Jahrhunderts.

- **Funding & budget**

Federal Ministry for Transport and Digital Infrastructures BMVI. Public (national/ regional/ local). 4,167 Mio € annually.

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

IFA 1.3: Responsible and innovative procurement and finance

8) Initiative: Framework for BIM implementation in design and construction phase of road life cycle

- **Website**

www.lvceli.lv

- **Funding country**

Latvia

- **Background and policy objectives**

Research activities to that will cast the basis for the development of a BIM strategy at Latvian State Roads.

- **Affected transport mode(s)**

Road

- **Frequency and duration**

N/A

- **Underlying strategy**

Yes

- **Funding & budget**

Budget: N/A. Coverage: Latvia

- **Matching infra4Dfuture Innovation Focus Areas**

3.2 Innovation Focus Area: Information provision for process optimisation in infrastructure management

9) Initiative: Future Mobility (MOTF)

- **Website**

https://www.bmvit.gv.at/en/topics/innovation/mobility/future_mobility.html

- **Funding country**

Austria

- **Background and policy objectives**

The research programme is developing designs to setup the mobility system of the future, a system to balance social, environmental and economic needs. The programme helps to develop systems that contribute significantly to ensuring mobility while minimising the negative impacts of transport. The complex interactions inherent in transport systems require interdisciplinary research approaches aiming at developing both technological and social organisational innovations. Thus, the programme focuses on new markets, generating solutions that respond closely to the essential needs of society.

- **Affected transport mode(s)**

Road

- **Frequency and duration**

2012 - 2020

- **Underlying strategy**

Yes

- **Funding & budget**

Budget: Annual Budget: 13 - 19 Mio. €. Coverage: Austria (primarily), international participation possible

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

IFA 1.3: Responsible and innovative procurement and finance

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 2.3: Integrating multi-layer networks and nodes

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

10) Initiative: IDRRIM

- **Website**

www.idrrim.com/

- **Funding country**

France (Industry)

- **Background and policy objectives**

The IDRRIM (Institute of Roads, Streets and Infrastructures for Mobility) brings together all the public and private players in the transport infrastructure community. IDRRIM is a platform for exchanges, designed to respond to the problems of its members, to design reference documents and promote French know-how internationally. The following three national programmes are currently being funded:

- PIA: Future Investment Programme

- CIRR: Innovation Committee Roads and Streets

- EVRA: Autonomous Road Vehicle Experimentation

- **Affected transport mode(s)**

Road

- **Frequency and duration**

N/A

- **Underlying strategy**

N/A

- **Funding & budget**

Budget: N/A. Coverage: France (primarily), international participation possible

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

11) NGInfra – Next Generation Infrastructures

- **Website**

www.nginfra.nl

- **Funding country**

Netherlands

- **Background and policy objectives**

The NGInfra initiative brings together a number of national infrastructure stakeholders and owners. Through Knowledge sharing and development solutions are searched for, in order to create responsive connections given the global and societal challenges the future is facing. Stakeholders involved share their visions and knowledge structured in a thematic approach lead by so called Theme Centres e.g. in the field of Data & Security and Availability where projects are being developed and carried out.

- **Affected transport mode(s)**

Multiple modes

- **Frequency and duration**

Ongoing

- **Underlying strategy**

Yes

- **Funding & budget**

N/A. Coverage: Netherlands

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

IFA 1.3: Responsible and innovative procurement and finance

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 2.3: Integrating multi-layer networks and nodes

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

12) Platform WOW – Dutch infrastructure managers

- **Website**

https://platformwow.nl/

- **Funding country**

Netherlands

- **Background and policy objectives**

In Dutch WOW stands for Road meets Road and Water meets Water. The WOW platform is a neutral partner who stimulates, facilitates and initiates collaboration between road, water supply and water infrastructure managers within the Dutch Government, port authorities and drinking water companies. By doing so WOW aims at a more efficient governance though connecting mutual interests and challenges.

- **Affected transport mode(s)**

Road, waterways and -systems

- **Frequency and duration**

N/A

- **Underlying strategy**

N/A

- **Funding & budget**

N/A. Coverage: Netherlands

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

IFA 1.3: Responsible and innovative procurement and finance

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 2.3: Integrating multi-layer networks and nodes

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

13) Initiative: PON Research and Innovation

- **Website**

www.ponricerca.gov.it

- **Funding country**

Germany

- **Background and policy objectives**

The main objective of the PON Research and Innovation is to produce structural changes to increase the ability of disadvantaged regions to produce and use quality research and innovation.

The application areas of the program are 12: Aerospace, Agrifood, Blue Growth (economy of the sea), Green Chemistry, Design, Creativity and made in Italy (non R&D), Energy, Intelligent Factory, Sustainable Mobility, Health, Smart, Secure and Inclusive Communities, Technologies for Living Environments, Technologies for Cultural Heritage.

The programme also intends to facilitate the creation of development opportunities for the territories of the regions concerned, with a view to launching initiatives aimed at promoting collaboration between business and other subjects (universities, research bodies, etc.), in order to achieve mutual benefits from an information, production, commercial and product point of view which may have very important consequences in terms of results.

All this is associated with the intent to encourage the development of new professional skills required by the labour market thanks to the activation of interventions on human capital such as to encourage the preparation of an offer of professionalism of adequate profiles.

- **Affected transport mode(s)**

Multiple modes

- **Frequency and duration**

N/A

- **Underlying strategy**

N/A

- **Funding & budget**

Budget: N/A. Coverage: Italy

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

IFA 1.3: Responsible and innovative procurement and finance

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 2.3: Integrating multi-layer networks and nodes

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

14) Initiative: Sustainable transportation

- **Website**

https://www.ressortforschung.admin.ch/rsf/de/home/themen/forschung-nach-politischen-bereichen/nachhaltiger-verkehr.html

- **Funder**

Switzerland

- **Background and policy objectives**

Organisation made by Swiss Federal Roads Authority (ASTRA) together with the Federal Office of Transport (BAV) and the Federal Office for Civil Aviation (BAZL).

The programme focuses on:

- sustainable development of traffic and reasonable use of individual means of transport;
- planning and realisation of sustainable infrastructures for transportation;
- improving global safety;
- promotion of intermodal use in the realm of passenger and goods traffic;
- improving the efficiency and optimal use of the capacities of all carriers.

➢ **Affected transport mode(s)**

Multiple modes

➢ **Frequency and duration**

Starting in 2002, ongoing

➢ **Underlying strategy**

Yes

➢ **Funding & budget**

34.3 Mio. CHF for period 2017 to 2020

➢ **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

IFA 1.3: Responsible and innovative procurement and finance

IFA 2.3: Integrating multi-layer networks and nodes

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

15) Initiative: TakeOff - Federal Ministry for Transport, Innovation and Technology (BMVIT)

➢ **Website**

https://www.ffg.at/content/takeoff

➢ **Funding country**

Austria

- **Background and policy objectives**

In line with ACARE Flightpath 2050 goals, the new strategy promotes four measures to be deployed within the framework of a five-year action plan. These are:

- Build strategic partnerships;
- Strengthen Austria's competencies and skills in R&I;
- Foster visibility and market uptake;
- Facilitate excellent qualification.

- **Affected transport mode(s)**

Air

- **Frequency and duration**

2015 - 2020

- **Underlying strategy**

Yes

- **Funding & budget**

Federal Ministry for Transport, Innovation and Technology (BMVIT). Public (national/regional/local): Budget: 40 Mio €.

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.3: Responsible and innovative procurement and finance

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 2.3: Integrating multi-layer networks and nodes

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

16) V&R programme (NL) "replacing and renewing of transport infrastructures"

- **Website**

www.rijkswaterstaat.nl/nieuws/2020/05/make-over-voor-bruggen-sluizen-tunnels-en-viaducten-op-leeftijd.aspx

- **Funding country**

Netherlands

- **Background and policy objectives**

In the coming years Rijkswaterstaat, the executive agency of the Dutch ministry of Infrastructure and Water Management will renovate and replace more than 100 bridges, tunnels, locks and underpasses of which many were built between 1950 and 1970. Back in those years infrastructure was being built with a 100 year lifecycle yet unaware of increasing traffic volumes. A challenging effort where the Dutch government will work in close collaboration with industry partners. A construction as well as knowledge driven effort facing climate adaptation as well as sustainable, digital and innovation challenges. The objective is to work from a capex approach meaning decisions on replacement or renovation will start with a technical inspection that will guide through the many decisions that have to be made given the challenges.

- **Affected transport mode(s)**

Multiple modes

- **Frequency and duration**

Start 2020 for the coming decades

- **Underlying strategy**

N/A

- **Funding & budget**

Netherlands: 300 Mio. EURO per year

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1 & 1.2: Integrated network performance management

IFA 1.3: Responsible and innovative procurement and finance

Table 3: Thematic links between Transnational and European Programmes and Initiatives and i4Df IFAs

	Transnational and European Programmes and Initiatives	IFA 1.1 / IFA 1.2	IFA 1.3	IFA 2.1	IFA 2.2	IFA 2.3	IFA 3.1	IFA 3.2
17)	Horizon Europe (EU)			X	X	X	X	X
18)	Connecting Europe Facility (EU)	X	X	X	X	X	X	X
19)	LIFE (EU)			X	X			
20)	Shift2Rail (EU)	X	X	X	X	X	X	X
21)	Benelux Union (BE, NL, LU)	X	X	X			X	X
22)	BRA - Baltic Road Association (EE, LT, LV)	X	X	X	X	X	X	X
23)	CEDR Research Calls (transnational)	X	X	X	X	X	X	X
24)	CHARM						X	X
25)	D&V Trajectory Benelux	X						
26)	D-A-CH (AT, CH, DE)	X	X	X	X	X	X	X
27)	NordFoU (DK, FI, FO, IS, NO, SE)	X	X	X	X	X	X	X

17) Programme: Horizon Europe

- **Website**

https://ec.europa.eu/info/horizon-europe-next-research-and-innovation-framework-programme_en

- **Funding countries**

European

- **Background and policy objectives**

Horizon Europe is a planned 7-year European Union scientific research initiative meant to succeed the current Horizon 2020 program. The document “Orientations towards the first Strategic Plan implementing the research and innovation framework programme Horizon Europe” (European Commission, 2019) presents six focus clusters for Horizon Europe, which are currently going through a wider consultation process. Within the context of i4Df Cluster 4,

'Digital, Industry and Space', Cluster 5, 'Climate, Energy and Mobility' will be considered for further analysis, and Cluster 6, 'Food, Bioeconomy, Natural Resources, Agriculture and Environment'. The result of matching the initial Horizon Europe structure to the i4Df IFAs can be found in Annex C. From this comparison it can be seen that IFAs 2.1 "Decarbonisation of Infrastructure Management", 3.1 "Smart Data and Information Ecosystem for Accommodating Automated and Connected Transport" and 3.2 "Information Provision for Process Optimisation in Infrastructure Management" have the most matches and IFAs in Capability 1 "Infrastructure Optimally Meeting End User Needs" the least.

- **Affected transport mode(s)**

Multiple modes

- **Frequency and duration**

Annual calls for specific topics, 2021 – 2027.

- **Underlying strategy**

Yes

- **Funding & budget**

100 billion provided.

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

18) Programme: Connecting Europe Facility - CEF

- **Website**

https://ec.europa.eu/inea/en/connecting-europe-facility

- **Funding countries**

European

- **Background and policy objectives**

The Connecting Europe Facility (CEF) is a key EU funding instrument to promote growth, jobs and competitiveness through targeted infrastructure investment at European level. It supports the development of high performing, sustainable and efficiently interconnected

trans-European networks in the fields of transport, energy and digital services. Nine “core network corridors” were introduced to facilitate the coordinated implementation of the core network. CEF investments fill the missing links in Europe's energy, transport and digital backbone. The CEF benefits people across all Member States, as it makes travel easier and more sustainable, it enhances Europe’s energy security while enabling wider use of renewables, and it facilitates cross-border interaction between public administrations, businesses and citizens. In addition to grants, the CEF offers financial support to projects through innovative financial instruments such as guarantees and project bonds. These instruments create significant leverage in their use of EU budget and act as a catalyst to attract further funding from the private sector and other public sector actors.

- **Affected transport mode(s)**

Multiple modes and energy and telecoms sector

- **Frequency and duration**

Annual calls for specific topics

- **Underlying strategy**

Yes

- **Funding & budget**

Ca. €28.7billion since 2014

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 2.3: Integrating multi-layer networks and nodes

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

19) Programme: LIFE

- **Website**

https://ec.europa.eu/easme/en/life

- **Funding countries**

European

- **Background and policy objectives**

The LIFE Programme is the European Union's funding instrument for the environment and climate action. The general objective of LIFE is to contribute to the implementation, updating and development of EU environmental and climate policy and legislation by co-financing projects with European added value.

LIFE began in 1992 and to date there have been five phases of the programme (LIFE I: 1992-1995, LIFE II: 1996-1999, LIFE III: 2000-2006, LIFE+: 2007-2013 and LIFE 2014-2020). During this period, LIFE has co-financed some 4600 projects across the EU, with a total contribution of approximately 6.5 billion Euros to the protection of the environment and of climate. For the next phase of the programme (2021-2027) the European Commission proposes to raise the budget to 5.45 billion Euros

- **Affected transport mode(s)**

Multiple modes

- **Frequency and duration**

Annual calls for specific topics, 2021 - 2027

- **Underlying strategy**

Yes

- **Funding & budget**

Ca. €5.45billion.

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

20) Programme: Shift2Rail

- **Website**

https://shift2rail.org/

- **Funding countries**

European Union

- **Background and policy objectives**

Shift2Rail (S2R) is the first European rail initiative to seek focused research and innovation (R&I) and market-driven solutions by accelerating the integration of new and advanced technologies into innovative rail product solutions. Shift2Rail promotes the competitiveness

of the European rail industry and meets changing EU transport needs. R&I carried out under this Horizon 2020 initiative develops the necessary technology to complete the Single European Railway Area (SERA).

S2R seeks to develop, integrate, demonstrate, and validate innovative technologies and solutions that uphold the strictest safety standards and the value

- **Affected transport mode(s)**

Rail

- **Frequency and duration**

2014 – 2020

- **Underlying strategy**

Yes

- **Funding & budget**

EU Joint Undertaking (JU). Budget: 920 Mio €.

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

IFA 1.3: Responsible and innovative procurement and finance

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 2.3: Integrating multi-layer networks and nodes

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

21) Programme: Benelux Union

- **Website**

www.benelux.int/nl/

- **Funding countries**

Belgium, the Netherlands, Luxemburg

- **Background and policy objectives**

The Benelux cooperation between the governments of Belgium, the Netherlands, and Luxembourg became operative in 1948 as the Benelux Customs Union. The economic cooperation expanded over time, leading to the signing of the treaty establishing the Benelux Economic Union in 1958.

Initially, the purpose of cooperation was to avoid customs barriers and ensure free movement of persons, goods and services. The Benelux cooperates at every level aiming to promote the prosperity and welfare of the citizens of Belgium, the Netherlands and Luxembourg. The Benelux works on the basis of an annual plan driven by a four-year joint work program.

- **Affected transport mode(s)**

Multiple modes

- **Frequency and duration**

Since 1948, ongoing

- **Underlying strategy**

Yes

- **Funding & budget**

N/A. Coverage: Benelux countries plus cross border initiatives with neighbouring countries

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

IFA 1.3: Responsible and innovative procurement and finance

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 2.3: Integrating multi-layer networks and nodes

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

22) Programme: BRA - Baltic Road Association

- **Website**

http://www.balticroads.org/

- **Funding countries**

Estonia, Lithuania, Latvia

- **Background and policy objectives**

The Baltic Road Association (BRA) was established in 2014 as a non-profit organisation in Estonia. It continues cooperation of the Estonian, Latvian and Lithuanian Road Administrations.

Key aim of the BRA is to seek possibilities for mutual co-operation, such as:

- To conduct joint studies;
- To co-ordinate the work of technical expert groups;
- To organize seminars of mutual interest;
- To organize international road conference every four years;
- To participate, if needed, in the process of harmonization of the legislation in the EU road sector;
- To co-operate with other relevant international organizations;

The presidency of BRA is based on a four-year rotation principle. The cycle is summed up in the international conference and exhibition. There are Technical Committees on the following five topics: Construction, Traffic Safety, Maintenance, Research, ITS.

In each of the five Technical Committees there are each two experts from the three member states. They meet biannually. An Action Plans describes the scope of the work of each Technical Committee.

- **Affected transport mode(s)**

Road

- **Frequency and duration**

./.

- **Underlying strategy**

No

- **Funding & budget**

BRA itself is not a fund and there is no fixed budget for common research projects. If agreed on, joint studies are financed by the three national road authorities.

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

IFA 1.3: Responsible and innovative procurement and finance

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 2.3: Integrating multi-layer networks and nodes

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

23) Programme: CEDR Research Call

- **Website**

https://www.cedr.eu

- **Funding counties**

Funding open for all CEDR (Conference of European Directors of Roads) members, each topic of a Call is funded by at least three CEDR members.

- **Background and policy objectives**

CEDR Action Plan, regularly updated every three years (latest version: 2019-2021).

- **Affected transport mode(s)**

Road

- **Frequency and duration**

Annual Call. Duration of the project: max. 3 years, implementation and assessment in the fourth years.

- **Underlying strategy**

CEDR Strategy (https://www.cedr.eu/1106/td-strategy-2016-warsaw/) .

- **Funding & budget**

Common pot model. Up to four topics with each up to three projects are funded. Budget: 2.5 to 5.9 Mio. €.

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

IFA 1.3: Responsible and innovative procurement and finance

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 2.3: Integrating multi-layer networks and nodes

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

24) Programme: CHARM - FUTURE PROOFING TRAFFIC MANAGEMENT

- **Website**

http://charmprogramme.com/

- **Funding countries**

England, the Netherlands and Belgium-Flanders

- **Background and policy objectives**

Rijkswaterstaat and Highways England want to significantly improve traffic management with innovative functions. The market does not yet provide these functions and they have therefore been developed in the CHARM PCP (Pre-Commercial Procurement) project.

- **Affected transport mode(s)**

Road

- **Frequency and duration**

N/A

- **Underlying strategy**

N/A

- **Funding & budget**

N/A

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

25) Programme: Demonstration and Validation Trajectory Benelux

- **Website**

N/A

- **Funding countries**

Belgium, the Netherlands and Luxemburg

- **Background and policy objectives**

Cross border collaboration on highway corridor from Rotterdam to Luxembourg. The aim of the project is twofold; knowledge dissemination and cross border optimisation through alignment of service levels.

- **Affected transport mode(s)**

Road

- **Frequency and duration**

N/A

- **Underlying strategy**

N/A

- **Funding & budget**

N/A

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

26) Programme: D-A-CH

- **Website**

https://www.ffg.at/dach-call2020

- **Funding countries**

Austria, Switzerland, Germany

- **Background and policy objectives**

The tree German-speaking countries launch annual in the field of transport infrastructure Calls since 2016. The research topics result from comparable or even similar research questions. Therefore the financial ressources are bundled to fund common projects allowing

a more effective research. Good practices are applied for the annual calls resulting in an effective administration and the avoidance of double research.

Each partner willing to support the annual call signs a cooperation agreement and thus agrees to fund the call by a certain budget. Experts from the road administrations supervise the selection of the consortia and the projects during the runtime of the projects.

- **Affected transport mode(s)**

Road

- **Frequency and duration**

Annual calls for specific topics

- **Underlying strategy**

No. The topics arise from the regular meetings on special topics attended by experts from AT, CH and DE. Every year, up to 4 topics are identified for common research calls. Some of the first calls tackled a certain field of transport infrastructure, e.g. concrete or asphalt roads.

- **Funding & budget**

Basis for the research is a Real Common Pot. The Budget is agreed on for each individual project of the topic by the funding partners. This results in the overall budget of each of the annual Calls.

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

IFA 1.3: Responsible and innovative procurement and finance

IFA 2.1: Decarbonisation of infrastructure management

IFA 2.2: Preserving the environment

IFA 2.3: Integrating multi-layer networks and nodes

IFA 3.1: Smart data and information ecosystem for accommodating automated and connected transport

IFA 3.2: Information provision for process optimisation in infrastructure management

27) Programme: NordFoU

- **Website**

http://www.nordfou.org/Sider/fgj.aspx

- **Funding countries**

Denmark, Finland, Faroe Island, Iceland, Norway, Sweden

- **Background and policy objectives**

NordFoU is a co-operation between the national Nordic road administrations to initialize, finance and run R&D projects. Its aim is to run and develop R&D with respect to innovation, synergy and development of Nordic R&D environments for the benefit of the Nordic road and traffic systems.

- **Coordination mechanism**

Base organisation:

Members of all NordFoU activities are officially nominated members of road/transport authorities. There is a base organisation consisting of a Steering Committee, a Task Force and a Secretariat.

The base organisation is responsible for strategic planning, project proposals, follow-up on ongoing projects and coordination of other joint Nordic R&D activities. Further on, it is responsible for setting up and handling management control, financing and financial reporting for projects within the auspices of NordFoU.

The chair rotates between the Nordic road and transport administrations every year.

- **Affected transport mode(s)**

Road

- **Frequency and duration**

Annual calls for specific topics

Underlying strategy

No

Current research topics include: Winter maintenance, Road infrastructure, Climate change solutions for roads and road transport, Environmental research, Road technology research.

- **Funding & budget**

NordFoU is not a fund. Projects are financed by national road/transport authorities. In the majority of the cases, the "common pot system" is applied: The financial partners establish a project fund. The scientific partners gets reimbursed from this fund. Any unused funds are reverted back to the original donor.

- **Matching infra4Dfuture Innovation Focus Areas**

IFA 1.1/1.2: Integrated network performance management

IFA 1.3:	Responsible and innovative procurement and finance
IFA 2.1:	Decarbonisation of infrastructure management
IFA 2.2:	Preserving the environment
IFA 2.3:	Integrating multi-layer networks and nodes
IFA 3.1:	Smart data and information ecosystem for accommodating automated and connected transport
IFA 3.2:	Information provision for process optimisation in infrastructure management

Annex B: Matching Horizon Europe with i4Df Innovation Focus Areas

Table 4: Thematic links between Horizon Europe, CLUSTER 4 - DIGITAL, INDUSTRY AND SPACE, and i4Df IFAs

CLUSTER 4 - DIGITAL, INDUSTRY AND SPACE	**IFA 1.1**	**IFA 1.2**	**IFA 1.3**	**IFA 2.1**	**IFA 2.2**	**IFA 2.3**	**IFA 3.1**	**IFA 3.2**
I. Enabling technologies ensuring European leadership and autonomy								
4.1 Manufacturing Technologies								X
4.2 Key Digital Technologies							X	X
4.3 Advanced Materials					0			
4.4 Emerging Enabling Technologies								X
4.5 Artificial Intelligence and Robotics							X	X
4.6 Next Generation Internet								X
4.7 Advanced Computing and Big Data								X
4.8 A globally competitive space sector reinforcing EU autonomy							0	0
II. Accelerating economic and societal transitions								
4.9 Circular Industries				X				X
4.10 Low-carbon and Clean Industries				X				
a. New services from Space for the EU society and economy							X	X

X – strong link, 0 – link (less strong as for 'X')

Table 5: Thematic links between Horizon Europe, CLUSTER 5 – Climate, Energy and Mobility, and i4Df IFAs

CLUSTER 5 - CLIMATE, ENERGY AND MOBILITY	IFA 1.1	IFA 1.2	IFA 1.3	IFA 2.1	IFA 2.2	IFA 2.3	IFA 3.1	IFA 3.2
4.1 Advance climate science and solutions for a climate neutral and resilient society				X				
4.2 Cross-sectoral solutions for decarbonisation				X				
4.2.1 Establish a competitive and sustainable European battery value chain				0				
4.2.2 Strengthen the European value chain for low-carbon hydrogen and fuel cells				0				
4.2.3 Develop sustainable infrastructure, services and systems for smart and sustainable communities and cities				0		X		
4.2.4 Foster emerging breakthrough technologies and climate solutions				0				
4.3 Develop cost-efficient, net zero-greenhouse gas energy system centred on renewables				0				
4.3.1 Achieve global leadership in renewable energy				X				
4.3.2 Develop flexible, zero greenhouse gas emission and citizen-centred energy systems and grids								
4.3.3 Develop carbon capture, utilisation and storage (CCUS) solutions for the power sector and energy-intensive industries				X				
4.3.4 Develop flexible and efficient energy storage solutions				0				
4.3.5 Leverage more public and private investments in				X				

CLUSTER 5 - CLIMATE, ENERGY AND MOBILITY	IFA 1.1	IFA 1.2	IFA 1.3	IFA 2.1	IFA 2.2	IFA 2.3	IFA 3.1	IFA 3.2
clean energy systems								
4.4 Develop demand side solutions to decarbonise the energy system								
4.4.1 Empowering citizens to engage in energy markets								
4.4.2 Achieving a highly energy-efficient and decarbonised EU building stock				0				
4.4.3 Support industrial facilities in the energy transition								
4.5 Develop low-carbon and competitive transport solutions across all modes								
4.5.1 Achieve zero-emission road transport				X				
4.5.2 Enhance the competitiveness of rail as a low-carbon mode of transport				X				
4.5.3 Make aviation cleaner and more competitive								
4.5.4 Enable low-carbon, smart, clean and competitive waterborne transport				X				
4.5.5 Reduce the impact of transport on the environment and human health				X	X			
4.6 Develop seamless, smart, safe, accessible and inclusive mobility systems								
4.6.1 Make automated and connected road transport safe and competitive							X	
4.6.2 Develop efficient and innovative transport infrastructure	X	X	X	X	X	X	X	X
4.6.3 Develop the future transport network and integrated traffic management		X					X	X

CLUSTER 5 - CLIMATE, ENERGY AND MOBILITY	IFA 1.1	IFA 1.2	IFA 1.3	IFA 2.1	IFA 2.2	IFA 2.3	IFA 3.1	IFA 3.2
4.6.4 Enable multimodal freight logistics and passenger mobility services							X	X
4.6.5 Increase transport safety across all modes	X	X						

X – strong link, 0 – link (less strong as for 'X')