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GLOBAL SUPPLY NETWORK COORDINATION AND COLLABORATION

Research & Innovation Roadmap

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Executive summary

In the frame of ALICE, the European Technology Platform for Logistics, Working Group 4 deals with coordination and collaboration among stakeholders in global supply networks. Coordination and collaboration refer respectively to vertical and horizontal synergies along and across different supply-chains. In this context, Supply Network Coordination deals with the synchronization and dynamic update of logistics and transport plans, across modes and actors (manufacturers, retailers, logistics services providers, carriers, terminal operators, etc.). Supply Network Collaboration deals with maximising resources utilization, such as vehicle and infrastructure capacity, by matching demand from multiple shippers with available transport and logistics services from different modes and service providers. Both Coordination and Collaboration can produce significant gains in terms of both efficiency and sustainability and represent a big step towards the Physical Internet, leading the transition from individually managed supply chains to open supply networks.

Roadmap implementation actions and projects are expected to make an extensive use of pilots and proof of concepts and business cases, clearly defining the operational framework assumptions of all new solutions.

In the area of Collaborative Supply Network Design, the identified research and innovation challenges concern strategic design, that should become multi-criteria and multi-stakeholder, as well as tactical planning and execution in supply networks, where new tools are needed to maximize resources utilization and manage events across the different stakeholders and systems. Also, resilience and risk management challenges have been identified; with the aim of ensuring that shared collaborative networks meet the resiliency and security standards expected in traditional supply chains, all this in connection to ALICE roadmap on Sustainable, Safe and Secure Supply Chains. Finally, innovative business models are needed to ensure economically sustainable provision of logistic services in open and collaborative supply networks.

In the area of Supply Network Coordination, research and innovation challenges concern coordinated planning of supply chain as well as logistics services along the chain and, on the execution side, automated and timely synchronization and event management. A prerequisite to achieve these goals is to overcome the barriers to data sharing that currently affect, on different levels, the various stakeholders and information systems along the chain.

In the area of Integration of Manufacturing and Logistics, research is needed to provide a holistic view where new approaches in both manufacturing and logistics concur to the creation of the future supply chains. The main challenges concern introduction of new manufacturing technologies and their impact on logistics, how collaboration and sharing of non-unique resources can happen in manufacturing villages (e.g. pharma industry), and which logistics models best support agile, modular and distributed manufacturing.

Finally, Drivers and Enablers for Collaboration and Coordination must be addressed to create the conditions for timely adoption and mass diffusion of collaboration and coordination among the logistics industry stakeholders. Innovation and implementation support is needed including change management approaches, awareness creation and good practices diffusion, legislative actions to remove antitrust and international commerce barriers, standardization and public incentives policies.

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1

INTRODUCTION

The European Technology Platform ALICE, Alliance for Logistics Innovation through collaboration in Europe, was launched on June 11, 2013, and received official recognition from the EC in July 2013[1]. ALICE has been set-up to develop a comprehensive strategy for research, innovation and market deployment of logistics and supply chain management innovation in Europe with the mission: *"to contribute to a 30% improvement of end to end logistics efficiency by 2030"*.

One of the key elements identified by ALICE as the Vision to achieve this improvement is **The Physical Internet (PI) concept**. PI is pursuing an open global logistic system founded on physical, digital, and operational interconnectivity, through encapsulation of goods, interfaces and protocols design, aiming to move, store, realize, supply and use physical objects throughout the world in a manner that is economically, environmentally and socially efficient and sustainable.

Logistic is a Global Business and Collaboration is needed at all levels. While ALICE is a European Platform all efforts should be made to open up the scope of every project to International Collaboration. Moreover, projects addressing research areas identified in this roadmap should comply with the following characteristics:

1. Extensive use of Pilots and Proof of Concepts.
2. Define clearly the operational framework assumptions of all new solutions.
3. Sharing of project information and results, to clearly map advances in roadmap implementation and identify new gaps. This process should be supported by ALICE.

1. STRATEGY FOR EUROPEAN TECHNOLOGY PLATFORMS: ETP 2020. SWD (2013) 272 final. Brussels, 12.7.2013

ALICE has identified five different areas that need to be specifically analysed and addressed in terms of future research and innovation needs to achieve its mission. These areas are:

- Sustainable and Secure Supply Chains.
- Corridors, Hubs and Synchromodality.
- Information Systems for Interconnected Logistics.
- Global Supply Network Coordination and Collaboration.
- Urban Logistics.

Five different Working Groups have been launched, one in each of these areas to further analyse and define research and innovation strategies, roadmaps and priorities agreed by all stakeholders to achieve ALICE Vision and Mission.

This document is the research roadmap in the field of ***Global Supply Network Coordination and Collaboration***.

Coordination and Collaboration can enable synergistic use of resources in global supply networks, with significant gains in terms of both efficiency and sustainability. This will be a big step towards the Physical Internet, ultimately leading to open global supply networks that are operated as a whole, meaning with full vertical coordination and horizontal collaboration along and across currently individually managed supply chains.

The EU is the world's largest exporter and biggest trader in goods[2]. It is estimated that in the next 10-15 years, 90% of the world's growth will come from outside the EU, so the EU has every interest in making sure that its companies remain very competitive and are able to access new markets and benefit from these sources of growth. Globalisation is not just about facilitating trade and exchanges. It is about joining global value chains and delivering products, services and technologies that no individual country would be able to produce on its own. In this context, logistics is a key enabler to access these new markets in a competitive and sustainable way.

Transportation is responsible for around a quarter of the EU greenhouse gas emissions[3]. Eurostat surveys estimate that 24% of good vehicles in the EU are running empty and the average loading of the rest is 57% giving an overall efficiency: of 43%. Flow imbalances can explain only half of this loss. The total cost of road freight transport inefficiency is estimated as €160 billion and 1.3% of EU27 CO^2 footprint per annum.

The CO3[4] project has demonstrated that better coordination and collaboration in global supply networks can enable synergies resulting in improvements in both competitiveness and sustainability; this is the broad scope of this research roadmap.

The vision is to get supply networks that are operated as a whole, meaning full vertical and horizontal coordination and collaboration. Coordination and collaboration concern the full scope of supply chain operations from sales planning and order management, logistics and transportation planning to strategic network design choices. The goal of the roadmap is to identify and define research and innovation challenges to achieve this vision, a breakthrough in EU logistic efficiencies via removing possible barriers through new concepts and approaches, for closer vertical and horizontal collaboration among different network owners in Europe. The aim is to favour a smooth transition from independent supply chains to open global supply networks. To make the most efficient use of available resources and modes, they will be compatible, accessible and easily interconnected.

The roadmap will contribute to the definition of research programs, including Horizon 2020, the European Programme for Research and Innovation. The implementation of the research topics and activities identified in this document are required to achieve the overall objective of ALICE.

Experts from important stakeholders, involved in supply chain operations and research activities, have been invited to contribute to this work[5].

2. Strategic approach for Horizon 2020 - a contribution from foresight. Ref. Ares(2014)1202380
3. http://ec.europa.eu/clima/policies/transport/index_en.htm
4. www.co3-project.eu/
5. See the list of members of the core group and additional experts consulted at the end of the document

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1.1

General expectations and scope of the roadmap

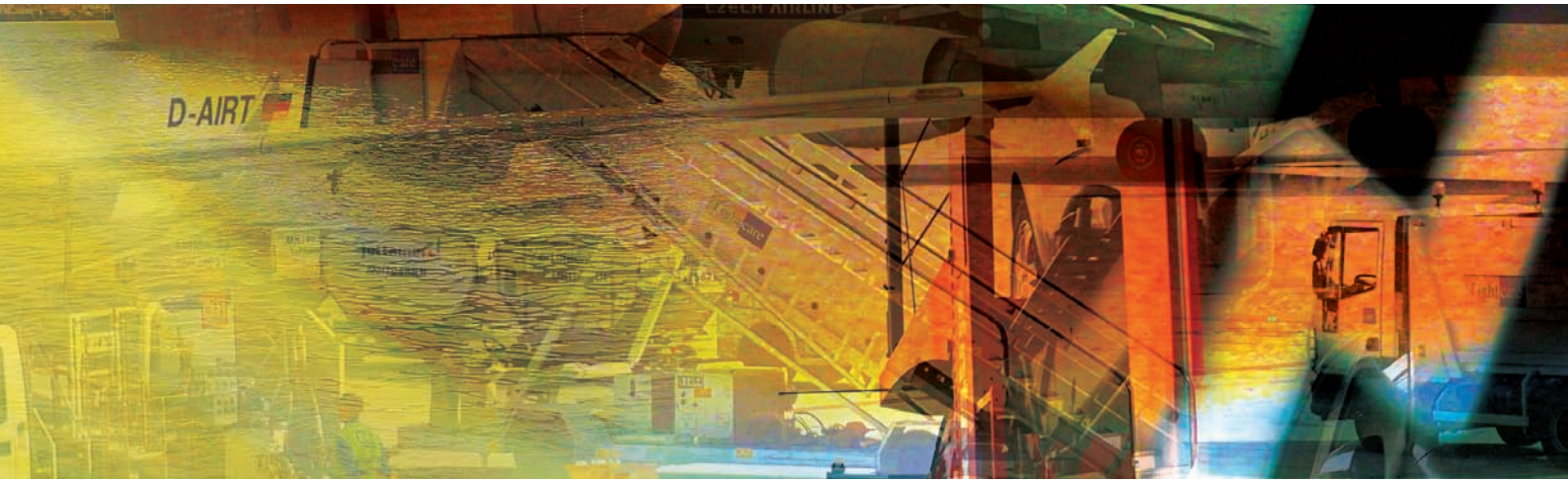
The implementation of this roadmap should contribute to supply chains that are fully integrated and coordinated (supply networks) and operating in a more efficient, sustainable way by using horizontal and vertical collaboration & smoother supply chain interfaces.

A key development expected in the next decade is the transition from the current independent supply chains, where transport and logistics resources cannot be shared or accessed by different cargoes and shippers, to open global networks where resources are compatible, accessible and easily interconnected. This will enable innovative freight management practices in two main areas:

- **Supply Network Collaboration** will deal with maximising resources utilization, such as vehicle and infrastructure capacity, by matching demand from multiple shippers with available transport and logistics services from different modes and service providers. This type of collaboration is also referred to as horizontal collaboration. Horizontal collaboration refers to multiple companies that are active on the same level of the supply chain and demand alike logistical functions.
- **Supply Network Coordination** will deal with the provision of door-to-door services based on the synchronization and dynamic update of logistics and transport plans, across modes and actors (manufacturers, retailers, logistics services providers, carriers, terminal operators, etc.). This practice is referred to as vertical collaboration. This is further specified and defined in the "Corridors, Hubs and Synchromodality" roadmap.

Some innovative schemes will only be possible when both Collaboration and Coordination are present at the same time (e.g. City Distribution Centres linked to ERTRAC/ALICE Research roadmap on Urban Freight). In the past most of the effort has been placed to vertical collaboration (Coordination), but this has stalled because of the lack of concurrent horizontal collaboration.

This roadmap identifies reapplication and valorisation potential from different business sectors as well as the need of pilots for new best practices and how to best leverage the Horizon 2020 program toward the innovations needed in this field.



1.2

Expected impacts of research and innovation activities

In order to define what kind of research is needed in the area of Global Supply Network Coordination and Collaboration, it is important to decide what impacts are expected from the initiatives and projects. In this section, an extensive list of expected impacts from the implementation of the strategy for research and innovation proposed by ALICE is included. These expected impacts cover all of the five areas focussed within ALICE. The areas of intervention defined later in this document and the research initiatives arising on those topics do not need to contribute to all of the listed impacts but at least positively to some of them and neutral to the rest.

ALICE mission is "to contribute to a 30% improvement of end-to-end logistics efficiency by 2030". This improvement needs to be translated into tangible People, Profit and Planet perspectives and therefore the impacts expected are divided into these three categories.

Further research needs to be done in order to define proper measurement units and indicators to define to what extent the expected impacts listed below will contribute to the 30% improvement of end to end logistics performance and accordingly define guiding targets for these indicators in the medium and long term.

The impacts have been divided in primary and secondary impacts. While primary impacts are the ultimate expected impacts, the secondary impacts will have a positive influence on the primary one. For example, energy consumption is a primary impact while increasing load factors of vehicles is a secondary impact that positively influence energy consumption as well as other primary impacts such as emissions reduction.

These expected impacts are related to logistics performance dimensions. All actions undertaken under the Alice umbrella should improve one or several of them without deteriorating others.

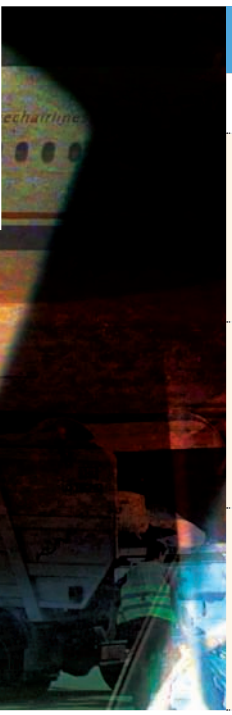


Table 1. Expected impacts out of the implementation of ALICE Strategy and Research roadmaps

	PRIMARY IMPACTS	SECONDARY IMPACTS
People	+ Increase customer satisfaction. + Products availability. + Secure societies.	+ Load factors: weight and cube fill of vehicles. + Volume flexibility (Time to market/ adaptability of capacity). + % Synchromodal. + Asset utilization. + Supply Chain Visibility. + Reliability of transport schedules. + Perfect order fulfilment. + Transport routes optimization (reducing kms). + Transport actors using automatic data exchange. + Cargo and logistics units integrated in the automatic data exchange. + Upside / Downside Supply Chain Adaptability and Flexibility. + Decoupling logistics intensity from GDP. - Empty Kilometres. - Waiting time in terminals. - Risk factor reduction. - end-to-end transportation time. - Travel distance to reach the market. - Lead times.
Planet	- Energy consumption (kWh Logistics/GDP). + Renewable energy sources share. - CO_2 Emissions (kg CO_2/tkm).	
Profit	+ Return on assets and working capital. - Cargo lost to theft or damage. - Total supply chain costs.	

On top of all these expected primary and secondary impacts, it is also key to achieve a more systematic and consolidated way on how research and innovation in logistics is approached by the industry. This includes a mental shift towards a more open vision on innovation and willingness to break current paradigms and pursuing an increased efficiency situation.

Logistics is a quite fragmented sector (more than 750.000 logistics companies around Europe), which makes broad market uptake of new knowledge and developments quite complex and usually it needs a lot of time to occur. Although all past EU projects include dissemination activities, these are not enough to reach this broad but disperse audience. Therefore there is little (compared to the size) industry knowledge of what was done on these projects and how this might be applied to their industry. Focussed activities for exploitation would be recommended. Specifically, activities conducted to identify what is needed to disseminate the outcome of the research that has been completed in projects or that are currently under way so that the industry knows about it and asses the opportunities. Best practices in this direction need to be clearly identified as well as a set of awards and incentives. Moreover, labour skills and profiles required will change in logistics, it is important to recognize this and pursue proper qualifications of future logistics labour force.

1.3

Past projects in coordination and collaboration

There are only a few publicly funded research projects with a main focus on this area of logistics and supply chain (see annex 2), namely:

- In the area of Collaboration: CO3.
- In the area of Supply Chain Coordination (or Vertical Collaboration): MODULUSHCA, iCargo, SECURE SCM.

In short the above projects enabled the following:

- CO3 addressed collaboration issues like business models, legal and operational tools for Horizontal Collaboration, enabling a number of business cases involving multiple collaborating shippers.
- iCargo and SECURE SCM enabled the ICT aspect of information sharing. iCargo has been developing an open ICT ecosystem to publish logistic services and compose door-to-door chains from the collaboration of different logistics services providers. SECURE SCM tested solutions and prototypes in the aeronautics industry, integrating different companies operating in the same supply chain.
- Modulushca addressed the physical aspects of combining loads through usage of iso-modular loading units.

Important lessons learnt from past projects are:

1. Collaboration can be successfully triggered and applied in almost any logistics environment, but it does not occur spontaneously with the existing market players
2. The new function of the Neutral Trustee developed in CO3, in addition to the existing roles of shippers and LSPs (3/4PLs), is essential in triggering and creating sustainable and large scale horizontal collaboration in the logistics market.
3. Horizontal collaboration among the right partners (shippers) can deliver simultaneous double-digit improvements in logistics cost; transport carbon footprint; empty mileage and network/asset utilisation while in many cases also improving customer service levels.
4. Anti-trust compliant, multilateral legal agreements will be key in the creation of sustainable and large scale collaborations. However, in most companies, there still exists a large "mental gap" between logistics and legal professionals.
5. Along with legal solutions, information technology (ICT) plays a crucial role in collaboration, but it is only an enabler.
6. To insure stability and fairness of the collaboration gain sharing is essential.
7. Many logistics services providers in the market are still hesitant or defensive to actively support collaboration between shippers, or to embrace collaboration among themselves.

1.4

Steps towards the Physical Internet

The **Physical Internet** is the fundamental background concept that should drive collaboration and coordination initiatives. For the industry stakeholders, the most important strategic drivers towards the PI are:

- Increasing the service level to the consumer of products and services, in the most efficient and sustainable way.
- Lowering the barriers to enter new markets and for consumers to have access to new products.

The efficiency and sustainability driver corresponds to the core message of the Physical Internet vision so far, that is: by opening the logistic networks and sharing resources, highest levels of efficiency can be achieved, unattainable by any individual company. Anyway, a company will never share assets/services in the supply chain if they are unique for its strategic position, i.e., if the logistic service-level is a differentiator against competitors.

The market driver is even more important, in the eye of the industry. The Physical Internet opens up new markets by multiplying the sources of supply. New products that were previously unavailable or too expensive to get to a certain market can be matched with new sources of demand, i.e., new retail models and the raising demand from on-line sales.

Full realization of the Physical Internet concept means that logistic assets and services cease to be a differentiator, as they are fully standardized, integrated and shared on global level. In other words, supply networks will become a commodity available to any sender and receiver. In this final scenario, competition will be no longer based on owned and individually -optimized supply chains. Higher-level logistic functions, such as demand-driven network planning, after-sales services and advanced stock allocation, will drive the competition among supply chain leaders.

In our vision, the Physical Internet will be realised in a gradual process where global supply networks evolve through three main stages, in chronological order:

1. Fully owned supply chains, where the assets and services are key constituents of the company products/services, as differentiators for the customer. This is the current situation.
2. Horizontal collaboration and vertical coordination in a defined limited network of companies, sharing what are considered "commodity" assets and services.
3. **Physical Internet** for most goods, in a full collaborative network involving multi parties, who are unaware of collaborating, with the lowest costs and maximum availability and service level.

1.5

Other Enablers

Besides Coordination and Collaboration, addressed by this roadmap, we recognize two other important enablers for the transformation process leading to the Physical Internet:

- **Internet-of-Things and Big Data infrastructure**. The Physical Internet represents the technological and informational basis for future coordination and collaboration in supply chains; emphasis should be laid on the smart analysis and management of event information addressed from the internet-of-things; the aim should be the development of advanced tools and systems which enable users to master the flood of information from big data for intelligent planning and control. These items are specifically addressed in the Roadmap Information Systems for Interconnected Logistics.

- **New manufacturing paradigms**. Future supply chains are networks of "Smart Factory". Emphasis should be laid on the integration of the Smart Factory (see Factory-of-the-Future) in supply network collaboration and coordination processes. The aim is to exploit the full potential of smart factories to improve flexibility and efficiency of production by intelligent coordination on the supply chain level. Further, the aim is to create new business processes and models based on the smart factory being integrated in intelligent supply chains. It is expected that the combination of Industry 4.0, Physical Internet and internet-of-things will lead to fundamentally new business models in manufacturing, retailing and customer services.

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1.6

Complementarities with other ALICE roadmaps

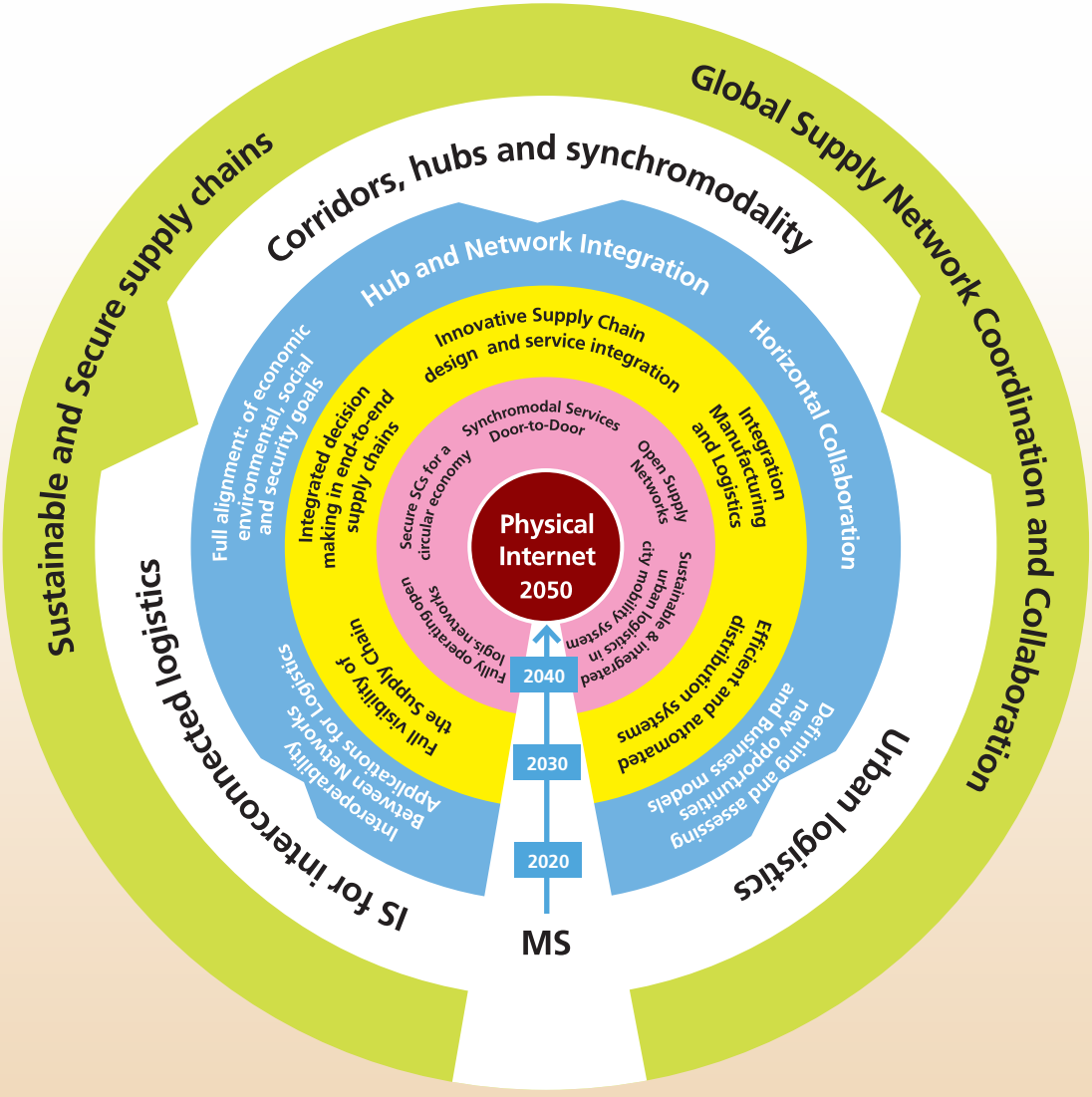

Figure 1: **Interrelation between roadmaps** (MS = milestone)

In Figure 1 the interdependencies of the roadmaps to achieve ALICE vision are included:

Specifically, the following links and complementarities with the other ALICE roadmaps are:

1. **Roadmap on Sustainable and Secure Supply chains**. Supply chain coordination and collaboration is one of the elements that can contribute to more sustainable and Secure Supply chains.

   Efficient vehicle and other assets utilisation through collaboration increase sustainability of operations by reducing costs and emissions. Therefore, the implementation of the roadmap included in this document will support the objectives of the sustainability roadmap.

   Moreover, better coordination and integration is a key element to increase safety and security reducing risks and increasing resiliency. In this roadmap, collaborative risk management and increased resiliency is addressed specifically, therefore contributing to that specific part within the scope of safety and security.

2. **Roadmap on Information Systems for Interconnected Logistics**. Information sharing is one of the most important baselines to achieve integration and coordination of supply networks. In the roadmap emphasis is laid on the smart analysis and management of event information from the internet-of-things; the aim is the development of advanced tools and systems which enable users to master the flood of information from big data by means of IT-tools and systems for intelligent planning and control. Specifically, information management (Data matching, Standards, Security, Protection of Confidentiality rights etc.) is addressed in this roadmap.

3. **Roadmap on Corridors, Hubs and Synchromodality**. Corridors and hubs may be important nucleation points for horizontal collaboration. They concentrate big volumes and therefore, big synergies could be found to increase operational efficiency.

4. **Roadmap on Urban Freight**. Urban environment is a specific area in which the developments of research and innovation in the area of coordination and collaboration can be tested and deployed. Specifically, providing business models and operations for well-functioning consolidation centers in cities. Moreover, the explosion of e-commerce requires more coordination and collaboration in the urban deliveries to reduce nuisance.

2

CHALLENGES AND THEMES

In this chapter we identify barriers and opportunities to collaborative business models that can pave the way to the development of the Physical Internet.

Chapters 2.1 to 2.4 address different operational areas in which horizontal collaboration and coordination is expected to have impact:

1. Collaborative supply network design.
2. Supply network coordination.
3. Integration of manufacturing and logistics.
4. Drivers and enablers for collaboration and coordination.

2.1

Collaborative supply network design

The following research themes have been identified:

Strategic collaborative logistic network design

Research and innovation activities in this area aim at supporting the strategic-level decisions that lead to the creation of collaborative supply networks, taking into account the typology and characteristics of logistic flows for the collaboration to identify collaboration opportunities and lead to network designs that maximise the resource utilisation. The resulting approaches and tools should be multi-criteria, weighting several aspects such as cost, service and sustainability, and offer different viewpoints to the different involved stakeholders.

Tactical planning and execution of collaborative networks

Research on this theme will deal with tools and approaches for tactical and operational optimisation of collaboration, including event management, maximizing resources utilisation. The focus should be on adaptation and integration of current logistics management approaches and systems, conceived for internal supply chain optimisation, to meet the requirements of open collaborative supply networks.

Resilience capabilities and risk management of collaborative networks

Research in this area will deal with the challenge of ensuring that shared collaborative networks meet the resiliency and security standards expected in traditional supply chains. This will require the alignment of proactive and reactive risk management approaches among the different stakeholders (in the supply chain and involving the collaborating partners as well as entities such as emergency authorities, customs, banks, governments, etc.).

Business models and change management for collaborative services

The challenge is to find economically sustainable business models for the provision of logistics services in open and collaborative supply networks. The new models will enable logistic services providers to meet the requirements of collaborating shippers, as well as to develop collaborations with other providers. The goal is to preserve profitability for services providers in collaborative networks, ensuring a smooth transition to the new business ecosystem based on shared resources and services.

In Table 2, the innovations and expected results out of the implementation of the research themes have been identified as well as the major drivers for change and barriers to overcome. It also includes the expected impacts out of the implementation of the themes.

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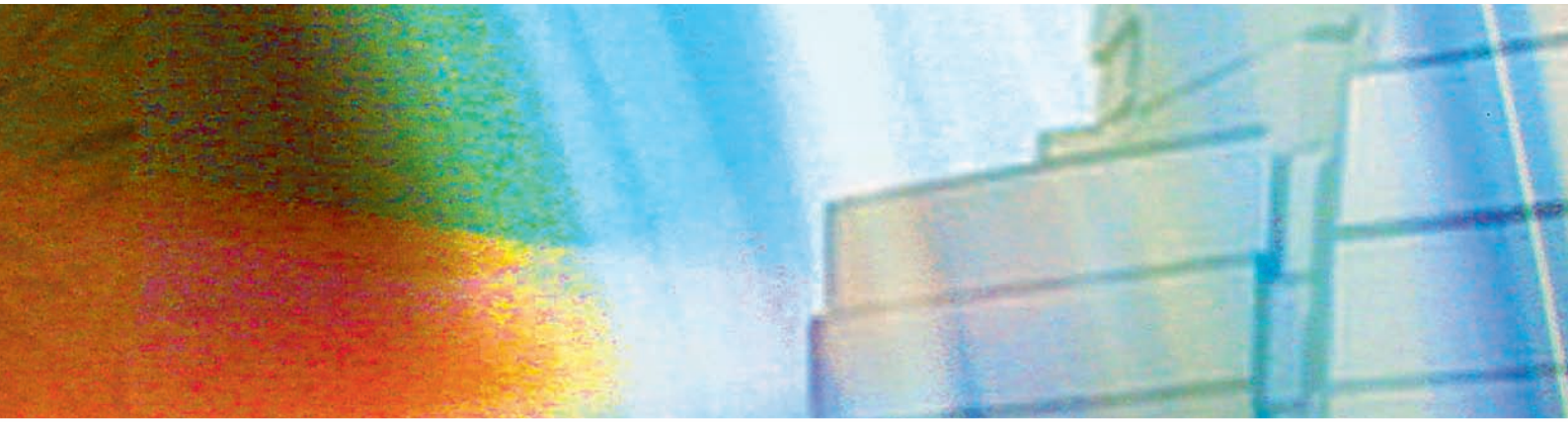
Table 2. Collaborative supply network design key elements

RESEARCH CHALLENGES	INNOVATIONS AND EXPECTED RESULTS	BARRIERS TO OVERCOME	EXPECTED SECONDARY IMPACTS	EXPECTED PRIMARY IMPACT
Strategic collaborative logistic network design	Business models and creation of a databank for match-making on macro level to find possible collaboration partners. Tooling for network analysis of typology and characteristics of logistic flows, taking into account affinity in products and processes, raw materials, bill of material, functionalities, handling and transport units, packaging materials, etc.	Exchange of sensitive data. Sharing supply chain with partners. New business models. Legal agreements. Antitrust rules.	+ Asset utilization. + Load factors. + Transport routes optimization. - Empty Kilometres. + Decoupling logistics intensity from GDP.	- Energy consumption. - CO_2 Emissions. + Return on assets and working capital. - Total supply chain costs.
Tactical planning and execution of collaborative networks	Collaborative planning and tools for daily optimization of collaborative networks, maximizing shared and complementary resources usage. Approaches and tools for supply chain execution and event management enabling users to manage operations in the physical internet, exploiting internet-of-things and big data availability.	Sharing responsibilities. Choice of common logistic service provider. Sharing goals. Gain sharing mechanisms.	+ Asset utilisation. + Load factors. + Transport routes optimisation. - Empty kilometres. + Decoupling logistics intensity from GDP.	- Energy consumption. - CO_2 Emissions. + Return on assets and working capital. - Total supply chain costs.
Resilience capabilities and risk management of collaborative networks	Methods and tools to ensure risk management and development of resilience capabilities in collaborative supply networks, including definition of quantitative metrics for the assessment of network risk and resilience.	Exchange of confidential data. Agreements on insurance, etc...	+ Reliability of transport schedules. + Perfect order fulfilment. - Risk factor reduction. + Supply Chain Adaptability and Flexibility.	+ Customer satisfaction. - Cargo lost to theft or damage. - Total supply chain costs.
Business models and change management for collaborative services	Proven business models and change management approaches for traditional carriers, forwarders and other services providers to develop new services in open collaborative networks.	Mental shift of participants. Cultural fit of collaborating companies.	+ Load factors. + Asset utilization. + Reliability of transport schedules. + Perfect order fulfilment. + Decoupling logistics intensity from GDP. - Empty kilometres.	+ Customer satisfaction. - Energy consumption. - CO_2 Emissions. + Return on assets and working capital. - Cargo lost to theft or damage. - Supply chain costs.



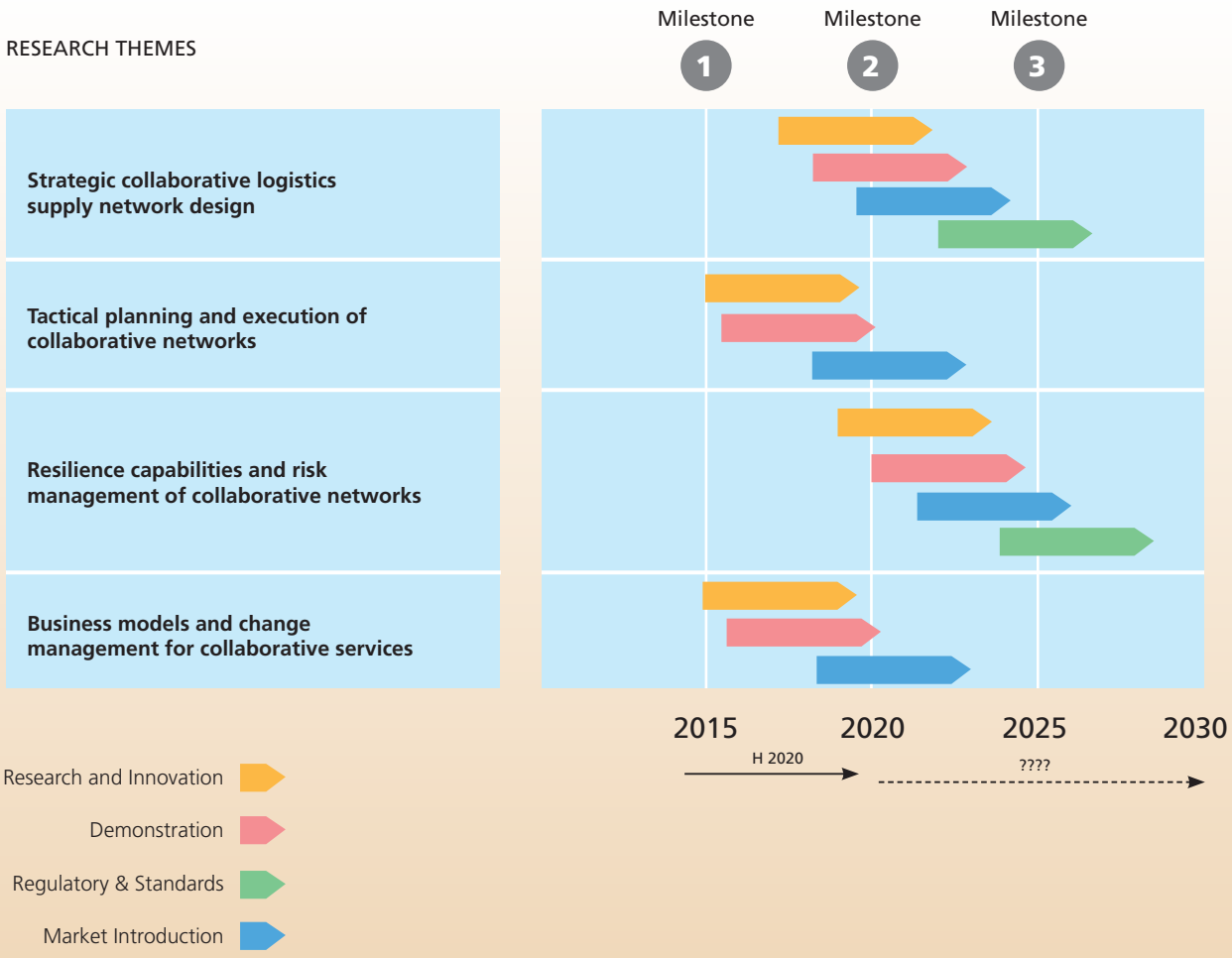


Figure 2: **Collaborative supply network design and operation timeline**

2.2

Supply network coordination

The following research themes have been identified as strategic:

Coordinated planning of supply chain and logistic services

Research in this area will deal with integration of traditional supply chain planning approaches with transport and logistics services planning, bringing control towers to the next operation level. The aim is to maximise resources utilisation through information exchange along the open supply network (several control towers), by matching forecast demand and stock allocation plans with logistics services availability. This will facilitate a number of efficiency-oriented management approaches, including vendor managed inventory models. Integration and synchronization of supply chain transportation/logistics with the production planning, sales and distribution planning of companies: manufacturers, distributors, logistics services providers and retailers should be addressed in order to promote the integrated coordination of value-networks.

Synchronization and dynamic update of logistics operations in open networks

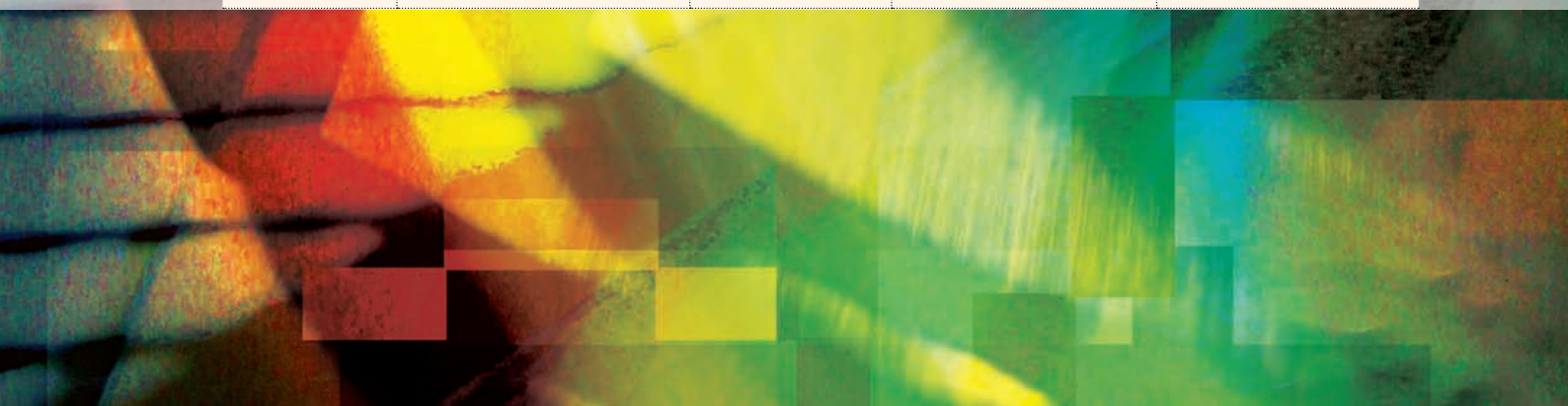
Research in this area is aimed at ensuring that shippers and services providers operating in open global networks are able to align and synchronize their operations in case of changes and deviations from plans. A number of initiatives have pursued similar objectives in the past, always within the boundaries of a single supply chain or in a restricted portion of the network (e.g., a port or inland terminal). The challenge is to achieve a high level of automated alignment in open networks, where many parties collaborate, even occasionally, covering the entire door-to-door chain.

Overcoming data-sharing barriers in collaborative networks

Supply network collaboration and coordination rely on capabilities to share, transform and use data among all the collaborating partners. A number of standards and ICT solutions are available to this purpose, yet these are far from being widespread in the logistics industry community. The challenge in this area is to understand the non-technological barriers that prevent data sharing, and to develop adequate countermeasures and approaches all this in coordination with the efforts and themes identified in ALICE roadmap on Information Systems for Interconnected Logistics.

Table 3. Supply network coordination key elements

RESEARCH CHALLENGES	INNOVATIONS AND EXPECTED RESULTS	BARRIERS TO OVERCOME	EXPECTED SECONDARY IMPACTS	EXPECTED PRIMARY IMPACT
Coordinated planning of supply chain and logistic services	Supply chain planning methods and tools integrated with transport and logistics services planning, covering the entire door-to-door chain.	Data sharing. Interconnection of IT platforms. Shared warehouses.	+ Load factors. + % Synchromodal. + Asset utilization. + Supply Chain Visibility. + Reliability of transport schedules. + Transport actors using automatic data exchange. - Empty Kilometres. - Waiting time in terminals.	+ Customer satisfaction. - Energy consumption. - CO_2 Emissions. + Return on assets and working capital. - Total supply chain costs.
Synchroni-zation and dynamic update of logistics operations in open networks	Tools for autonomous coordination based on the internet-of-things (automated reporting, self-controlled sub-systems). Governance models and cases to bridge gap between technological research and innovation.	Data availability and reliability. Governance of common systems.	+ Volume flexibility (Time to +/- capacity). + % Synchromodal. + Supply Chain Visibility. + Reliability of transport schedules. + Transport routes optimization. - Risk factor.	+ Customer satisfaction. + Return on assets and working capital. - Total supply chain costs.
Overcoming data-sharing barriers in collaborative networks	Approaches and policies to enable wide scale adoption of data-sharing solutions. Governance models to bridge gap between research and innovation in logistics data sharing, supported by proven and demonstrable business cases.	Data sharing. Interconnection of IT platforms.	+ Supply Chain Visibility. + Transport actors using automatic data exchange. + Cargo and logistics units integrated in the automatic data exchange.	- Energy consumption. - CO_2 Emissions. + Return on assets and working capital. - Total supply chain costs.



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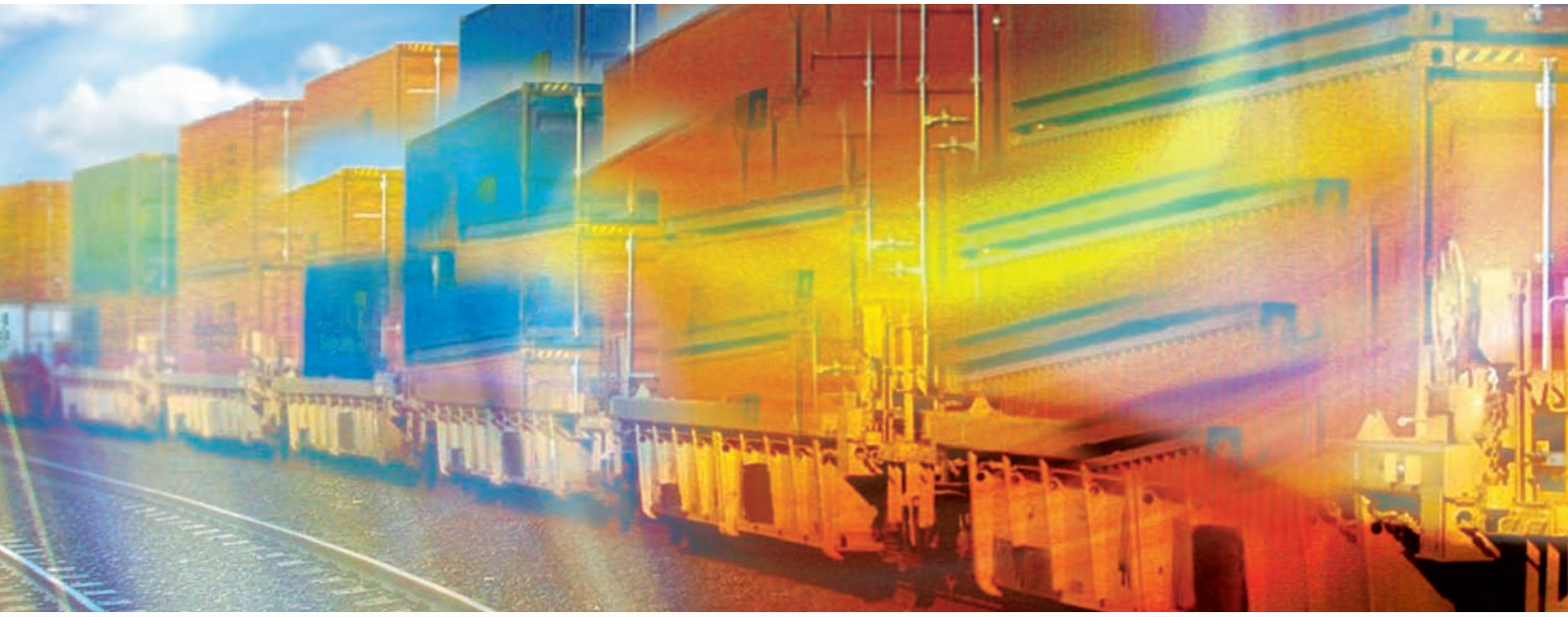

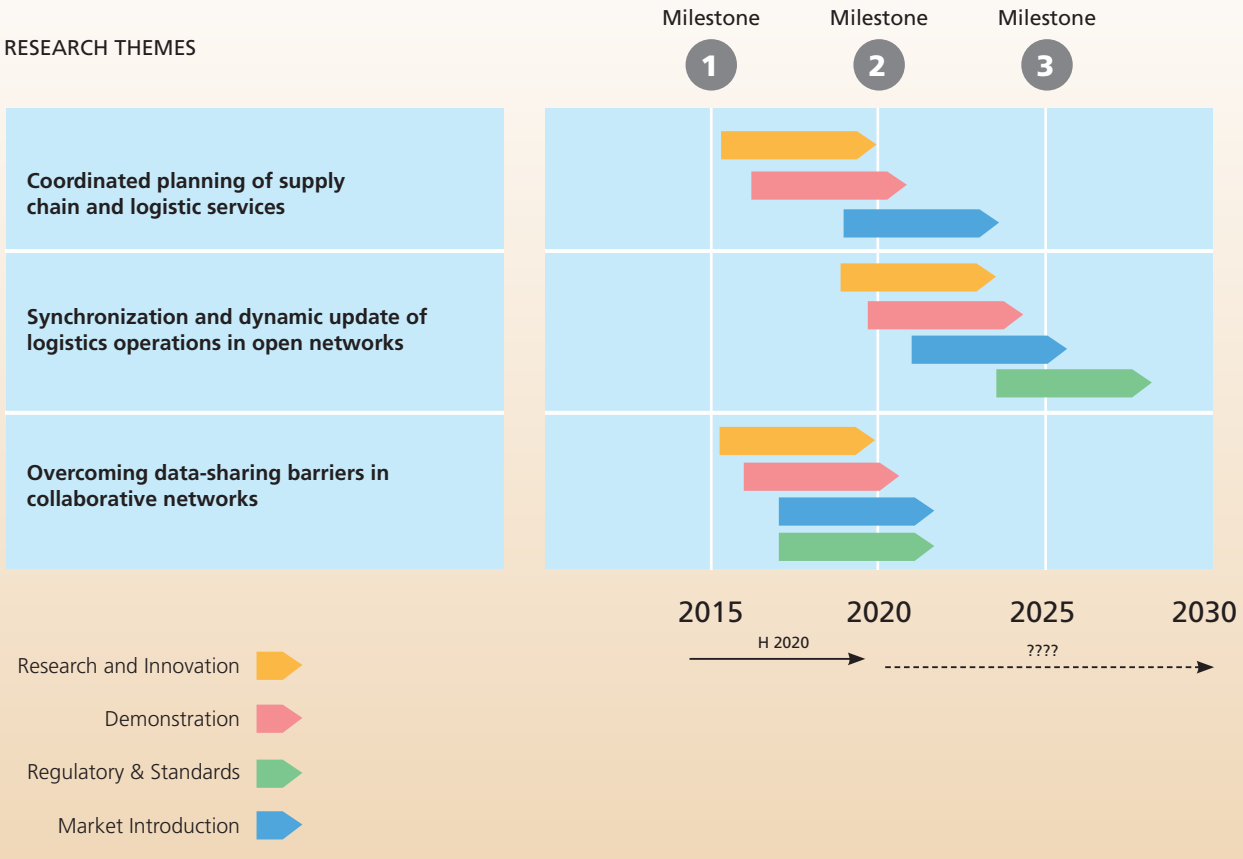

Figure 3: **Supply network coordination timeline**

2.3

Integration of manufacturing and logistics

The following research themes have been identified as strategic in the field of Integrating flexible manufacturing into open logistic networks.

Research in this area will deal with the planning of collaborative supply networks, on strategic, tactical and operational level, also including flexible manufacturing nodes relying on new technologies, such as micro-processing, on-site repairs, additive manufacturing, containerization of manufacturing, re-shoring manufacturing, etc. The opportunities and major development areas within this field are still not clear, so the content of this section is subject to change as further analysis is required to better understand the implications of the following concepts:

1. Holistic Supply Chain view.
2. Manufacturing villages for collaboration and sharing of non-unique resources (e.g. Pharma industry).
3. Agile, modular and distributed manufacturing: requirements, implications and opportunities for logistics.

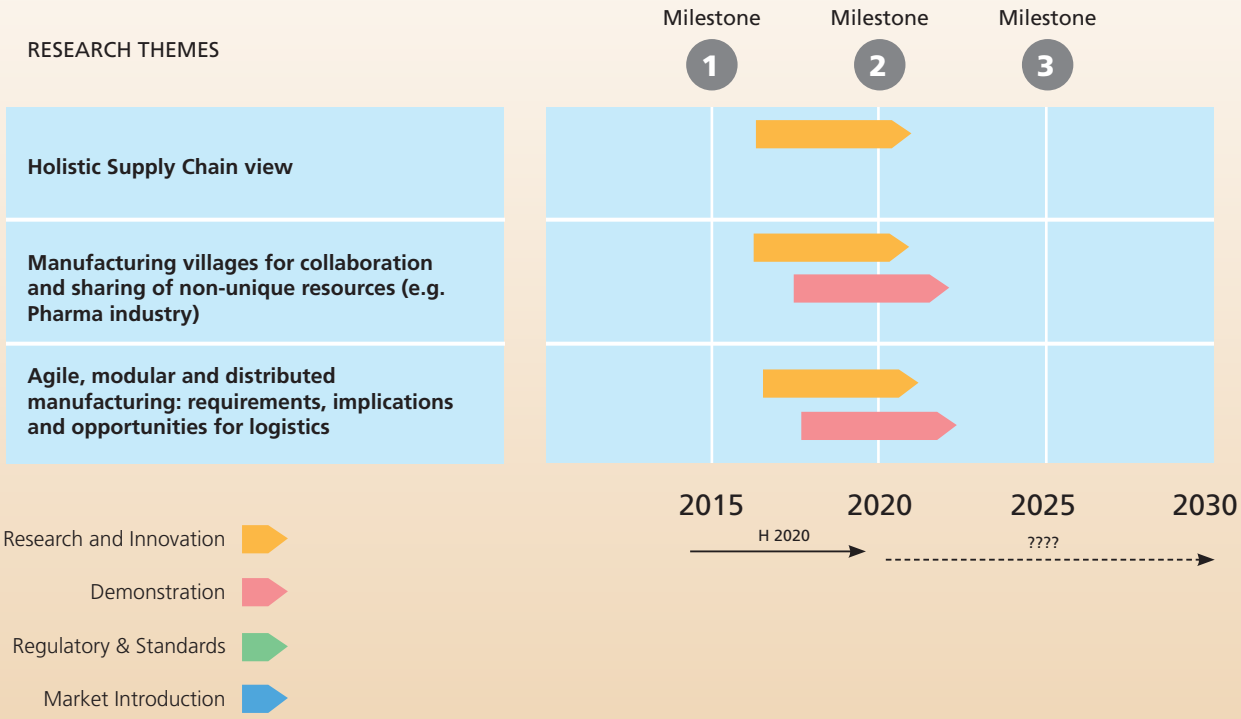

Figure 4: **Manufacturing and logistics integration timeline**

Additional exploratory work to define specific research challenges, innovations and expected results, drivers for change and Barriers to overcome and potential impacts is still needed.

2.4

Drivers and enablers for collaboration and coordination

The following research themes have been identified as strategic:

1. Favouring the transition to the new collaborative environment.
2. Understanding the impact of collaborative logistics.

Favouring the transition to the new collaborative environment

Innovation support is needed to favour the transition to new logistic networks based on collaboration, and to implement the necessary changes on current processes and systems. The activities in this area should be aimed at removing in-company barriers to collaboration, through proper change-management approaches, as well as at creating awareness and promote the diffusion of collaborative logistics approaches in the logistics community at large.

Expected Results:

- Change management approach to align organizations to collaborative logistics, addressing costs and investments, training needs on operations and management level, cultural and behavioural change requirements.
- Awareness creation actions including, e.g., collaboration practices identification and dissemination through visible "champions", involvement of catalysts to mobilize communities towards collaboration opportunities, e.g., organizations with recognized neutral roles, industry players with relevant experience and visibility.
- Review guidelines on antitrust rules and collaboration practices.
- Public incentives and awareness creation on political level, involving governments (e.g., in urban areas) to support collaboration initiatives and to address legal issues at national level.
- Resolving brand-related issues: company logo on shared trucks, for example through neutral certification entities like US Smartway or Greenfreight Europe or Lean & Green, and "closed door" multistage – "distributed" production for products with strong brand image component.
- Acting on barriers on international level, as highlighted in the Free trade agreements logistic impact study (Collaborative with the US/Canada).
- Reducing conflicts in standards (e.g. ISO pallets and containers).

Understanding the impact of collaborative logistics

Strategic drivers to collaboration in logistic networks have to be understood and quantified, internally within each partner but also across partners, to align the individual strategic visions for a successful long-term collaboration. Forward-looking KPIs are needed, supported where necessary by modelling and simulation techniques, to enable local as well as global strategic planning decisions, also supporting public authorities in policy planning and assessment.

Expected Results

- Tools and techniques to assess collaborative logistics impact, e.g., a particular Net Present Value formula for measuring the feasibility of collaboration, when benefits (including environmental ones) can be compared with investment (and risks) from every partner, in order to decide the gain sharing mechanism. Neutral tools are needed for all the players to agree on collaboration and ease the involvement (especially of SMEs). Qualitative benefits can correct the formula (e.g. sustainability, innovation, flexibility or other long term impacts, such as the benefits of supply chain visibility for shippers).
- Approach to find out the limit of collaboration opportunities, i.e., when the involved players become too many. Is there a breakpoint when it is best to move from active Collaboration to a market opportunity? This should be done through a measure/study of the breakpoint from where collaboration turns into a market (e.g. > 20 actors).
- Assessment of the value sharing model equivalent for new assets (e.g. a Public Private Partnership context) and best and efficient use of existing ones Key issue for the EU Corridor Coordinators.
- Creation of a Cube/Weight fill indicator to get more significant measurements of load factor.
- Acceptance, momentum, number of champions, countries (regulatory), inter-states links, pilot cases, critical mass for mental shift.

Table 4. Drivers and enablers for collaboration and coordination

RESEARCH CHALLENGES	INNOVATIONS AND EXPECTED RESULTS	BARRIERS TO OVERCOME	EXPECTED SECONDARY IMPACTS	EXPECTED PRIMARY IMPACT
Favouring the transition to the new collaborative environment	Change management approach…* Awareness creation actions... * Review guidelines on antitrust rules and collaboration practices. Public incentives and awareness creation on political level…* Resolving brand-related issues…* Acting on barriers on international level, as highlighted in the Free trade agreements logistic impact study (Collaborative with the US/Canada). Reducing conflicts in standards (e.g. ISO pallets and containers).	Cultural attitude towards change. Lack of an adequate business model.	+ Load factors. + Asset utilization. - Empty Kilometres. + Decoupling logistics intensity from GDP.	- Energy consumption. - CO_2 Emissions. + Return on assets and working capital. - Total supply chain costs.
Understanding the impact of collaborative logistics	Tools and techniques to assess collaborative logistics impact…* Approach to find out the limit of collaboration opportunities...* Assessment of the value sharing model equivalent for new assets...* …Mental shift *	Decision and set up cost of collaborative logistics.	+ Load factors. + Asset utilization. - Empty Kilometres. + Decoupling logistics intensity from GDP.	- Energy consumption. - CO_2 Emissions. + Return on assets and working capital. - Total supply chain costs.

* Full text in the sections: "Favouring the transition to the new collaborative environment" and "understanding the impact of collaborative logistics".

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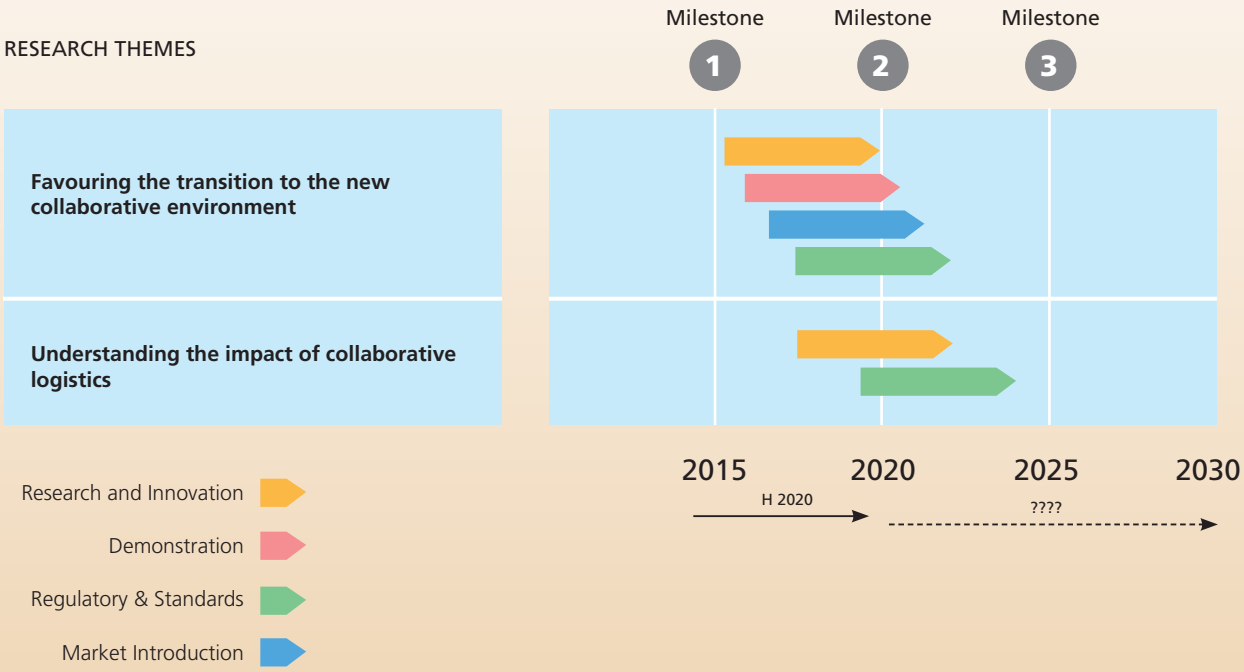
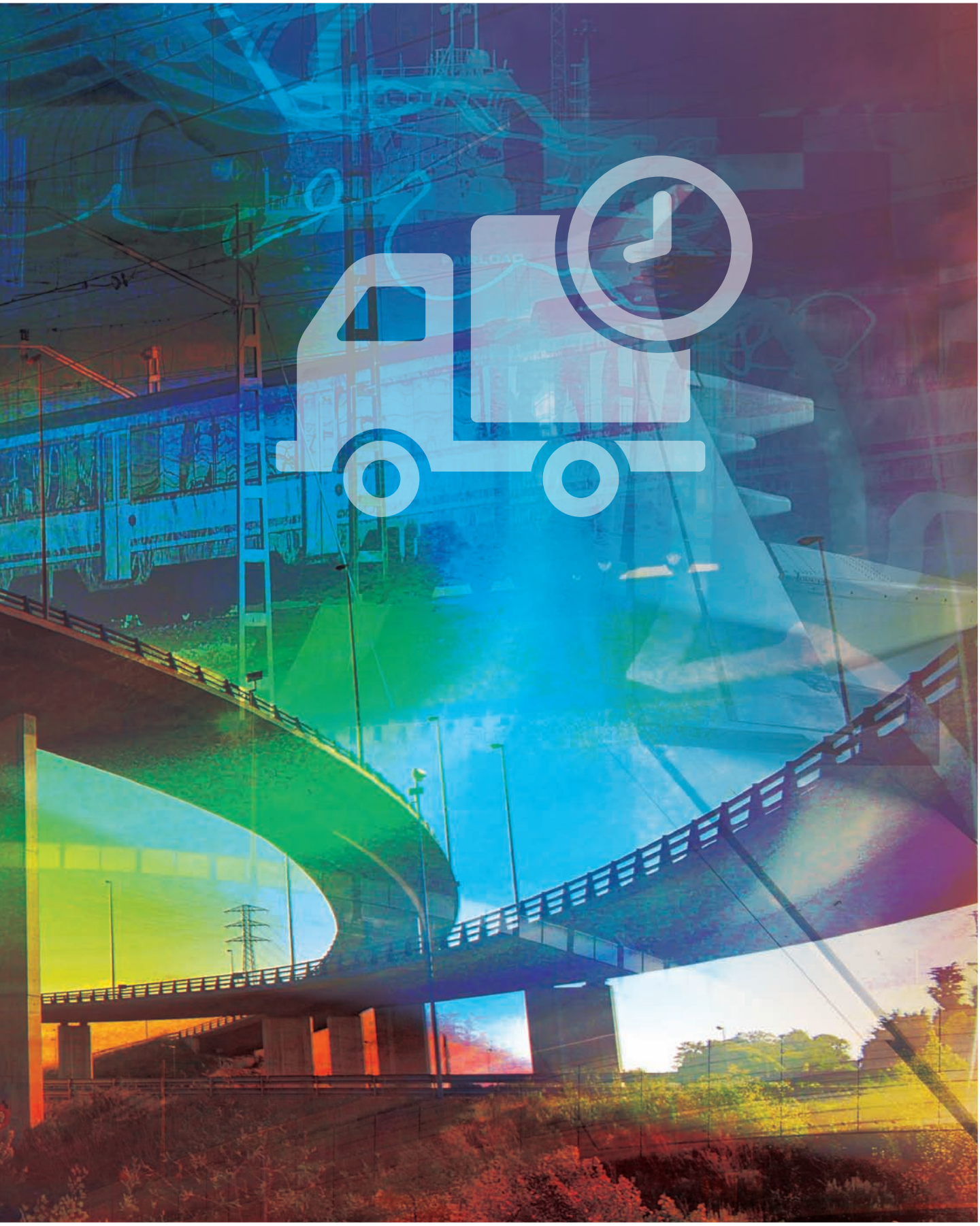
RESEARCH THEMES





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Annex 1

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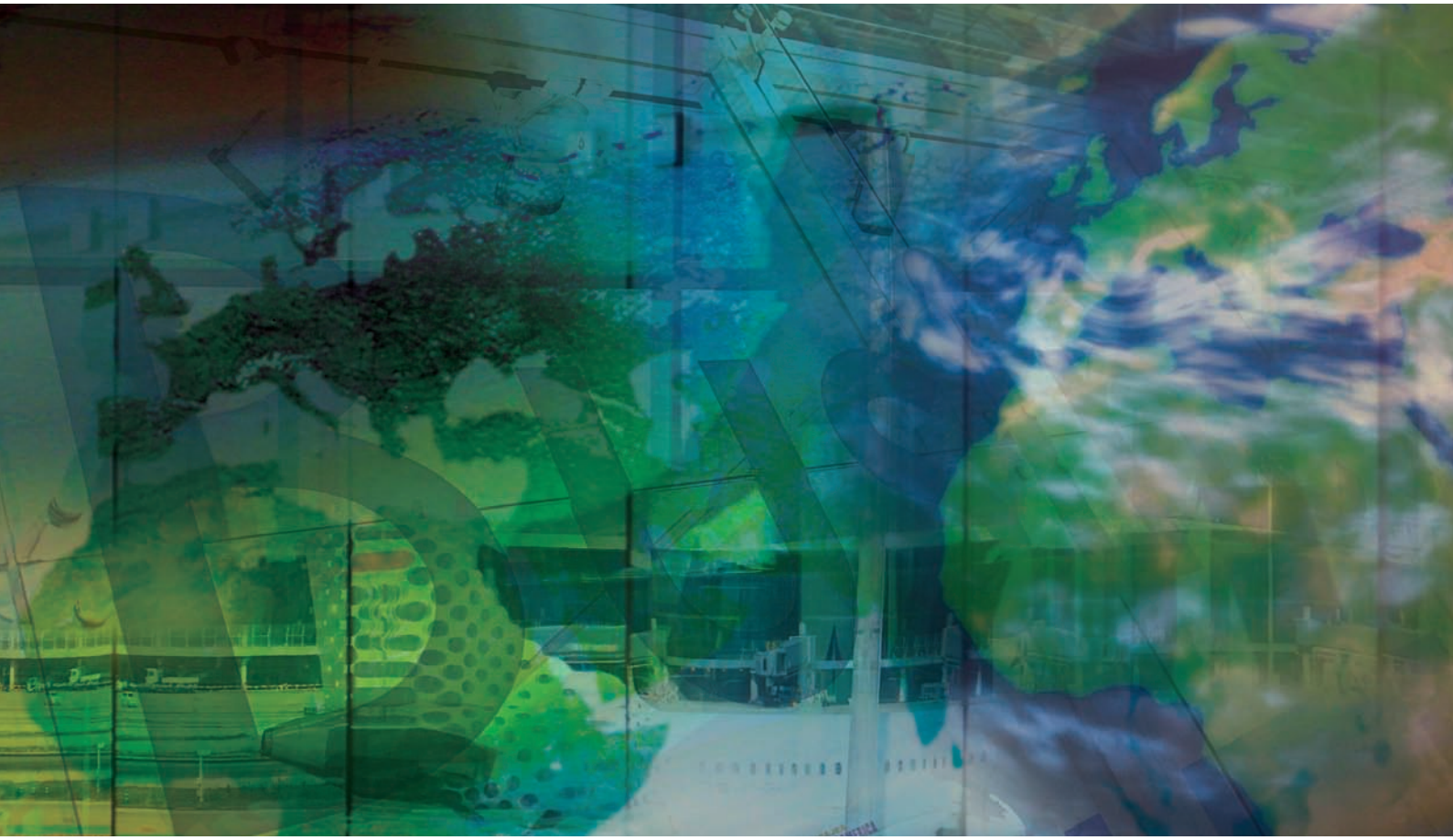
Annex 2

Overview of relevant projects and initiatives

ACRONYM	FULL TITLE	DESCRIPTION	DURATION	WEBSITE	EU/ NATIONAL INITIATIVE
CO3	Collaboration Concepts for Co-modality	CO3 is a business strategy enabling companies throughout the supply chain to set up and maintain initiatives to manage and optimize their logistics and transport operations by increasing load factors, reducing empty movements and stimulate co-modality, through Horizontal Collaboration between industry partners, thereby reducing transport externalities such as greenhouse gas emissions and costs.	36 months	www.co3-project.eu	EU
MODULUSHCA	Modular Logistics Units in Shared Co-Modal Networks	The objective of Modulushca is to achieve the first genuine contribution to the development of interconnected logistics at the European level, in close coordination with North American partners and the international Physical Internet Initiative. The goal of the project is to enable operating with developed iso-modular logistics units of sizes adequate for real modal and co-modal flows of fast-moving consumer goods (FMCG), providing a basis for an interconnected logistics system for 2030.	36 months	http://www.modulushca.eu/	EU
ICARGO	Intelligent Cargo in Efficient and Sustainable Global Logistics Operations	iCargo aims developing an "Open freight management ecosystem" for the easy publication of logistic services and logistic resources to improve collaboration in the logistics chain composition of door-to-door logistic services and dynamic re-planning with situational awareness.	42 months	http://i-cargo.eu/	EU
SECURE SCM	Secure Supply Chain Management	The project allows lowering data-sharing risks in SC Collaborative environments by developing secure computation protocols, including a successful demonstration in the real-world, the industrial supply chain of an aerospace manufacturer.	36 months	http://www.securescm.or/	EU

ACRONYM	FULL TITLE	DESCRIPTION	DURATION	WEBSITE	EU/ NATIONAL INITIATIVE
LOGICON		Logicon provides access to Logistic platforms to transport SMEs, from the sophisticated ones to simple ones. 4. By developing secure lean data exchange replacing proprietary and manual solutions, such as fax, email attachments or calls 5. By demonstrating the solution is simple, transparent, easy to use, with quick benefits 6. By easing the adoption by SMEs as bridge towards collaboration platforms 7. By developing specific solutions for real existing industrial problems. For instance: a universal fleet on-board system.	24 months	http://www.logicon-project.eu/	EU
DISCWISE	Digital Supply Chains for European SMEs based on the Freightwise Framework	The project developed the Common Framework for transport and logistics information systems, mainly targeting SMEs (LSCs and LSPs). It improved the integration of small and medium sized transport & logistics service providers into efficient digital supply chains, allowing clients to make more informed choices regarding the planning and execution of transport & logistics services. Co-modality was made easy-to-use for SMEs by enabling them to plan and execute door-to-door transport chains in which multiple services were combined.	24 months	http://www.discwise.eu/	EU
ITChain		A service oriented platform to achieve collaboration in the supply chain. The project developed tools for the improvement/automation of the demand/ offer management for fresh fish chain, so different brokers of the same buyer could cooperate adjusting shopping prices and conditions	24 months		Spanish Goverment
T-Scale	Virtual Collaboration in the Supply Chains	The project has explored new business and operational models for vertical and horizontal cooperation between shippers, freight forwarders and providers of transport & logistics services with the aim to increase load factors and reduce transport costs through co-modality.			
DaVinc3i	Dutch Agricultural Virtualised International Network with Consolidation, Coordination, Collaboration and Information availability	The Dutch ornamental plan cultivation industry functions as the center for trade for the whole of Europe. The implementation of virtualization and internationalization in this industry by using the concepts of remote purchasing and European distribution hubs can reduce the refrigerated storage and transport of fragile flowers and plants both in time and distance.	48 months	http://www.davinc3i.com	DINALOG (The Netherlands)
BESTFACT	Best Practice Factory for Freight Transport	The objective of BESTFACT is to develop, disseminate and enhance the utilisation of best practices and innovations in freight transport that contribute to meeting European transport policy objectives with regard to competitiveness and environmental impact.	36 months	http://www.bestfact.net/	EU

Project ended

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