INTERIM TESTING REPORT ON PILOTS / LIVING LABS

Final version

FEDeRATED MILESTONE 8

11 March 2022

www.federatedplatforms.eu

FEDeRATED NETWORK OF PLATFORMS

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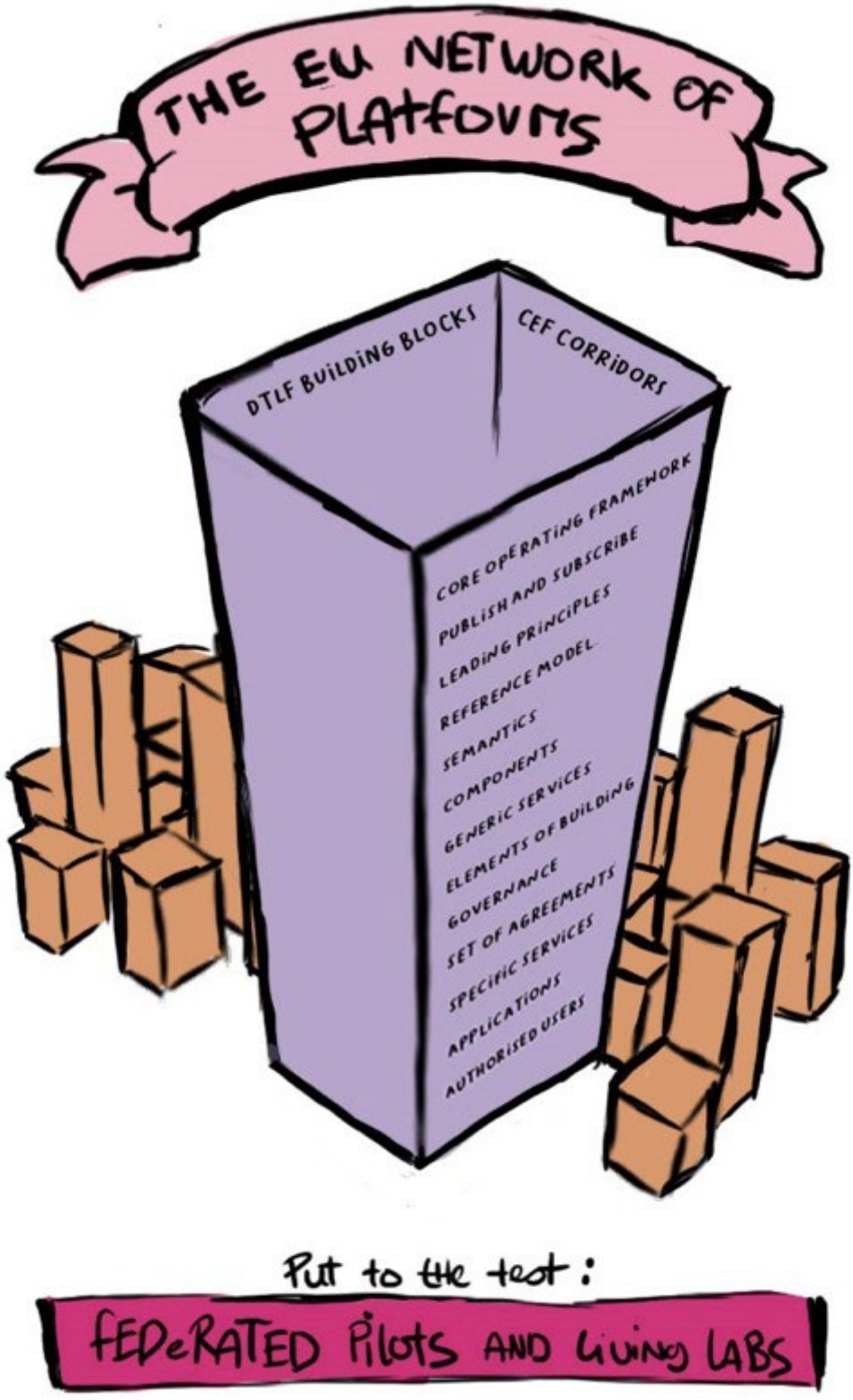

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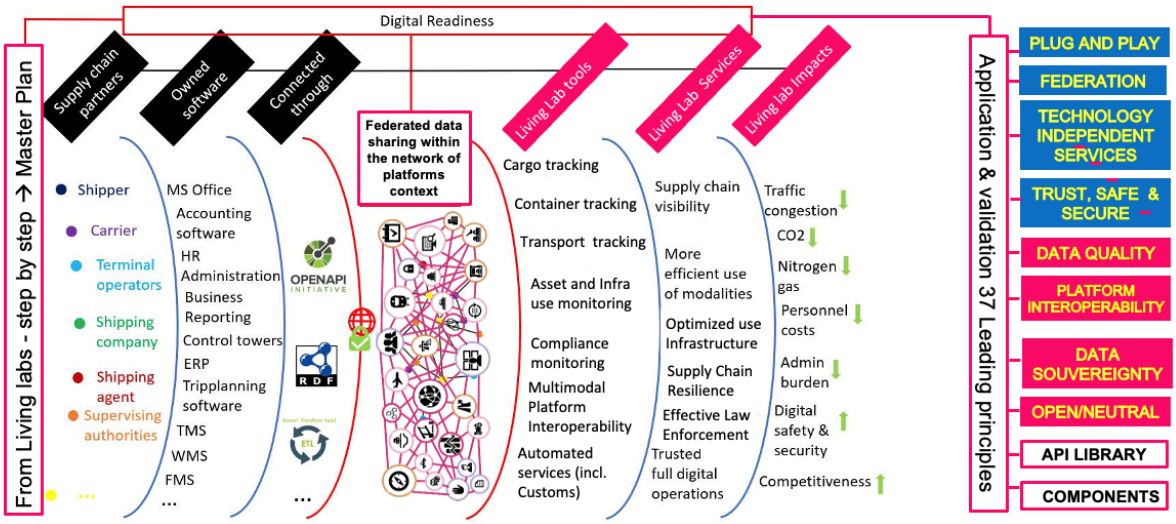
EXECUTIVE SUMMARY

The 15 FEDeRATED partners have joined forces to showcase how the various stakeholders in the logistic chain can benefit from real time data exchange, i.e. practically translate the EU DTLF policy towards developing a federated network of platforms in real life scenarios.

For practical purposes the FEDeRATED Activity has identified the federated network of platforms as "*an infrastructure provision containing a set of arrangements and technical applications to enable data in existing IT systems (platforms) of companies and public administrations to become available to authorized users through a publish and subscribe approach".* The feasibility of the infrastructure provision will be concretely identified through a multitude of Living Labs.

The various aspects of the Living Labs are covered in the illustration hereunder



The goal of all LL's is to benefit from the opportunities of real time data exchange profit by putting appropriate measures in place

The Living Labs contribute to the final FEDeRATED product being: A validated Masterplan on how to do future proof real time data sharing in logistics.

The conditions to successfully pursue data driven business cases for logistics are:

1. Full stakeholder's engagement.
2. Non propriety data spaces development,
3. Application of the overarching EU interoperability framework (EIF).
4. Digital readiness – competence. To benefit from this enabling Internet provision, stakeholders need to be competent, digital ready.
5. Full engage with the virtual infrastructure, the Internet,
6. Applicability of the DTLF and FEDeRATED stack

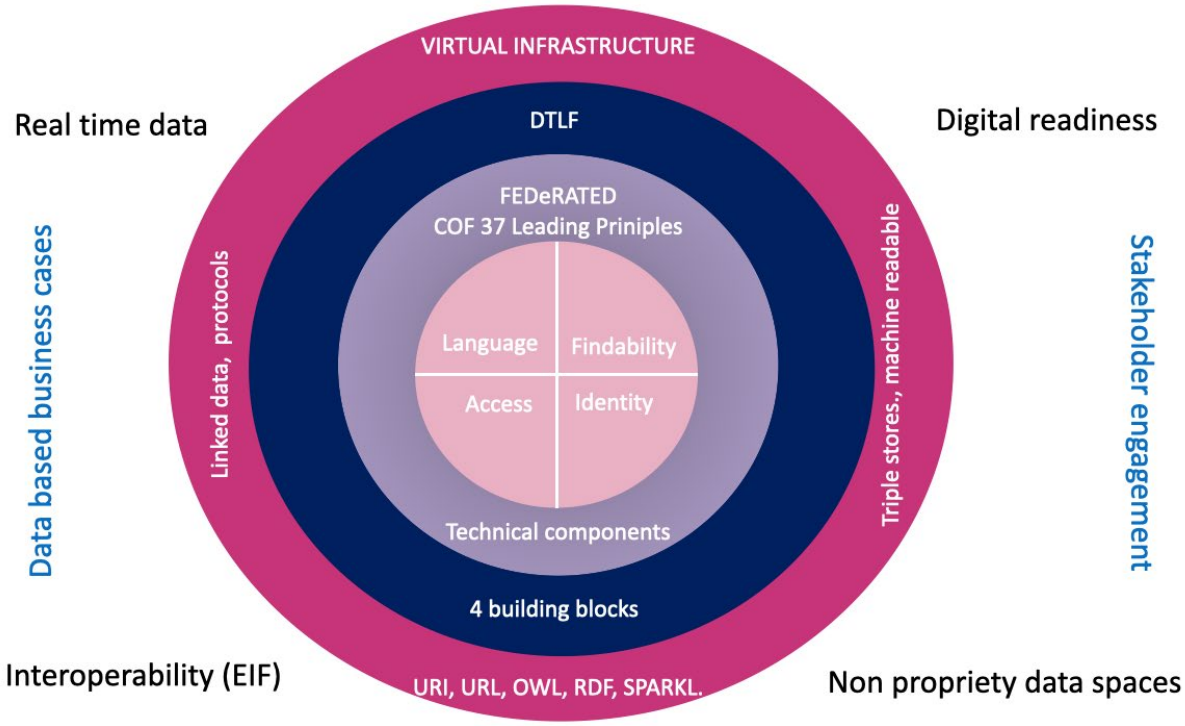
This Milestone 8 reports on the progress of the Living labs. The progress is measured based on:

1. The 4 DTLF building blocks
2. The 5 FEDeRATED Core Operating Framework (COF)

3. 37 Leading principles, also up for validation.
4. A set of technical components.
5. Experience of the LL's – retrieved from their own reporting (a reporting scheme has been developed).

In addition, a first indicative overview of the perception from the LL project managers how their LL's fit into the decomposition and functionalities of the DTLF / FEDeRATED Reference Architecture under development

After publication of this Milestone 8, the LL shall be further developed and monitored by transferring them transferred to the DTLF/FEDeRATED architecture stack (condition nr 6 above, referring to successfully pursue data driven business cases for logistics). This DTLF/FEDeRATED stack needs output of the FEDeRATED project: A validated Masterplan on how to develop a EU future proof network of platforms approach.



The major outcomes relating the progress of the LivingLabs are:

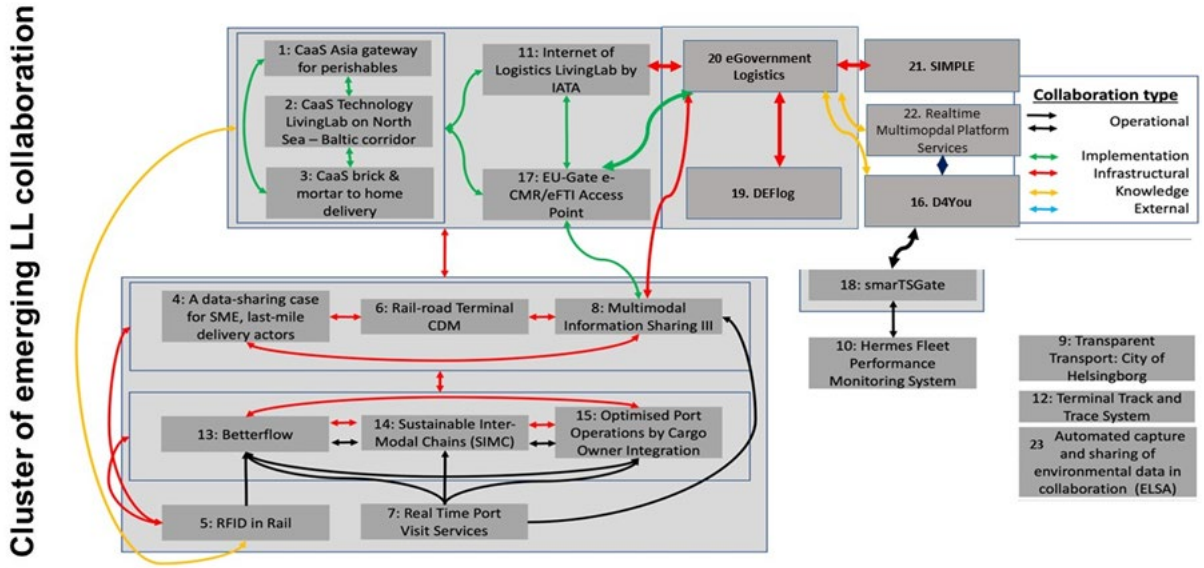
1. In general, the FEDeRATED Leading Principles cover the overall concept of the federated network of platform concept – functional requirements and technical specifications. However, many LLs ask for more architecture guidance and interaction.

2. Most Living Labs cover some or all of the following elements: specified business process, dedicated services, security, data semantics, API's, various data exchanges techniques, Identity and Authentication, Access control and access points, Authorisation and Identification.

3. Five Living Labs are exploring all 37 of the FEDeRATED Leading Principles (SIMPLE, Internet of Logistics, RFID in Rail, eGovernment Logistics and Real-time Multi-Modal Transportation platform). These LivingLabs are focussed primarily on developing comprehensive infrastructures based on the FEDeRATED semantic model and pull-based data availability.

4. In general, the Living Labs' development can be identified as being under one of two separate levels:
    - Level 1 - developing a data sharing platform - providing a limited number of operators access and experimenting their solutions on a wide variety of different services
    - Level 2 - developing a federated infrastructure provision - focussing on genuine platform interoperability and elements such as: Index, Service Registry, Access, IAM (integrated assessment modelling) and semantic modelling.

5. In 2022 and 2023, the LL will intensify their collaboration and finetune their solutions with the technical settings developed by DTLF Subgroup II and FEDeRATED Activity 2. Possible collaboration between the Living Labs is illustrated hereunder



6. The Leading Principles should be further developed as functional requirements and technical specifications, allowing the development of a validated Master Plan, possibly including a Toolbox and "How To" guidebook, in 2023. The various aspects laying down the foundations of a federated infrastructure provision should cover the following functionalities (global features – the FEDeRATED stack), closely related to DTLF Subgroup II recommendations and FEDeRATED Activity 2 work, i.e.

    a) Semantics with (open) standards –
    17 LL's indicate to (also) focus on this functionality

    b) Identity and Authentication - Determining the identity of a person/organisation/'thing'

from a recognised provider-
17 LL's indicate to (also) focus on this functionality

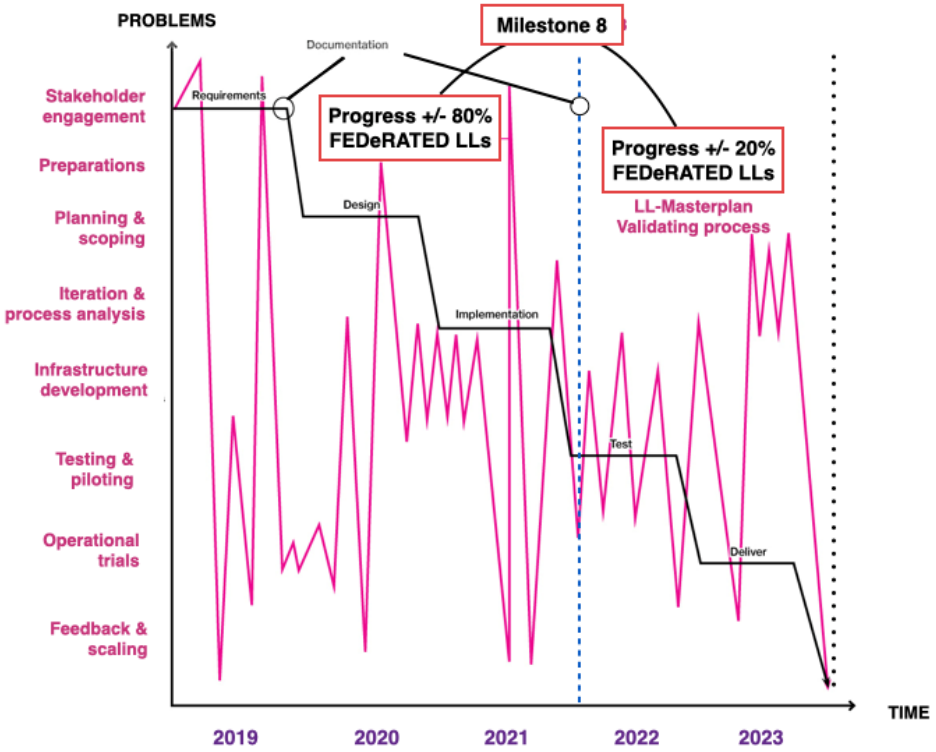
c) Access points and control - determine what data a person has access to and to identify the points for integrating organisations with or unlocking IT services (GUI) of the infrastructure –
20 LL's indicate to (also) focus on this functionality

d) Findability - Search systems with metadata - findability of all kinds of data (cargo, qualifications, certificates, electronic documents) for supervisors and enforcers-
12 LL's indicate to (also) focus on this functionality

e) Governance. Concern of to all LivingLabs. Under development.

7. The implementation of the federated network of platforms approach in terms of technical solution indicate the following:
   A. 7 LL's indicate to contribute to developing/facilitating a Peer2Peer solution.
   B. 15 LL's indicate to contribute to developing/facilitating Single Platform solution.
   C. 10 LL's indicate to contribute to developing/facilitating Multiple Platforms solution.
   D. 7 LL's indicate to contribute to developing/facilitating P2P and a Platform solution.

8. The progress of the Living Labs also in the perspective of the problems and timings the LLs have to overcome is illustrated hereunder



9. Regularly updated information on the LLs is available at the FEDeRATED website – (Living Labs (federatedplatforms.eu)

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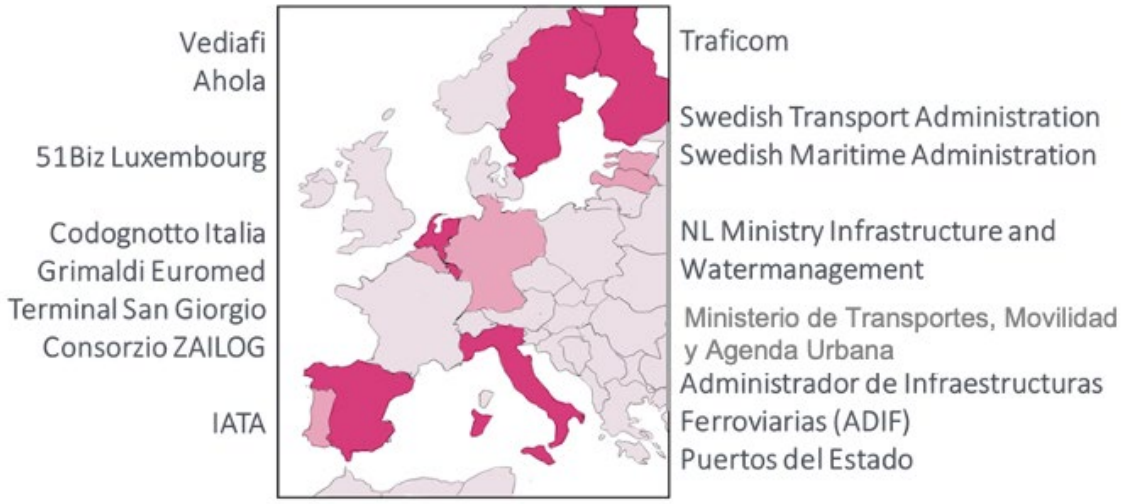
INTRODUCTION

The FEDeRATED project is running from 2019-2023. The main reason for the 15 FEDeRATED partners to join forces is to showcase how the various stakeholder in the logistic chain can benefit from real time data exchange. This will done will be done by practically implementing the EU DTLF federated network of platforms approach ("data sharing as a commodity").

This federated network of platforms approach has been developed in the first mandate of the DTLF – 2015-2019. It is fine tuned in its second mandate that runs until End 2022, also in connection to knowledge generated by FEDeRATED. This implies that the insights are evolving over time.

In 2023, according its planning, the FEDeRATED Action will ultimately **deliver the building blocks (templates/Master Plan) for developing an EU future proof data sharing infrastructure for freight transport and logistics established through testing sites with participation of various supply chain operators.**

FEDeRATED consist of partners from business as well public authorities. Both B2B as well as B2A, A2A and A2B business processes are incorporated in the action.



The quality of the input of the partners that the FEDeRATED Action will deliver. The basic FEDeRATED project approach is: **Learning by doing**. In practical terms this approach boils down to:

- Get real – both-feet-on-the-ground
- Identify the challenges
- Use the DTLF network of platform approach
- Develop a workable concept/Vision
- Reach out
- Find alliances
- Apply lessons learnt
- Try to find a solution

- Build trust
- Keep learning
- Put words in practice
- Connect the dots
- Structure the approach
- Conceptualize the results
- Keep the learning curve moving

In terms of the FEDeRATED Action, this approach has been translated into the following Activities:

1. Vision, including a definition of what a network of platform concept contains and a Core Operating Framework (2019).

2. A Masterplan describing on how all stakeholders can future proof exchange real time data. The Masterplan will be delivered in different stage:
    a. 2020, an Interim Masterplan (Milestone 2), including 37 Leading principles and various elements of building (including a Reference Model and technical components).
    b. 2020-2023 additional work, especially based on the work of the IT Architecture Group, the Semantic Modelling Group and the working group on Governance and Legal Affairs.
    c. 2022 Milestone 10 report comparing the Living Lab results with the development of the Master Plan
    d. 2023 Final Masterplan (Milestone 14)

3. A minimum of 10 Living Labs indicating how data sharing can be concretely done, thereby also providing input in for the development of the Masterplan, i.e. providing validation of the Interim Masterplan and followed research. The Living Labs are developed based on different stages
    a) 2019/2020 - identification of pilots and Living Labs by the FEDeRATED partners. (Milestone 4)
    b) 2020/2021 - descriptions and progress report of the Living Labs as compared to the Milestone 2 report (Milestone 8, this report)
    c) 2022/2023 – execution of the Living labs and validation of the Living Labs based on work done by Activity 2. (Milestones 10 and 12)
    2. Support is provided by Activity 4 – stakeholder engagement, consultation, and dissemination (various Milestone reports) – also to assist the Action to keep both feet on the ground and spread the word (two major public Events)
    3. Project management, including close cooperation of the FEDeRATED action with EU DTLF and regularly alignment with the EU CEF project FENIX. Specific actions:
        a) 2021, a FEDeRATED Peer Review Report (Milestone 5) was developed validating the work of FEDeRATED in the context of the progress made in the EU DTLF and FENIX.
        b) 2023, a second Peer Review (Milestone 13) should identify the validity of the output of the FEDeRATED Action.

In short, the development and execution of the Living Labs is very much intertwined between the 5 FEDeRATED Activities.

This report is called testing report on Pilots and Liviong Labs. It is to be considered as a technical report consolidating the test results, best practice and lessons learnt from each Living Lab as compared to the FEDeRATED Milestone 4 report Pilot/Living Lab Scoping (http://federatedplatforms.eu/index.php/library/item/federated-milestone-4-report-pilots-livinglab-scoping?category_id=7). The major input for drafting this Milestone 8 was provided by the Living Labs since Summer 2021. The first stage was a general description and general assessment of the progress by the various Living lab coordinators[1]. A second step was the development of 23 factsheets in the period December 2021 – February 2022. These LL Factsheets are an essential part of this report and cover the business case, the technical setting and organizational aspects. They are published on the FEDeRATED website and will be updated every quarter.[2] - Living Labs (federatedplatforms.eu)

The parameters to validate the progress and outcomes of the Living Labs are not fully set, yet. They are under development. Therefore, this report will focus on comparing the progress of the Living Labs against the FEDeRATED Interim Master Plan – updating Milestone 4 – and including the reactions of the LL's on their progress and content. The importance of Milestone 8 is to elaborate on the Living Lab providing per chapter the following information:

1. The context and general assessment of the progress
2. General LL issues
3. The LL technical setting
4. The LL collaboration
5. The major outcomes
6. The suitable architecture
7. An Action Plan

In addition, 5 Annexes attached containing a list of abbreviations and elaboration on some content provided by the Living Labs.

This Milestone 8 report can also be considered as a prelude to a dedicated FEDeRATED effort to validate the progress of the Living labs in relation to the perceived architecture framework. The follow-up FEDeRATED reporting will be increasingly focused on compliance with the final reporting of DTLF Subgroup 2 and the Activity 2 work regarding architecture, semantics and governance.

[1] *The analysis and the result of the first stage is summarized in the Intermediary progress report Pilots/LivingLabs.- FEDeRATED 2021 – available at* Intermediary Pilots Living Labs Progress Report 16 December 2021 (federatedplatforms.eu)

[2] *- For Living Lab overview see. Living Labs (federatedplatforms.eu). Specific per Living lab see: Individual Living Lab information (federatedplatforms.eu)*

1 GENERAL ASSESSMENT OF THE LIVING LABS DEVELOPMENTS

1.1 Context

On 2 and 3 February 2020, the FEDeRATED project hosted its final workshop (Gothenburg) on the Living labs before the covid-19 pandemic break-out. Ever since, no opportunities were available for the FEDeRATED partners to physically discuss LL progress and further develop issues like stakeholder engagement, technical settings and common Living Lab development. This was also the case in many EU Member States.

Despite the covid-19 pandemic the FEDeRATED project succeeded in developing a mature technical context for the LL's to be further explored, i.e. the reference architecture (including semantics). This progress could hardly be reflected within the progress of the Living Labs. Therefore, some discrepancies started to appear within the FEDeRATED project between theoretical knowledge gathering and developments (Activity 2) and both-feed-on-the-ground-approach which characterize the Living Labs. As from April 2022 - the covid-19 pandemic is expected to evolve as an epidemic and enabling safe physical contact - this discrepancy between theory and practice should be mended.

In macro-economical and global policy terms, the covid-19 pandemic showcased the importance of digital savviness – call it digital readiness – for logistic operators as well as public authorities. For the upcoming years, it is generally acknowledged that much money will be invested in supply chain resilience, emerging technologies (not in the least to enabling real time date exchange) and alternatives for fossil fuels. These three areas also touch upon the working context of the FEDeRATED project.

1.2 FEDeRATED contribution to EU's digital stack

All over, the work of the FEDeRATED project aims to contribute to building a digital stack for Europe. "*In technology, the stack is the technologies and services on which particular application relies, from silicon to operating a network. In politics it means much the same at the level of the state. The national stack is a sovereign digital space made up of not only software and hardware (increasingly in the form of computing clouds) but also infrastructure for payments, establishing online identities and controlling the flow of information. … the stack can be seen as a new form of state, piled up one on top of the other, each of them analogous to the territory defined by its physical border. The default stack is largely American because that is where the internet grew up. But other places are trying to differentiate their stack. Some seeing opportunity, some staving off perceived threats. The EU, with ambitions to become the world's super-regulator for all things digital, is putting together what it hopes will be more open stack, less tied into propriety technologies and monopolistic applications.* "[3]

A question for the FEDeRATED LL's: What can be the LL contribution to the EU open digital stack development? It would be interesting to validate the contribution of the FEDeRATED LL's developing

[3] *The Economist – 19 February 2022, "The Russian stack. Russia is building its own alternative to Western digital infrastructure. How far has it got?"*

a EU digital space made up of software, including a set of agreements (governance), and infrastructure for establishing online identities and controlling the flow of information for logistics within a federated approach. (See further 1.5)

1.3 Enabling real time data sharing

The goal of the Living Labs is to set up experiments for the sharing of real time data between various stakeholders to substantially optimize asset and infrastructure use management, supply chain visibility and develop new services. The Living Labs are based on various business cases, such as:

- To track cargo, transport modes and loading units (trailers, containers),.
- To enhance planning, forecast delivery time.
- To produce status reports.
- To support traffic and corridor management
- Integrate new technologies (i.e. IoL, RFID, sensors…)
- To enhance risk management capability.
- To lower administrative burdens.
- To allow more trade facilitation
- To optimize law enforcement capacity planning.
- To monitor compliance.
- To monitor sustainability and carbon footprint
- To realize situational awareness.

A wide range of services can be developed based on seamless real time data interoperability.[4]

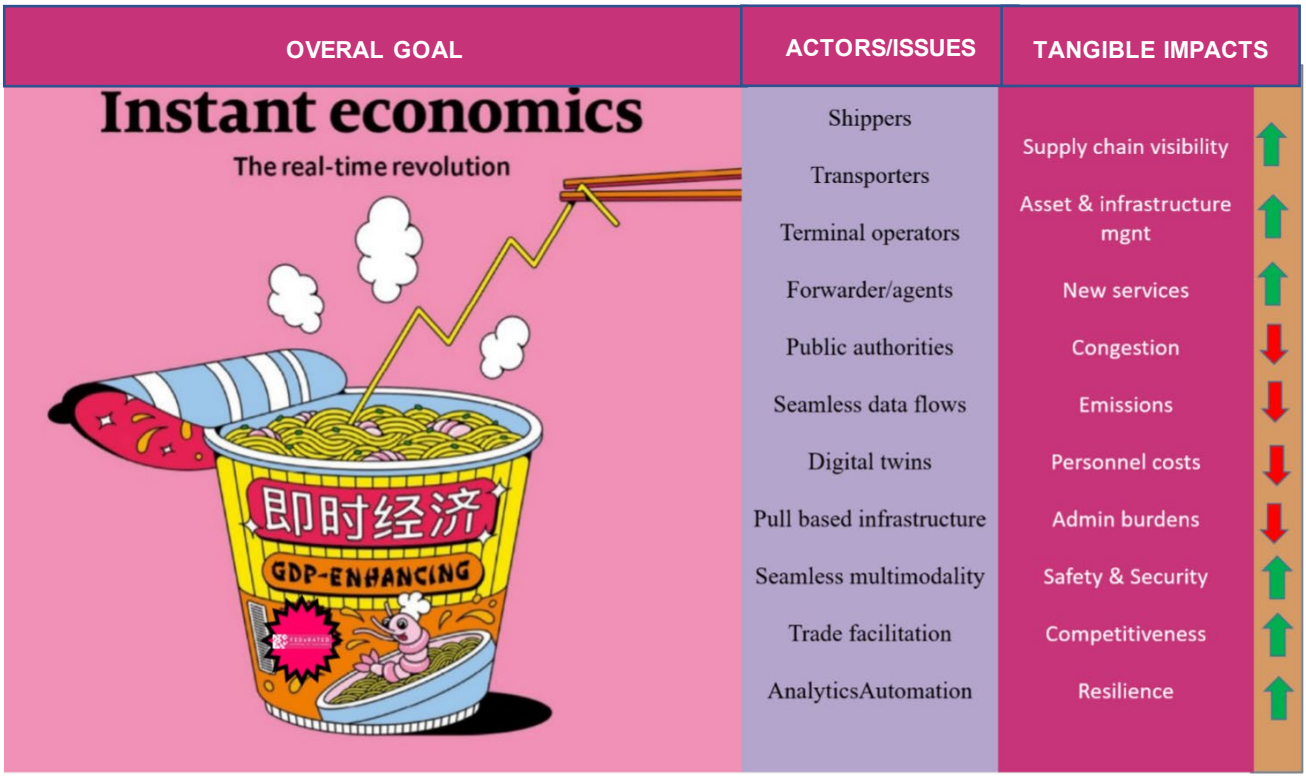


Illustration 1: Instant economics and supply chain real time data interoperability in a nutshell

[4] On the relation between real time data and logistics click Real time data and logistics (federatedplatforms.eu)

1.4 Assessing the Living Labs

The basis of the FEDeRATED Action is to assist the EU DTLF developing a network of platforms approach. FEDeRATED has translated this approach as **"an infrastructure provision containing a set of arrangements and technical applications to enable data in existing IT systems (platforms) of companies and public administrations to become available to authorized users through a publish and subscribe approach"** (Milestone 1 Vision). Connectivity within the supply chain between all operators relating to the elements in the FEDeRATED reference model - Events, nodes/hubs/place, transport modes, cargo, goods, equipment, Customs, business service, and person - is required.

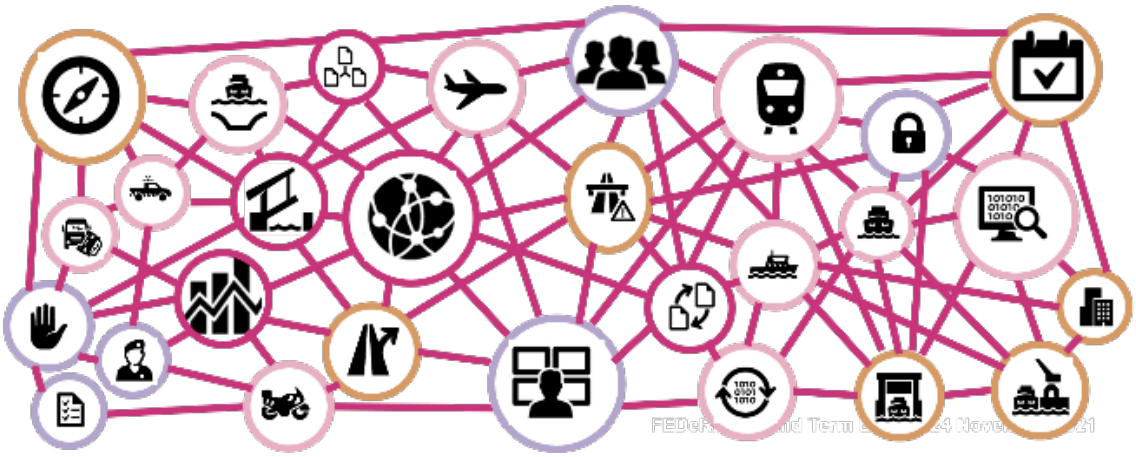


Illustration 2 FEDeRATED data sharing within the network of platform concept

Since 2019, the FEDeRATED partners have developed in total 23 Living Labs. The basis of developing the Living Labs was:

1. A business case per partner supporting the need for data sharing with one or more stakeholders.
2. The need to further develop and apply the 4 DTLF building blocks.
3. The FEDeRATED Core Operating Framework (Vision Document -Milestone 1).
4. The FEDeRATED Interim Masterplan (Milestone 2), i.e. covering a Reference Model, 37 leading Principles (based on 1 and 2) and a elements of building (list of technical components).

In this report, the progress of the 23 Living Labs is monitored mainly based on these four elements.

Since 2019, the development of Living labs proved to be very challenging indeed. In illustration 3 the various steps to be considered by the Living Labs are identified. They are:

1. The identification of the partners, preferably based on a business case
2. The access of appropriate software in place to enable data to be exchanged between data holder and data user.
3. To identify the data flows that need to connect through the Internet and identify how to technically do this (API's, semantics, nodes, digital twins, etc.
4. To apply the federated approach
5. To select, possibly develop, the appropriate tools (i.e. dashboards, nodes) to allow data to be seamlessly exchanged and shared
6. To define and agree on the required services

7. To quantify the impacts, such as contributions to policy objectives and better value for money.
8. The synergy with the DTLF policy concept and FEDeRATED Vision and Masterplan elements

These steps are pictured in illustration 3, hereunder.

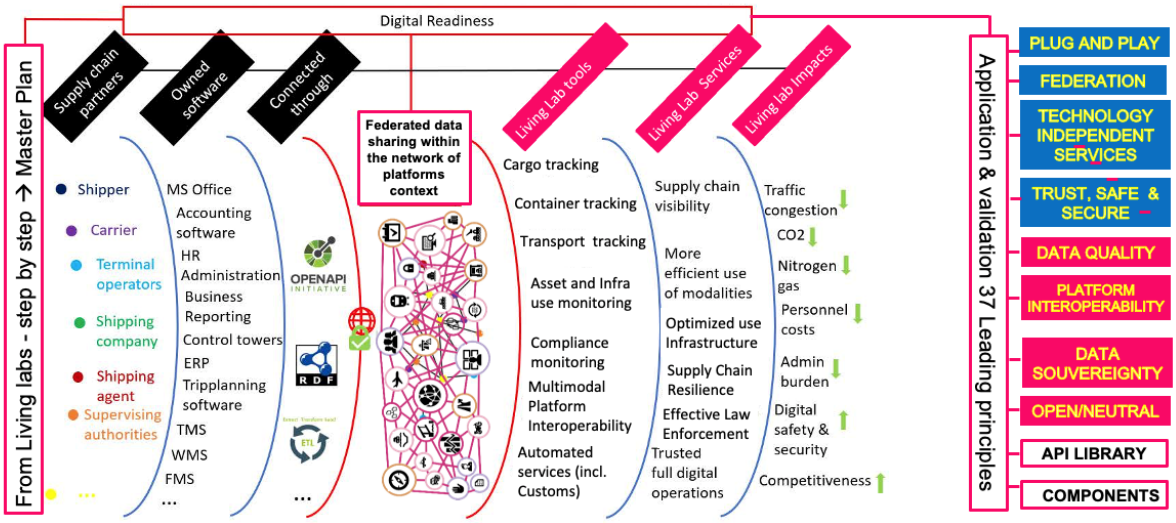


Illustration 3 The steps to be taken by every Living Labs – stakeholders, assessment/application soft- and hardware,, using the Internet, engineering tools (enablers), developing services and impact assessment

These 8 steps are not easy to take. They require:

a) A shared sense of urgency and importance between the LL project manager and the stakeholders to develop and execute the LL.,
b) Insights into the conceptual design (technical setting),
c) Identification of the value for money for all participants (what's in it for me)
d) Knowledge on the available and applicable instruments, software, technology, and architecture designs.
e) Executive drive, especially to enable many stakeholders to effectively work with data.

1.5 Setting the Living Labs successfully in motion

The 5 steps identified above requires a substantial change and adjustment of current operational processes for many operators, often including the need to engage in new and inconceivable new business model. The figure hereunder illustrates the confrontations many LL's endure while trying to apply of the DTLF building blocks for establishing a federated network of platforms approach.

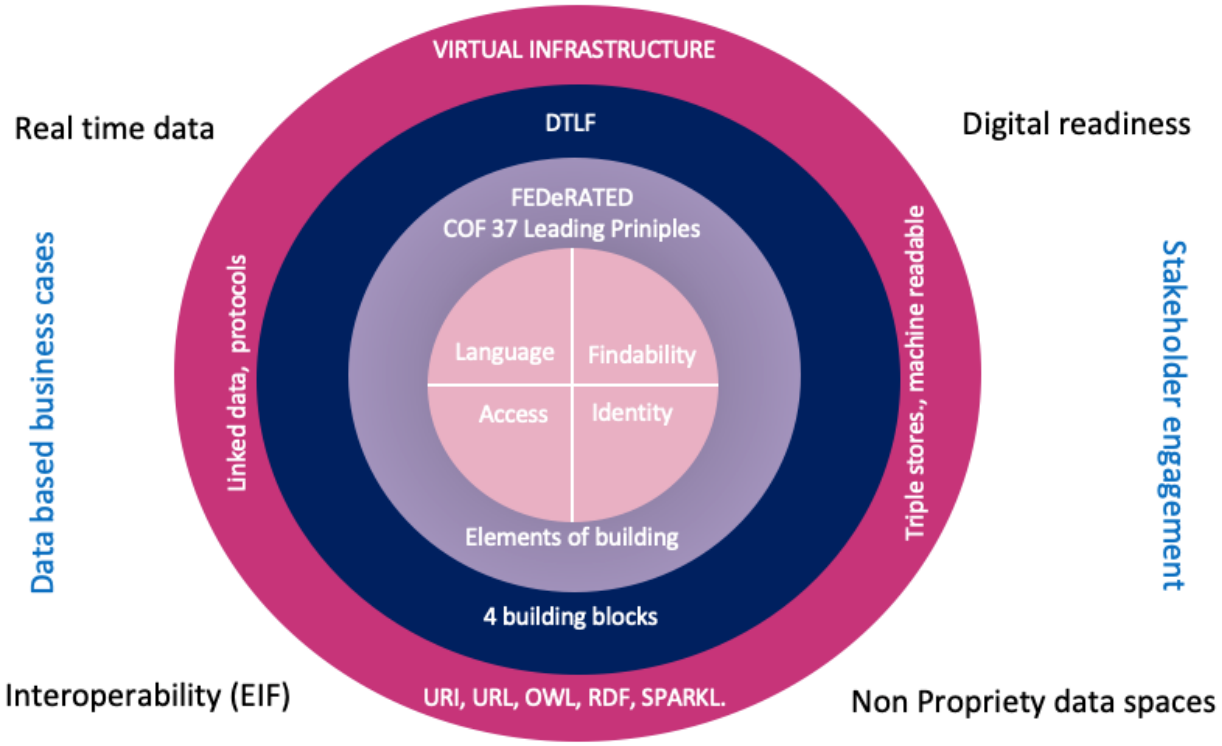


Illustration 4. The conditions to successfully pursue data driven logistics

Illustration 4 pictures the conditions to successfully pursue data driven business cases for logistics are:

1. Full stakeholder's engagement. This requires awareness, an engagement to learn and a trustworthy working space that stimulates to work with data instead of paper. The physical world is replaced with the virtual infrastructure - unknown territory must be made familiar. Living Labs often play a vital role in guiding the participating stakeholders through a transition process, inside organizations and between organizations. This is most challenging

2. Non propriety data spaces development, restricting the free flow of data. This is contrary to what many FEDeRATED partners are confronted with. Frequently, logistic operators and related public authorities seem to engage into developing their own data spaces, including applying specific ontologies, application of their own legacy systems, thereby primary focusing on existing hard- and software and applicable standards. Often this leads to building dedicated platforms or IT services, preventing access to a multitude of different networks. This might prevent stakeholders to fully engage and connect with the existing virtual infrastructure, the Internet.

3. Application of the EU interoperability framework. A majority of the LivingLabs provided comments regarding interoperability. Interoperability is one of the key enablers to achieve a Federated Network of Platforms. The EIF (European Interoperability Framework) (EU, 2021) defines a set of common principles, models, and recommendations concerning interoperability. The EIF interoperability model builds on four interoperability layers; legal, organisational, semantic and technical.
   - Legal interoperability is about ensuring that organisations operating under different legal frameworks, policies and strategies are able to work together.

- Organisational interoperability refers to the way in which public administrations align their business processes, responsibilities and expectations to achieve commonly agreed and mutually beneficial goals.
- Semantic interoperability ensures that the precise format and meaning of exchanged data and information is preserved and understood throughout exchanges between parties.
- Technical interoperability covers the applications and infrastructures linking systems and services. Aspects of technical interoperability include interface specifications, interconnection services, data integration services, data presentation and exchange, and secure communication protocols.

4. Digital readiness – competence. To benefit from this enabling Internet provision, stakeholders need to be competent, digital ready. Digital readiness requires stakeholders to have complied with the following elements:
   - A digital strategy in place, as part of their operational process
   - Paperless workflow management
   - Digital connectivity at the core of stakeholder engagement
   - IT connectivity is Independent from IT-suppliers
   - Data accessibility (internally and externally)
   - No shadow registration, all included into digital data and IT systems
   - Data is more important than hard- or software
   - Digital savvy personal – human resources.

5. Full engage with the virtual infrastructure, the Internet, For many logistic operators this is very challenging indeed. The Internet serves as the corner stone – an enabler – for a data sharing enabling many parties to take full benefit from. However, this is new to many. The EU DTLF and FEDeRATED infrastructure provisions aim to assist the stakeholders to soundly navigate the – for many inconceivable new working space - Internet. Thereby applying the Internet in such a way that a freight transport and logistics data space can evolve.

6. Applicability of the DTLF and FEDeRATED stack – the principles and technical setting and reference architecture (further elaborated in this report, mainly chapters 3 and 5)

Full engagement with the virtual infrastructure

Internet contains data flows enabling global connectivity. It only works because every network is connected, somehow, to every other with standardized protocols and addressing schemes. This connection physically happens through the cables and glass fiber between all the large variety of nodes (routers, switches) that constitute the Internet.

Building upon previous developments, browsing as a basis for eCommerce applications, mail, chatting, and all other types of applications has been developed by Tim Berners-Lee. This has been extended to facilitate searches through large data collections (like the description of the genoom) that lead to the Semantic Web. All these concepts and technologies are applied to construct the so-called federated network of platforms (DTLF), like:

- Internet and browsing protocols for end-to-end connectivity
- URLs (Uniform Resource Indicators) and URIs (Uniform Resource Identifier) to uniquely identify web servers (web-addresses used in for instance browsers).
- Various security mechanisms added to improve cyber resistance of these protocols
- Ontology Web Language (OWL) to specify data semantics
- Resource Description Framework (RDF) to actually share data
- Linked (open) data for sharing links to source data (with RDF)
- SPARQL as a query language to formulate all types of queries
- TripleStores as technology to implement the aforementioned standards.

These types of solutions are applied to support AI (Artificial Intelligence). Parts are also applied in Application Programming Interfaces (so-called REST APIs).

Berners-Lee visualized this with its 5-star model where web-presence (1 star) evolves into linking of RDF data sets (5 stars).

Governance is essential! Building upon the Internet governance structure and applying the 5-star model, the vision of Berners-Lee has been that each participant can have its own semantic model, that is either aligned with others (if the functionality is not overlapping) or matched (in case of overlapping functionality), thus entering into the fifth star. This type of governance structure is under development by DTLF, to be fed by FEDeRATED

2 LIVING LABS - GENERAL

2.1.1 List of Living Labs

At the date of issue of this report, the following LivingLabs are operating[5]:

#	LivingLab name	Start and finish	Responsible Beneficiary
1	CaaS Asia gateway for perishables	03-2019 – 10-2023	Vediafi (FI)
2	CaaS Technology Living Lab on North Sea – Baltic corridor	08-2020 – 10-2023	Vediafi (FI)
3	CaaS brick & mortar to home delivery via Scandinavia-Mediterranean corridor	04-2021 – 10-2023	Vediafi (FI)
4	A data-sharing case for SME, last-mile delivery actors	11-2020 – 10-2023	Swedish Transport Administration (STA) (SE)
5	RFID in Rail including intermodal	02-2020 – 06-2022	STA (SE)
6	Rail-road Terminal CDM	03-2020 – 06-2023	STA (SE)
7	Real Time Port Visit Services	07-2019 – 06-2023	Swedish Maritime Administration (SMA) (SE)
8	Multimodal Information Sharing III	09-2020 – 06-2023	STA (SE)
9	Transparent Transport: City of Helsingborg	01-2020 – 09-2022	STA (SE)
10	Hermes Fleet Performance Monitoring System LivingLab	01-2019 – 10-2023	Grimaldi Euromed (IT)
11	Internet of Logistics LivingLab by IATA	01-2019 – 10-2023	IATA
12	Terminal Track and Trace System LivingLab	09-2019 – 12-2022	Zailog scarl (IT)
13	Betterflow	03-2019 – 10-2023	STA (SE)
14	Sustainable Inter-Modal Chains (SIMC)	03-2019 – 10-2023	STA (SE)
15	Optimised Port Operations by Cargo Owner Integration	03-2019 – 10-2023	STA (SE)
16	D4YOU (Digitalisation for you)	01-2019 – 06-2023	Codognotto (IT)
17	EU-Gate e-CMR/eFTI OneAPP Living Lab	01-2019 – 10-2023	51Biz Luxembourg (LU)
18	smarTSGate	01-2019 – 06-2023	Terminal San Giorgio (IT)
19	Data Exchange Facility Logistics (DEFLog)	03-2019 – 10-2021	MinIenW (NL)
20	eGovernment Logistics	03-2019 – 10-2023	MinIenW (NL)
21	SIMPLE	01-2019 – 10-2023	PdE, MITMA & ADIF (ES)
22	Automated capture and sharing of environmental data in collaboration (BEAst-ELSA)	10-2021 – 10-2023	STA (SE)
23	Real Time Multimodal Transportation Visibility Platforms Services	03-2019 – 10-2023	Ahola/Attracs (FI)

It is to be noted that in the M4 (Scoping report) the total number of Living Labs under consideration was reported as 21. This Milestone 8 report is dealing with 23 Living Labs:

[5] Each LivingLab represents an overarching theme. This may be translated into multiple use cases and/or pilots within each LivingLab and this will be further expanded on in due course (during the realisation of the LivingLab) as more insights are developed

- LL#22 has been commenced in order to further address issues concerning environmental data sharing and the use of existing standards within the federated network of platforms arena.
- LL#23 has been operational since 2019 however due to an oversight in versioning of the M4 report it was not included in the final version as distributed. LL#23 has been included in this report and all relevant information on this LL is available in the factsheet (see FEDeRATED website) and in the Annexes to this report.

2.1.2 Progress of the LivingLabs towards fulfilment

The figure hereunder describes the progress of the LivingLabs, and their own estimation regarding progress in terms of percentage of completion. In a general overview of all the LivingLabs, most of them have reached a level of about 20% completion, eight of them have reached or are above 50 percent (see figure 7).

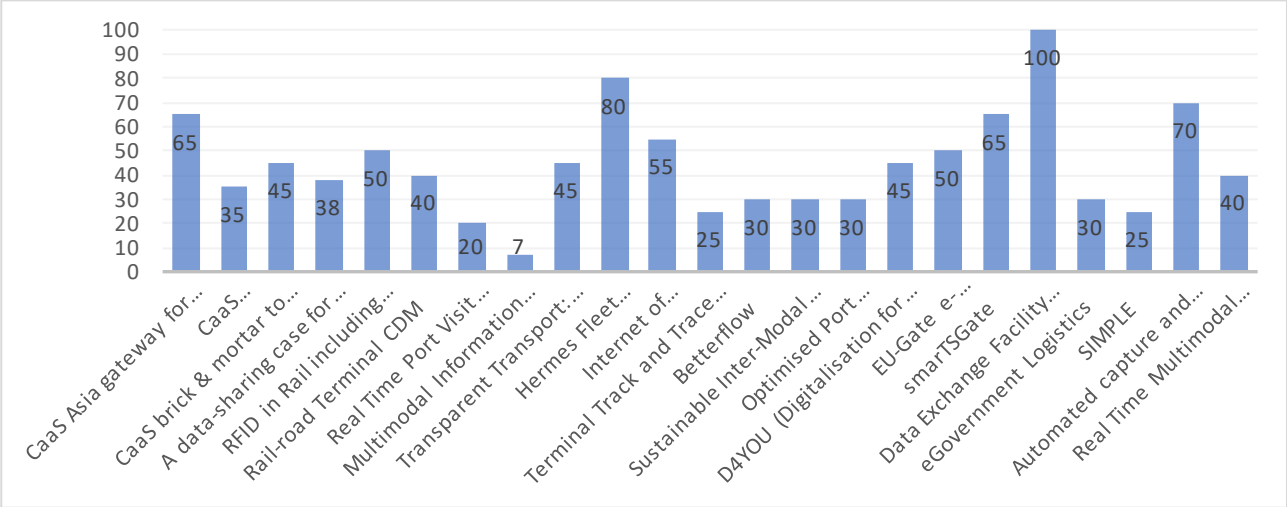


Figure 5: Estimated completion degree reported by the LivingLabs

On the next page a more detailed overview has been pictured.

#	LivingLab name	2019				2020				2021				2022				2023			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1	CaaS Asia gateway for perishables																				
2	CaaS Technology LivingLab on North Sea – Baltic corridor																				
3	CaaS brick & mortar to home delivery via Scan-Med corridor																				
4	A data-sharing case for SME, last-mile delivery actors																				
5	RFID in Rail including intermodal																				
6	Rail-road Terminal CDM																				
7	Göta Älv																				
8	Multimodal Information Sharing III																				
9	Transparent Transport: City of Helsingborg																				
10	Hermes Fleet Performance Monitoring System LivingLab																				
11	Internet of Logistics LivingLab by IATA																				
12	Terminal Track and Trace System LivingLab																				
13	Betterflow																				
14	Sustainable Inter-Modal Chains (SIMC)																				
15	Optimised Port Operations by Cargo Owner Integration																				
16	D4YOU (Digitalisation for you)																				
17	EU-Gate e-CMR/eFTI Access Point																				
18	smarTSGate																				
19	Benelux transport data sharing facility																				
20	eGovernment Logistics Data Sharing Infrastructure																				
21	SIMPLE																				
22	Automated capture and sharing of environmental data in collaboration (BEAst-ELSA)																				
23	Real Time Multimodal Transportation Visibility Platforms Services																				

Study
Piloting
Implementation-ready
Transition Study - Piloting
Transition Piloting - Inplementation-ready

In Appendix 1 an overview of the business cases and the main emphasis of the Living labs has been made available. In the specific Factsheets per Living Lab - available at the website…. – more detailed timing per LL has been made available.

It must be said that mainly due to the covid-19 pandemic many LL's are running late in their progress. As a matter of fact, 17 LL's have not reached the implementation yet. In general, the problems many arriving at an implementation phase is to create full stakeholder engagement and arrangements on a technical scope that correlates with the DTLF/FEDeRATED stack (infrastructure developments).

The figure hereunder illustrates the 5 stages a LL is supposed to surpass in connection to the problems that need to be accommodated and a general assessment of the state of play. FEDeRATED pursue to make up for lost time through intensified and coordinated actions in 2022 and 2023.

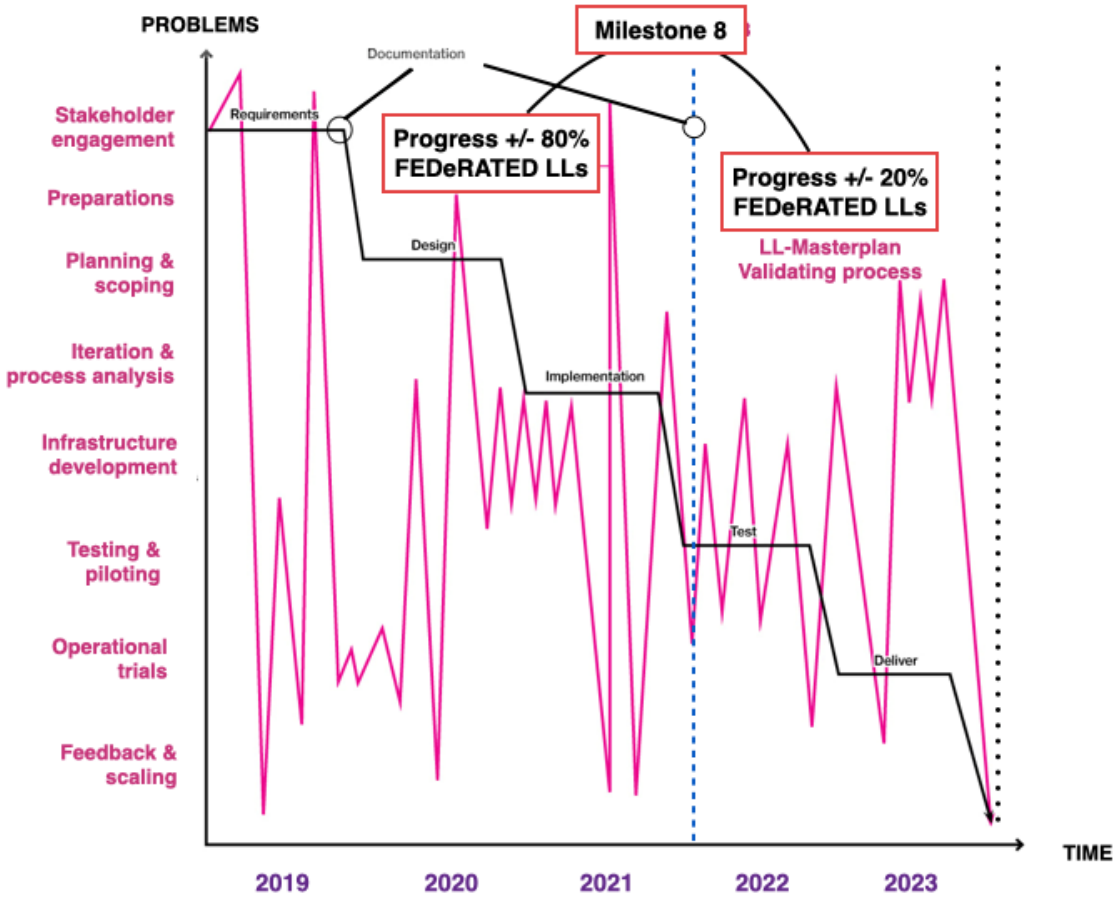


Figure 6. Generic LL state of play - project management features and progress

2.1.3 Summary of major changes that have been made to the LivingLabs

Based on the reported progress of the LivingLabs, some LivingLabs are progressing well towards completion while some LivingLabs are still at the beginning of their journey towards completion due

to changes occurring in the LivingLab setup. The major changes reported by the LivingLabs are described here below.

#	LivingLab name	Nature of change	Main reason/cause
4	A data-sharing case for SME, last-mile delivery actors	A new platform company entered the market (in May 2021) potentially offering a federated data sharing system whereby the former host of the data sharing platform used in LL#4 would be side-stepped. Under this new scenario the original scope of the LivingLab could not be achieved. For this reason the LivingLab redirected its scope to learn about such market actors and also to investigate whether it is susceptible to external desires towards the federated data sharing principles.	Changes in the market impacting the LivingLab partner structure and setup
7	Real Time Port Visit Services	LL#7 - RealTime Information Services (formerly LL#7 - Göta Älv) experienced difficulties in starting up as a world in lockdown (due to the Covid-19 pandemic) as the LL relied on physical interaction between people in order to reach a common understanding and be successful. The LL had to rethink its initial strategy and build a new solution for information sharing. A name change was also necessary to cover other use cases with possible new stakeholders.	Changes in the market impacting the LivingLab partner structure and setup
8	Multimodal Information Sharing III	In LI#8 the key partner (the operational infrastructure provider), withdrew its participation in March 2021. This jeopardised the ongoing LL resulting in a search for a new infrastructure partner. The LL is now strengthened by RISE which has stepped in using Deplide as the infrastructural foundation, building on the already established infrastructural connectivity made by the other participants in the LL, and based on the same foundation as the original key partner.	Replanning of LivingLabs
11	Internet of Logistics LivingLab by IATA	Delays in concluding agreements impacts resources and budgets and create timeline shifts that can have a great impact on the overall delivery of a project. To avoid this, LL#11created a multi-party data agreement to simplify the administration and avoid the need to conclude the same contract with each stakeholder. The importance of having agreements and NDAs in place is highlighted particularly in what happened in LL#8, mentioned above, when the infrastructure provider withdrew its participation.	Changes in the LivingLab activities due to agreements and trust
19	Data Exchange Facility Logistics (DEFLog)	LL#19 - Data Exchange Facility Logistics (DEFLog) was finalised in September 2021 as a FEDeRATED LL. DEFLog aims to serve as an independent, standalone data sharing	Replanning of LivingLabs

#	LivingLab name	Nature of change	Main reason/cause
		platform allowing various stakeholders some opportunity to further engage and share data. In addition to this development the initiative was taken to move on to a next stage by engaging the core DEFlog partners into developing a genuine federated infrastructure provision. This provision will be developed further in LL#20 - eGovernment Logistics - and in other activities outside FEDeRATED. In effect, aspects of the DEFLog business case will now continue to be pursued in LL#20.	
20	eGovernment Logistics	This LL has been expanded in order to continue the development of the relevant parts of the Reference Architecture, especially to develop the so called BDi node allowing platform interoperability based on the application of the FEDeRATED semantic model synergizing with IAM issues and a Service Registry and Index. It's scope of stakeholders was also extended to data sharing practices in connection to the implementation of the eFTI Regulation.	Replanning of LivingLabs
22	Automated capture and sharing of environmental data in collaboration (BEAst-ELSA)	A new LivingLab - Automated capture and sharing of environmental data in collaboration (LL#22), has been incorporated. Its activities are in line with, and will support, several other LLs. The LL 22 will act as an enabler for the rollout of the BEAst standard in Sweden that has been established and proven by LL participants. The experiences from LL#22 will be shared with LLs in other countries for the implementation of standards and processes for sharing environmental data between actors in the supply chain.	Introducing an additional mature LivingLab to FEDeRATED
23	Real Time Multimodal Transportation Visibility Platforms Services	LL#23 is not new, rather was omitted in the Scoping document (M4) due to an oversight in version management.	Omission in the M4 report

3 TECHNICAL SETTING

3.1 Coverage LP's

As stated in section 1 of this report, the Leading Principles refer to the implementation of the DTLF Building blocks and the FEDeRATED Core Operational Framework. All LivingLabs have indicated the applicability of the Leading Principles.

Hereunder is a list providing an overview of the 37 Leading Principles, the LL that applying what LP's and the number of LivingLabs that are seeking to evaluate them [6].

Leading Principle	Living Lab																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOT
1	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	22
2	Y	Y	Y	M	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	22
3	Y	Y	Y	N	Y	M	Y	N	Y	Y	Y	Y	M	M	M	Y	Y	Y	Y	Y	Y	Y	Y	16
4	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	M	Y	M	Y	Y	Y	Y	Y	19
5	M	Y	Y	N	Y	N	Y	M	M	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	17
6	Y	Y	Y	M	Y	N	N	M	Y	Y	Y	Y	M	Y	Y	Y	M	N	Y	Y	Y	Y	Y	15
7	Y	M	Y	N	Y	N	Y	N	M	Y	Y	M	M	M	M	Y	M	N	Y	Y	Y	Y	Y	12
8	Y	Y	Y	N	Y	N	Y	N	Y	N	Y	N	Y	M	M	Y	Y	N	Y	Y	Y	Y	Y	15
9	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	M	Y	22
10	Y	Y	Y	N	Y	N	N	N	Y	N	Y	N	M	M	M	Y	Y	N	Y	Y	Y	Y	Y	12
11	M	M	M	N	Y	N	Y	N	N	N	Y	N	N	N	N	Y	Y	N	N	Y	Y	Y	Y	9
12	M	M	M	M	Y	N	Y	N	N	N	Y	N	M	M	M	Y	N	M	N	Y	Y	Y	Y	8
13	Y	Y	Y	N	Y	N	Y	N	N	Y	Y	Y	M	M	M	Y	Y	N	N	Y	Y	Y	Y	14
14	M	M	Y	N	Y	N	Y	N	Y	N	Y	N	M	N	N	N	Y	N	Y	Y	Y	Y	Y	11
15	Y	Y	Y	N	Y	N	N	Y	N	N	Y	N	M	M	M	Y	M	M	Y	Y	Y	Y	Y	12
16	M	Y	Y	M	Y	N	Y	Y	N	Y	Y	N	M	M	M	Y	M	M	Y	Y	Y	Y	Y	11
17	M	M	Y	N	Y	N	N	N	N	N	Y	N	M	M	M	N	N	N	Y	Y	Y	M	Y	7
18	Y	Y	Y	N	Y	N	Y	Y	M	N	Y	M	Y	Y	Y	Y	Y	Y	Y	Y	Y	M	Y	17
19	Y	Y	Y	Y	Y	M	Y	Y	M	Y	Y	M	Y	Y	Y	Y	M	M	Y	Y	Y	Y	Y	18
20	Y	Y	Y	Y	Y	Y	Y	Y	M	Y	Y	Y	Y	Y	Y	Y	M	Y	N	Y	Y	Y	Y	20
21	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	M	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	19
22	Y	Y	Y	Y	Y	N	Y	Y	M	Y	Y	N	M	M	M	Y	M	M	N	Y	Y	Y	Y	14

[6] *FEDeRATED (2022) Intermediary progress report Pilots/LivingLabs, forthcoming at http://federatedplatforms.eu*

Leading Principle	Living Lab																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOT
23	M	Y	Y	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	M	N	Y	Y	Y	Y	18
24	Y	Y	Y	M	Y	Y	Y	N	Y	Y	Y	Y	M	M	M	Y	M	N	Y	Y	Y	Y	Y	16
25	Y	Y	Y	M	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	21
26	M	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	20
27	M	Y	Y	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	M	N	N	Y	Y	Y	Y	16
28	Y	Y	M	M	Y	Y	Y	Y	Y	Y	Y	Y	M	M	Y	Y	M	Y	Y	Y	Y	Y	Y	18
29	Y	Y	Y	N	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	20
30	Y	Y	Y	N	Y	N	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	17
31	Y	Y	Y	M	Y	M	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	21
32	Y	Y	Y	N	Y	M	Y	Y	Y	Y	Y	Y	M	M	M	Y	Y	Y	Y	Y	Y	Y	Y	18
33	Y	Y	Y	Y	Y	N	Y	M	N	Y	Y	Y	Y	Y	Y	Y	Y	M	Y	Y	Y	Y	Y	19
34	M	M	Y	N	Y	N	Y	Y	Y	Y	Y	M	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	17
35	Y	Y	Y	Y	Y	N	Y	N	N	Y	Y	Y	M	M	Y	Y	N	Y	N	Y	Y	Y	Y	16
36	Y	Y	Y	N	Y	N	Y	N	N	Y	Y	M	M	M	M	Y	M	M	N	Y	Y	Y	Y	12
37	Y	Y	Y	Y	Y	N	Y	Y	M	Y	Y	Y	Y	Y	Y	Y	Y	M	N	Y	Y	Y	Y	19
TOT	27	31	34	11	37	6	25	22	19	28	37	21	21	20	22	34	23	15	25	37	37	34	37	

The leading principles are further elaborated in the FEDeRATED website and the Milestone 4 report.

Based on the above template it can be identified that overall, most LL's apply or try to apply the Leading Principles. Some LL need more attention and better interaction in order to upgrade the level of LP application, possibly also to explain the significance of several Leading Principles. Special attention will be given to the LL's 4, 6, 9 and 17.

3.2 Coverage Technical Components

The Interim Master Plan as also identified various technical components to be important for developing a federated network of platforms approach. The LL's have indicated whether they work with these components.

Technical components	LivingLab																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOT
1 Access point	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	M	M	Y	Y	Y	N	Y	Y	Y	Y	18

Technical components	LivingLab																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOT
2 Certification authority	Y	Y	Y	N	Y	N	Y	N	N	N	Y	N	N	N	N	Y	Y	M	N	N	Y	Y	Y	12
3 Chain modelling toolset	M	N	N	Y	Y	N	N	N	N	N	Y	N	N	M	M	Y	Y	N	N	N	N	Y	M	6
4 Component	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	18
5 Configuration toolset	M	Y	Y	N	Y	N	N	N	M	Y	Y	Y	N	N	M	Y	Y	N	N	Y	N	Y	M	10
6 Connector	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	18
7 Endpoint	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	21
8 End-user	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	21
9 Federated platform	Y	Y	Y	Y	N	Y	Y	Y	M	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	19
10 Identity Provider	Y	Y	Y	N	Y	Y	Y	Y	N	N	Y	N	N	N	N	Y	Y	M	Y	Y	Y	Y	Y	16
11 Maintenance toolset	N	Y	Y	N	Y	N	N	N	M	N	Y	M	N	N	N	Y	Y	N	N	Y	Y	Y	Y	10
12 Modelling toolset	N	N	N	Y	M	N	N	N	M	N	Y	N	N	N	N	Y	Y	N	N	Y	Y	Y	M	7
13 Platform	Y	Y	Y	N	N	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	M	Y	Y	Y	Y	Y	Y	20
14 Platform Services component	Y	Y	Y	N	N	Y	N	Y	M	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	17
15 Registry component	Y	N	N	N	N	N	N	N	M	N	Y	Y	N	N	N	Y	Y	M	Y	N	Y	Y	Y	9
16 Storage component	M	Y	Y	Y	M	Y	Y	Y	M	N	N	M	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	15
TOTAL																								

The technical components are further elaborated in the FEDeRATED website and the Milestone 4 report.

3.3 *The LL and the DTLF types of implementation*

In general, the technical solutions that are being developed by the Living Labs are tailored to the needs of the specific business cases identified by the Living Labs. The specific technical solutions are elaborated in the textboxes 9 of various LL factsheets. See website ….

Overall, the Living Labs fulfil the DTLF requirements to make optimal use of existing solutions and create an open and neutral data sharing infrastructure. Therefore, the LLs seek the development of either platforms and solutions and facilities that enable organizations to share data and

- to provide independent technology services and
- to support rapid on-boarding of any organization to the federation of networks.
- to be findable in such a network,
- to allow data sharing in a safe, secure and trusted environment.

Within the DTLF, Subgroup II, four different types of implementations are foreseen:

A. Peer-to-peer data sharing – different organizations use their own internal solutions to share data with each other. They implement identified interfaces and components of the architecture themselves.
B. Single platform – each organization interfaces with a single platform, where the platform implements (a subset of) the Technology Independent Services.
C. Multiple platforms – each organization connects to a platform of choice and is able to share data (via another platform) with another organization.
D. A combination of peer-to-peer and a platform – one organization uses a platform and an own data sharing solution. They have to interface with one or more platforms and other p2p solutions of organizations.

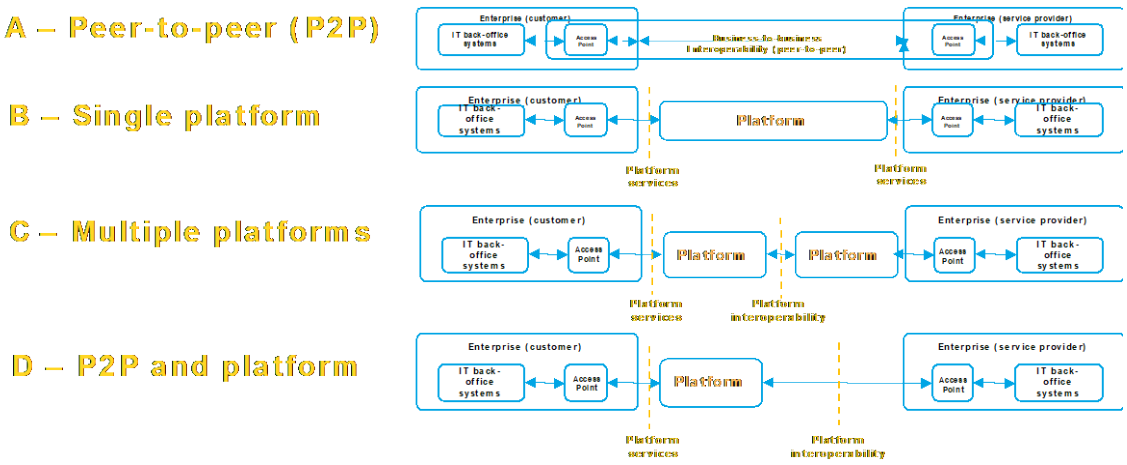


Figure 7 implementation variants

All Living Labs (LL) have indicated their preferred implementation variant, whereby a variation can be identified. The results are illustrated hereunder (based on the assessment of the LL project managers).

Implementation mode	LivingLab																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOT
A Peer-to-Peer	Y										Y		Y			Y		Y				Y		6
B Single Platform	Y	Y				Y	Y	Y	Y		Y	Y	Y	Y	Y	Y			Y		Y		Y	15
C Multiple platforms					Y	Y				Y	Y		Y	Y	Y			Y						8
D P2P and a Platform			Y	Y	Y						Y						Y			y			Y	7

The A, B, C or D implementation variants can be further decomposed by DTLF in functionality (global features), like shown in the next figure.

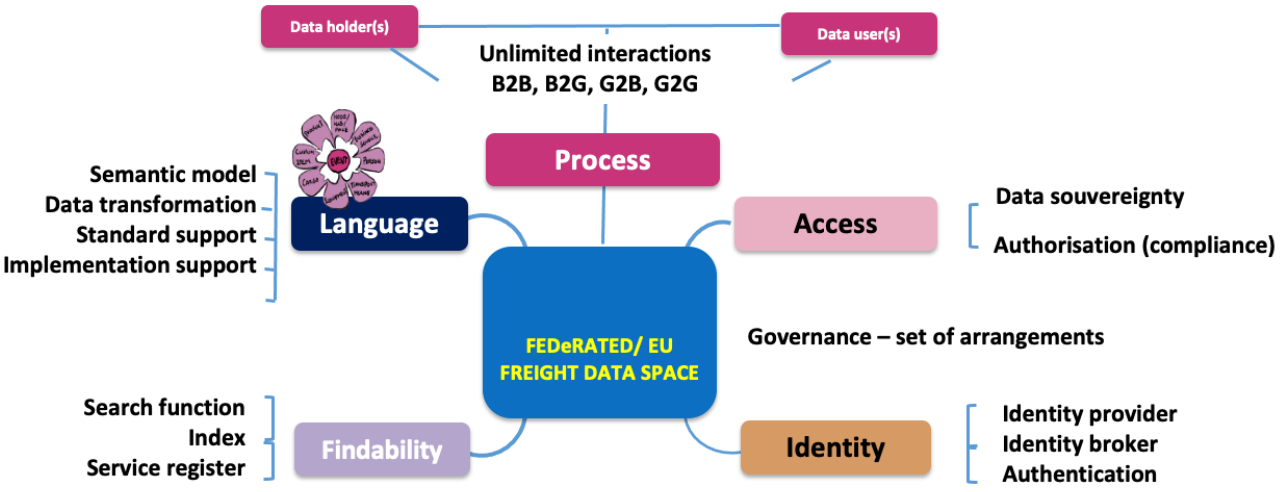


Figure 8 Decomposition of the technical solution

This decomposition identifies the need for the process aspects to support business services resulting in business contracts with business transactions. These must be compliant with regulations; they need to support the necessary data for compliance. All LL's fulfil this requirement, see their business case. They aim to advance business process collaboration. The preferred outcome should preferably be set of IT services required to support collaboration of business processes for providing and governing commercial services. These IT services are called the Technology Independent Services; they can be implemented by REST Application Programming Interfaces (APIs).[7]

The decomposition shows 4 major functionalities (global features). With respect to data sharing solutions, these functionalities have to comply to (a relevant subset of) the components developed in the specific LL's. The four functionalities (common features) are:

- The common **language** is decomposed in a semantic model(s) support data sharing in supply and logistics. These must be mapped to existing standards and organizations have to

[7] *Source of this text: DTLF, Subgroup II, Interim report. 2021*

configure data transformation according to plug and play. Each enterprise needs to provide relevant data for meeting compliance to applicable regulations and support of business services. To assist organizations, tools for implementation support have to be provided.

- **Identity** and Authentication is decomposed in Identity Providers and – Brokers supporting Authentication – each organization should have an identity that is issued by a certified identity provider and can be authenticated. Multiple identification domains may have to be specified, each based on its certification mechanism supported by an identity broker. eIDAS is an example where the EU Member States have implemented an agreed certification mechanism for B2G data sharing, both for employees and IT systems. Open standards should be applied, in combination with the implementation of the Technology Independent Services (e.g. OAUTH2.0 and REST API identity tokens)..
- **Accessibility** covers data sovereignty for B2B data sharing and data access by authorities implementing compliance to regulations – each enterprise should be able to control its data sharing, compliant with any restrictions (e.g. GDPR) and data requirements of authorities based on regulations, where the EU authorities implement goal binding.
- **Findability** (Discoverability) mainly consists of an index for sharing event data and a service registry for publication of business services. Search functionality will have to be specified on each of these components, where the functionality is implemented in a distributed way – for inclusiveness and optimization commercial services and the past (e.g. a trace or container track), present, and future (e.g. a planned flight, itinerary, or voyage with available capacity) state of supply and logistics chains in networks. State changes are shared via events that support business collaboration.

All Living Labs have indicated the functionalities covered by their technical solution cover the above 4 functionalities. The results are illustrated hereunder.

Functionalities / Global features	LivingLab																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	TOT
Language	y	Y	Y			Y	Y		X	Y	Y		Y	Y	Y	Y	Y		Y		Y	Y	Y	17
Identity	Y	Y	Y		Y	Y	Y			Y	Y	Y	Y	Y	Y			Y	Y	Y	Y		Y	17
Access	Y	Y	Y	Y		Y	Y	y	Y	Y			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	20
Findability	Y	Y	Y	Y	Y	Y		y						Y	Y					Y	Y		Y	12

Overall, two levels of technical solutions are emerging in the Living labs:

1. Level 1 type Living Labs are centred around access points. Operational platforms servicing a transport node or specific use cases need mechanisms, so-called access points, to share data with each-other to enable more complex use cases, such as end-to-end supply chain visibility.

2. Level 2 type Living labs are concerned with consideration of the broader interoperability issues in developing comprehensive federated infrastructures, whereby most of the functional components are addressed.

There are clear examples of technical solutions of the types described so far that have been developed in the LivingLabs, see figure 9.

Figure 9: Emerging IT-infrastructural solutions for a Federated Network of Platforms (Illustration: Sandra Haraldson)

In summary, there are several IT-infrastructural solutions emerging in the LivingLabs. These solutions are of different types and constitute key architectural building blocks in the Federated Network of Platforms. As part of the continued activities within FEDeRATED more focus is to be placed upon the network characteristics. For instance, testing interoperability between technical infrastructural solutions in real settings through the collaboration between relevant LivingLabs and actually sharing data between their solutions.

There are several operational platforms, such as

- the D4YOU data sharing platform, based on MS Azure and Power BI,
- the DEFLog data sharing platform, based on AWS Cloud,
- the eGovernment Logistics platform, applying various technologies such as Corda
- the SIMPLE platform, applying various technologies such as blockchain.
- The Deplide platform, applying various technologies such as Kafka supporting the elicitation of experiences and requirements for implementation, that is developed together with several Swedish LivingLabs.

A multitude of different data sources are being explored, such as

- RFID readers for railway wagons,
- IoT sensors on ships, IoT sensors on train wagons,
- IoT sensors and on-board units on trucks,
- IoT sensors on buildings and road side infrastructure,
- IoT equipment in the port, etc.

Also various applications addressing the needs in certain use cases are being developed, such as

- the Automated border crossing (ABC) service, and
- the OneAPP for Authorities. Finally, there are access points to connect different platforms together, such as the EU-Gate Access point.

4 EMERGING LL COLLABORATION

An important value added of the FEDeRATED project would be Living Lab collaboration. The reasons for LL collaboration can be either:

- *Operationally*-based, in the sense that data is being shared between the LivingLab environments based on agreements between the LivingLabs
- *Implementation-based,* in the sense that they build upon the same implementation principles where the implementation principles become the focal point for sharing experiences
- *Infrastructurally-based,* in the sense that they are using the same generic infrastructural solution made as instances for each LivingLab where the infrastructural solution becomes the focal point for sharing experiences
- *Knowledge-based,* where LivingLabs are meeting and exchanging experiences not related to the three collaboration types specified above.
- *External, as* between the FEDeRATED and FENIX projects.

Based on the input provided by the Living Labs a clustering of the emerging LL collaboration can is illustrated hereunder.

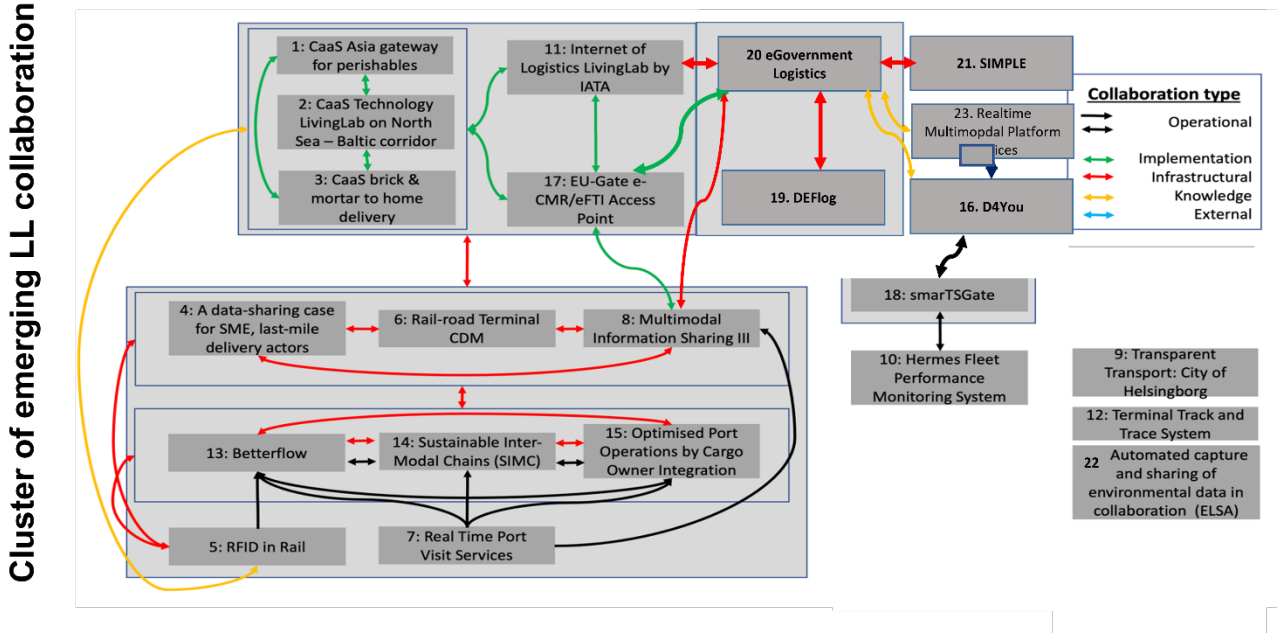


Figure 10: Emerging collaborations between LivingLabs and externally

To further elaborate on figure 10.

- Operationally based we see some LivingLabs that are feeding information between each other, for example from RFID in rail (LL#5) and Real Time Port Visit Services (LivingLab 7) providing information to the three LivingLabs at Kvarken Ports (LL#13, #14 and #15) and to Multimodal Information Sharing (LL#8). Operational relationships exist between smartTSGate (LL#18) and Hermes Fleet Performance Monitoring System (LL#10) of which those LivingLabs are feeding information between each other.
- infrastructural based, collaboration among several LivingLabs building upon the same infrastructural solution (Deplide with associated front-end services providing situational

awareness inspired by the collaborative decision-making concept). Deplide, by complying as a ONE Record node can be conceived as the implementation of LL #11 the Internet of Logistics being adopted by several LivingLabs. The ONE Record implementation schema is being followed by the three CaaS LivingLabs (LL#1, #2, and #3) as well as by the EU-gate e-CMR/eFTI access point LivingLab (LL#17). Further there is also knowledge sharing between eGovernment Logistics (LL#20), the Data Exchange Facility (DEFLog) (LL#19) and SIMPLE (LL#21).

- Externally, due to overlapping partnerships between FEDeRATED and FENIX and initiatives of collaboration, there are also project-wide collaborations emerging regarding semantics. On a LL level this especially concerns smartTSGate (LL#18).

In 2022 and 2023, further collaboration opportunities should be identified and explored among the LivingLabs, such as:

1. The three CaaS LivingLabs (LL#1, #2, and #3) sharing knowledge with the eGovernment Logistics (LL#20) and Automated capture and sharing of environmental data in collaboration (ELSA) (LL#22)
2. The LivingLab on data sharing for SME in last mile delivery (LL#4) interacting with D4YOU (Digitalisation for you) (Ll#16) and Automated capture and sharing of environmental data in collaboration (ELSA) (LL#22)
3. The LivingLab on Real Time Port Visit Services (LL#7) operationally collaborating with Rail-road Terminal CDM (LivingLab 6)
4. The LivingLab on EU-Gate e-CMR / eFTI OneApp (LL#) sharing knowledge with D4YOU (Digitalisation for you) (LL#16), Internet of Logistics (LL#11), eGovernment (LL#20), and CaaS Gateway for Perishables (LL#1)
5. The LivingLab on eGovernment logistics (LL#20) possibly collaborating with Internet of Logistics (LL#11), SIMPLE (LL#21), and Realtime Multimodal Transportation Visibility Platforms Services (LL#23)

5 MAJOR OUTCOMES - SUMMARY

To summarize the major outcomes relating the progress of the LivingLabs since the Milestone 4 – issued October 2020 - one could say:

1. In general, the FEDeRATED Leading Principles cover the overall concept of the federated network of platform concept – functional requirements and technical specifications – however more architecture guidance and interaction is required.
2. Most LivingLabs cover some or all of the following elements: specified business process, dedicated services, security, data semantics, API's, various data exchanges techniques, Identity and Authentication, Access control and access points, Authorisation and Identification.
3. Five LivingLabs are exploring all 37 of the FEDeRATED Leading Principles (SIMPLE, Internet of Logistics, RFID in Rail, eGovernment Logistics and Real-time Multi-Modal Transportation platform). These are LivingLabs that are focussed primarily on developing comprehensive infrastructures based on the FEDeRATED semantic model and pull-based data availability.
4. In general, the LivingLabs' development can be identified as being under one of two separate levels:
    - Level 1 - developing a data sharing platform - providing a limited number of operators access and experimenting their solutions on a wide variety of different services
    - Level 2 - developing a federated infrastructure provision - focussing on genuine platform interoperability and elements such as: Index, Service Registry, Access, IAM (integrated assessment modelling) and semantic modelling
5. The Leading Principles should be further developed as functional requirements and technical specifications, allowing the development of a validated Master Plan, possibly including a Toolbox and "How To" guidebook, in 2023. The various aspects laying down the foundations of a federated infrastructure provision should cover the following basic elements:
    a) **Semantics with (open) standards**
        i. Core: data representation of physical reality (Digital Twins and Events) and logistics services such as transport, transhipment, storage
        ii. Status diagrams for data quality: consistency and order of milestones (track container, track vessel, route, etc.)
        iii. Usable for: specification documents, messages, generation APIs, capturing data needs of supervisors and enforcers
        iv. Taking into account legal restrictions (GDPR, Rotterdam Rules, etc.)
        v. Integration of business processes ('**choreography**') for searching/finding logistics services, booking and ordering, visibility and exceptions (resilience)
    b) **Unique identification** (URIs, legal entity identifier, etc.) of all kinds of 'Digital Twins' (cargo, containers, trucks, organisations, etc.) to link with sensors (IoT - Internet of Things)
    c) **Many APIs to support applications** - search and find logistics services, book and order, visibility, tracking (cargo, transport means), stock access, access to data by supervisors/enforcers.
    d) **Identity and Authentication** - Determining the identity of a person/ organisation/'thing' from a recognised provider
    e) Data exchange **techniques** - messages (push), Application Programming Interfaces (APIs - pull); all kinds of syntaxes - EDI, XML, JSON, RDF, ..

f) **Access control** - determine what data a person has access to
g) Search systems with metadata - findability of all kinds of data (cargo, qualifications, certificates, electronic documents) for supervisors and enforcers
h) Distributed **logistics services registers** with trusted suppliers (linked to Identity/Authentication, certificates, etc.)
i) **Access points** for integrating organisations with or unlocking IT services (GUI) of the infrastructure
j) **Linked infrastructure components** for (temporary) storage, operations (e.g. ETA prediction), etc. of data during exchange (peer-to-peer connectors, platforms, ledger networks, etc.)
k) **Logs and audit trails** for evidence in disputes

6 PROVIDING THE LIVING LABS WITH A SUITABLE ARCHITECTURE

The focus of the FEDeRATED project is to assist its partners to effectively make use of the current virtual infrastructure, e.g. to realize a network of platforms in logistics. In the introduction, it was identified that the FEDeRATED Action is based on the concept of Learning by doing. This also implies that most Living Labs that started their work in 2019/2020 have to constantly readjust their work to. They made use of an architecture framework, including semantics, that was not sufficiently matured (Milestone 2). This Milestone 2 was the framework the Living Labs are measured against in this Milestone 8 report. However, as the learning curve never stops, follow-up FEDeRATED reports (from Milestone 10 onwards) will fully take new insights on board.

In 2020/2021, much work has been put into developing a mature federated network of platforms architecture. This was done by FEDeRATED Activity 2 in coordination with the DTLF SG2 on IT architecture. The underlying concept of the IT architecture is the pull of data, where a pull can be combined with push. Such a pull-based architecture implies that links to data are shared with appropriate data users, where the latter can evaluate the links. Upon link evaluation, a data holder can still decide to provide access. Also, Identification, Authentication, and Authorisation (IAA) is core to the open FEDeRATED architecture, together with encryption. IAA with data sovereignty defines who has access to which data and supports data sovereignty. Based on linked data and IAA, the DTLF/FEDeRATED building elements of the IT architecture consist of the following elements (see also figure 5):

- *Conceptual level* capturing conceptual building elements supporting semantic and organisational interoperability. These building elements are:
    - Language – a semantic model supporting data sharing in supply and logistics (multimodal) supported by tools and algorithms for its implementation by individual organisation, supporting required standards.
    - Process – data sharing between business processes of collaborating organisations, business-to-business, business-to-administration, and administration-to-business.
- *Functional components* which address the required components to realise data sharing in a technology independent way. These are grouped into discoverability of data and business services, data sovereignty for B2B and B2A based on access control compliant with regulations, and IAA mechanisms aligning with existing solutions like the eIDAS Regulation, iSHARE, and Decentralised Identities (DIDs).
- *Technical - Data sharing solutions* putting emphasis on different types of solutions (proprietary, COTS – commercial off the shelf, and open source) and third party (platform) services. They must implement functionality, independent of any application area. The functionality basically supports non-repudiation, technical standards like REST APIs, PKI certificates, and end-to-end security mechanism to share commercial - or privacy-sensitive data.

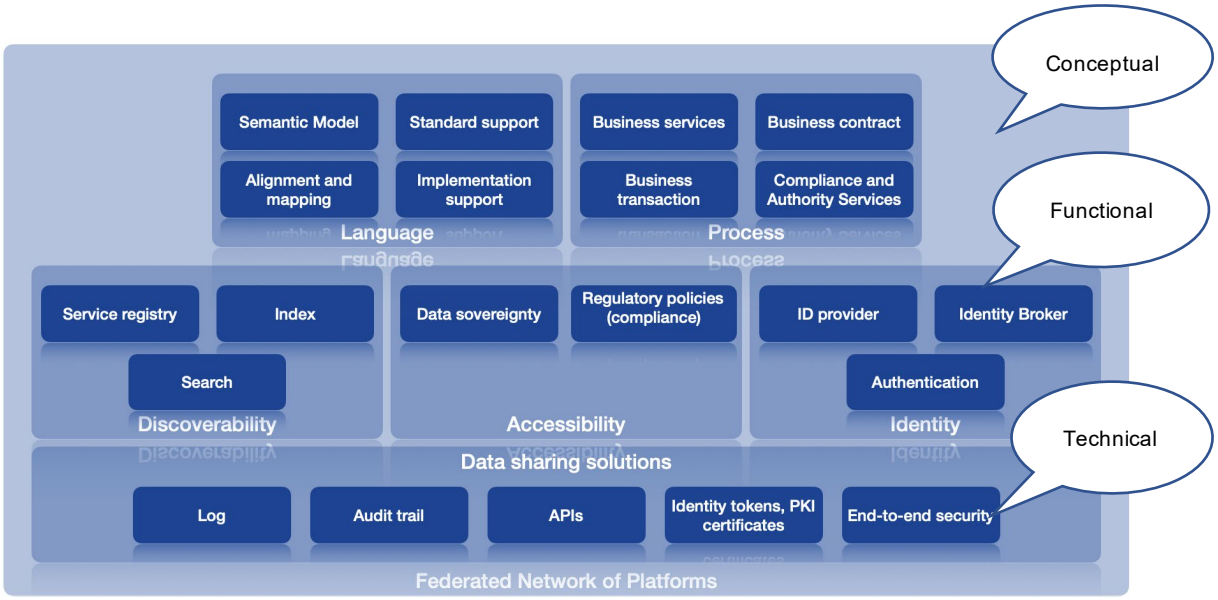


Illustration 11. DTLF technical, conception and functional architecture

This DTLF architecture design will be incorporated into the final FEDeRATED Master Plan. The envisaged FEDeRATED Masterplan is still under development. The Masterplan will incorporate the DTLF building blocks, the FEDeRATED Interim Master Plan, including its 37 Leading Principles, the DTLF Subgroup 2 reporting and all FEDeRATED insights developed since the Interim Master Plan into a "How to Guide", i.e a Guide on " How to Build a federated infrastructure provision?" and "How to use it?". Apart from dealing with issues like CEF standards[8], the specific elements the FEDeRATED Master Plan are pictured in illustration 12. This illustration covers the architecture guidance that is in production to validate the Living Labs and vice versa, after publication of this Milestone 8 report.

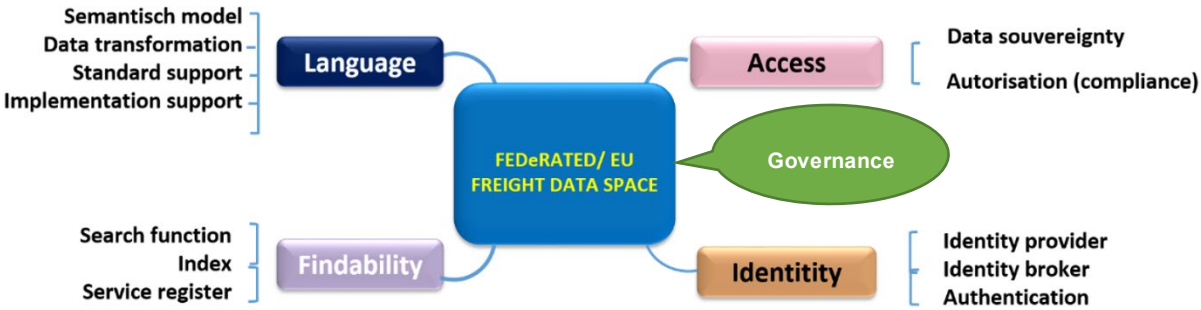


Illustration 12 The architecture guidance to validate the LL and vice versa

[8] *The issues are Identified in the EC-FEDeRATED Grant Agreement 2019*

The purpose for the Living Labs is to contribute to the development of a future proof federated network of platforms. This is a network form in which computers communicate directly with each other and no central control is present. This differs greatly from the usual platform approach, in which one central link is in control and regulates the data exchange.

To achieve a reliable and secure federated network, without central control, 5 basic functionalities (global features) must be filled collectively in the infrastructure provision:

- Language: the information components, terms, meanings and concepts are translated from a semantic model into a (common) language that can be understood by the various data users, so that harmonized data interoperability can take place in the multimodal transport chain.
- Identity: a (centralized or not decentralized) organized registration of identities is realized, so that companies can be authenticated, and it can be determined within the network who each party is.
- Access: a register of authorization agreements for data sharing, so that data sovereignty is guaranteed, and data sharing can take place safely and it can be arranged who has access to what.
- Findability: an Index and register (yellow pages of addresses and computers) that is linked to a search function accessible to everyone to look up information about protocol support at the various actors.
- Governance: a structure on how the participating parties can rely on another and the validity of the change management in place

These functionalities (global features) all contribute to large scale applicability of data sharing. Ideally, the Living Labs should develop these functions, also identifying the validity and various aspects of these functions. Before this can be achieved, the LivingLabs need some guidance on How to implement these functions.

7 ACTION PLAN

This report is the last report of Activity 3 on Living Labs. The next report on the Living Labs will be developed by Activity 2. This change identifies the need to extend the genuine reporting on the progress of the Living Labs based on Milestone 2, Interim Master Plan (February 2020) onto the state-of-the-art insights gained after February 2020, especially by DTLF as well as FEDeRATED (see chapter 1, paragraph 3). Therefore, the identified knowledge gap between the LL and the state of play within Activity 2 must be closed. How to do this? An Action Plan is proposed.

The goal of the Action Plan is the finetuning of the development of Master Plan development in connection to the LL's and vice versa. This will be done from January 2022-May 2023. This Action plan is based on the following elements

Nr	What (availability of)	Who	Date
1	23 LL's Factsheets, including technical setting	Living Labs	March 2022
2	Draft Table of Contents Master Plan	IT Architecture Group	April 2022
3	FEDeRATED reference architecture document	IT Architecture Group	April 2022
4	Agenda Semantic Modelling	Semantic Modelling Group	April 2022
5	Draft report Governance and Legal Affairs Group	Working Group	April 2022
6	Start concrete application Semantic Model	Semantic Modelling Group	April 2022

1 is ready. 2 and 3 will be used to assess and guide the LLs in such a way that the FEDeRATED objective of a scalable (on-boarding with plug and play) data sharing infrastructure provision for supply and logistics can be created. The preferred outcome will be that every LL is able to identify their level of compliance with the FEDeRATED Master Plan which is under development. This MasterPlan will at least contain the 37 Leading Principles translated into either functional requirement and technical specifics featuring the 5 constituting functionalities (global features), plus governance of the FEDeRATED infrastructure provision.

In order to do so, in 2022 and 2023 the LL will be closely correlated with the masterplan, i.e. the four elements as illustrated hereunder, also to be expressed on how these LL align with this elements and how they can input it. The percentage of meeting the demands in terms of percentages will be monitored.

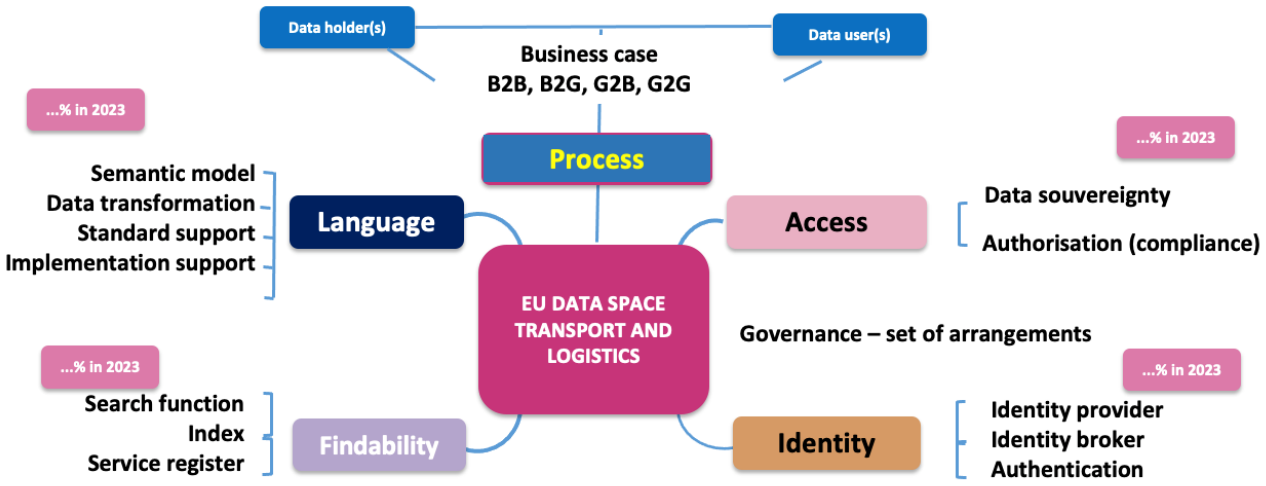


Figure 13: The FEDeRATED architectural Mindmap, including 5 functionalities (global features)

In general, the following steps must be taken for each LL:

1. Specify and agree how the LL can contribute to the fulfillment of the FEDeRATED objective - an infrastructure provision containing a set of arrangements and technical applications to enable data in existing IT systems (platforms) of companies and public administrations to become available to authorized users through a publish and subscribe approach.

2. Define and agree on the strategy to reach the FEDeRATED objective,
   - to be reached through its architecture: interoperability and seamless data sharing between the various LL infrastructures (federated network of platforms). Issues to be considered:
     - Semantics – a LL models its data semantics as ontology, either by adopting, tailoring, and proposing extensions to the FEDeRATED semantic model or by aligning its ontology with the FEDeRATED ontology
     - Technology – is a FEDeRATED gateway required or is there uniformity of technology are some of the potential migration strategies to reach the objective.

3. Specify and agree upon an assessment format
   Assessment is made by comparing the various solutions of a LL with the FEDeRATED architecture Mindmap (illustration 13). This will be based on a structured format derived from the architecture. The format will be agreed amongst all relevant stakeholders. The basis of this format is the LL factsheet, i.e. the technical setting described in the FActsheets

4. Fit-gap analysis
   This is about assessment of the LLs and to identify which parts of the components they have implemented, the principles that they apply, the scalability of the LL solution, and the way they conform to the Architecture Mindmap Preferably, the assessment should identify the possible gap that prevents large scale applicability of the solution and interoperability with other solutions.

5. Recommendations on the way forward
   The feasibility, timelines, and solution taken by each LL to migrate to meet the agreed final objective should be discussed and adopted by each LL.

The migration strategies that are identified and applicable to the LLs will be input to the final Master Plan. These will describe how a federated network of platforms can be constructed.

In 2022, the execution of the above steps relates to the following actions:

1st quarter – Orientation towards a LL FEDeRATED approach

- Joint workshop Activity 2 and 3 (The Soul of the Machine), elaborating the Reference Architecture, Semantics and the table of contents of the draft master Plan
- Installment of a LL coordination team (to closely monitor LL progress also in connection to Activity 2)
- First draft Governance and Legal Affairs document
- All Factsheets available online
- Governance Review team established

2nd Quarter – establishing a FEDeRATED grip onto the LLs

- In-depth study of the Factsheets followed by tailor made meeting between LLs and the LL coordination team
- Identification on what the LL's need to deliver – what is still lacking, solving current issues
- Dedicated sessions between a LL coordination team and various LL's
- Selection of potentially strong LL's
- Identification of possible bottlenecks and remedies
- Updated Factsheet reporting every LL, also based on additional guidance
- Start editing team Milestone 10 (Pilots/LivingLabs scoping report)
- LivingLab 2 day workshop – common LL's
- Governance and Legal Affairs document finalized
- Dissemination of major results LL's

3th quarter - M10 (Pilots/LivingLabs scoping report) development

- Validation of the LL reporting on factsheets
- Discussion Milestone 10 editing team and LL's
- Various workshops, also identifying bottlenecks and mitigation measures
- Future prospects, including common pilots
- Adaption LLs of semantic model
-

4th quarter – countdown towards result based execution

- Consortium Board meeting
- Milestone 10 reporting (31 October 2022)
- Assistance DTLF final reporting
- Second validation of all LL's
- 2 days Workshop LL and Activity 2
- Recommendation on viable architecture elements

ANNEX 1 LIST OF INITIALISMS AND ACRONYMS

A significant number of initialisms and acronyms are used in this report. The following list is provided to assist readers who may not be familiar with some of those initialisms and acronyms.

5G	Fifth generation telecommunications
A2A	any-to-any
A2B	Administration to Business
ABC	automated border crossing
API	Application Programming Interface
B2A	Business to Administration
B2B	Business to Business
B2C	Business to Consumer
B2C2B	Business to Consumer to Business
CaaS	Corridor as a Service
CDM	Collaborative Decision Making
CEF	Connecting Europe Facility
CMR	United Nations Convention for the carriage of goods, known as the CMR
CO_2	carbon dioxide
CoF	Cost of Freight
COTS	Commercial-off-the-shelf
COVID	Coronavirus
DTLF	Digital Transport and Logistics Forum
eCMR	Digitalised transactions done to meet the requirements of the United Nations Convention for the carriage of goods, known as the CMR
eFTI	electronic Freight Transport Information
ELSA	European Large Scale bridging Action
EMSA	European Maritime Safety Agency
ERP	enterprise resource planning
ETA	estimated time of arrival
ETD	estimated time of departure
EU	European Union
FENIX	European Federated Network of Information eXchange in LogistiX
FTL	Full Truck Load
GPS	Global Positioning System
GUI	Graphical User Interface
IAA	Identification, Authentication, and Authorisation
IAM	Integrated Assessment Modelling)
IATA	International Air Transport Association
ICT	Information and Communication Technology
ID	identification details
IMO	International Maritime Organization
IoT	Internet of Things
IT	information technology

KPI	Key Performance Indicator
LP	Leading Principles (FEDeRATED)
LSP	Logistics Service Provider
LTL	less than truck loaded
M2M	Machine to Machine
MDA	Multiparty Data Sharing Agreement
MMIS III	Multimodal Information Sharing III
MRN	Movement Reference Number
NDA	Non-Disclosure (or confidentiality) Agreement
NMEA	National Marine Electronics Association
NOx	Nitrous oxides
OCR	optical character recognition
OTM	Open Trip Model
P&P	plug and play
PMS	Port Management System
PPU	portable pilot unit
R&D	research and development
RFID	Radio-Frequency Identification
RISE	Research Institutes of Sweden
RRTCDM	Rail Road Terminal Collaborative Decision Making
S2S	System to System
SMA	Swedish Maritime Administration
SME	small and medium enterprise
SOG	Speed Over the Ground
SoS	System-of-Systems
SOx	Sulphur dioxide
TEN-T	Trans-European Transport Network
TIS	*Technology independent Infrastructure Services*
TMS	Transport Management System
TNO	Toegepast Natuurwetenschappelijk Onderzoek (Netherlands Organisation for Applied Scientific Research)
TOGAF	The Open Group Architecture Framework
TOS	Terminal Operating System
UAT	User Acceptance Test
UNCEFACT	United Nations Centre for Trade Facilitation and Electronic Business
VSAT	Very Small Aperture (satellite receiving) Terminal
XML	extended markup language

ANNEX (2) TO CHAPTER 2 GENERAL – BUSINESS CASE

Geographical Coverage

The following updated information highlights the coverage of the Living Lab in terms of TEN-T Corridors and EU and non-EU countries involved.

#	LivingLab name	TEN-T Corridors and/or transport focus areas		Countries involved
1	CaaS Asia gateway for perishables	D, E	E8 road, which is linked to the North Sea – Baltic corridor and Scandinavian Mediterranean corridor. E75 road will be used for Oulu to Helsinki traffic.	Finland, Norway Asia, Russia
2	CaaS Technology LivingLab on North Sea – Baltic corridor	D	North Sea – Baltic corridor Multimodal road-sea-road transport for B2C and B2A use cases.	Finland, Estonia, Latvia Russia
3	CaaS brick & mortar to home delivery via Scandinavia-Mediterranean corridor	E	Scandinavia-Mediterranean corridor Multimodal road-sea-road transport for B2C2B use cases.	Finland, Sweden and central Europe
4	A data-sharing case for SME, last-mile delivery actors	E	The Scandinavian-Mediterranean Corridor (foremost the Swedish hubs Örebro and Stockholm).	Sweden
5	RFID in Rail including intermodal	E	The LivingLab will mainly be within the Rail Freight Corridor 3. Port of Gothenburg and Verona Quadrante will be major site in the European context.	Sweden, Germany, Denmark, France, Italy
6	Rail-road Terminal CDM	E	The action is located on one of the main transport corridors in Sweden as part of the Scandinavian-Mediterranean TEN-T corridor.	Sweden
7	RealTime Information Services	E	Scandinavian – Mediterranean, SCANMED	Sweden
8	Multi Modal Information Sharing III (MMIS III)	E	The action is located on the TEN-T corridor Scan-Med and the Motorways of the Sea.	Germany, Netherlands, Belgium
9	Transparent Transport: City of Helsingborg	E	The LivingLab is conducted in the City of Helsingborg (Sweden), in relation to the deliveries to a recipient (Rönnowska School). The city is located on the Scandinavian-Mediterranean Corridor.	Sweden
10	Hermes Fleet Performance Monitoring System LivingLab	A, B, C, D, E, F	Corridors involved: North Sea - Baltic; Mediterranean; Scandinavian - Mediterranean; Rhine - Alpine; Atlantic; North Sea – Mediterranean	Italy, Spain, Belgium, Germany, Finland United States of America, Far East

<table>
<tr><th>#</th><th>LivingLab name</th><th colspan="2">TEN-T Corridors and/or transport focus areas</th><th>Countries involved</th></tr>
<tr><td>11</td><td>Internet of Logistics</td><td>(D), H</td><td>The sub-labs are predominantly operating on intra-European and Europe-World trade lanes. Initially seven sub-labs had distinct trade lanes, however as the project matures more stakeholders and trade lanes are initiated creating a cross pollination and collaboration between the initial sub-lab participants
<table>
<tr><th>Sub-lab acronym</th><th>Trade lanes</th></tr>
<tr><td>DCF</td><td>Estonia via HEL/CDG to worldwide</td></tr>
<tr><td>FRA</td><td>ex Frankfurt to Chicago</td></tr>
<tr><td>LHR</td><td>London to/from Hong Kong</td></tr>
<tr><td>DOH</td><td>ex Doha to London</td></tr>
<tr><td>SIN</td><td>ex Singapore to Sydney</td></tr>
<tr><td>HKG</td><td>Amsterdam to/from Hong Kong</td></tr>
<tr><td>YUL</td><td>Montreal/Toronto to/from Milan Malpensa</td></tr>
</table></td><td>Estonia, Finland, France, Germany, Italy, Netherlands, Spain, Sweden, Switzerland

Australia, Canada, India, Qatar, SAR Hong Kong, PR China, Singapore, Turkey, United Kingdom, United States of America</td></tr>
<tr><td>12</td><td>Terminal Track and Trace System LivingLab</td><td>A, E</td><td>Corridors involved: Mediterranean and Scandinavian - Mediterranean</td><td>Italy, Germany and UK</td></tr>
<tr><td>13</td><td>Terminal Flow (BetTerFlow)</td><td>E, (H?)</td><td>The LivingLab will most likely be held at different sites but are planned to start at Kvarken Ports, Umeå.
(Potentially goods flow to and from Norway?)</td><td>Sweden, Finland</td></tr>
<tr><td>14</td><td>Sustainable Inter-Modal Chains (SIMC)</td><td>E, H</td><td>The Midway Alignment with the EU freight corridors Scandinavian-Mediterranean (Scan-Med) corridor on the Swedish side and North Sea Baltic on the Finnish side.
The LivingLab will also look at the possibilities of connecting to “The New Silk Road” (the corridor between Kouvola/Helsinki-Russia-Kazakhstan-China) as an additional corridor.
There is also “Silk Road” like corridor for trucks via Russia to China that is faster than the train, which also will be investigated in this LivingLab.</td><td>Sweden, Finland</td></tr>
<tr><td>15</td><td>Optimised Port Operations by Cargo Owner Integration</td><td>B, D, (E?)</td><td>From the sawmills in northern Sweden to Kvarken Ports Umeå in Holmsund where the goods are transported on trucks to be stored in warehouses in the port to wait for ships to come and pick it up for export to northern Africa.</td><td>Sweden

Africa (Tunisia, Egypt)</td></tr>
<tr><td>16</td><td>D4YOU (Digitalisation for you)</td><td>A, G</td><td>The pilot will focus on the followed corridors:
1. IT- UK
2. IT - PL
3. IT - IT
4. PL – UK
5. IT - ES</td><td>Italy</td></tr>
<tr><td>17</td><td>EU-Gate e-CMR/eFTI Access Point</td><td>F</td><td>The scope of the LivingLab is cross-border road transport, eventually par of multi-modal air-cargo shipments</td><td>Luxembourg, Belgium, Netherlands, Germany,</td></tr>
</table>

#	LivingLab name	TEN-T Corridors and/or transport focus areas		Countries involved
18	smarTSGate	F	The pilot will focus on the final (south) stretch of the Rhine – Alpine corridor for trailers; more specifically, it will cover the final road connection to the port of Genoa, and subsequently the sea transfer to Sicily.	Italy
19	DEFlog	(D), E F	North Sea-Baltic Corridor (Finland–Estonia–Latvia–Lithuania–Poland–Germany–Netherlands/Belgium). Rhine-Alpine Corridor (Netherlands/Belgium–Germany–Switzerland–Italy).	The Netherlands
20	eGovernment Logistics	H	North Sea-Baltic Corridor (Finland–Estonia–Latvia–Lithuania–Poland–Germany–Netherlands/Belgium) Rhine-Alpine Corridor (Netherlands/Belgium–Germany–Switzerland–Italy) North Sea-Mediterranean Corridor (Ireland–Belgium-Netherlands and Ireland–France)	The Netherlands, Belgium, Luxemburg, Germany, possibly more (Spain, Finland). Singapore, China and possibly other third countries.
21	SIMPLE	A, B	Mediterranean and Atlantic Core Network Corridors	Spain
22	Automated capture and sharing of environmental data in collaboration (BEAst-ELSA)			Sweden, Norway, Finland And other European countries (EU).
23	Realtime Multimodal Transportation Visibility Platforms Services		Corridors involved: Mediterranean and Scandinavian - Mediterranean	Finland, Germany, Belgium, Italy, Spain, Poland

Stakeholders & Transport Modes

The following updated information highlights the participating Stakeholders and the transport modes covered in each of the Living Labs.

#	LivingLab name	Participating organisation(s)	Type of participating actor(s) and/or potential participating actor(s)	Transport mode covered
1	CaaS Asia gateway for perishables	Vediafi Ltd, Finnair Cargo, Customs (Finland and Norway), IT & VR service provider, Pajalanmäen kuljetus, Tangen Logistics	Fish farm, LSP(s), Forwarding agent, Customs (Finland and Norway)	*Road-Air*
2	CaaS Technology LivingLab on North Sea – Baltic corridor	Vediafi Ltd, Finnair Cargo, GoSwift, Eckerö line, Port of Tallin, Ericsson, Telia	Logistics companies, goods suppliers and maritime operators, multimodal operators, port authorities	*Road-Sea-(Air/rail?)*

#	LivingLab name	Participating organisation(s)	Type of participating actor(s) and/or potential participating actor(s)	Transport mode covered
3	CaaS brick & mortar to home delivery via Scandinavia-Mediterranean corridor	Vediafi Ltd, GLS, Van & Poika, NTG, Alnilam, YSDS	the end-users or consumers, the shops and shopkeepers, as well as LSPs and national and international customs, smart ports and ferry operators	*Road-Sea*
4	A data-sharing case for SME, last-mile delivery actors	Dalarna University Swedish Transport Administration	JALE AB; DHL; ICA; IKEA; Spendrups; Electro Helios; Orkla; Budbee; regional, subcontracted carriers of last-mile	*Trailers, Semi-trailers, Box trucks and Panel vans*
5	RFID in Rail including intermodal	Swedish Transport Administration, LearningWell, Port of Gothenburg, Real Rail, ScandFibre Logistics, DB Netze, Bane DK, SNCF Réseau, Rete Ferroviaria Italiana (RFI)	Rail infrastructure owners, railway operators and logistic companies TX logistic, Scand Fibre Logistics, SBB Netz, ÖBB Netz, Network Rail, DB Cargo, MercItalia, Verona Quadrante	*Mainly Railway, reloading terminals, customer sidings*
6	Rail-road Terminal CDM	CLOSER, RISE, Region of Jönköping, Bring Intermodal, Jönköping kombiterminal, Transab, Södra Munksjön Utveckling AB, GDL	Jysk, Maersk, Gothenburg Port, APM Terminal, Ancotrans	*Rail and road transport*
7	RealTime Information Services	Swedish Maritime Administration, Swedish Transport Administration, Swedish Ports	Train control centre and its operators, maritime pilots with its support services. Swedish port operators.	Water and land transport
8	Multi Modal Information Sharing III (MMIS III)	CLOSER, RISE, Sandvik Material Technology. Geodis, Swedish Maritime Administration, Swedish Transport Administration	more actors will be identified and be invited to this LivingLab	*Road transports and Sea Transports (feeder, and deepsea container traffic)*
9	Transparent Transport: City of Helsingborg	The city of Helsingborg, Swedish Transport Administration.	Suppliers of goods to the city (food, furniture, work clothes, office supplies), The suppliers' carriers, Discussions with IT providers are ongoing.	*Road transport, truck, possibly cargobike*

#	LivingLab name	Participating organisation(s)	Type of participating actor(s) and/or potential participating actor(s)	Transport mode covered
10	Hermes Fleet Performance Monitoring System LivingLab	Grimaldi Euromed S.p.A.,	Car manufacturer, Terminals, Ports and all stakeholders involved in the commercial chain, software houses, service provider companies, Different customers will participate to the LivingLab e.g., FCA Group (car manufacturer), FEDERICO II University of Naples, Italian Naval Register (RINA) and Terminal San Giorgio and Marin Traffic (option).	*Maritime Transport*
11	Internet of Logistics	IATA, Qatar Airways, Lufthansa Airlines, Cathay Pacific, Cargo Community System UK, Cargo Community Network, Air Canada	Shipper, Freight Forwarder, Ground Handling Agent, Airport, Airline, Customs authority, Trucking company, Cargo Community Systems	*Mainly Air but Road is also in the scope*
12	Terminal Track and Trace System LivingLab	Zailog scarl, Terminali Italia, Quadrante Servizi and Codognotto.	The Multimodal Transport Operator, the Shunting company, Railway Undertakings, Rental wagon and loading units' companies, Forwarders	Railway and Road (mainly trailers and swap bodies)
13	Terminal Flow (BetTerFlow)	RISE, Kvarken Ports, INAB, Swedish Transport Administration, NLC Ferry, Wasaline, Umeå Hamn AB, Hillskär future terminal operator, Ahola Digital.	Hillskär future terminal operator, more actors will be identified and be invited to this LivingLab.	*Railway, trucks, and maritime transports (mainly ferry),*
14	Sustainable Inter-Modal Chains (SIMC)	RISE, Ahola Digital, Kvarken Ports, INAB, Swedish Transport Administration, NLC Ferry, Wasaline, Ahola Digital	A client to Ahola will be identified in the LivingLab.	*Mainly trucks and maritime transports. Some small portion of railway*
15	Optimised Port Operations by Cargo Owner Integration	RISE, Umeå Hamn AB, INAB, Kvarken ports, NLC Ferry, AF Shipping, Wasaline, Swedish Transport Administration, Stevedoring Company Umeå, Forrest product producer,	Haulage company which will be identified.	*Trucks, maritime transports and railway*

#	LivingLab name	Participating organisation(s)	Type of participating actor(s) and/or potential participating actor(s)	Transport mode covered
16	D4YOU (Digitalization for you)	Codognotto, Electrolux, IKEA, UNILEVER	BSH Hausgeräte GmbH (or BSH Home Appliances)	*Road, Intermodal (Train and Vessel)* *Equipment Involved* *Trucks, Trailers, Boxes*
17	EU-Gate e-CMR/eFTI Access Point	51Biz Luxembourg Benelux authorities involved in e-CMR/eFTI project EUROMOVERS removal and forwarding consortium ABONA-ERP (IT division of Hegelmann Group) dependence on Benelux e-CMR/eFTI Project IATA OneRecord Estonia Logistics Center of Excellence (to be confirmed)	Authorities and enforcement bodies from Belgium, Luxembourg and The Netherlands, DIGI-Transit e-CMR Consortium e-CMR IT Service Providers involved in the Benelux and Baltic e-CMR Projects Global data standardisation organisations (UN/CEFACT Transport and Logistics Expert Group, GS1)	*Road, Air*
18	smarTSGate	Terminal San Giorgio (TSG), Luigi Cozza Trasporti (LCT), Grimaldi Lines, Circle Group	Maritime terminal operators, truck/ maritime carriers & consulting/ICT firms	*Road (trailers) and sea*
19	DEFlog	MinIenW, Portbase, Rijkswaterstaat (Smartwayz), NDW, Jan de Rijk Logistics, TLN, SUTC, evofenedex, iSHARE, NDW, DALTI, Port of Rotterdam and Port of Amsterdam.	National authorities for management of infrastructure (Rijkswaterstaat) and Road Traffic Data (NDW), LSP's, local and regional governments, mainports and Port Community Systems.	*Road transport.*
20	eGovernment Logistics	MinIenW, Rotterdam and Amsterdam seaports, Schiphol Airport, Portbase, Cargonaut, Dutch Customs Authority, ILT, Rijkswaterstaat, Danser, Rheinports, Interstream, Transfollow, Belgium Authorties, Pioneera, Collect & Go, Dashdoc, Hessing, evofenedex, Topsector Logistiek, Connekt, TNO, Vermeer Transport, iSHARE	The Dutch Ministry, Customs, Portbase and Schiphol Airport LSP's, BENELUX, IT Service providers, standardisation bodies, international organisations	*Maritime, aviation, road transport, inland navigation, and Customs import/ export chain*

#	LivingLab name	Participating organisation(s)	Type of participating actor(s) and/or potential participating actor(s)	Transport mode covered
21	SIMPLE	PdE, MITMA, Adif	Railways infrastructure manager, National Port Authority and Ministry of Transport. Logistic, rail and maritime operators, carriers, shippers, forwarders, shipping and cargo agents. Most probably some Railways Terminal, some Ports and National Customs office will be also involved.	*Railway, Maritime and Road Transportation*
22	Automated capture and sharing of environmental data in collaboration (BEAst-ELSA)	Nordstjernan Construction Company (NCC), SVEVIA, Kubicom, Högskolan i Dalarna. Upcoming participants: BEAst member organisations.		
23	Realtime Multimodal Transportation Visibility Platforms Services	Ahola/Attracs, SSAB, Rostock harbor, Deutsche Bahn, VR cargo, Hanko harbor, TMA logistics	Maritime terminal operators, truck/ maritime carriers.	*Road, Maritime, and Railway Transportation*

APPENDIX (3) TO CHAPTER 3 - TECHNICAL SETTING

Coverage reference model

The following updated information (from the FEDeRATED Milestone 4 report (Scoping)) indicates the reference model elements that are incorporated into each Living Lab.

#	LivingLab name	Coverage reference model
1	CaaS Asia gateway for perishables	Node/Hub/Place of interest, Business services, Transport means, Equipment, Cargo, Customs item, Location, Product, Event
2	CaaS Technology LivingLab on North Sea – Baltic corridor	Event, cargo, equipment, transport means, node/hub/place
3	CaaS brick & mortar to home delivery via Scandinavia-Mediterranean corridor	Business service, Node/Hub/Place, product, cargo, transport means, equipment, person, event, customs item
4	A data-sharing case for SME, last-mile delivery actors	Business service, Node/Hub/Place, Transport means, Products
5	RFID in Rail including intermodal	Node/Hub/place, Business service, Cargo, Location
6	Rail-road Terminal CDM	Hubs, transport means, cargo
7	RealTime Information Services	Product, person, transport means, equipment, event
8	Multi Modal Information Sharing III (MMIS III)	Business service, Node/Hub/Place, product, cargo, transport means, equipment, person, event, custom item
9	Transparent Transport: City of Helsingborg	Event, place, business service, transport means, product, cargo
10	Hermes Fleet Performance Monitoring System LivingLab	Node/Hub/Place, business service, person, transport means, equipment, cargo, custom item, product, event
11	Internet of Logistics	Node/Hub/Place of interest, Business services, Transport means, Equipment, Cargo, Customs item, Location, Product, Event, Person
12	Terminal Track and Trace System LivingLab	Elaborated but not yet connected to references model
13	Terminal Flow (BetTerFlow)	Node/Hub/Place of interest, Business services, Person, Transport means, Equipment, Cargo, Customs item, Product, Event
14	Sustainable Inter-Modal Chains (SIMC)	Node/Hub/Place of interest, Person, Transport means, Equipment, Cargo, Customs item, Product, Event
15	Optimised Port Operations by Cargo Owner Integration	Node/Hub/Place of interest, Person, Transport means, Equipment, Cargo, Customs item, Product, Event
16	D4YOU (Digitalisation for you)	Elaborated but not yet connected to references model

#	LivingLab name	Coverage reference model
17	EU-Gate e-CMR/eFTI Access Point	Digital twin, cargo, transport means, consignment note. A key objective of the EU-Gate project is to understand how the FEDeRATED ontology provides a seamless integration with the IATA air-cargo ontology and the UNCEFACT vocabulary
18	smarTSGate	Node/Hub/Place, cargo, transport means, business service, product, custom item, equipment, person, events
19	DEFlog	Node/Hub/Place of interest, Business services, Transport means, Equipment, Cargo, Location, Product, Event, Person
20	eGovernment Logistics	Node/Hub/Place of interest, Business services, Transport means, Equipment, Cargo, Customs item, Location, Product, Event, Person
21	SIMPLE	Digital twin: Product, Cargo, Equipment, Transport Means, Location, Person, Physical infrastructure, Node/Hub/Place, Business services, Customs item, Event, Standard transport documentation Waybills (CMR, bill of lading…), Formalities (customs, legal, administrative, inspections…)
22	Automated capture and sharing of environmental data in collaboration (BEAst-ELSA)	Project name, Fuel consumption, Type of fuel, Traceability data for excavated material, etc
23	Realtime Multimodal Transportation Visibility Platforms Services	Node/Hub/Place, Cargo, Transport means, Business service, Product, Custom item, Person, Events

Adopted baseline standards & Security Solutions

The following updated information (from the FEDeRATED Milestone 4 report (Scoping)) indicates the adopted baseline standards and security solutions that are incorporated into each Living Lab.

#	LivingLab name	Adopted baseline standard	Data security
1	CaaS Asia gateway for perishables	ONE Record - IATA data sharing standard	Data security will follow IATA's ONE Record security specifications
2	CaaS Technology LivingLab on North Sea – Baltic corridor	ONE Record - IATA data sharing standard	Data security will follow IATA's ONE Record security specifications
3	CaaS brick & mortar to home delivery via Scandinavia-Mediterranean corridor	Harmonised System Code	JSON Web tokens-based authentication and token service
4	A data-sharing case for SME, last-mile delivery actors	JALE data as of 2019 on data as listed under 4.4	Not yet elaborated
5	RFID in Rail including intermodal	GS1 standards to be used for RFID vehicle identification based on EVN numbers and GS1 EPCIS standards for information sharing amongst stake holders	The RFID concept will follow GS1 standards. Data sharing methods still to be elaborated

#	LivingLab name	Adopted baseline standard	Data security
6	Rail-road Terminal CDM	Not yet elaborated	Not yet elaborated
7	RealTime information Services	IMO reference data model	Ongoing
8	Multi Modal Information Sharing III (MMIS III)	To be developed	To be further developed. The layering of security used by the LDI include: • OAuth 2.0 – Used for Authentication. Uses JWT with claims identifying the User and Company. • Logistics (Business) Object Access Control Lists (ACL) for Authorisation – Each resource or object has its own list of authorised companies. TLS – Used for Transport Encryption.
9	Transparent Transport: City of Helsingborg	Not yet elaborated	Not yet elaborated
10	Hermes Fleet Performance Monitoring System LivingLab	Most of data interchange between legacy system is based on proprietary protocols, although specific data items use baseline standards (e.g. ISO 8601 for timestamps, ISO 6709 for geographic coordinates, ISO 3166 for country codes, etc. From the ECDIS System and AIS System we register the following NMEA Standard sentences: ZDA - Time & Date GLivingLab - Geographic Position, Latitude/Longitude VTG - Track Made Good and Ground Speed VBW - Dual Ground/Water Speed MWV - Wind Speed and Angle ROT - Rate of Turn DBT - Depth Below Transducer HDT - Heading, True RTE - Routes WPL - Waypoint Location R00 - Waypoint active route (not standard) RSA - Rudder Sensor Angle VDO - Ship's Own VDM - other vessels	TLS 1.2

#	LivingLab name	Adopted baseline standard	Data security
11	Internet of Logistics	The following are the baseline standards for the ONE Record IATA LivingLab: ONE Record - IATA data sharing standard Cargo XML - IATA messaging standard Cargo IMP - IATA messaging standard W3C - WWW consortium web standards RFC - Internet Engineering Task Force standards IATA Special Cargo - Dangerous goods, Pharma, Perishables, Live Animals standards UN CEFACT - UN CEFACT Core Component Library WCO - World Customs Organisation data model	The IATA LivingLab data security needs to be viewed from two viewpoints: • Security of the data on the ONE Record nodes, i.e. the platforms • Security infrastructure of the federated network. Security specifications include: 1) OAuth 2.0 for authentication 2) Access Control Lists Mutual TLS
12	Terminal Track and Trace System LivingLab	Not yet elaborated	The authentication of data will be managed by the "FEDeRATED" authorisation component that provides the permit to access the platform to the operators of the multimodal chain (especially to the truck drivers and to the terminal manager). This component is under definition by the architecture group.
13	Terminal Flow (BetTerFlow)	Not yet elaborated	Not yet elaborated, will follow Deplide decision
14	Sustainable Inter-Modal Chains (SIMC)	Not yet elaborated	Not yet elaborated, will follow Deplide decision
15	Optimised Port Operations by Cargo Owner Integration	Not yet elaborated	Not yet elaborated, will follow Deplide decision
16	D4YOU (Digitalisation for you)	Used the EDIFACT Standard for some integrations.	Not yet elaborated
17	EU-Gate e-CMR/eFTI Access Point	The semantic model will be aligned with the UN/CEFACT BuyShipPay vocabulary. (RDM2API project by the global EDI3.ORG project team)	Same as IATA OneRecord eventually in combination with iShare
18	smarTSGate	Most of data interchange between legacy system is based on proprietary protocols, although specific data items use baseline standards (e.g. ISO 8601 for timestamps, ISO 6709 for geographic coordinates, ISO 3166 for country codes, etc.). Along the development of the Living Lab, some messages may be migrated to EDIFACT standard	TLS1.2, secured authentication through user key and subscription key
19	DEFlog	(eIDAS certified) PKI certificates for system-to-system data sharing. In case of human-to-system, OAUTH2.0) tokens are used. iSHARE Identity Provider is used to store Identities of users for human-to-systems data sharing; it is registered by an agreed Identity Broker The Open Trip Model (OTM) is applied	eIDAS certified PKI certificates for system-to-system data sharing. In case of human-to-system, so-called (OAUTH2.0) tokens are used. iSHARE is used as Identity Provider to store Identities of users for human-to-systems data sharing.

#	LivingLab name	Adopted baseline standard	Data security
20	eGovernment Logistics	The FEDeRATED semantic model will be applied and mappings will be constructed to existing platforms (Portbase, Cargonaut, Tradelens). Data retrieved from back-office systems (e.g. B/L, AWB) will be integrated into a linked data set as a basis for data analytics. (eIDAS certified) PKI certificates for system-to-system data sharing. In case of human-to-system, OAUTH2.0 tokens are used. The iSHARE Identity Provider will be used to kick start the storage of Identities of users for human-to-systems data sharing; it is registered by an agreed Identity Broker.	Each use utilises (eIDAS certified) PKI certificates for system-to-system data sharing. In case of human-to-system, so-called (OAUTH2.0) tokens are used. A temporary Identity Provider is used to store Identities of users for human-to-systems data sharing. As a temporary solution this can be done by the iSHARE foundation, acting as Identity Broker. It may also be possible to use another Identity Provider than iSHARE option. The condition being that such an Identity Provider is registered by a recognised Identity Broker and has implemented the aforementioned open standards. A focus is to pursue a decentralised identity broker.
21	SIMPLE	SIMPLE is being developed according to international standards and UE regulations in terms of transport, logistics and exchanged data and messages (GS1, UNECE, WCO, IMO FAL, ONE Record IATA, EMSWe Regulation, EFTI Regulation, Union Customs Code and EUCDM, TAF Directive -TSI, DATEX II, inland waterways). SIMPLE is also aligned with FEDeRATED architecture and semantic model, which are being developing.	Identity provider (IdP) based on open-source technologies (Keycloak) that will manage the identification and authentication of users through CI@ve or 2FA. The IDP will allow integration with applications through standard federation protocols SAML, OAUTH, OIDC, HTTP Headers. • User repository: it will be based on the LDAP standard and open-source technologies (Open LDAP deploying two instances for high availability in a multimaster configuration). • User management: the platform will include functionality for managing the life cycle of users, their passwords and their authorisations. • Signature service: A signature service based on @firma's FIRe integrated with the CI@ve service, which offers a common platform for the identification, authentication, and electronic signature of the citizen before Public Administration bodies that are integrated. The eIDAS certificate will be used when available to integration.
22	Automated capture and sharing of environmental data in collaboration (BEAst-ELSA)	BEAst, ISO / IEC 19845:2015	Sending information to the"Swedish Transport Administration" will require the use of a server-side certificate, used to authenticate using OAuth 2.0 Client Credentials Flow.

#	LivingLab name	Adopted baseline standard	Data security
23	Realtime Multimodal Transportation Visibility Platforms Services	Most of data interchange between platform components is based on proprietary protocols. However numerous well-known standards are used. W3C - WWW consortium web standards RFC - Internet Engineering Task Force standards like a (rfc6749) ISO 8601 for timestamps ISO 6709 for geographic coordinates ISO 3166 for country codes ISO 9735 for Edifact ISO Blockchain standards and documents used with Hyperledger and smart contracts	Security specifications include: • Public Key Infrastructure (X.509 certificates) for sharing the data between systems (web apps' servers and blockchain network); JWT for client to server communication. • OAuth 2.0 for authentication • Role based Access Control (RBAC) • Mutual TLS

APPENDIX 4 LESSONS LEARNT

#	LivingLab name	Lessons Learnt
1	CaaS Asia gateway for perishables	Progressing the ABC pilot between Norway and Finland has been much slower than originally expected. However, the national authorities have shown their interest towards digital solutions, but are still lagging behind companies when comparing their respective levels of digitalisation. Especially in international logistics this forces Logistics Service Providers (LSP's) to maintain manual procedures, which will decrease some of the benefits of digitalisation. The ABC pilot has also shown that technology could enable fully automated border crossing, but it requires some changes to supply chain and authority processes. Vediafi has been working so that the solution is compliant with the IATA ONE Record process; hopefully during the 2022 Vediafi will open its own ONE Record server. Regarding FEDeRATED Leading Principles the LivingLab 1 has highlighted the multi actor supply chain environment and digital format of data. In addition, the ABC case is focusing on the data sharing between private and public sector and their system federation. A business case is not available yet, since the ABC case is still on pilot mode. In addition, the current global situation and logistics challenges have had a strong impact on the demand for and availability of fresh Nordic salmon. For the ABC case, identification of driver, vehicle and cargo and synchronisation of those in specific time and location is vital. In this LivingLab, data is used as a proof to enable identification, which also has implications on data sovereignty.
2	CaaS Technology LivingLab on North Sea – Baltic corridor	The Baltic region is pushing digitalisation in many sectors and there are many activities related to the digitalisation of logistics. Baltic actors have developed eCMR under active Public-Private Partnership (PPP) collaboration and they have a big interest in FEDeRATED actions. Dialogue between Vediafi and Baltic stakeholders is active. Baltic corridor stakeholders have indicated their interest to utilise the FEDeRATED initiative to develop and test future eFTI (electronic Freight Transport Information) solutions. The Baltic corridor has a great impact on EU-Russia logistics. Thus, Russia-EU interoperability is an important aspect for this corridor. Russia is following EU actions and could even implement EU initiatives before the EU. This LivingLab focusses on IoT devices and other new technologies. The aim is to integrate these actions with the FEDeRATED model and hence provide better transparency and sustainability monitoring. One topic is also to pilot how smart infra can support FEDeRATED and what benefits it could offer. Applying the FEDeRATED Leading Principles has identified several challenges. All systems have their own operational models and technical implementations, and the digitalisation maturity varies between zero digitalisation to fully digital solutions. The main idea of LivingLab 2 is to focus on supply chain tracking and device monitoring, which will provide more information for logging and audit trails but also for supply chain monitoring.
3	CaaS brick & mortar to home delivery via Scandinavia-Mediterranean corridor	Online shopping has been impacted a lot because of COVID 19 and many stakeholders have been enhancing their services, which has made the current operational environment very dynamic. However, this has increased the demand for data sharing and fully digitalised supply chain management. Although digitalisation maturity has increased, cargo/package tracking in multimodal supply chains is still challenging. The pilot proved that crowdsourcing solutions, where smart phones are used as base stations, could be suitable and effective for cargo tracking. Collaboration between road and maritime transport showed that, currently there are many actions on the maritime transport sector to develop smart port data sharing platforms/portals and both public and private organisations are providing their solutions. In future, these must be linked to the network of FEDeRATED platforms. CO_2/sustainability monitoring is topical at the moment. Currently, stakeholders do not have well-developed solutions to meet the increasing need for the sharing of sustainability data. However, sustainability is seen as a must-win battle, where actors are seeking quick results. Vediafi tested eSeals between Finland, Sweden and Denmark and in Norway on commercial multimodal transportations. Results showed that eSeals are interesting and promising supply chain tracking/IoT devices, which can be used on multi stakeholder and multimodal supply chains to improve security, transparency and manageability of transportations. In addition, eSeals can be used to enable carbon footprint monitoring. Discussions with LSPs showed that eSeals must conform at the EU level/EU standardisation in order to utilise them in B2A data sharing, such as eFTI. LivingLab 3 activities focus on supply chain transparency and thus this LivingLab is used to adapt tracking features and devices to FEDeRATED architecture. The aim is to utilise IATA ONE Record and adapt tracking on it. The LivingLab will also work with supply chain CO_2 monitoring and related data sharing and pilot how those can be adapted to the FEDeRATED architecture.

#	LivingLab name	Lessons Learnt
		Regarding the FEDeRATED Leading Principles the LivingLab 3 is focusing on data sets, data timestamps, unique identifiers, federation and the monitoring of supply chains. Especially ETA and CO_2 data have been interesting topics under LivingLab 3. Pilots have also shown that especially when operating in multimodal supply chains where there might be various carries and LSPs this kind of basic data is not easily available and data does not move between organisations. This highlights the need for federated/agile data sharing solutions and interoperable data.
4	A data-sharing case for SME, last-mile delivery actors	The point of departure of this LivingLab was the multi-actor last-mile distribution system and the so-called platform game amongst these actors. The platform game refers to a situation, in a multi-actor setting, where actors make data accessible only on their platforms in the belief that this will increase their own market power. The system in the region where the LivingLab is situated was considered to be a conventional spoke-hub-system where distribution of the goods between the sender/receiver location and the spoke is subcontracted by international couriers to local last-mile carriers. The couriers squeeze the carriers' data space in order to obtain power in the platform game. It was hypothesised that the CoF-methodology could be applied to mitigate the platform game to achieve information sharing between concerned actors and improve on distribution efficiency. Unexpectedly, abruptly, and radically the platform game has been subject to a game change in the LivingLab. In May 2021, a platform company entered the market (Täuscher, K., & Laudien, S. M. (2018). Understanding platform business models: A mixed methods study of marketplaces. European Management Journal, 36(3), 319-329) offering a direct connection between sender and receiver whereby the former controller of the platform would be side-stepped. The platform company is not offering any logistics services, but promises to provide carriers with IT-infrastructure and orders upon subscription, and vendors with IT-infrastructure and access to carriers upon partnership. However, the detailed business model and modus operandi of such companies is not well understood as they are only very recently being described in the literature under the title *Crowdsourced logistics* (Mangiaracina, R., Perego, A., Seghezzi, A., & Tumino, A. (2019). Innovative solutions to increase last-mile delivery efficiency in B2C e-commerce: a literature review. International Journal of Physical Distribution & Logistics Management; Kjellsdotter Ivert, L., Kalantari, J., Hiselius, L., Henriksson, P., & Karlsson, J. (2020). Energieffektiv distribution av dagligvaror vid ökad e-handel genom transporteffektiv logistik och minskade bilresor. VTI rapport 1062.). The original purpose of the LivingLab cannot now be achieved under the latest development. The scope of the LivingLab is therefore being redirected to consider the last-mile distribution market with actors aspiring to monetise data-sharing. No test results have been consolidated so far. Lessons learnt: 1. With regard to the scope of corroborating the applicability of the CoF-methodology to address the platform game in last-mile logistics, it can be concluded that the methodology is insufficiently precise to allow for implementation. 2. Drawing upon Dutch experience, it seems unfeasible to remedy the lack of co-ordination resulting from the platform game without an exceptionally powerful actor in the market. Co-ordination between vendor, carrier, and consignee is viable. 3. The market will solve urban logistics for e-tailing efficiently 4. It has been confirmed that the market dynamics of the region mimics the Veneto region in Italy. 5. Crowdsourced logistic solutions are technically viable and probably also viable businesswise. 6. Platform companies entering the market will disrupt the current platform game – it remains to figure out how these actors intend to play the platform game. 7. It is pointless to further delve into the methods of addressing the current platform game as it is now subject to radical change. It seems there is a semantic shortfall with regard to Crowdsourced-logistics and platform companies. The publication below could be helpful: Mangiaracina, R., Perego, A., Seghezzi, A., & Tumino, A. (2019). Innovative solutions to

#	LivingLab name	Lessons Learnt
		increase last-mile delivery efficiency in B2C e-commerce: a literature review. International Journal of Physical Distribution & Logistics Management.
5	RFID in Rail including intermodal	Different stakeholders have different ideas of what are the best data sharing methods or what kinds of devices should be used - RFID/GPS or other. The standards and messages/protocols of transmission of data seems to be solvable.
6	Rail-road Terminal CDM	Since the start of the LivingLab, important experience has been gained for the continuation of the project. The participants have now got a better understanding for processes, such as physical and administrative events, as well as coordination points related to the two intermodal terminals. By producing process descriptions for the two use cases, it has been easier to define and understand the challenges and possibilities with digital information sharing for the involved actors. This will now be the basis of the further development of digital collaboration and demonstration. The DTLF-building blocks are relevant for RRTCDM. However, the LivingLab has been in the pre-study phase and therefore we cannot say with certainty which exact principles and building blocks will be relevant in the long run. So far, the following principles have been highlighted by the involved actors: • Electronic/digital format • Business relations • Supply and logistics chains • Publish/subscribe • Identification of organisations • Identification of users • Unique identifier(s) of data (sets) • Data sharing solution • Federation • Logging and audit trail
7	Real Time Port Visit Services	Starting up FEDeRATED initiatives in a world of lockdown is very difficult if you are beginning from scratch. The need to meet and interact with people in order to come to a common understanding is vital to success. As a result, important face to face meetings, particularly with other stakeholders, has been delayed. The name of the LivingLab has been changed from *Göta Älv* to a more generic name that still covers the needs for the Göta Älv case but also covers other use cases too.
8	Multimodal Information Sharing III	It is very important to have written agreements and NDA´s in place. A project is vulnerable when a key partner leaves the project.
9	Transparent Transport: City of Helsingborg	The first phase of the project ended in May 2021 and focused on the collection of knowledge regarding the school´s purchasing process, learnings from similar initiatives, the selection of and interviews with suppliers of goods, and data that could be shared with the LivingLab. The discussions show that there are many similar ideas currently under development and the LivingLab will follow these developments forward. The results of the first phase have been analysed and compiled in a report that has been used to specify future activities in the LivingLab. The project results so far show that there is great willingness among the interviewed suppliers to participate in the LivingLab, and that possible efficiency gains by sharing data and working closer with the customer (in this case the City and the school) are of interest. The interviews also showed that the suppliers use different methods and formats to send their transport documentation to the contracted carriers, and the suppliers use different transport administration (TA)-systems. The suppliers have provided information on which type of data they would be willing to share with the LivingLab, and most are willing to share enough relevant datatypes needed to move forward. The suppliers of goods to the chosen case-study school have expressed that it is less “risky” for them to share data connected to transport of goods to the school, compared with data arising from transport to other private customers/companies. The results also show that customers’ purchasing behaviour greatly affects the suppliers’ opportunities to achieve higher transport efficiency and/or

#	LivingLab name	Lessons Learnt
		lower emissions. Thus, it will be important to ensure that the school's processes - in addition to increased data sharing – can contribute to reaching the goals of this Living Lab. The LivingLab's preliminary results show different ways in which co-loading can be achieved with the support of data sharing: co-loading between carriers, cooperation between suppliers and new business models - which can be developed through visualisation of transport needs and data, as well as through more sustainable behaviours from the customer when ordering goods. These alternatives, and possibly a combination of them, will be explored in the next stages of the project in dialogue with the suppliers. The LivingLab will now focus on developing a conceptual platform, consisting of a description of how relevant data can be collected, compiled and analysed, whilst also looking into which formats/standards the data is currently in and the possible need for translations into a common format. The conceptual platform will, to its greatest extent, be developed in consistency with the reference architecture. Information from the conceptual platform will then be used in dialogue with the suppliers' carriers and IT-system providers, in order to investigate the possibilities for developing a digital platform and to test it within the project. The FEDeRATED Leading Principles will be guiding the upcoming work, to ensure that relevant contributions can be made from this LivingLab. The LivingLab has adapted an exploratory approach where the goals were clearly established from the beginning, but the means to reach them are continuously adapted throughout the project based on new experiences, input and changes in the commercial market for platform providers.
10	Hermes Fleet Performance Monitoring System LivingLab	• Difficulties in data sharing between different software - not only between different companies but also between different software of the same company. • People in different organisations are reluctant in data sharing. • Cyber security policies very stringent resulting in long time for internal procedures. • Difficulties in NMEA sentences interfaces on board ship. • Satellite costs high for ships so very high attention paid to the volume of data to be shared and timeframes. • Lack of data due to spot zones where satellite connection is not available in the middle of ocean • Lack of data due to breakdown of technologies installed on board ships such as satellite antenna (e.g. Vsat systems) There is, as yet, no semantic schema for the Hermes LivingLab.
11	Internet of Logistics LivingLab by IATA	As the LivingLabs continue to evolve, it has become clear that the ambitions of a Federated Network are very realistic. There is also a need for such initiatives as the logistics supply chain modernises, chiefly as a consequence of the COVID pandemic. The main lessons learned from the LivingLabs thus far can be summarised as follows: • Transparency is key. As stakeholders tend to progress at different speeds (this can be due mainly to budgets and resource allocations) they tend to be at different stages of implementation respective to each other. This creates varying needs per stakeholder, especially when trying to inter-connect. In order to address this issue a system of implementation levels needs to be created to provide visibility to all stakeholders on each other's progress. • Communication moves the project forward. Without awareness and communication on the overall project (status), the aim and end result are less comprehensible, especially to new stakeholders and other industry bodies. • Engagement brings the stakeholders together to work as one. When stakeholders feel engaged and part of a project's success, there is more motivation and ultimately better cooperation. • Support. One aspect that did not seem obvious at first was the need for data non-disclosure agreements. Since there is no more physical paper and material being exchanged, it created trust issues between stakeholders. Therefore, a multiparty data agreement had to be created. This simplifies the administration of not signing the same contract with each stakeholder.

#	LivingLab name	Lessons Learnt
		• Planning the project sets the course. Changes in resources and budget creates timeline shifts. A slight change in resource allocation can have a great impact on the overall delivery of a project, as multiple stakeholders are involved in each LivingLab stream. Commitment should be made clear at the beginning of the project. • Customs' participation would be beneficial for the entire project as this would accelerate the adoption of digitalisation on a global scale. It has been recognised that customs organisations have the influence to bring the most value to this project and expedite adoption. • Mapping of data fields is crucial as the world switches over to this new data sharing standard. Backwards compatibility is desirable and to be included whenever possible although it should not dictate the creation and subsequent evolution of digitalisation. There has been significant progress in LivingLab 11 regarding architecture and semantics: • Both Architecture and Semantics are anchored in a foundation based on design principles. These are then refined through an iterative development process that is based on stakeholder input and implementation experience. • IT Architecture is a subject that evolves over time. Therefore, the architecture is and needs to be modular to allows modules to evolve whilst ensuring backward compatibility. This is particularly important for the based interoperability components such as APIs and security. • One challenge is that the various LivingLabs are not in the same stage of development. Some are operational whereas others are still in an early development stage. This means that the development process is hampered by the lack of input from some projects and is biased towards the more mature projects. This is normal, of course, but it means that the lagging projects will need to re-factor their architecture to align with the emerging architecture. • The semantic design follows a similar trajectory but is further hampered by the fact that semantic standards are a relatively new concept. It requires a design process that is not common to all LivingLabs. There is a risk that some semantic concepts may not be understood. • In addition to the semantic model developed by the Semantic Modelling Group, a set of tools and a tool chain is needed that allows the LivingLabs to develop their implementation of the semantic models. This toolchain is not available yet and probably was not explicitly budgeted for. At present we rely on a few organisations to provide this (TNO and IATA principally) but it creates a dependency for the other LivingLabs that will likely proceed independently. Overall, the asynchronous development of architecture and semantics in the FEDeRATED project is a challenging process but it is also a highly productive approach to innovation. Only by basing developments on commonly agreed ideas and concepts and to accept that both the architecture and semantic models will evolve during the project duration with the consequence that LivingLabs will need to adapt and realign from time to time, only then can we expect to deliver a FEDeRATED architecture and semantics that will match the needs of the end of the project rather than the start of it. Given that the project lasts 5 years, industry best practices for architecture and semantics evolve considerably in such a period and we need to take this evolution on board.
12	Terminal Track and Trace System LivingLab	The Italian railway (RFI - Rete Ferroviaria Italiana) is planning significant investments in its terminals across the Italian network. Therefore, digitalisation is crucial to maximise the effects of these investments. LivingLab 12 has raised the awareness among the multimodal chain players about the potentialities given by a real time track and trace system able to speed up the daily operations both inside and outside the terminal area. There is a sound interest of the actors involved that need to simplify the entire terminal process in view of the planned works that will probably congest some terminal zones. Over the years, the experience acquired in other projects (such as LOGISTAR) shows that the collaboration and the sharing of knowledge has led to an improvement in the daily terminal activities with an overall enhancement of efficiency. Consequently, it is planned to adopt the solutions developed so far, using IoT devices and the API to create a federated system able to increase the data sharing, fostering the cooperation among the players of the multimodal chain. The results expected are an improved management of yard management with benefits both on the rail and road-side.

#	LivingLab name	Lessons Learnt
13	Betterflow	LivingLabs 13, 14 and 15 are all centred on Kvarken Ports which is planning big investments in infrastructure (new berths, refitting/expansion of existing berths and storage area, etc). To maximise the effects of these investments, digitalisation is crucial. Focus so far in the LivingLab has been on investigating information sources and digitalisation needs. Interest to share and visualise goods-related data is high among the partners. Experience so far shows that collaboration and knowledge-sharing among the partners in the LivingLab and the project has strengthened. As a result, it is planned to use RFID readers inspired by LivingLab 15 - RFID in Rails. Several meetings have been held and discussions are ongoing. It is planned to use Deplide with different front-ends for data sharing and exploring different use cases. The first step will be to connect different data sources to Deplide and visualise the information in different front-ends. The second step will be to share data between Deplide and the Port Management System (PMS) Terminal Operating System (TOS) that will be installed at Kvarken Ports/Hillskär. In addition, Deplide will share information with Attracs with a focus on railway transport through Hillskär. Experience and learning from using Deplide will be used for sourcing of operational solutions in later steps. Regarding the Leading Principles (LP), the experience so far is primarily based on theoretical discussions rather than practical evaluation. Future work will focus on applying the LPs in the LivingLab context, and mainly through the use of Deplide and connecting to existing systems. In our comments to specific LP we have pointed out the need for further elaborations and clarifications.
14	Sustainable Inter-Modal Chains (SIMC)	LivingLabs 13, 14 and 15 are all centred on Kvarken Ports which is planning big investments in infrastructure (new berths, refitting/expansion of existing berths and storage area, etc). To maximise the effects of these investments, digitalisation is crucial. Focus so far in the LivingLab has been on investigating information sources and digitalisation needs. Interest to share and visualise goods-related data is high among the partners. Experience so far shows that collaboration and knowledge-sharing among the partners in the LivingLab and the project has strengthened. As a result, it is planned to use RFID readers inspired by LivingLab 15 - RFID in Rails. Several meetings have been held and discussions are ongoing. It is planned to use Deplide with different front-ends for data sharing and exploring different use cases. The first step will be to connect different data sources to Deplide and visualise the information in different front-ends. The second step will be to share data between Deplide and the Port Management System (PMS) Terminal Operating System (TOS) that will be installed at Kvarken Ports/Hillskär. In addition, Deplide will share information with Attracs with a focus on truck transport. Experiences and learnings from using Deplide will be used for sourcing of operational solutions in later steps. Regarding the Leading Principles (LP), the experience so far is primarily based on theoretical discussions rather than practical evaluation. Future work will focus on applying the LPs in the Living Lab context, and mainly through the use of Deplide and connecting to existing systems. In our comments to specific LP we have pointed out the need for further elaborations and clarifications.
15	Optimised Port Operations by Cargo Owner Integration	LivingLabs 13, 14 and 15 are all centred on Kvarken Ports which is planning big investments in infrastructure (new berths, refitting/expansion of existing berths and storage area, etc). To maximise the effects of these investments, digitalisation is crucial. Focus so far in the LivingLab has been on investigating information sources and digitalisation needs. Interest to share and visualise goods-related data is high among the partners. Experience so far shows that collaboration and knowledge-sharing among the partners in the LivingLab and the project has strengthened. As a result, it is planned to use RFID readers inspired by LivingLab 15 (RFID in rails). Several meetings have been held and discussions are ongoing. It is planned to use Deplide with different front-ends for data sharing and exploring different use cases. The first step will be to connect different data sources (IoT sensors, etc) to Deplide and visualise the information in different front-ends. The second step will be to share data between Deplide and the Port Management System (PMS) Terminal Operating System (TOS) that will be installed at Kvarken Ports/Hillskär. As a consequence, the goal is to make more port-related information publicly available. In addition, Deplide will share information with different stakeholders, such as AF Shipping, new cargo owner, etc. Experiences and learnings from using Deplide will be used for sourcing of operational solutions in later steps. Regarding the Leading Principles (LP) the experience so far is primarily based on theoretical

#	LivingLab name	Lessons Learnt
		discussions rather than practical evaluation. Future work will focus on applying the LPs in the Living Lab context, and mainly through the use of Deplide and connecting to existing systems. In our comments to specific LP we have pointed out the need for further elaborations and clarifications.
16	D4YOU (Digitalisation for you)	The following decision on existing applications as preliminary study on the Data & Analytics platforms in the market were identified as a suitable option for Codognotto: Microsoft Azure / PowerBI / Synapse The following functionalities are covered by the Analytics platform and the Analytics Transformation program: • Data Lake • Ingestion of data from every transactional system (ERP, TMS, WMS, CRM) or Ingestion of high volume structured and unstructured data from other sources (DMS, IoT Devices) • Analysis Layer or Provisioning of data marts for reporting, dashboarding and analysis built around subject areas: Customer Insights, Vendor Insights, Sales Insights and Operations Insights • Provisioning of the data structures where to build vertical calculations (e.g. customer segment attribution, commissions calculation for sales agents, operational workforce scheduling) based on transactional data • Reporting and Dashboarding • Provisioning of reports and dashboards built on the analysis data marts, through a user-friendly tool which allows the user to self-explore data (slide & dice, drill down) and creates / adjust reports • ML, AI, Data Science Provisioning of Machine Learning, AI and Data Science capabilities where to build vertical use cases. The creation of the data lake offered the opportunity to activate an API Gateway for federating date with the objective to share data with external actors.
17	EU-Gate e-CMR/eFTI OneAPP Living Lab	The concept of the "internet of logistics" is being confirmed in all modes of transport. Both authorities and economic operators agree on the importance of interoperable API (Application Programming Interfaces) that can be achieved through interoperable semantics and harmonised security structures. The distance between top-end technology experts and the transport and logistics professional is unfortunately widening. The acceptance of a semantic web by the end-user community is more complex than expected. Especially for data experts that have a broad experience with the approaches that are followed by global standards. Training and education will be essential to achieve a sustainable mind shift. During the second part of the EU-Gate e-CMR/eFTI LivingLab, we plan to further develop real-world multimodal use cases that can be analysed by business and technology experts. It is a conclusion that the "OneAPP/API for Authorities" application is more important than anticipated. Another important lesson is that the LivingLab use cases can demonstrate the opportunity to leverage the FEDeRATED principles as a foundation for the eFTI reference architecture that is currently defined by the European Commission to become part of the eFTI secondary regulation. The OneAPP for Authorities shows the importance of linked data within a federated API architecture. Data is kept at source to be accessed in a secure environment by mandated public authorities.
18	smarTSGate	The concept of "federation of platforms" (or "federation of services") is still somehow confused; especially in the community of ICT vendors; it is quite common that basic M2M interoperability (e.g., through static software connectors) is marketed as "federation of platforms". It would be useful if FEDeRATED provided a clear definition of "federation of platforms" and proposed a usable framework for its successful implementation. Starting from *EIF Interoperability Levels* and *DTLF Building Blocks*, the project produced a broad range of Leading Principles, which cover almost every possible form of cooperation between parties (enterprises, authorities) and platforms, ranging from very basic organisational integration to sophisticated ICT architectures; these principles have been acknowledged by different project

#	LivingLab name	Lessons Learnt
		LivingLabs in a flexible way, so that different solutions implement different "blends" of interoperability. Although each of these blends is perfectly in line with the objectives of the project, it shall be clearly stated that a true federated ecosystem is only possible through the harmonised and coordinated development of all the four interoperability levels (legal, organisational, semantic and technical), as pushing only one (leaving the others behind) would probably lead to partial results. For instance, a strong push on technical interoperability, without a corresponding effort on semantic interoperability, may lead to the paradox of two platforms that are able to authenticate and connect, but are not able to communicate. Moving from theory (DTLF directives, project deliverables) to practice (design of technical solutions, on-field verification, periodic LivingLab experience sharing meetings) consolidated the project vision and gave a reference framework for ongoing activities. Maybe some technical workshops (like the special session on 22 February 2021) may further help the development and the harmonisation of the LivingLabs.
19	Data Exchange Facility Logistics (DEFLog)	1. The marketing of a data sharing platform is not difficult 2. It is difficult to find market parties to start sharing data 3. Semantic interoperability requires a sustainable solution. The OTM solution applied in the DEFlog proved to be rather expensive 4. The DEFlog approach applied already existing IT solutions that need to be implemented in an integrated approach
20	eGovernment Logistics	• There is a huge interest for a generic BDI infrastructure layer enabling a multitude of parties to share data with one another in a secure way. • Knowledge and skills. Discussion regarding functional and operational requirements in connection to technical specification require different skills of the people to be engaged. Regularly, this leads to highly confusing discussions. IT solutions can only be generated when IT specialists are requested to technically comply with functional and operational requirements. It is very difficult to find the right people to set these requirements. The consequence being that IT specialists have to develop themselves these requirements and thus have to define their own work; whereas they prefer to execute a clear-cut task description. • Holistic approach. For contributing parties, it is very difficult not to think in terms of "what is in it for me", "can I gain a competitive advantage for my current business model?" E.g., the PCS's find it difficult to cooperate and develop a generic BDI Index, as they prefer their own, platform based, Index • Governance. It takes much time to organise a structure connecting the various layers of the organisations involved in such a way that responsibilities for the various parts of the solution and engagement of third parties are soundly implemented. In this solution it is also very necessary that a future prospect on how to organise the BDI infrastructure has been made clear and shared amongst the participants • Stakeholder involvement. Use cases can only succeed when the offer you make to solve a data sharing problem is sufficiently clear and tangible. In addition, the involvement of IT people working for third parties to discuss the implementation of the BDI solution can take many months. The basic attitude of IT specialists when confronted with a novel approach is to ask the question: Why? • The FEDeRATED approach has multiple IT layers – architecture, technology, design, policy, etc. It is very difficult to find the right wording for the different stakeholders involved, not in the least because it requires the basic attitude of an open mindset and acceptance of *Not Invented Here*. The FEDeRATED Semantic model is proving to be the way to go to solve the AC/DC problem. People that put time in getting a clue on what the FEDeRATED Semantic Model implies tend to become very engaged and enthusiastic. In the Netherlands, a stakeholder community regarding FEDeRATED semantics is evolving, not in the least as it also connects to the concept of Linked Data.
21	SIMPLE	**Collaboration with the community** In order to define a platform that answers the needs of the sector, the collaboration with the logistics and transport community has been the main tool that has enabled the solution to evolve. Through the work of various working groups, it has been possible to validate the project's proposals and move towards solutions adapted to the procedures currently used in the sector, thus avoiding the redesign of communication procedures and facilitation adoption. The solution involves the harmonisation of communications using open and standardised systems and data, which are already fully adapted in the sector. This is important point, because maximising the network effect

#	LivingLab name	Lessons Learnt
		by having the maximum number of actors sharing and using data from SIMPLE in the context of the FEDeRATED pilot is the most significant KPI (key performance indicator), as the main goal of SIMPLE is to generate the necessary trust and commitment among all stakeholders. **Use of the SIMPLE ShipmentID** In order to track the complete flow of a shipment throughout a logistics chain, it is necessary to have the ability to identify the shipment in the different events and nodes that are part of a logistics flow. However, during the analysis meetings with the SIMPLE Working Group, the existence of a standard for identification of shipments that is known and shared among all the actors and that can be sufficiently generic to serve all the cases included in SIMPLE has not been identified. Therefore, SIMPLE will assign a ShipmentID at the origin of each logistic flow. For subsequent events, both through the API and the SIMPLE GUI, the ShipmentID can be used for associating subsequent events, such as an admission and delivery order. At the time of recording the shipment events, the specific references of each mode of transport, such as the unique waybill code, can also be linked. **API for interoperability considering the different levels of technological development of the transport and logistics ecosystem.** During the project, while collaborating with the agents of the logistics and transport sector it has been evident the variety of enterprises (size, level of technological adoption, available resources…) in the ecosystem. For entities with capacity and interest in S2S integration, SIMPLE provides an API, with the possibility of querying, publication and subscription, which allows sharing and receiving information on all the events of a logistics chain, grouped according to a Unique Shipment Identifier, the reference assigned by SIMPLE that allows full traceability from origin to destination of a logistics flow. Also, via GUI (Graphical User Interface) it will be possible to publish and access such information, for those entities without the capacity to exchange S2S via the SIMPLE API. Therefore, SIMPLE will offer both solutions to allow the adoption to the needs of the platform users through the standardisation of communication systems and information sharing. This solution allows to incorporate in SIMPLE both the systems that are already operating in the market and to offer the functionalities for the registration of transport-related information through the SIMPLE GUI. **Importance of Governance** Due to the multi-stakeholder nature of the platform, with competing companies as potential users, and the complexity of the logistics environment, it is essential to articulate mechanisms to provide a comfortable context for the users and therefore foster participation. The most relevant aspects to govern include the relationship with the ecosystem, including companies and administrations, the protection of sensitive data and the interoperability of the participant platforms. The project is paying special attention to all these aspects to provide a solid basis for collaboration.
22	Automated capture and sharing of environmental data in collaboration (BEAst-ELSA)	Overall, the lesson is that the challenges are not technical or process related issues. The BEAst standard has tried to change as little as possible in the existing way of working, but just to make the way of working easier, by digitalising the communications in a standardised way. Since the first pilots in 2012 the standard has delivered results for proof of concept. The way of working has also been a catalyst for improving quality. Today, existing rules, responsibilities and needs for communication between the stakeholders internally and externally, are not always adhered to. This has been revealed through the digital way of working and large improvements have been made. One lesson learned is that, even with the positive outcome, the way of working does not expand and get established by itself within the companies where it has been tested. An industry comprising some 100,000 companies cannot coordinate and handle such an expansion by itself. Many initiatives are going on from authorities and individual companies, and it is not clear what will be the future solution. Therefore, it is necessary that somebody take a digital leadership role and decide, in cooperation with the stakeholders in the industry – to establish a common future path – to enable a cost-efficient digitalisation with all the opportunities that has being picked up and introduced by other industries. If this is not conducted in the very near future, the future cost for changing to a standardised way will be very high, as many actors today are developing their own ways of working and building ICT-systems for capturing climate and transport data. Success factors: It must be **digitalised**, it must be done in a **standardised** way, the standard must be described in a **detailed** way, not only functional, to make it possible to require in procurement and as a basis of specification for developing ICT systems, It must be **easy** and

#	LivingLab name	Lessons Learnt
		economically feasible, even for small companies.
23	Real Time Multimodal Transportation Visibility Platforms Services	More and more logistics service providers are looking for ways to minimise the environmental impact of their operations and to provide environmental reports for their customers. The companies are interested in improving the operations and resolving the inefficiencies that originate in the diverse levels of technology adoption and data silos. There are investments and projects ongoing that aim to improve harbour operations and require cooperation between different parties to provide timely and accurate data. There is an interest in the platform that can enable data sharing in a safe way. Various players of the logistics chain are interested in the visualisation of the information that is related to the cargo along with the real-time status monitoring and alerting in case of issues. The Leading Principles were taken to the extent and are guiding the development of the platforms and the future work. It is planned to start testing the outcomes of the R&D activities in real-world cases and rebuilding the current track and trace applications to use the results. Additionally, providing the customers with the information of the greenhouse gas emission calculations reports as soon as possible.

APPENDIX 5 ELABORATE ANALYSIS AND OBSERVATIONS - DIRECTLY ATTRIBUTABLE FINDINGS

Based on an analysis of the input received from the LivingLabs, two types of issues have been identified that can (and do) have an impact on the general progress of the Living Labs in varying degrees. These are

A. ***Wider*** issues prevalent throughout the transport and logistics sector and are beyond the control of the FEDeRATED LLs. They include:
   - Limited digital competence – digital readiness;
   - Propriety data spaces;
   - Limited use of the Internet potential;
   - Knowledge gap.

B. **Immediate** issues are aspects that require attention now in order to secure the continued progress and value-added contribution of the Living Labs to the further development of the FEDeRATED Master Plan. They include:
   - Continued alignment with the FEDeRATED Leading Principles and Architecture, including the work on semantics;
   - Governance;
   - Validation means;
   - …..

The following analysis of the current state-of-play, lessons learnt and areas for further attention are in the main related to the **immediate** issues. As highlighted above, the **wider** issues have the potential to (indirectly) impact the Living Labs and even though not limited to FEDeRATED, these issues do need to be addressed on the short-term if only for the continued development and eventual success of the Living Labs in meeting their ultimate goals. Therefore, the general texts relate more to the **immediate** issues and the texts highlighted in text boxes relate more to the **wider** issues.

The following considerations need to be considered when analysing the various inputs/outputs from the Living Labs:

- Differing focal points of the Living Labs:
  The Living Labs are addressing “federated” issues from one of two angles (or “levels”), i.e. from the viewpoint of data sharing platforms and/or from the viewpoint of developing federated infrastructure provision.
- Differing levels of maturity:
  Some Living Labs are still in the “study” phase whereas others have progressed through the “piloting” and are in the “implementation-ready” phase and potentially have therefore more perception on the potential impact of their interim findings;.
- Differing levels of knowledge and/or experience:
  In part due to the differing levels of maturity of the Living Labs, in part due to the COVID-19 pandemic and in part due to the evolving nature of the work of the IT Architecture Board in the previous period, the Living Labs are not all aligned and/or conversant to the same degree with respect to the architecture (and semantics) issues.

Organisation (lead organisations, timing and budgets)

It is to be noted that in the M4 (Scoping report) the total number of Living Labs under consideration was reported as 21. This Milestone 8 report is dealing with 23 Living Labs. The additional Living Labs are:

- LL#22 has been commenced in order to further address issues concerning environmental data sharing and the use of existing standards within the federated network of platforms arena.
- LL#23 has been operational since 2019 however due to an oversight in versioning of the M4 report it was not included in the final version as distributed. LL#23 has been included in this report and all relevant information on this LL is available in the factsheet (see FEDeRATED website) and in the Annexes to this report.

Further, one Living Lab has finalised their works as of end-2021, transferring any further aspects to another Living Lab:

- LL#19: Replanning has been done so as to complete this LivingLab earlier. Further development of the solutions will be done in LL#20 and in other activities outside FEDeRATED.

Further, it is to be noted that a number of Living Labs have faced (minor) delays, in the main as a consequence of collaboration and/or commitment issues arising as a result of the COVID-19 pandemic and/or changes in the marketplace.

Setting (Objectives, main emphases and challenges addressed)

There are several business benefits emerging from the enhanced connectivity between systems and platforms identified by the LivingLabs that would create value and provide competitive advantages for the organisations involved. The LivingLabs describe use cases building upon real time information sharing associated with products and carriers across different transport modes leading to shorter lead times, reduced wastage (in warehouses), increased turnover rate (in warehouses), reduced manual handling, more efficient handling and return/reverse logistics, easier compliance with legal requirements and regulations, increased loyalty and a strengthened brand, increased goodwill by avoiding counterfeit products, avoidance of duplication and errors, increased capacity utilisation, well-dimensioned transport with a high degree of fill rate, global supply chain visibility, new revenues and service level agreements (SLA´s).

The benefits to be achieved through a Federated Network of Platforms range from eliminating inefficiencies in current processes, allowing interoperability between different actors and modes of transport while ensuring traceability of goods, means of transport and, thanks to the flow of information in real time and availability to all actors in the multimodal transport chain, contributing to cost reduction through better use of available resources. The possibility to centralise administrative processes with administrations, for example customs processes, summary declarations and cargo manifests, has also been identified. Several benefits for users would be the reduction of logistic costs thanks to the implementation of a route generator/optimiser and the optimisation of transport resources with the launch of a marketplace for logistics services.

There are also several findings regarding the substantial enhancement of the value contribution

empowered by digital solutions for brand owners, transport and logistics providers, and for customers.

When it comes to last-mile distributors the FEDeRATED project is expected to have a great impact on digital services, possibly inviting new operators to this market. Today there are a few well-known services such as Checkout Service that PostNord & LogTrade provide (in Sweden and Scandinavia), Track and Trace DBS Schenker and DHL Express (worldwide), Unifaun Track & Trace SmartShip (Sweden part of Consignor Norway and in Scandinavia) and UPS. This will lead to more effective routing and pricing in geographical areas and the usage of vehicles.

A couple of LivingLab´s raised awareness among the multimodal chain players about the opportunities that could be given by a real time track and trace system, to speed up the daily operations both inside and outside the terminal area.

Scale (geographical coverage, modes and stakeholders)

Geographical coverage and transport modes

The TEN-T Corridors, (third) countries involved and transport modes covered in the Living Labs has as a minimum the same level as that originally reported in the Milestone 4 (Scoping) repot. Some minor additions have been made to a couple of Living Labs concerning the involvement of stakeholders from other countries/regions.

Stakeholder involvement and commitment

It has been identified by the LivingLabs that enhanced collaboration among diverse actors, private and public, operators and technology providers, is key for the implementation of an advantageous supply chain empowered by digital solutions to reach added business and societal benefits.

Transparency, at the relevant level, among the involved participants is essential for the realisation of the use cases. As stakeholders tend to progress at different speeds, which may be as a result of budget and resource availability constraints, each participant in the multi-organisational setting that co-produces value for its clients, tends to be at different stages of implementation respective to each other. This creates needs for capabilities for adaptation, that may vary over time, for each stakeholder especially when trying to inter-connect.

A major underlying factor here is also the issue of digital readiness. Even within the FEDeRATED Living Labs, stakeholders are still in the process of realising their digital transition and transformation processes. In developing federated network of platforms applications and infrastructure, the Living Labs are further confronted with challenges outside of their remit, i.e. engaging with, and securing the commitment of, all stakeholders.

Wider issue: ***Limited digital competence – digital readiness***

The COVID-19 pandemic has clearly shown that digital competence - digital readinesss – is an essential ingredient for companies and public authorities to manage turbulent times. To many logistic operators and connected public authorities the full dependence on data for information exchange is a novel approach, often costly. It is rather complex to shift from a paper-based environment – physical infrastructure – into a virtual infrastructure, to deal with a multitude of various partners and to act in a setting that is not owned by oneself. In addition, working and benefitting from real time data sets high standards for internal and external collaboration. A mind shift has to take place and will take a long time.

Digital readiness allows for making use of real time data and learn to trust third party data and engage into the offering of cyberspace – virtual infrastructure. In reality no companies and public authorities have fully managed the transition process towards digital readiness, yet. The illustration hereunder identifies some of the digital readiness elements that constitute a roadmap towards allowing stakeholders to fully engage with the already existing virtual infrastructure.

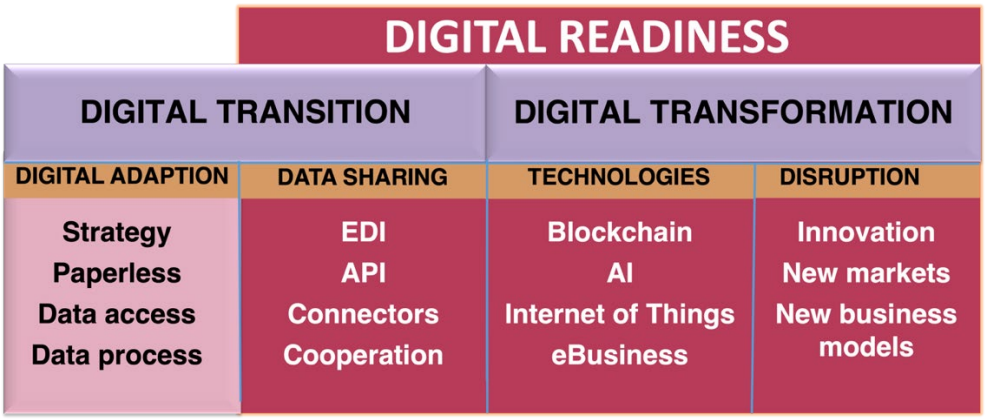


Illustration: Digital readiness, the roadmap towards digital competence – FEDeRATED Mid-term Event – 24 November 2021

One LivingLab is in part addressing these issues by proposing that a system of implementation levels needs to be created to provide the visibility to all stakeholders on each other's progress. The forecast would be an implementation plan to improve the visibility from the very beginning, and to follow up on the processes and progress in the projects to achieve greater success in sharing transparent information. One LivingLab expressed that their experiences show that collaboration and knowledge sharing among the partners in the LivingLabs and the projects has strengthened and inspired each other in their continuing work.

Several of the LivingLabs emphasised the importance of cross-organisational communication as many of the participants in the LivingLabs have business relations with existing stakeholders such as customers, suppliers, logistics operators, TA (transport administration)-suppliers (TAS), digital service providers, etc, and also try to reach out to new potential stakeholders. Enhanced cross-organisational communication levels up the degree of being able to do business and support the business ideas and the collaboration format. Collaboration within the community defined by each of

the LivingLabs has been pointed out as an important aspect.

Further, collaboration between logistics operators and authorities is key to achieving societal benefits. The involvement of customs organisations in driving more secure and efficient operations empowered using digitalised services is a key element. This will help when developing the customs processes and greater visibility in the supply chain.

Solution (technical set-up and relation to FEDeRATED Architecture components)

As stated previously, the Living Labs are addressing "federated" issues from one of two angles (or "levels"), i.e. from the viewpoint of data sharing platforms and/or from the viewpoint of developing federated infrastructure provision. In itself. this presents challenges.

Wider issue: Proprietary Data Spaces

Many participating FEDeRATED partners develop and execute a Living Lab – often including third parties - based on their own legacy systems, thereby primary focusing on existing hard- and software and applicable standards. Frequently, logistic operators and related public authorities seem to engage into developing their own data spaces, including applying specific ontologies. Often this leads to building dedicated platforms or IT services, preventing access to a multitude of different networks. This might prevent stakeholders to fully engage and connect with the existing virtual infrastructure, the Internet.

This issue is represented within FEDeRATED itself, however is an issue that has the potential to impact further roll-out and implementation strategies post-FEDeRATED and DTLF.

In general, the need for (and value of) common FEDeRATED architectural and semantics models has been re-emphasized by several LivingLabs, including:

- a common architecture to support information exchange in border crossing supply chain logistics (LL#1)
- architectural components for supply chain CO_2 monitoring and related data sharing (LL#3)
- the semantic model to capture aspects associated to crowdsourced logistics and platform companies (LL#4)
- provision of time stamp data associated to a particular means of transport to be consumable by others (LL#7)
- digital intra- and inter-organisational collaboration (LL#9)
- API's using XML messages based on FEDeRATED Semantic Standards (LL#12)
- Better transparency of the flows of the commodities in the European transport corridors utilising a FEDeRATED semantic model (LL#16, LL#18)
- eGovernment Logistics architecture as a case driving the needs of FEDeRATED architectural components (LL#20)
- Seamless multimodal supply chain requires an interoperability for data and document exchange (LL#23)
- Transparent traceable sustainable logistics supply chain needs a common way to share CO2 calculation results per transport modality used in a shipment. This shall be shared with used calculation method for verification and future backward tracebility purposes (LL#23)

The LivingLabs stress the need for a common approach to semantics and architecture by adopting FEDeRATED semantics and architecture as the means for gluing actors together in forthcoming efforts and building more and better information about the shipments and logistics events in multi actor supply chains. One of the LivingLabs highlights the need to secure harmonisation between adopted semantic model (in this case, the IMO reference data model) with the emerging FEDeRATED semantic model.

Overall, it can be concluded that the LivingLabs have identified the needs for architectural and semantic support given how far the LivingLabs have now progressed. The activity to develop content for the architecture and semantic components has been initiated by two teams within FEDeRATED where the more mature[9] LivingLabs (such as LivingLabs 11, 12, 20 and 21) have provided input more than others that have not been progressed as far as yet. Those efforts are to be seen as a step towards detailing and providing the basis for some of the Leading Principles, such as Data sets (Leading Principle #27), Business Service Discovery (Leading Principle #12) enabling the FEDeRATED approach to business services, data sovereignty, and logging and audit trail. The action of developing supporting knowledge and principles associated to architecture and semantics has been initiated since the Milestone 4 report but has not yet been brought to validation. The architectural and semantic models have been informed by progress in some LivingLabs and will provide support to the other LivingLabs.

Leading Principles

Each Living Lab has provided input on their experiences regarding the appropriateness and applicability of the Leading Principles as formulated in the Interim Master Plan. As noted previously, the Living Labs are at varying stages of development and therefore not all feedback relates to the appropriateness and applicability of the LPs as such, whereby some Living Labs are still in the definition phase and seeking clarity on how best to combine the various functional and technical "requirements" represented through the FEDeRATED Leading Principles, Architecture and Semantics.

The emerging work on the FEDeRATED architectural components is a promising addition to the Leading Principles, providing a context and structure to the Leading Principles. Consequently, the activities regarding the Leading Principles and the architectural components should be coordinated and synchronised. It is apparent that the ongoing work of the IT Architecture Board (including the Semantics Working Group) needs to be (re-)communicated to the Living Labs, and where necessary individual support provided, in order to better align with the FEDeRATED Architecture etc.

Architecture and Semantics

Besides adopting and validating the FEDeRATED Leading Principles, the FEDeRATED LivingLabs have the objective to adopt and/or validate the emerging FEDeRATED architectural components, which are captured as:

[9] in other words: have progressed so far that they now have a basis to actively evaluate the Leading Principles in their LivingLab

- **Conceptual architecture - Language** captured in a semantic model that is open and extendible, meaning that it can be easily extended to support new functionality.[10]
- **Functional architecture** capturing the building elements that are required to create interoperability between systems and platforms. This functional architecture puts focus upon functionality, such as data discovery (search, registries, index), identification, authentication, and authorisation, and data sovereignty that must be available and can be deployed in different ways.
- **Technical architecture** (data sharing solutions) with special emphasis on functionality for non-repudiation (logging, audit trail, and data integrity) and safe and secure data sharing and thereby putting attention towards the implementation of the language and the functional architecture.

However, these architectural components have continued to be developed in the recent past and it is necessary to consider any impacts of these developments with regards to the ongoing Living Labs. The need to (re-) confirm alignment is also indicated in the separate reports (see annexes).

At a high level, the LivingLabs have indicated the need for support regarding how to practically implement the architecture and semantics described in the (Interim) Master Plan (FEDeRATED, 2020a) and subsequent additions, and more specifically the semantic model, governance, interoperability, and security. Issues with the semantic model and security, are discussed in this sub-section, while governance, interoperability and the Leading Principles will be discussed in later sub-sections.

The FEDeRATED reference model and the semantic model (and how they relate to each other) are described in the (Interim) Master Plan (FEDeRATED, 2020a). There are several activities outside FEDeRATED regarding semantic models associated to supply chain operations that are relevant to the scope of FEDeRATED; such as the IMO Reference Data Model (Cauwer, et al., 2021), the UN/CEFACT Buy-Ship-Pay Reference Data Model (UNECE, 2021) containing the Supply Chain Reference Data Model and the Multi-Modal Transport Reference Data Model, the IATA ONE Record data model (IATA, 2021), and the eFTI data model (EU, 2020b). Security is described and elaborated on in the Master Plan, section 6.3.1.4 Data security.

Additional perspectives on semantic models can be provided by the System-of-Systems (SoS) community (Maier, 1996), for instance the research applied to SoS in the construction domain inspired by Industry 4.0 and its Reference Architecture Model RAMI4.0 (Axelsson et al., 2019) and the usage of linked data and ontologies (Axelsson, 2019).

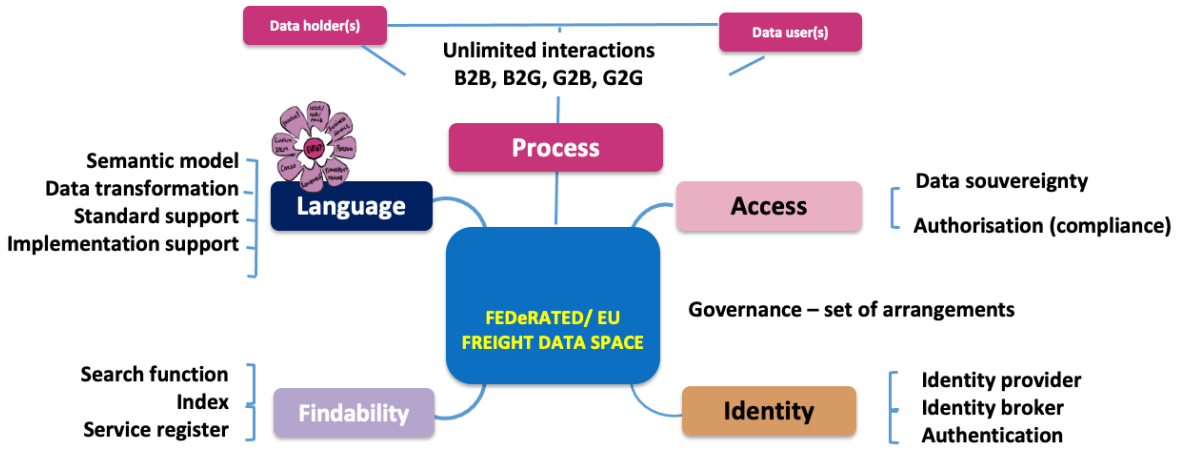
In innovation efforts, there is a need to find sources for continually seeking equilibrium between different components at the same time as contradictions between the components are looked for to provide impetus for development efforts. Such an approach for innovation and knowledge development has been used in many industries (c.f. e.g. Zhang et al., 2017; Pesendorfer, 1995; Carranza, 2010).

Within the FEDeRATED context this would mean both the identification of contradictions between architecture and semantics at the generic level as well as between the same components between the generic level and the instance level where the LivingLabs are conducted.

[10] The semantic model and its structure as can be found in the developer portal of FEDeRATED (federatedplatforms.eu). The process aspects related to the language still needs further elaboration.

This way of working is strengthened by statements provided by several LivingLabs. These FEDeRATED endeavours fully support the work done in the DTLF SG2 on IT architecture. The underlying concept of the IT architecture is the pull of data, where a pull can be combined with push. Such a pull-based architecture implies that links to data are shared with appropriate data users, where the latter can evaluate the links. Upon link evaluation, a data holder can still decide to provide access. Also, Identification, Authentication, and Authorisation (IAA) is core to the open FEDeRATED architecture, together with encryption. IAA with data sovereignty defines who has access to which data and supports data sovereignty. Based on linked data and IAA, the DTLF/FEDeRATED building elements of the IT architecture consist of the following elements (see also figure 7 in chapter 1):

The DTLF architecture design will be incorporated in the final FEDeRATED Master Plan. The Master Plan will translate the DTLF building blocks and the FEDeRATED COF elements and the Interim Master Plan, including its 37 Leading Principles, into a " How to Guide": A How to Build a federated infrastructure provision?" and "How to use it?". Apart from dealing with issues like CEF standards[11], the specific elements of the FEDeRATED Master Plan are covered in the following illustration. This illustration covers the architecture guidance to validate the Living Labs and vice versa.



The architecture guidance to validate the LL and vice versa

From the different LivingLab reports, it can be seen that they are developing at different rates and are at different maturity levels. This is confirmed in the collaborative arenas for the LivingLabs where they share experiences from different actions taken to develop the LivingLab.

In addition, the FEDeRATED project is also working conceptually at the forefront by elaborating on and using new concepts, providing opportunities to also contribute to the more general discourse. This is, however, at the same time a challenge. Further, the need for tools supporting the implementation of semantic models is acknowledged by the LivingLabs.

[11] *The issues are Identified in the EC-FEDeRATED Grant Agreement 2019*

There are also aspects associated with the content of the architectural model. Some LivingLabs provided concerns about security, either in terms of the need for security solutions or proposing solutions. Given the need for arenas where different participants work at the generic and the instance level, several LivingLabs highlighted the need for knowledge sharing and technical workshops like the special session that was conducted in February 2021.

To conclude, the identified needs for architectural and semantic models as guiding support to the LivingLabs, there seems to be a need for further knowledge sharing and technical workshops around architectural solutions, security solutions, and the semantic model. In this way, the architectural and semantic models, both as generic and specific adopted by the LivingLabs, is a common concern that needs to be used as common objects of interest in collaborative arenas, both within FEDeRATED and in other forums conducted in parallel and after the FEDeRATED project.

Wider Issue:* *Knowledge gap

Despite the pandemic, Activity 2 achieved some major breakthroughs developing the appropriate and useful federated infrastructure provision elements to be implemented for developing a federated network of platforms approach. Unfortunately, these developments (see next paragraph) relating the appropriate architecture and semantics were not sufficiently shared with the Living Labs in 2020 and 2021. This has resulted in a knowledge gap between Activity 2 and Activity 3. Some of the Activity 2 work was explained in a specific workshop with Living Lab project managers in June 2021. Three workshops were organized in 2021 with the FENIX consortium.

Since the publication of the Interim Masterplan - Milestone 2 report – in February 2020, FEDeRATED Activity 2 continued its work on architecture, also in conjunction with the DTLF. In 2021, the FEDeRATED IT Architecture Board and Semantic Modelling Group produced some major products, i.e.:

- FEDeRATED Reference architecture detailing
- FEDeRATED System Architecture
- Semantic detailing of the FEDeRATED reference model
- FEDeRATED Semantic modelling more defined, leading up to FEDeRATED developer portal.
- FEDeRATED Supply Chain Visibility Ledger.

In 2021, FEDeRATED provided input to the DTLF through a Peer Review appraisal – Milestone 5 - on 31 March 2021. In this report, the FEDeRATED and FENIX architecture developments were compared with another within the context of the DTLF. Some constituting elements of building were identified and elaborated. In November 2021, the EU DTLF Subgroup 2 on data sharing issued its Interim report on the progress, Corridor Management Information System.

The EU DTLF Subgroup 2 Interim Report very much reflects the knowledge developed by Activity 2. The report enables the FEDeRATED project to guide the LL's towards a developing a viable federated data sharing provision and – vice versa – assist the development of the FEDeRATED Masterplan to be structurally validated by the Living Labs.

Underlying / Overarching issues

This sub-section provides for observations and conclusions drawn from the Living Labs on issues having an overarching impact on the further progress of the Living Labs. These issues are not necessarily exclusive to any one aspect as covered I the previous sub-section. This sub-section considers:

- The need for Governance;
- The importance of the interoperability layers;

Governance

Within the perspective of data sharing there are three governance approaches: a centralised control over an integrated infrastructure, a private decentralised model, and a community-led network. FEDeRATED considers that the latter, due to the large number of participants and systems operating in the self-organised ecosystem of multi-modal transport, to be the most suitable option to choose to achieve green and integrated performance in multi-modal transport. Governance in such community-led networks requires actor inclusive models for governing and maintaining generic standards and specifications guidelines to be adopted by the different participating actors.

A complementary perspective on governance stems from the System-of-Systems (SoS) community (Maier, 1996) which identifies four different types of governance (ISO, 2019); virtual, collaborative, acknowledged, and directed SoS, in increased order of central control. In this perspective, FEDeRATED aims for collaborative SoS, in which parts of the SoS interact more or less voluntarily to fulfil agreed-upon central purposes.

Within FEDeRATED, the work on governance is ongoing, having been identified in the (Interim) Master Plan under section 8.2 Next steps.

The importance of governance has been stressed by several LivingLabs:

> *"The concept of "federation of platforms" is still somehow confused; especially in the community of ICT vendors, it is quite common that basic M2M interoperability (e.g., through static software connectors) is marketed as "federation of platforms". FEDeRATED is called to provide a clear definition of "federation of platforms" and propose a usable framework for its successful implementation."*

> *"Currently there are many actions on the maritime transport sector to develop smart port data sharing platforms/portals and both public and private organisations are providing their solutions. In the future, these must be linked to the network of FEDeRATED platforms."*

Several LivingLabs have underlined the need for the role of governance for the Federated Network of Platforms to secure sustainability:

> *"The FEDeRATED and DTLF ambitions can only survive the lifetime of the DTLF and the consortiums if the European Commission makes a formal commitment to set-up the governance and means for a sustainable operation."*

> *"Due to the multi-stakeholder nature of the platform that includes competing users, it is essential to articulate mechanisms for participation and data sharing that allow them to feel secure about the protection of sensitive data. Work in this area, covering all aspects, is essential for the success of the platform."*

> *"A strategic committee and change advisory board have been installed, but there is a need*

to integrate this in the near future with the covering set of arrangements of the Datasharing Infrastructure as being developed in LivingLabs … "

"The most relevant aspects to govern include the relationship with the ecosystem, including companies and administrations, the protection of sensitive data and the interoperability of the participant platforms."

This aspect of governance, surfaced by the LivingLabs, is a clear request for governance strategies and established bodies to ensure that the investments made within FEDeRATED become long-lasting. This was also identified as upcoming activities in the Master Plan (section 8.2), and to this end FEDeRATED has initiated this additional work regarding governance. The need for governance in connection with interoperability is discussed further in the next sub-section.

Interoperability

A majority of the LivingLabs provided comments regarding interoperability. Interoperability is one of the key enablers to achieve a Federated Network of Platforms. The EIF (European Interoperability Framework) (EU, 2021) defines a set of common principles, models, and recommendations concerning interoperability. The EIF interoperability model builds on four interoperability layers; legal, organisational, semantic and technical.

- Legal interoperability is about ensuring that organisations operating under different legal frameworks, policies and strategies are able to work together.
- Organisational interoperability refers to the way in which public administrations align their business processes, responsibilities and expectations to achieve commonly agreed and mutually beneficial goals.
- Semantic interoperability ensures that the precise format and meaning of exchanged data and information is preserved and understood throughout exchanges between parties.
- Technical interoperability covers the applications and infrastructures linking systems and services. Aspects of technical interoperability include interface specifications, interconnection services, data integration services, data presentation and exchange, and secure communication protocols.

In addition, there is a "background layer" called Interoperability governance. Interoperability governance refers to decisions on interoperability frameworks, institutional arrangements, organisational structures, roles and responsibilities, policies, agreements and other aspects of ensuring and monitoring interoperability at national and EU levels.

Interoperability on a global level to support trade and transport is managed under the umbrella of global organisations such as UN/CEFACT (UN/CEFACT, 2021) and the International Maritime Organization (IMO). In FEDeRATED, several parts of the Master Plan concern interoperability, such

As part of the information received from the LivingLabs, several of them highlight the need for assuring interoperability on all layers. As one LivingLab describes:

"Starting from EIF Interoperability Levels and DTLF Building Blocks, the project produced a broad range of Leading Principles, which cover almost every possible form of cooperation between parties (enterprises, authorities) and platforms, ranging from very basic

organisational integration to sophisticated ICT architectures; these principles have been acknowledged by different project LivingLabs in a flexible way, so that different solutions implement different "blends" of interoperability. Although each of these blends is perfectly in line with the objectives of the project, it shall be clearly stated that a true federated ecosystem is only possible through the harmonic and coordinated development of all the four interoperability levels (legal, organisational, semantic and technical), as pushing only one (leaving the others behind) would probably lead to partial results. For instance, a strong push on technical interoperability, without a corresponding effort on semantic interoperability, may lead to the paradox of two platforms that are able to authenticate and connect, but are not able to communicate."

Another LivingLab continued:

"In order to define a platform that answers the needs of the sector, the collaboration with the logistics and transport community has been the main tool that has enabled the solution to evolve. Through the work of various working groups, it has been possible to validate the project's proposals and reach to solutions adapted to the procedures currently used in the sector, thus avoiding the redesign of communication procedures and facilitation adoption. The solution involves the harmonisation of communications using open and standardised systems and data, which are already fully adapted in the sector."

Furthermore, as described by a third LivingLab:

"IT Architecture is a subject that evolves over time. Therefore, the architecture is and needs to be modular that allows us to evolve the modules whilst ensure backward compatibility. This is particularly important for the based interoperability components such as APIs and security."

Another LivingLab experienced:

"Difficulties in data sharing between different software not only between different companies but also between different software of the same company."

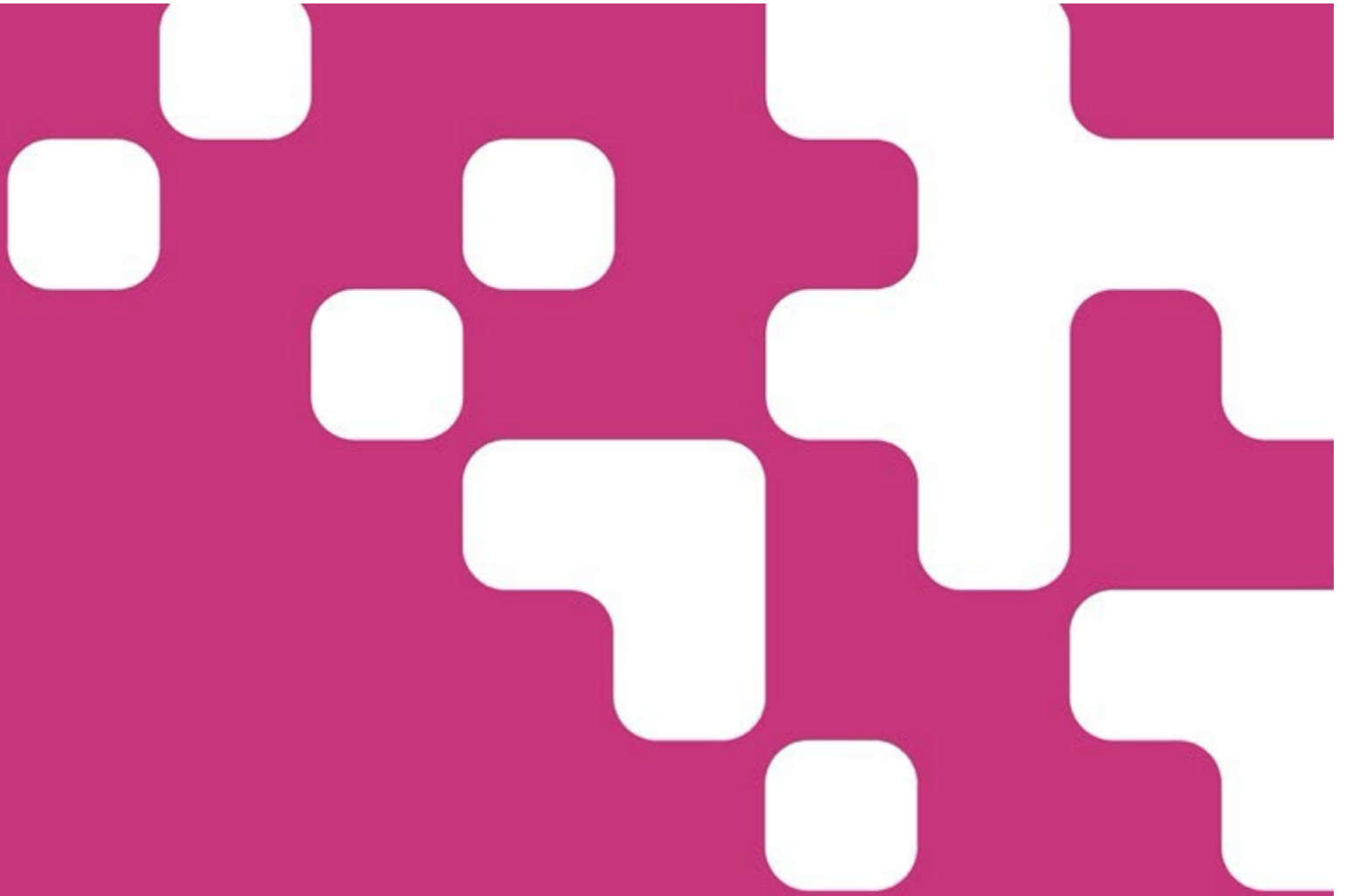
Some LivingLabs indicated how they solve the interoperability challenge:

"The concept of the "internet of logistics" is being confirmed in all modes of transport. Both authorities and economic operators agree on the importance of interoperable API (Application Programming Interfaces) that can be achieved through interoperable semantics and harmonised security structures."

"For entities with capacity and interest in S2S integration, LivingLabs provide an API, with the possibility of querying, publication and subscription, which allows sharing and receiving information on all the events of a logistics chain, grouped according to a Unique Shipment Identifier, the reference assigned by LivingLabs that allows full traceability from origin to destination of a logistics flow. Also, via GUI (Graphical User Interface) it will be possible to publish and access such information, for those entities without the capacity to exchange S2S via the API. Therefore, LivingLabs will offer both solutions to allow the adoption to the needs of the platform users through the standardisation of communication systems and information sharing. This solution allows to incorporate in LivingLabs both the systems that are already operating in the market and to offer the functionalities for the registration of transport-related information through the GUI."

As a conclusion, the LivingLabs are recognising the importance of interoperability on all layers; legal, organisational, semantic and technical, as well as the need for governance. Based on the input received from the LivingLabs, an increased focus on interoperability will be at focus within

FEDeRATED. For instance, interoperability between technical infrastructural solutions could be tested in real settings through the collaboration between relevant LivingLabs and actually sharing data between their solutions. The different infrastructural solutions emerging from the LivingLabs will be described in a later sub-section. Furthermore, several of the Leading Principles defined in FEDeRATED concern interoperability, and they will be elaborated on in the next sub-section.



FEDeRATED
NETWORK OF PLATFORMS

Co-financed by the Connecting Europe Facility of the European Union