Progress towards Federated Logistics through the Integration of TEN-T into A Global Trade Network

D3.7 EGTN Generic Use Case v.1

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Glossary of terms and abbreviations used

Abbreviation / Term	Description
AI	Artificial Intelligence
DASH7	Developers' Alliance for Standards Harmonization of ISO 18000-7
DoA	Document of the Action
DSS	Decision Support System
EGTN	EU-Global Transport &Logistics Networks
EPCIS	Electronic Product Code Information Services
ETA	Estimated time of arrival
EU	European Union
GS1	Global Standard 1
KPI	Key Performance Indicator
HMI	Human Machine Interface
ICT	Information and communications technologies
IoT	Internet of Things
IT	Information technology
LL	Living Lab
LMD	Last Mile Delivery
LPWSN	Low Power Wireless Sensor Networks
LSP	Logistics Service Provider
MAMCA	Multi-Actor Multi-Criteria Analysis
MLP	Multi-level perspective approach
M2M	Machine to Machine
PEN	Principal Entry Node
PEP	Principal Entry Point
PI	Physical Internet
PP	Position Paper
RFID	Radio Frequency Identification

SSCC	GS1 coding: Serial Shipping Container Code
T&L	Transport and Logistics
T&T&M	Track and Trace and Monitoring
UC	Use Case
VNA	Value Network Analysis
WP	Work package

1 Executive Summary

This deliverable sets up and specifies the parameters of an EGTN Generic Use Case. It brings together elements from the three PLANET Living Labs under a common EGTN framework and employs the analysis of the effects of the new trade routes in the TEN-T network carried out in T1.2.

The EGTN Generic Use Case is used in PLANET to produce a Digital clone aiming at investigating through simulation the impacts of introducing the EGTN infrastructure and the new logistics concepts and technologies along complete TEN-T corridors. The initial approach towards it is also presented in this document.

This report, as other deliverables produced in WP3, aims to facilitate the EGTN adoption by EU T&L actors and communities. It incorporates contributions from all relevant project partners. Main aim is to demonstrate how EGTN generic models and services based on the outputs of the three LLs can be applied by T&L communities. Specifically, the framework here developed will be later applied in port of Sines Use Case (D3.9).

The methodology to identify additional use cases during the project and their Value Network Analysis is also presented in this document. This strategic analysis allows to identify the changes required to enable the transition towards the EGTN adoption by T&L communities.

A second release of this report will be done at M34: D3.8-EGTN, Generic Use Case final version. This final release will include the simulation of the selected TEN-T corridors covering financial, business, economic and social impacts.

2 Introduction

2.1 Mapping PLANET Outputs

The purpose of this section is to map PLANET's Grant Agreement commitments, both within the formal Deliverable and Task description, against the project's respective outputs and work performed.

Table 1: Adherence to PLANET's GA Deliverable & Tasks Descriptions

PLANET GA Component Title	PLANET GA Component Outline	Respective Document Chapter(s)	Justification
DELIVERABLE			
D3.7 EGTN Generic use case v1	EGTN Generic use case that brings together and expand the results of the three Living Labs.	Chapter 5, Chapter 6, Chapter 7	EGTN Generic Use Case framework is presented in Chapter 5. The simulation design is introduced in Chapter 6, and the Generic Use Case impact assessment in Chapter 7. Chapter 4 introduces the LL-related activities.
TASKS			
ST3.4.1: EGTN Generic use case.	The EGTN Generic use case will be built in order to bring together and expand the results of the three Living Labs. The generic use case will use the results of the simulation of selected TEN-T corridors (the ones to be mainly impacted by the emerging trade routes to/from Europe) undertaken in T1.2, but this time taking into consideration the actual impacts of the LLs.	Chapter 5	Chapter 5 addresses the framework for the Generic Use Case, specifically its components and principles (section 5.1.2) and the Criteria and Selection of TEN-T corridors (section 5.1.4)
	A Digital clone will be produced based on the generic use case enabling answers to the question: what would be the impact of introducing the EGTN infrastructure and the new logistics concepts & technologies that were	Chapter 6	Chapter 6 describes the simulation design of the Generic Use Case and the approach towards the Digital Clone.

	tested in the LLs, along complete TEN-T corridors?		
	The assessment will include: (i) financial & business impacts, i.e. quality improvements and cost efficiencies achieved in day-to-day operations; (ii) economic & social impacts, i.e. congestion, accidents, air & noise pollution and climate change.	Chapter 7	The Impact Assessment Methodology of the Generic Use Case is described in Chapter 7. The generic KPIs for determining the impacts at financial&business levels, and economic&social are also listed. The simulation of selected TEN-T corridors covering financial, business, economic and social impacts will be addressed in the final release of the report in M34 (D3.8)
ST3.4.4 Identification and engagement of interested agents, complementary networks and use cases.	Additional external networking opportunities and networks for the project to link up with during the project, will be identified. A Value Network Analysis, in which the collaboration between each of the partners will be visualised, and the way of fulfilling this collaboration, will be used to show the relations between partners, for both tangible and non-tangible transactions.	Chapter 8	The identification of additional use cases and their VNA is addressed in Chapter 8.

2.2 Deliverable Overview and Report Structure

In this section, a description of the Deliverable's structure is provided, outlining the respective Chapters and their content.

- **Chapter 3** introduces the EGTN concept and vision for 2030. It is based on the work carried out in T1.5 EGTN Reference Specification and more specifically, reported in D1.10: EGTN Reference Specification v1. It also presents the basics of the Cloud-based Open ICT Platform under development in WP2.
- **Chapter 4** provides a background regarding the three individual PLANET Living Labs and use cases in which the generic one is based upon.
- **Chapter 5** describes the EGTN Generic Use Case purpose, components and principles.
- **Chapter 6** deeps into the Generic Use Case simulation design and scenarios definition. It also provides the basics regarding the Digital Clone that will be further developed in the final release of this document.
- **Chapter 7** provides a set of generic Key Performance Indicators which will allow the Generic Use Case impact assessment on a standard and common basis among different scenarios.

- **Chapter 8** deals with the identification and engagement of interested agents, complementary networks and use cases.
- **Chapter 9** summarizes the outputs of the present deliverable and how it has contributed to the overall project goals.
- **Chapter 10** contains the bibliographic references used in the document.

3 EGTN Framework

PLANET aims at speeding up the process and transition towards the Physical Internet paradigm, demonstrating how different technologies, business cases and standards come together in real-world applications, and are able to deliver added value to the users and have positive impacts in the environment. PI lays the foundations to realize the EGTN strategy towards Smart, Green and Integrated T&L Network. PLANET contributes to the PI concept together with other previous completed European projects, being ICONET[2] the most directly related, and also noteworthy to mention SENSE[3], CLUSTERS 2.0[4] or SELIS[5]. A comprehensive list of European projects for the PI development can be found at the ALICE-ETP Knowledge Platform[6].

3.1 The EGTN concept and vision

This section aims at introducing the PLANET environment describing the main purposes and attributes of the EGTN, exploiting the preliminary results coming from WP1. Specifically. it is based on the work carried out in T1.5 and more specifically on D1.10 EGTN Reference Specification v1, that defines the EGTN vision for 2030.

The **Integrated Green EU-Global T&L Network** (EGTN) can be understood as an advanced European strategy that implies the development of a Smart, Green and Integrated Transport and Logistics Network of the future to efficiently interconnecting infrastructure (TEN-T, Rail-Freight Corridors) with geopolitical developments, as well as to optimize the use of current & emerging transport modes and technological solutions, while ensuring equitable inclusivity of all T&L participants, increasing the prosperity of nations, preserving the environment, and enhancing Citizens quality of life. The strategy definition, the support to strategy implementation, the strategy possible outcomes (digital & physical infrastructures, new operational methods etc.) and the monitoring and maximization of strategy impact are functional components of the EGTN concept.

It can be defined as a green, globally connected and smart network that will be aware of the global and EU geo-economic developments and take advantage of technological advancements, timely responding to changes by adapting its development and operation. It will be an optimisation ready network in terms of logistics operations, able to better respond to the industry needs through the implementation of innovative technologies under the PI concept. At the same time, it will be an open network in terms of information sharing by its stakeholders, supporting their decision making at every level (operational, strategic etc.) and including them to its governance scheme through a multi-level governance approach. Finally, its structure will ensure that the disadvantaged regions of EU will have the required level of connectivity.

In this context PLANET defines the **Attributes** of the future EGTN as following:

- **Geo-economics aware:** A European T&L network that is aware of the geo-economics aspects driving the development of new trade routes and flows to/from Europe and their impact on the TEN-T;
- **Innovation:** A European T&L network that takes advantage of the potential of innovative logistics concepts (e.g. PI) and enabling technological innovations (Industry 4.0, blockchain, IoT, 3D printing, etc.) in its operation;
- **Impact:** A T&L network that is more economically, environmentally and socially sustainable than the existing TEN-T;
- **Integrated:** An EU T&L network integrated with the global network both in terms of hard & soft infrastructure;
- **Inclusive:** Accessible to disadvantaged regions, supporting the development of workforce skills & knowledge.

[2] https://www.iconetproject.eu/
[3] https://cordis.europa.eu/project/id/769967/
[4] http://www.clusters20.eu/
[5] https://cordis.europa.eu/project/id/690588/
[6] https://knowledgeplatform.etp-logistics.eu/

The TEN-T network was intended to address the implementation and development of a pan-European network of railways, roads, inland waterways, maritime shipping routes, ports, airports and railroad terminals. TEN-T policy evolved into supporting the application of new technologies and digital solutions to all modes of transport with the aim to reduce environmental impact and enhance energy efficiency and safety. The EGTN vision goes a step further in its ambitions and has the following **additional characteristics:**

- Responsive to changes
- Optimisation ready
- Resilient
- Oriented towards facilitating EU exports
- Supporting social cohesion & inclusiveness
- Bridge business/industry needs for planning to EU policy and infrastructure planning

The EGTN is foreseen composed by three interactive layers:

- The physical/**infrastructural layer**. It refers to how the EGTN will be structured in terms of physical corridors and nodes. The objective is to have a network that is better adapted to the new EU & Global geo-economic conditions, serve more efficiently future freight flows and facilitate better the development of disadvantaged regions in comparison to the current TEN-T structure. In this context, the infrastructural layer of EGTN is defined as the TEN-T of the future in terms of T&L infrastructure consisting of revised and enriched existing rail/road/maritime TEN-T infrastructure (nodes & corridors). The forecasting of future freight flows for years 2030 and 2050 which will lead to defining the final form of the physical network needed to be able to efficiently serve these flows is mainly being done in PLANET WP1.
- The **technological layer**, that represents the digital EGTN infrastructure and aims at leveraging emerging enabling technologies capable to support the PI paradigm. The main objective of the EGTN technological layer is to ensure that the EGTN fulfils its 'innovation embedding' attribute in the sense that it takes full advantage of the potential of innovative logistics concepts and enabling technological innovations in its operation, ultimately aiming to become a network operating under a PI paradigm. Towards achieving this goal, a Cloud-based Open Platform is being developed in the context of WP2 to support accordingly the main aspects of the EGTN concept: the planning and the decision support (on governance level) for the development of EGTN infrastructure and the operationalisation of the EGTN.
- The **governance layer**, that consists of the ecosystem of stakeholders interacting and collaborating for developing and sharing T&L infrastructure and participating in the decision making of the EGTN. The EGTN governance goal is to ensure that the EGTN members in the PI network engage in collective and mutually supportive action, that conflict is addressed and that network resources are used efficiently and effectively.

3.2 The Open EGTN platform overview

The EGTN platform is a platform for sustainable, integrated, and multimodal freight transport that engages diverse stakeholders of the T&L supply chain and enables them to interoperate and exchange data through a secure ICT infrastructure. It supports decision making, ensures transparency and equity to all stakeholders, improves operational procedures, and goes one step further towards the materialization of the PI concept. The EGTN platform is cloud-based and integrates services for interoperable logistics by exposing secure interfaces for data ingestion, data management, data governance and data visualization. PLANET **Cloud-based Open** EGTN platform developed in the framework of WP2 features a modular, multitier architecture (Figure 1) and brings together cutting-edge technologies such as IoT, 5G, AI and Blockchain (further information regarding the EGTN Platform Infrastructure can be found in D2.1).

Figure 1: PLANET high-level architecture

The Open EGTN platform will provide tools and services that will support stakeholder for operational decision making and will improve procedures towards achieving operational excellence for customers and external stakeholders, made possible by disruptive transport and logistics concepts and technologies.

The Open EGTN platform develops and integrates:

- Visibility services, exploiting the available technologies (low cost satellite, IoT sensors, drones etc.) for monitoring assets (tracking and tracing of the location and status) and processes of companies which will be accessible through an appropriate visualization dashboard.
- A data lake and tools for data analytics & aggregation of data resulting from PI services, leading to 'Big data' utilization for the creation of advanced transport and logistics services such as route optimisation, warehousing as a service and supplier collaboration and also for feeding Indices calculation for supporting public & industry decision making.
- Connectivity tools to digital infrastructure available at corridors and nodes (inside & outside EU) and to federated public and private platforms at EU for providing open access to data & services & for creating neutral Data availability to enable visibility, collaborative planning among stakeholders & optimization of supply chains "using" the network and "consuming" its capacities.
- Tools and services for planning of regional logistics in order to enhance operations at a regional level through achieving collaborative logistics & shared capacity models' implementation by the ecosystems in a geographical area or along a corridor.
- Tools to support cross organizational, cross country and cross system workflows with the use of interoperable distributed ledger ('blockchain') and 'smart contract' technologies.
- Synchromodality modelling & PI simulation capability for supporting Industry decision making.
- Models to support optimum network setup and routing optimisation.

4 PLANET Living Labs and use cases

Compared to the TEN-T, the EGTN will be a network with an increased focus on regional logistics through the development of infrastructure and services that will enhance operations at regional level as an approach that will increase inclusiveness of the disadvantaged regions and support their development.

The PLANET Living Labs and use cases are examples of those EGTN regional ecosystems. In the LLs, local and global actors are collaborating for implementing technological solutions which meet ecosystem needs for optimised logistics operations. These ecosystems will be enriched and PLANET tools will contribute to regional PI hubs infrastructure planning and further logistics operation enhancement in the view of the 2030-time horizon. They encompass multi-modal and intercontinental routes with the overarching objective of optimizing end to end supply chains.

This section contains a summary of the three PLANET Living Labs, use cases, technologies to be tested and expected impacts.

4.1 Living Lab 1

The LL1 aims at testing new technology solutions and concepts to improve process, operations, and efficiency along door-to-door transport chains linking China with Spain, as depicted in Figure 2.

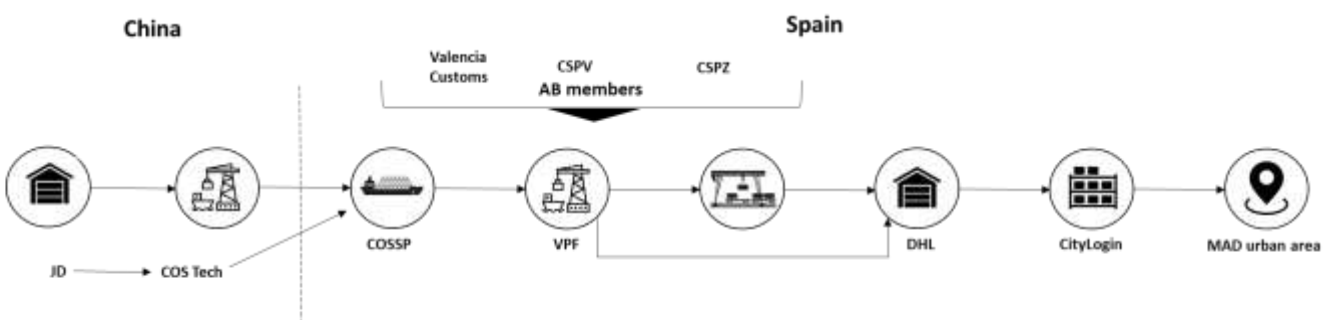

Figure 2: LL1 D2D transport chain and actors involved

Two use cases are being developed:

1. **Use case 1 on improving container cargo operations between China and Spanish hinterland.**

The use case 1 will be developed by performing the following activities:

1A: Intelligent decisions at transport and logistics hubs (operations and routing):

- Simulation and assessment of a real-time synchro modal planning approach aligned with PI principles where the port-terminal logistics hubs provide optimized dynamic routing of containers through the network considering capacity, level of service and cost of the multiple modes of transport available; the connection of the Spanish network with the European TEN-T will be assessed.
- Application of intelligent algorithms (based on AI machine-learning) for the detailed assessment of the impact of route changes of large oceanic container ships on terminal operations, considering the necessary inland transport re-routing of shipments.

1B: Extend the simulation performed in activity 1 to the last mile delivery, testing of a PI network, including entry nodes (ports) and adding warehouses (DHL) and city-hubs (CityLogin) using the EGTN Architecture designed in WP2. Specification of a PI network in Spain, by providing intelligence to the entry nodes to take decisions and linking them to the automated warehouse nodes that will then be connected with the city nodes.

1C: Develop the blockchain technology at Valencia Port's hinterland, managing multiple interactions and transactions during Import procedure with a large number of different stakeholders, public and private, including port and maritime authorities, customs and other inspection bodies, transport companies, port terminals and rail terminals, freight forwarders, importers and exporters, etc. Explore the possible interoperability in between.

1D: IoT deployment for worldwide tracking of containers and other load units and logistics assets: (i) Testing with specific Asia-Europe shipments of the innovative solutions proposed and developed within PLANET (T2.2).

2. **Use case 2 on optimizing warehouse operations and automation and last mile deliver efficiency and sustainability.**

The use case 2 will be developed by performing the following activities:

2A: Intelligent decisions at transport and logistics hubs (operations and routing):

- Apply Machine Learning & Analytics to enhance predictive logistics and warehouse operations planning.
- Apply simulation for optimization possibilities in terms of resources and warehouse operations based on volume forecast combined with Assisted Picking robots and Digital Clones for warehousing.

2B: Extend the simulation performed in activity 1 to the last mile delivery, testing of a PI network, including entry nodes (ports) and adding warehouses (DHL) and city-hubs (CityLogin) using the EGTN Architecture designed in WP2 (demonstrate link between use cases 1 & 2). Simulate optimal routes to deliver goods coming from ports to warehouses and city-hubs, compare existing DHL last mile delivery vs CityLogin Green vehicles, explore collaboration for sharing transport/warehouse with other companies and the use of Blockchain for Smart Contracts.

2C: End to end visibility over different operators and means of transport: IoT deployment for real time container tracking to monitor freight on inland transport and warehouse in order to increase the visibility, traceability and reliability of logistics operations.

The different EGTN technologies implemented in both UCs and their expected benefits are summarized in Table 2 and Table 3.

Table 2: LL1 UC1 EGTN technologies and expected benefits (from PLANET D1.2)

LL1 UC1 Improving container cargo operations between China and Spanish hinterland

Technology	Expected benefits
Blockchain	• Time reduction in administrative processes • Secure business-to-business data exchange
IoT	• Control of the location of the cargo • Reduction of waiting times in the loading/unloading process (lorry, ship, train). •Improved synchronization of processes.
AI	• Selection of the best means of transport according to timetable, capacity... • Vessel planer decision. If there is congestion in a port: wait for the port to clear or go to another port.
PI	• Autonomous decision per container at each node. • Open logistics environment to share capacity data to improve the use of assets.

Table 3: LL1 UC2 EGTN technologies and expected benefits (from PLANET D1.2)

LL1 UC2 Optimizing warehouse operations and automation and last mile deliver efficiency and sustainability.

Technology	Expected benefits
Blockchain	• Facilitate collaboration with other companies • Greater use of green vehicles • Help with conflict resolution
IoT	• Anticipated arrival of container at short range • Location of a package during delivery
AI	• Cargo demand forecast • Route optimization • Standardization of information (addresses, opening hours...)
PI	• Collaboration with other companies • Standardization of containers for last-mile delivery

4.2 Living Lab 2

This living lab addresses improvements in the handling of rail freight between China-USA with the port of Rotterdam as transshipment and modality shift point.

Three use cases are developed:

1. **Use case 1** focuses on Synchromodality in a Blockchain-enabled Platform involving the Port of Rotterdam community and customers. A Blockchain demonstrator has been implemented to deal with post-Brexit customs processes for food related products between the Netherlands (Port of Rotterdam) and the UK (Figure 3). This demonstrator will be further extended to support shipping documentation (i.e. the electronic Bill-of-Lading). Furthermore, it could be used to prototype key requirements identified in use case 2.

2. **Use Case 2** focuses on investigating the potential of a Eurasian rail freight expansion. Depending on the identified key requirements of the relevant stakeholders and on the growth hurdles, the most appropriate organizational measures and (IT-) technologies will be identified and selected.

3. **Use case 3** will analyse LL2 corridor flows and assess the implication for TEN T infrastructure. This use case will not develop or test technologies, but carry out a dedicated infrastructure analysis.

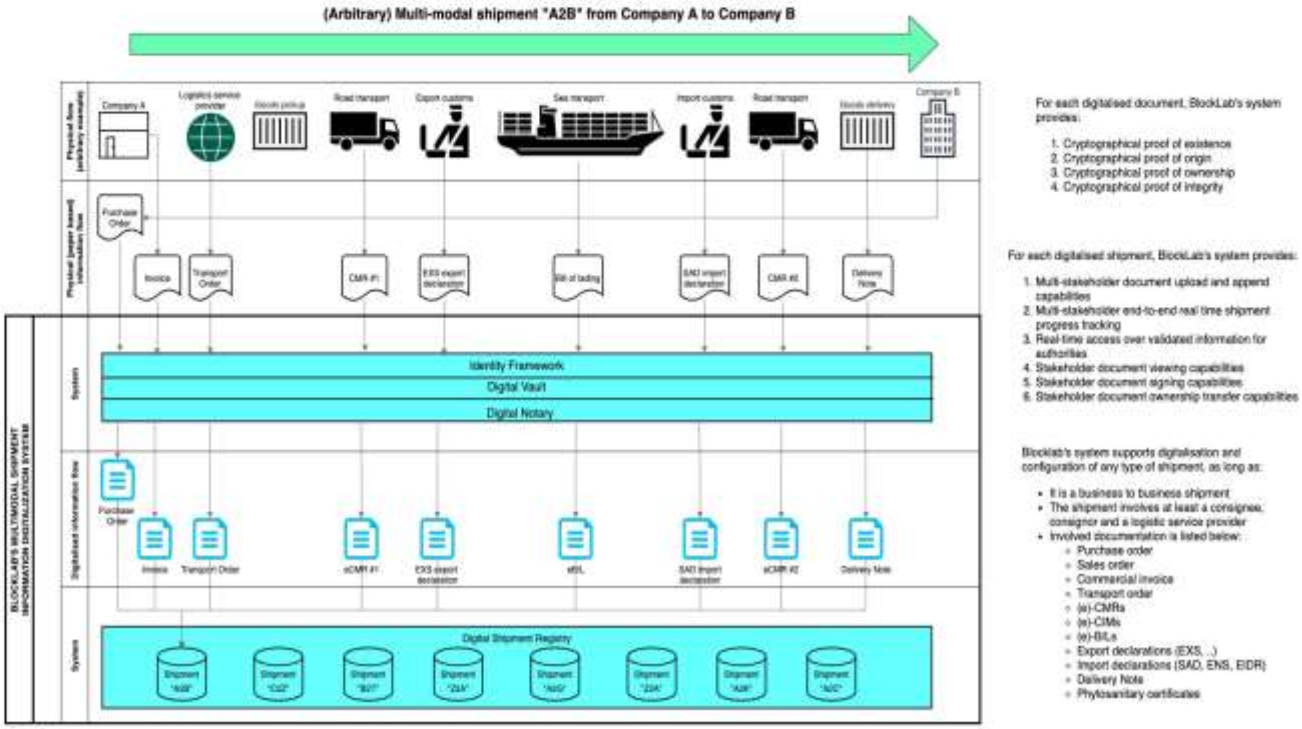

Figure 3: Living Lab 2, Use Case 2-Blockchain enabled platform

Table 4: LL2UC1 EGTN technologies and expected benefits

LL2 UC1 Synchromodality in a Blockchain-enabled Platform

Technology	Expected benefits
Blockchain	• Significant (up to 40%) cost reductions per shipment for customs clearance through automation of existing paper-to machine-to paper processes. • Provide digital proof-of-integrity, proof-of-origin and proof-of-ownership of digital (document) assets providing unprecedented levels of compliance. • Secure digitization of multi-modal information flows at shipment level.
Machine Learning	• Reduce manual entry time per shipment up to 50% through Optical Character Reading of documents.

Table 5: LL2UC2EGTN technologies and expected benefits

LL2 UC2 Investigating the potential of Eurasian rail freight expansion

Technology	Expected benefits
Blockchain	• Improvement the electronic management of documents (commercial and customs) will be defined. The relevant processes on specific intercontinental rail routes are mapped, based on which the optimal digital solutions are defined. The digital solution(s) will build upon the results from UC1, using Blockchain as preferred technology for platform implementation.

4.3 Living Lab 3

This Living Lab is focused on streamlining logistic processes in flows from China to Europe by implementation of IoT technologies and EPCIS platform as well as other GS1 standards that facilitate transmission of data between the partners involved in the logistics operations along the Silk Road Route.

The two main objectives are:

1.-Increased visibility of goods thanks to IoT along the Silk Road

Development of IoT solutions based on DASH7, RFID, LPWSN and sensors systems that help control resource parameters in real time and identify them while moving in the transport process, examining potential positive results in terms of broad implementation

2.-Standardization of information flow

Creation of a digital connection between actors in the transport network, enabling standardized data flow and access to information about cargoes coming from China to Poland in the whole supply chain in real time (implementation of the SSCC number and EPCIS test)

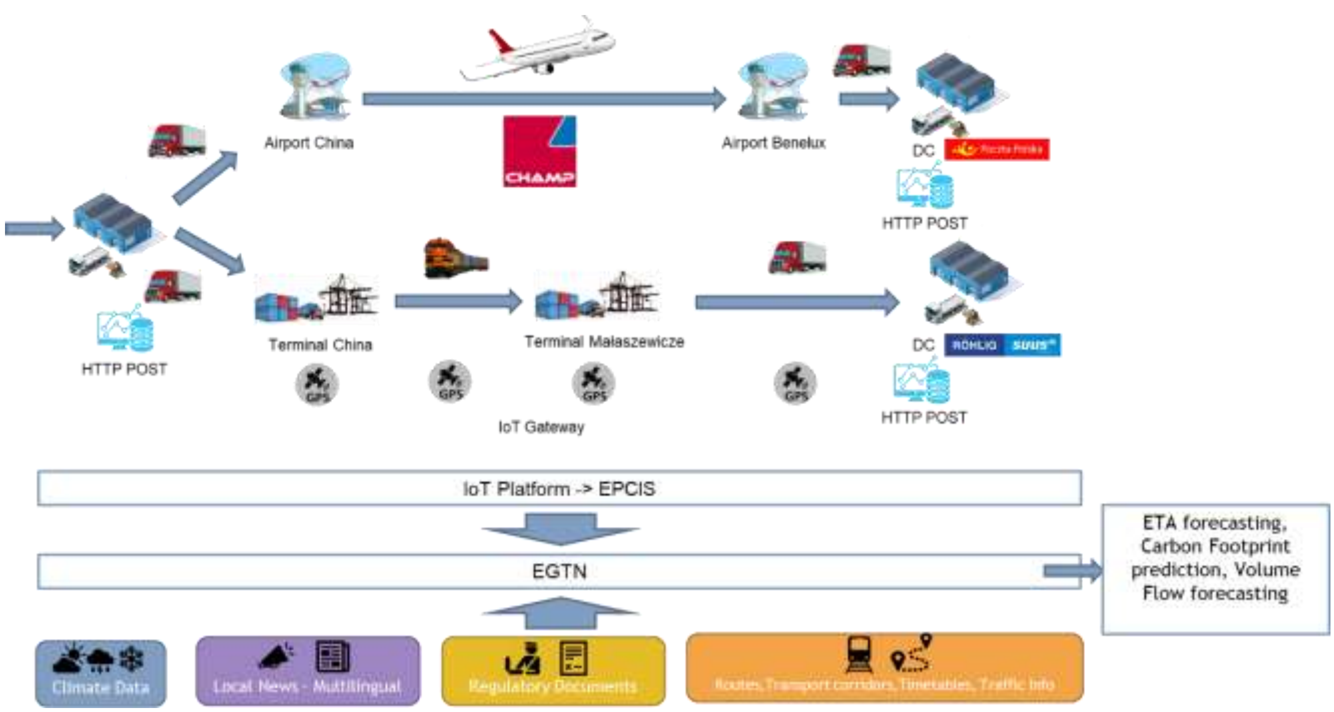

Figure 4 LL3 use cases scenarios

The identified business needs of the Living Lab partners were the starting point for developing LL3 use cases (Figure 4). Looking at both the business needs of the partners as well as the scope for testing solutions in LL3, two primary scopes were identified to be tested:

- Container transport monitoring on the New Silk Road (Rohlig Suus - RS),
- Monitoring shipments on the New Silk Road including air transport, in terms of e-commerce parcel distribution (Polish Post - PP).

This subdivision of use cases results from the specific business characteristics of the partners in LL3 and the used solutions. Therefore, each use case includes the following activities:

- Use Case 1 Monitoring and optimization of container flow along the New Silk Road:
    - Activity 1: Implementation of sensor network mobile base stations and beacons on containers and selected logistic units - Implementation of sensor network technology to collect data on container transport conditions and selected logistic units during transport,
    - Activity 2: Integration of operational data in the supply chain - Use of EPCIS for event data collection and integration with IT systems of business partners and IoT sources,
    - Activity 3: Use of EGTN for estimation and prediction of selected logistic KPI's - Use of EGTN for Volume Flow forecasting, Carbon Footprint Prediction and ETA forecasting. Comparison of different ETA calculation models on the bases of ETA forecasting accuracy,
- Use Case 2 Optimization of e-commerce flows in global supply chains:
    - Activity 1: Integration of operational data in the supply chain - Use of EPCIS for event data collection and integration with IT systems of business partners,
    - Activity 2: Information flow standardization in supply chains - Application of GS1 standards (mainly SSCC) for monitoring e-commerce parcel shipments from China to Poland,
    - Activity 3: Use of EGTN for estimation and prediction of selected logistic KPI's - Use of EGTN for Volume Flow forecasting, Carbon Footprint Prediction and ETA forecasting. Comparison of different ETA calculation models on the bases of ETA forecasting accuracy.

Table 6: LL3UC1 EGTN technologies and expected benefits

LL3 UC1 Monitoring and optimization of container flow along the New Silk Road

Technology	Expected benefits
Sensor Network	• Shortening the time of transport thanks to faster reaction at individual stages • Providing information on the status and location of goods on an ongoing basis • Clear records of events affecting the cargo condition (exceeding temperature, humidity, shocks, tampering) and a clear division of responsibilities for damages
EPCIS platform	• Reduction of operational errors due to the lack of detailed information about the delivery • Possibility of confirmed and documented conditions and risks of rail transport

Table 7: LL3UC2EGTN technologies and expected benefits

LL3 UC2 Optimization of e-commerce flows in global supply chains

Technology	Expected benefits
GS1 Standards	• Cost optimization • Operational times optimization • Transparency and supply chain correctness • Distribution time reduction
EPCIS platform	• Reduction of operational errors caused by lack of detailed information about delivery • Lower risk of shipment loss in international supply chain • Improvement of delivery status monitoring in transit to Client • Possibility of monitoring of additional data, which cause in higher delivery service quality

4.4 Port of Sines Use Case

The port of Sines is an important multimodal transfer node interfacing TEN-T (Atlantic corridor). It is the third in total cargo handled in the Iberian Peninsula (the first in Portugal). More than 90% of the total cargo (containerized and dry bulk) that is directed to the hinterland goes by train. Thus, Sines is an important rail freight platform, with trains carrying containers, refined & petrochemical products, and coal. In the framework of PLANET project, the Generic Use Case will be applied in conjunction with the Cloud-based Open.

EGTN ICT Infrastructure developed in WP2 to demonstrate how EGTN generic models and services can be applied by Sines T&L communities. It will be reported in D3.9 (M34) together with a transferability guide. This sub-section provides a preliminary description of this specific use case.

Portugal belongs to the EU Disadvantaged (less developed) Regions[7]. The regional policy of the EU, also referred as Cohesion Policy, is a policy with the stated aim of improving the economic well-being of regions in the European Union and also to avoid regional disparities. More than one third of the EU's budget is devoted to this policy. On the other hand, the TEN-T planning was segmented in the period 2014-20 in 30 Priority Projects (or axes), most of which are still in progress. Two of those priority projects involve Sines terminal and are aligned with part of the activities foreseen in PLANET (Figure 5).

- Priority Project 8. Multimodal axis Portugal/Spain-rest of Europe.
- Priority Project 16. Freight railway axis Sines/Algeciras-Madrid-Paris

[7] https://ec.europa.eu/regional_policy/en/atlas/portugal

Figure 5: TEN-T programme priority projects involving Sines terminal

The Use Case will take advantage of the insights gained and developments of the project to further advance the following activities. Main objective is to transform the Port in a Principal Entry Node (PEN) interfacing TEN-T to global trade routes.

- Activity 1: EGTN implementation by the Port Community focusing on the creation of a Global trade zone as EGTN PEN. Extension of the Single Logistics Window concept (Figure 6) not only at the port, but also internationally involving other Iberian dry ports, supporting multimodality.

Figure 6: JUL (Logistics Single Window) (Source: APS-Port of Sines and Algarve Authority 2019)

- Activity 2: Closing the loop of the Silk Road (Figure 7). Last leg of the cargo train from Yiwu: Madrid-Sines. PLANET will analyze the extension of the route to Portugal and provide recommendations to overcome the current barriers. The port of Sines is in position of providing backhaul cargo to make the overall route more efficient.

Figure 7: Yixinou Series Train Operation Diagram as per today

5 EGTN Generic Use Case Framework

5.1.1 General Overview

The EGTN Generic Use Case aims to demonstrate how EGTN generic models and services based on the outputs of the three LLs can be applied by T&L communities. Thus, simulation model can be used to further investigate specific use cases proposed in the context of the project (i.e. Port of Sines). It is based on the Generic Use Case developed in the European Project ICONET which linked the Living Labs under a common PI framework following a top-down approach. In PLANET, disruptive technologies and the impact of the new trade routes in the TEN-T are also incorporated following a bottom-up approach. It is defined with the time horizon of 2030.

The Generic Use Case represents an abstraction of the TEN-T network operating under the PI paradigm, based on the selected elements which correspond different LLs within PLANET and following the EGTN principles and requirements from T1.5. It makes a representation of a real-world system by creating a conceptual model for a generic geographic area, a series of descriptive elements, the logical relationships relative to the components of the system, the input and output data and a set of capabilities for different scenarios configuration.

PLANET EGTN Generic Use Case is conceived as a modelling use case in a strategic planning context (Figure 8).

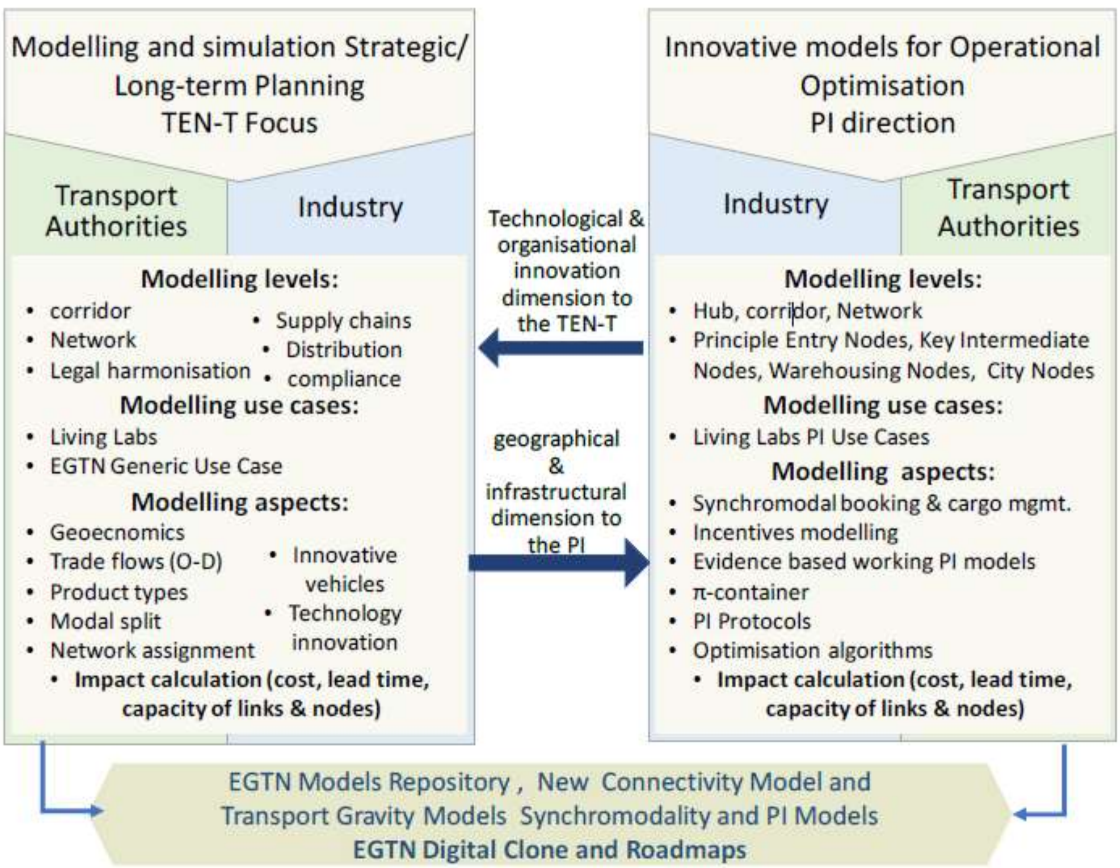

Figure 8: PLANET's modelling and simulation scope and approach (from PLANET DoA)

By **modelling use case**, PLANET refers to a specific situation in which a model could potentially be used. To define the modelling use case, the first step is: 1) to provide main user (stakeholder interested in the analysis), 2) the context of application (logistic setting of interest) and 3) the evaluation scenarios of interest. The user of the Generic Use Case is foreseen to be an operational user, supporting companies to create strategies business and technology. However, it can be also used by Policy Makers to explore the impacts of EGTN-related concepts and create policies in advance. The context of application and evaluation scenarios are described in subsequent sections in this document.

PLANET's "modelling syntaxis" defines model and simulation as (see D1.2):

- a **model** is a representation of the structure and operation of a system of interest. It is similar to, but simpler than the system it represents, and its purpose is to enable the analyst to predict the effect of changes to the system. A model should be a close approximation to the real system and incorporate most of its key features while at the same time it should be simple enough to understand and experiment with it.
- a **simulation** is the operation of a model of an existing or proposed system to evaluate its performance under different configurations and over extended periods of real time. It is used before an existing system is altered or a new system is built, to reduce the chances of failure to meet specifications, to eliminate unforeseen bottlenecks, to prevent under or over-utilization of resources, and to optimize system performance.

The initial Generic Use Case model representation and simulation are addressed in the next sub-sections and chapters.

5.1.2 Components & Principles for composing the Generic Use Case

The Generic Use Case addresses the attributes of the EGTN in the following way:

Table 8: Generic Use Case Attributes

EGTN Attributes	Generic Use Case
Geo-economics aware	Incorporates the Impact of the new trade routes on the TEN-T corridors (results from T1.2)
Innovation	Considers logistics innovations (PI, Cargoloop) and disruptive technologies (tools and services offered through the cloud-based Open EGTN platform)
Impact	Provides a set of generic KPIs which will allow the Generic Use Case impact assessment on a standard and common basis among different scenarios.
Integrated	Considers the integration of the European T&L network integrated with the global network (in both, entry and exit points)
Inclusive	Can be and will be latter applied to European less developed regions (Port of Sines use case)

The initial approach of PLANET EGTN Generic Use Case is defined in Figure 9, combining generic elements from the three Living Labs.

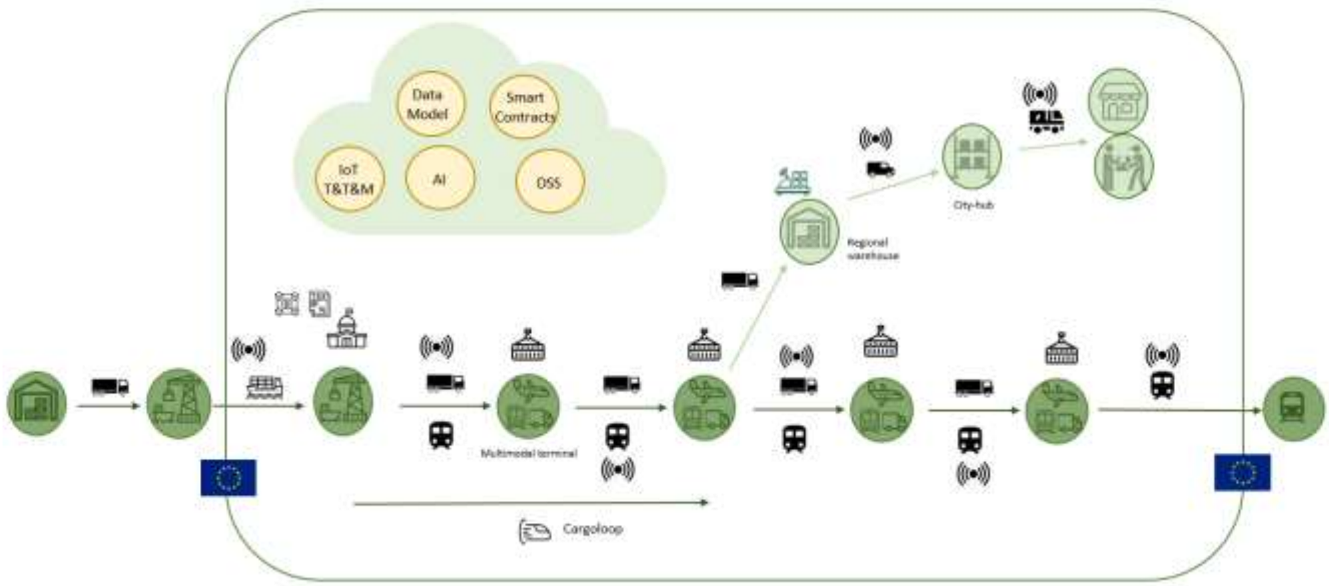

Figure 9: EGTN Generic Use Case overview

The Generic Use Case is composed of the following elements:

- Time-horizon: 2030
- Geographic Coverage: Europe, including EU disadvantaged regions and the interface with Intercontinental trade routes.
- Nodes/hubs: ports, multimodal terminals, (smart) warehouses.
- Corridors: current and future Ten-T network (as per the analysis carried out in T1.2)
- Long-distance transport/Last mile delivery with sustainable vehicles
- Disruptive logistics technologies: AI, IoT, Blockchain, Cargoloop, smart warehouses…
- Cloud-based Open EGTN platform offering services to the actors
- Cross organizational, cross country and cross system workflows.

5.1.3 Tools and services in the EGTN platform

The proposed PLANET Cloud-based Open EGTN Infrastructure Platform developed under WP2, will accommodate 'live' technologies and services that allow stakeholders to better understanding the impact of emerging technologies, and also to exploit such technologies to optimize their infrastructures and operations within the new economic reality of global trading systems so as to gain economic, environmental, and societal benefits. It is expected to be a collaboration platform for sustainable integrated multimodal freight transport.

In order to properly model the Generic Use Case and simulate the impacts of PLANET innovations, it is essential to understand the tools and services that the Open EGTN platform will offer to the different T&L actors and how collaboration will be articulated. This workstream is currently being developed in WP2 through the interaction with PLANET LLs (WP3).

The following table shows the preliminary list of specific services hosted by the Platform and the interoperability with other services.

Table 9: Services to be hosted by PLANET EGTN Platform (under construction)

Service	Description	Stakeholders	Interoperability with other services
Interface to all offered services (HMIs, M2M)	Unified interface(s) to provide the user(s) with an overall real-time support visualization of EGTN infrastructure components (services & data). It will aid decision making.	LL users (internal and external) Transport services, customer services, terminals, authorities, warehouses, HR depts., buyers, LSPs, FFs, IT depts., associates	Interaction with all other services
Volume flow forecasting service (AI)	Predicts the quantity of pallets flowing in and out of a warehouse for the next day.	Warehouse operator, LSP	Can integrate with smart contract service to advance book delivery vehicles and other resources.
Container flow forecasting service	Predicts the flow of containers coming into a port.	Shipping line	Integrated with Port choice model to make maritime routing decisions
EGTN blockchain Interoperability Service	Develop a universal front-end to BCs existing in the LLs (within and between)	All stakeholders involved in T&L process (from Port Authorities to Customs and Shipping Companies) and need access to transported documents	Blockchain events will be displayed on the EGTN HMIs. Smart contracts will consume IoT Data from the Connectivity Layer of the EGTN Platform.
AI-enabled smart contracts	Trigger smart contracts based on the output of the AI models.	Warehouse operators	PLANET AI models
Track and Trace and Monitoring (T&T&M) of pallets along the entire supply chain.	Pallet-wise T&T&M covering both last-mile and cargo logistics. Cloud Platform based on Kafka. Real-time data processing for features extraction. API based on EPCIS 2.0.	Supply chain actors, AI services, Data layer of the platform	With EGTN platform using EPCIS2.0
Port choice model	The model determines which ports a vessel should call depending on hinterland transport availability and port congestion	Shipping line, port, LSP	Interacts with the congestion prediction model. If the PI has a networking service that registers available capacity and cost per hinterland transport services, it needs that too.
Urban delivery rounds redistribution	The model determines how to mitigate delays in late running urban delivery rounds. It identifies nearby rounds that can help and then redesigns the route for the round helping through a meeting point.	LMD operators	Prediction of the time of completion for each round.
Kafka data pipeline	An Apache Kafka service running on the EGTN platform enables data providers to push their heterogeneous data to the platform	Data providers, Developers/Engineers to perform post-processing of the data	EGTN Dashboard to visualize data, EGTN Connectivity layer to create a common data model, other services possibly

Figure 10 shows a summary of the potential EGTN platform services offered to a generic user through a human-machine interface.

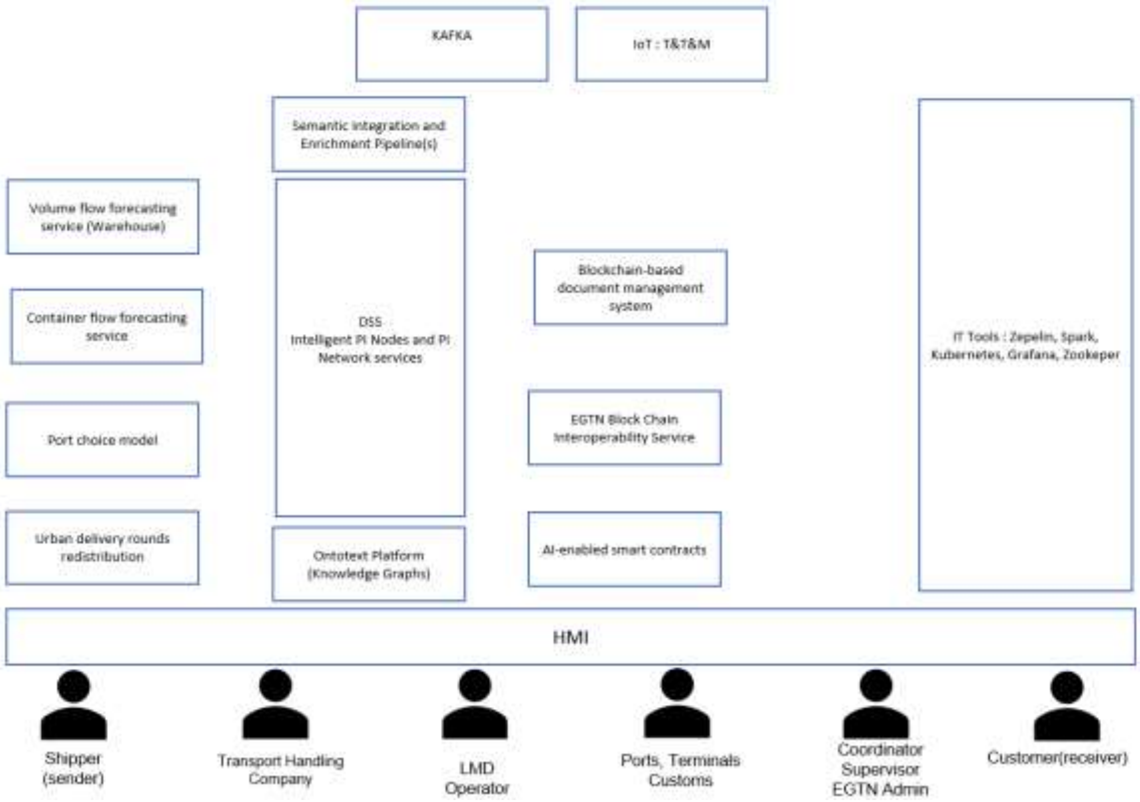

Figure 10: Representation of the current services in the EGTN Platform

5.1.4 Criteria and Selection of TEN-T corridors

One of the objectives of PLANET project is to better understand the impact on the TEN-T network of global transport and geo-economic trends. In order to do so, the project performs a strategic analysis of the most relevant emerging trade routes which are expected to gradually change global transport patterns, and a simulation of their potential impacts on the TEN-T.

The modelling and simulation of the expected impact of new trade routes on the TEN-T is done in T1.2. It consists of a strategic analysis of the most relevant emerging trade routes which are expected to gradually change global transport patterns, and a simulation of their potential impacts on the TEN-T.

Those emerging trade routes are (D1.1):

- China's Belt and Road Initiative
- Northern Sea Route/Arctic route
- North-South Trade Corridor

The Generic Use Case incorporates the integration of new trade routes to the TEN-T through the results of T1.2. Outputs such as the flows (Figure 11), lead times and capacity/congestion of the network will be used by the EGTN simulation capability to better represent the future network.

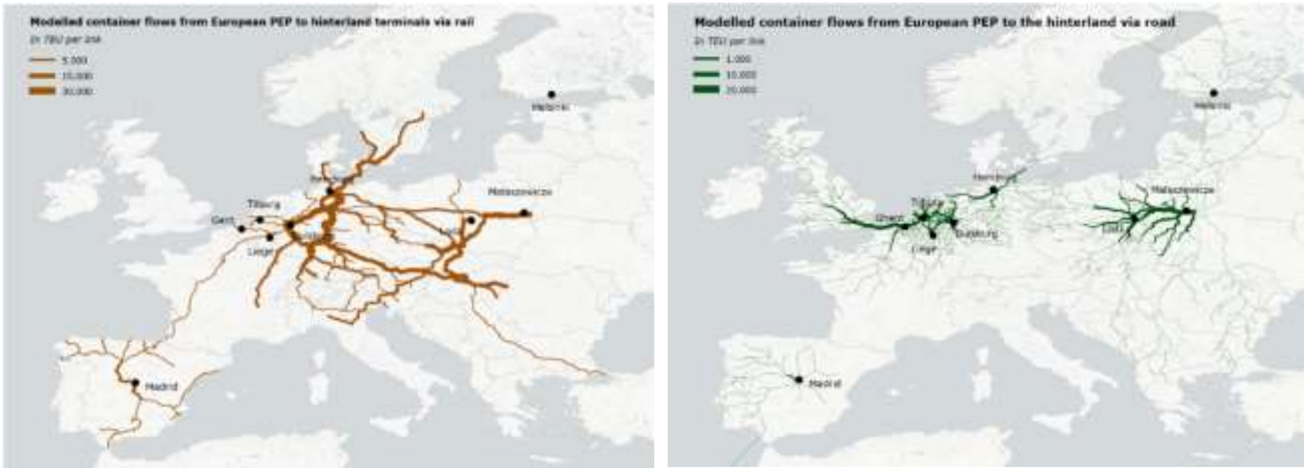

Figure 11: Modelled container flows from China to the European PEP on the rail/road network (2019)

Table 10 shows an example of data extracted from the simulation carried out in T1.2. Trade volumes from China to Europe considering the different routes possible via selected nodes on the Iberian Peninsula are aggregated.

Table 10 Trade volumes from China to Europe, via nodes on the Iberian Peninsula (2019)

Seaport	Total volume (tonnes)	Rail terminal	Total volume (tonnes)
Barcelona	1.348.236	**Madrid RT**	76.718
Leixões	601.935	**Duisburg RT**	2.089
Bilbao	366.701		
Valencia	2.147.417		
Algeciras	315.742		
Sines	346.657		
Le Havre	209.773		

The baseline scenarios (year 2019) for the three new trade routes are reported in D1.4. D1.5 will explore the 2030 and 2050 simulations and link the usage of the corridors to changes in the disadvantaged regions (e.g. accessibility, economic growth, population).

Besides the current/planned network of roads, railways, airports and water infrastructure in the European Union, the Generic Use Case will also take into account the **hyperloop network**.

Hyperloop has an unmatched potential to be the key factor in tackling European (and global) sustainability challenge. This can be achieved on a continental scale by creating the European hyperloop network.

In its envisaged shape (Figure 12), the continental hyperloop network in Europe supports all strategic corridors within the Trans-European Transport Network policy (TEN-T policy), providing fast and sustainable connections to all major economic and population centers.

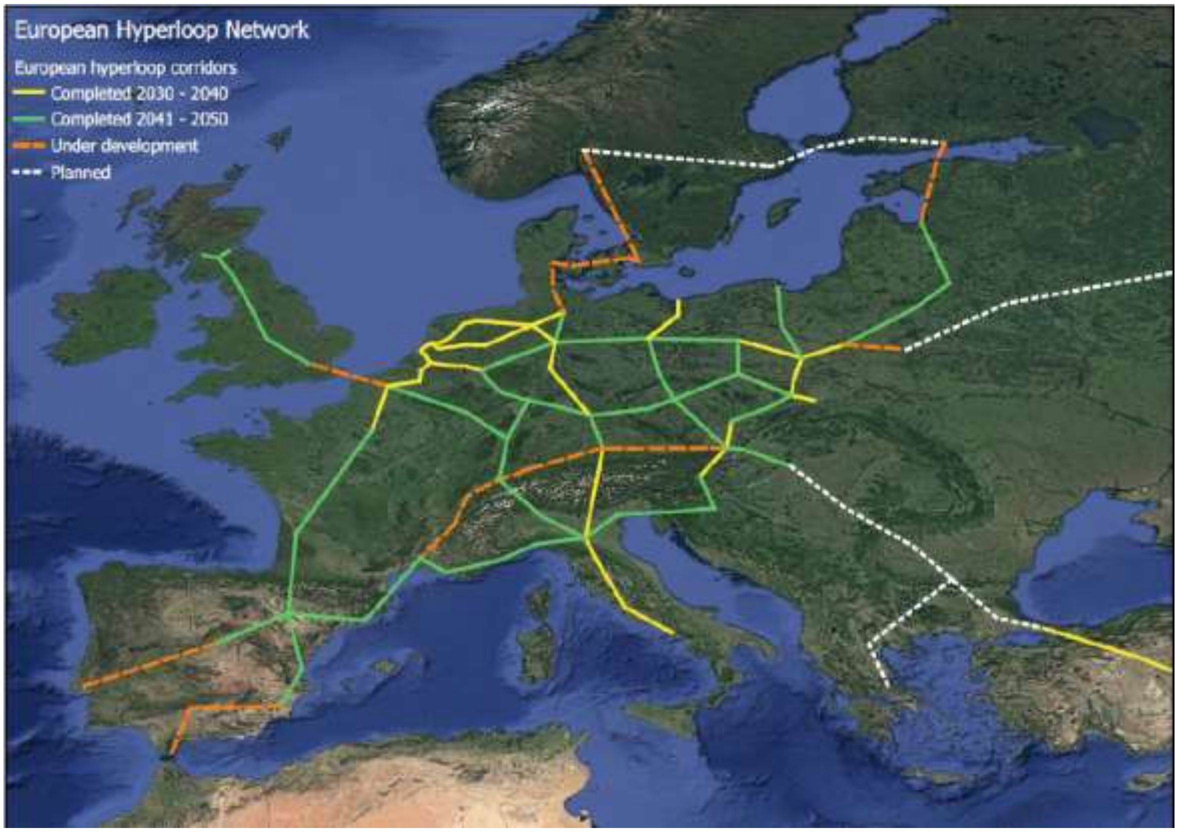

Figure 12 European hyperloop network

The hyperloop network comprises of links and nodes. The same links are used by both passengers and cargo, while nodes are passenger stations or cargo hubs. The network links will be those currently experiencing heavy cargo flows and requiring breakthrough transportation and infrastructure solutions to solve transport, logistics and socioeconomic problems, such as congestion, inefficiency, lack of reliability and pollution.

The hyperloop cargo hubs are designed to provide necessary services to enable seamless integration of hyperloop into the existing logistics processes. All hubs provide a basic set of loading/unloading and staging services, larger hubs also provide added value services such as such as container destuffing, palletizing and sorting. The hub layouts and functionalities differ depending on the size of the catchment area, the type of cargo and the type of environment it is placed in (urban, industrial, greenfield / brownfield).

There are four basic types of cargo hubs:

- **Regional (or 'Gateway') hubs** (Figure 13-A) are large facilities with 4-8 hyperloop (un)loading platforms which can accommodate high throughput of cargo (1,000 - 2,000 pallets per hour). They are located at regional business or logistics parks, often close to multi-modal connections, service large catchment areas, and a variety of cargo types. They are accessible for heavy and light vehicles. Regional hubs provide space for all basic hub functionalities and also for value added activities, such as container destuffing, palletizing and sorting.
- **Local hubs** (Figure 13-B) are medium facilities with 2-4 hyperloop (un)loading platforms which can accommodate cargo throughput of 500 – 1,000 pallets per hour. They service one

business/logistics/industrial park and can be connected to adjacent facilities (like sorting sorters) with automated conveyors. They are accessible for heavy and light vehicles. Local hubs provide space for all basic hub functionalities.

- **Urban hubs** (Figure 13-C) are small facilities with one hyperloop (un)loading platform which can accommodate cargo throughput of up to 7,000 parcels per hour. They are located at the edge of a city or urban area that their serve to allow emission free last mile delivery. Their design is focused on spatial integration and a limited physical footprint, and they are accessible for light last-mile vehicles only. Urban hubs provide space for all basic hub functionalities, added value functionalities are possible depending on space available.
- **Direct facility hubs** (Figure 13-D) are small facilities with one hyperloop (un)loading platform which can accommodate cargo throughput of 250+ pallets per hour. They are located directly at a cargo generating facility and integrated with its logistics processes, so no additional handling or transport is necessary. Their design and functionalities are tailored to provide services required by the facility they serve. These hubs are not accessible by third parties.

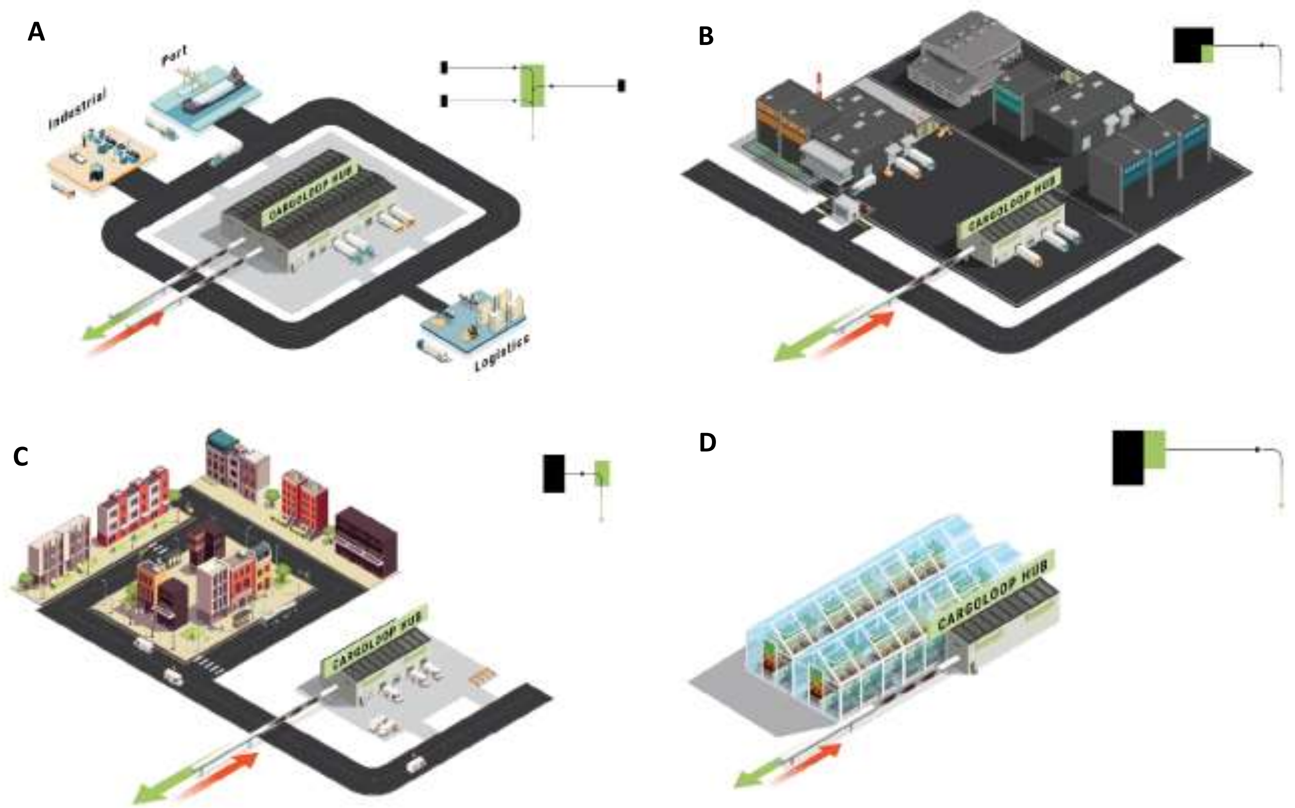

Figure 13 Types of cargo hubs

The future hyperloop network together with details of the system operation (operation times and travel speeds), cost data, capacity and vehicle characteristics will be incorporated into the simulation to assess the impact of introducing this transportation system.

6 EGTN Generic Use Case Simulation Design

6.1.1 Simulation purpose

The Generic Use Case is used in PLANET to produce a **Digital clone** aiming at investigating the impacts of introducing the EGTN infrastructure and the new logistics concepts and technologies, along complete TEN-T corridors. Such assessment includes financial, business, economic and social impacts (see Chapter 7).

As per the project DoA, PLANET Digital Clone is conceived as an open collaborative planning tool for TEN-T Corridor participants, infrastructure planners, and industry/technology strategists. The aim of this clone is to facilitate a future PI-oriented EGTN. It will be accessed through the EGTN platform, and will provide a dynamic model of EU-Global T&L Network or sub-Network utilizing the EGTN models (see PLANET D1.2 and D1.8 for more information) providing data driven simulation and AI based decision support to stakeholder groups.

The user of the Digital Clone is foreseen to be an operational user. However, it can be also use by Policy Makers to explore the impacts of EGTN-related concepts. Thus, the Digital Clone may help governments to create policy in advance and companies to create strategies business and technology.

Underpinning the simulation, an EGTN Dataspace is constructed supporting an ecosystem of actors that interact through the sharing of data in assessing the status of EGTN and contributing to its developments.

The simulation technology will facilitate in this generic use case the evaluation of possible future scenarios based on the generic components of the EGTN.

Within the PLANET project different types of models are considered to simulate transport networks. One of them uses **multi-agent simulation** technology. In this case, agents can represent diverse things: vehicles, freights, nodes, people in distinct roles, etc. The agents are the main components of the simulation model. The agent is a component of the design of the model that can have behaviour, memory (history), timing, contacts, etc. The data needed to set up a simulation model are associated with the physical internet elements. For example, information on node position (location, capacity), transport (speed, type of transport, capacity), connections (road status, congestion level) and orders (origin, destination, number of containers, estimated ETA). Additional information on the content of the simulation models and inputs needed can be found in the deliverable D1.2-Modelling & Simulation Capability.

The purpose of the use of simulation in this generic use case is to evaluate and compare different virtual scenarios in order to assess the impact of the different innovations in the project in certain network settings.

The simulation is a powerful tool to visualize the movement of products over a PI network, including flows from different companies. The models are used to quantify the impact of the different services and economic (transport and handling costs), business/operational (reducing lead time) and social (CO_2 emissions) indicators are obtained.

Thus, the simulation has two main objectives: on the one hand, to consolidate the expected impact of each of the living labs in terms of technology. This will demonstrate the potential that technologies such as IoT, Blockchain, Artificial Intelligence or Cargoloop have for improving the efficiency of the logistics network in economic, operational and environmental terms through greater visibility of the cargo, standardized information or streamlining administrative and operational processes.

On the other hand, to check the impact that the evolution of certain corridors has on the network. For this purpose, the T1.2 simulation results of the selected TENT-T corridors will be taken into consideration.

6.1.2 Scenarios definition/configuration

The simulation will be utilized to represent and compare different scenarios. The results will be studied and compared. The initial list of scenarios considered is the following:

- **S1. AS IS simulation:** first, the simulation will represent the transport processes in the corridors as they are currently carried out. This will be the base scenario (AS IS) to produce indicators for comparison. For this purpose, following the agent-based approach at an operational level, each agent will be modelled according to its actual process diagram. As an example, a possible AS IS process diagram for the "truck" agent is proposed in Figure 14.

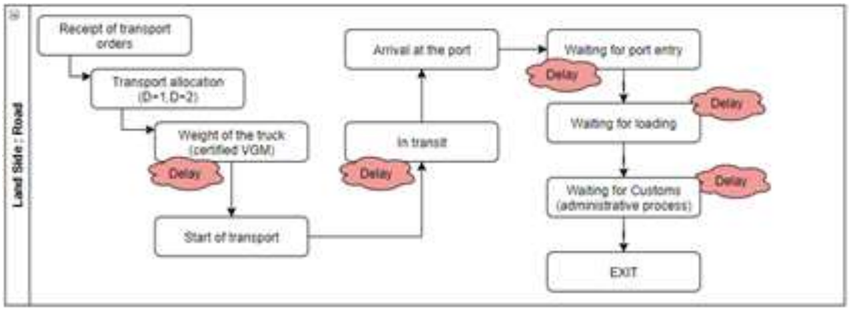

Figure 14: AS IS "truck" agent process diagram

- **S2. AS IS + 2030 projected flows:** from here, the transport flows in the year 2030 will be evaluated. The results of the projections in T1.2 will be simulated according to the expected transport increases based on the current network, without considering any of the improvements provided by PLANET's technological developments. This scenario will help to test whether the current network can withstand these transport increases by maintaining current operations and not incorporating new technologies. Therefore, in order to compare with the base scenario, some key KPIs could be the network congestion, transit times or order lead time.
- **S3. 2030 projected flows + EGTN innovations:** after that, the 2030 scenario will be analyzed by applying the technological concepts to be developed in the PLANET project on the current transport network. The impact of EGTN innovations can be transferred to models through simulation parameters, by adding new transport agents (e.g., Cargoloop) or modifying current process diagrams. For example, it is expected that the adoption of blockchain smart contracts will reduce the time trucks spend in customs or that the use of IoT sensors in the containers will eliminate the weighing stage (see Figure 15). In addition, certain algorithms could be tested during the simulation runtime, such as routing or the port choice model for container ships. All these innovations are expected to have a positive impact on transport cost, end-to-end visibility, cargo safety and many others.

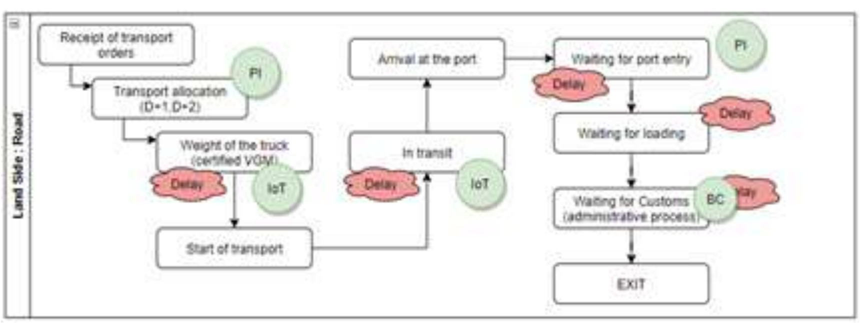

Figure 15: Technology-enabled "truck" agent process diagram

- **S4. 2030 projected flows + TEN-T evolution:** then, the 2030 scenario will be analyzed considering the evolution of the corridors for that year, with the expanded TEN-T network (after the integration of the three emerging trade routes as per the results of T1.2). In this scenario, it will be possible to check how the proposed investments or modifications to the current infrastructure (new terminals, warehouses, routes…) affects the whole TEN-T network.

- **S5. 2030 EGTN innovations + TEN-T evolution:** finally, the 2030 scenario will be analyzed considering both, the evolution of the corridors of the TEN-T network and the technological improvements developed in the PLANET project. This is expected to be the most favorable scenario, leading to a more collaborative, reliable, efficient and technology-enabled transport network that will have a positive impact on day-to-day operations, economy and society.

6.1.3 Simulation Plan

The following figure shows a high-level timeline on how the development of the digital clone will be put in place from the time the current deliverable is submitted (M17) until the next release in M36 (D3.8).

Figure 16 also shows the dependences on other project outputs (deliverables represented by diamond shapes, other milestones by triangles).

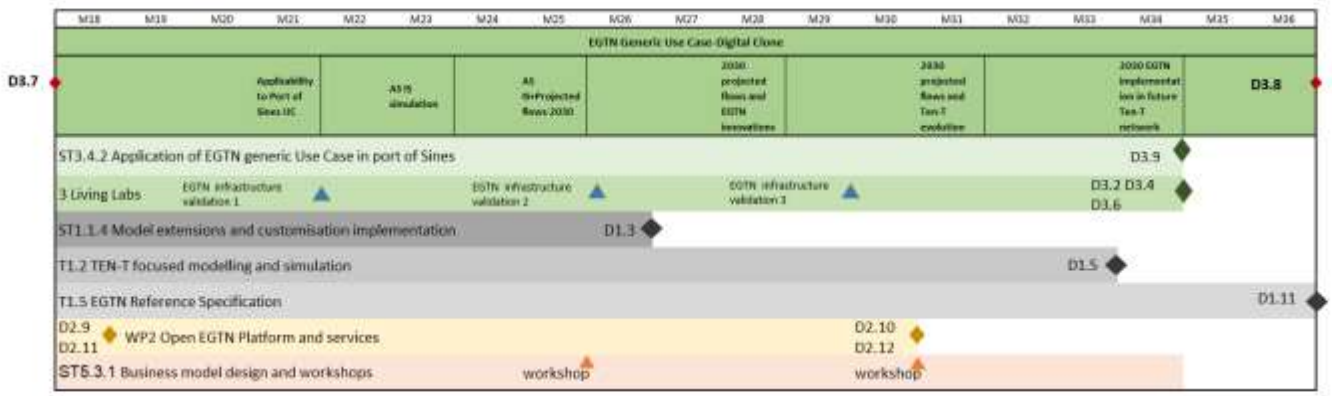

Figure 16: High level timeline of the simulation plan

7 EGTN Generic Use Case Assessment Methodology

Traditional supply chains have been reshaped by customers' requirements and new technologies. Increasing digitalization, and closer cooperation between partners have increased performance management demands on supply chains [1].

Supply chain performance is defined as the ability of the supply chain to deliver the right product to the correct location at the appropriate time at the lowest cost of logistics [2].

Typically, there are three basic criteria of performance evaluation [3]:

- efficacy: the relationship between the achieved results and the pursued objectives. It is related to the level of customer satisfaction with respect to the resources committed for this purpose;
- efficiency: the relationship between efforts and resources involved in the operation and the actual utility value as a result of the action. It is linked to the achievement of objectives at a lower cost;
- effectiveness: is related to the satisfaction with the results.

In practice, the functioning of the supply chains should be constantly improved, so measures to support the improvement of the performance of the global supply chain should be used, not only those that relate to the individual companies and their functions [4].

The performance measurement system should be adapted to the specific needs of each supply chain. Proper selection of a set of indicators, and their dimensions helps to identify problem areas, and is crucial in managing the organizations and whole supply chains in a turbulent environment and competitive global markets. An adequate system of performance measurement, considering the strategies of the company and the supply chain, provides the necessary information for decision-makers [5].

This section defines generic Key Performance Indicators (KPIs) which will allow a standard and common assessment of EGTN performance among different scenarios.

Those KPIs have the mission of giving a comprehensive vision of the impact of EGTN with regard to current situation and being an instrument able to shed light of strengths and weaknesses about different scenarios.

The EGTN Generic Use Case performance measurement system will analyze the EGTN on two different levels:

- individual performance indicators: each actor in the supply chain
- a set of performance indicators: supply chain as a whole

This approach is similar to the one followed in D1.8 where micro and macro EGTN KPI in the PLANET integrated modelling capability were introduced. Alignment between both sources of KPIs will be done in the final release of this deliverable.

The assessment of the EGTN Generic Use Case has been organized around two key performance indicators' broad categories, as per the project Grant Agreement: Financial and Business, and Economic and Social. Each of these perspectives focus on a key aspect of supply chain and its logistics and transport related processes and activities.

- Financial and Business perspective refers to the quality improvements and cost efficiencies achieved in day-to-day operations
- Economic and social perspective. It refers, on the one hand to the cost measurements/savings across the whole supply chain and within an individual actor. On the other hand, it addresses safety and environmental improvements (intra-logistics activities, long-haul transport and LMD).

The KPIs included in these categories have been defined and agreed in close collaboration with PLANET's Consortium partners, particularly with those leading and participating in the project's living labs. The table below details each of the KPI categories. The overall EGTN impact assessment will be reported in D3.10-EGTN Impact assessment- due in M36.

Table 11: KPIs used in the Generic Use Case assessment, classified per category

	Considerations	KPIs
Financial and Business	Quality improvements and cost efficiencies achieved in day-to-day operations	• Use of infrastructure • Total transit time • Total waiting time • On Time Delivery • Real route distance vs Ideal route • Distance • Total distance travelled empty and full • Disruptions of the Supply Chain • End-to-end visibility • Cargo safety
Economic	Covers not only costs measurement within an individual or isolated organisation but also total supply chain management cost (across the supply chain)	• Transport cost o Cost of transportation ABC principles (Activity Base Cost) o Cost/km • Handling costs o Storage o Handling • Inventory holding cost
Social	Safety and environmental improvements (intra-logistics activities, long-haul transport and LMD)	• Accidents rate • Network Congestion • % CO_2 emissions saved • % Energy/fuel saved

8 Identification and engagement of interested agents, complementary networks and use cases

8.1 Value Network Analysis

The concept of a value chain has assumed a dominant position in the strategic analysis of industries. The value chain concept was originally introduced by Porter in 1985 [6] to include logistics, operations, marketing, sales and services as primary activities. Under this model, secondary activities are procurement, human resource management, technological development and infrastructure. A value chain has traditionally meant activities needed in order to deliver a specific valuable product or service for the market. Activities are seen as independent sequential tasks, which form a value chain.

However, as products and services become dematerialized and the system increases its complexity, the value chain itself no longer having a physical dimension, adopting a network perspective provides an alternative perspective that is more suited to many industries today and uncover sources of value (Figure 17 shows both perspectives). Value chain is focused on the end product and the chain is designed around the activities required to produce it. Every company occupies a position in the chain; upstream suppliers provide inputs before passing them downstream to the next link in the chain, the customer. In the value network concept, value is co-created by a combination of players [7]. A value network generates economic value through complex dynamic exchanges between companies, customers/suppliers, strategic partners and the community [8].

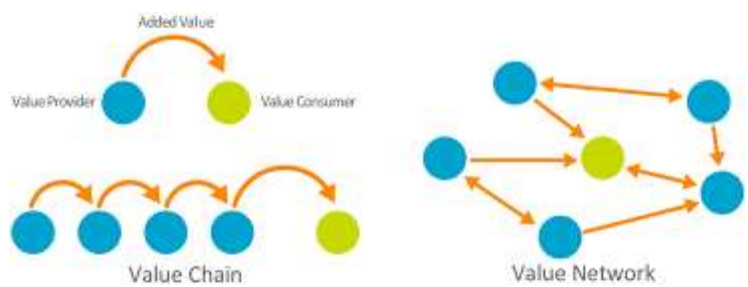

Figure 17: Value chain vs Value network perspective [9]

Value network analysis (VNA) is a methodology for understanding, using, visualizing, optimizing internal and external value networks and complex-and competitive- economic ecosystems [10]. The methods include visualizing sets of relationships from a dynamic whole systems perspective. All players of the network are considered: customers, suppliers, competitors, allies, regulators and policy makers, and any other network actors whose presence in the network can influence value creation. To understand the value generation of the network not only transactions around goods, services and revenues are considered, but also knowledge and other intangibles [11].

Identification of value networks can be a way of concretizing the actions and actors required for adopting the EGTN by T&L actors in the future. PLANET adapts to the project context the methodology developed by Tuominen (2015) [8]. It was originally applied to the transition towards biofuels in Finnish road transport. However, many similarities can be found between the transition towards sustainable energy systems in road transport and the wider adoption of EGTN concept by T&L actors in Europe. To support this goal, the VNA will be at use case level in those new cases identified in the project.

The approach consists of three phases (Figure 18):

1.- Building future context for value networks

2.-Identification of prospective value networks and actors

3.- Analysis of the prospective value networks and chains: changes required for the EGTN adoption.

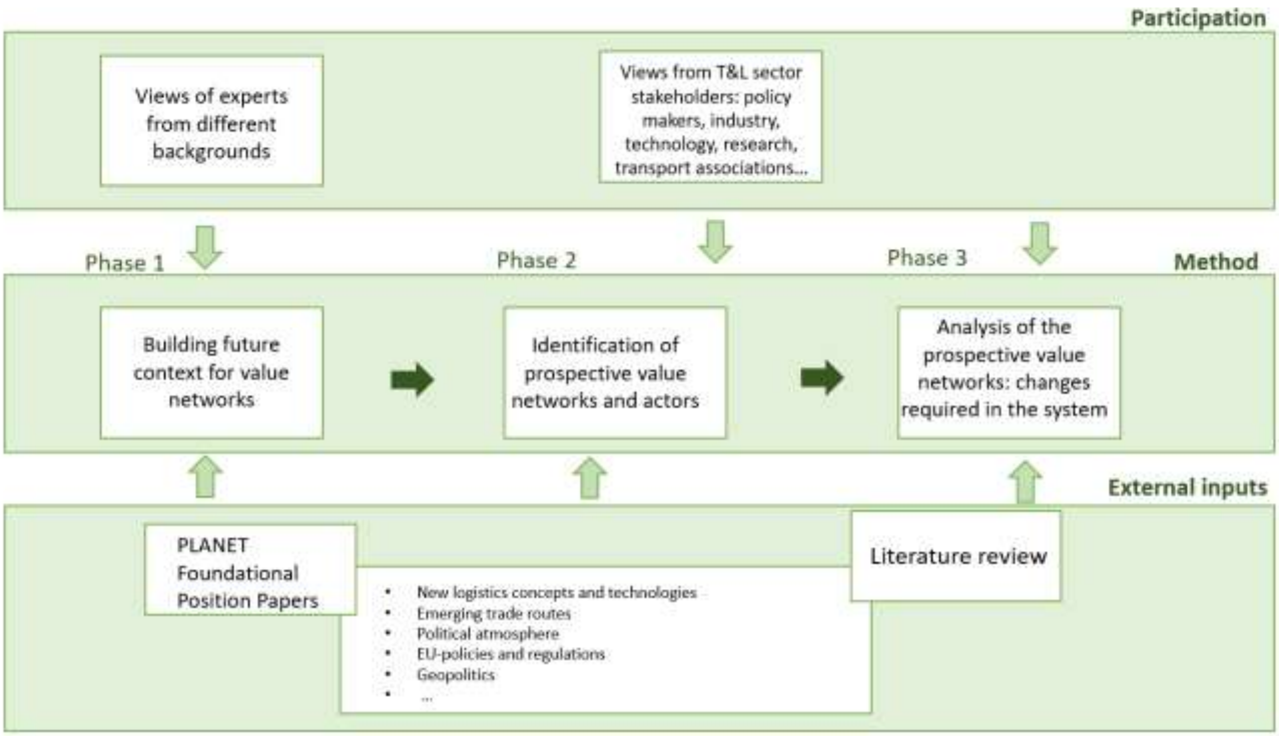

Figure 18: VNA process applied in PLANET (adapted from Tuominen, 2015)

Participatory process and external inputs are cross-cutting to the 3 phases.

Phase 1: Building future context for value networks. This phase considers alternative futures and anticipates the context where prospective value network will operate. The scenarios considered will be the ones developed in PLANET's WP1 for the future EGTN based on the Position Papers (Figure 19).

	All main critical uncertainties	Variation	Scenarios: Scenario 1	Scenario 2	Scenario 3	Scenario 4
PP1	*Impact of drought (climate change)*	High	✓		✓	
		Low		✓		✓
	World economy	Regionalisation	✓	✓		
		Globalization			✓	✓
PP2	*Location of production*	Regionalisation				
		Globalization				
	Development of digital solutions	High				
		Low				
	Development of hard infrastructure	High				
		Low				
PP3	*Level of door-door document harmonization EU/transit countries /origin countries*	High				
		Low				
	Railway Infrastructure interoperability	High				
		Low				
	Restrictions on transport of dangerous goods	Reduced				
		Remaining				
	Level of Chinese subsidies	Reduced				
		Stable				
PP4	*EU PI supporting Policy*	Weak	✓		✓	
		Strong		✓		✓
	PI adoption	High	✓	✓		
		Low			✓	✓

Figure 19 Future EGTN scenarios as per the project Position Papers (st 1.1.2)

Phase 2: Identification of prospective value networks and actors.

In this phase, the identification of the value network actors, individual interests and connections between them is performed. The work is performed in one or several workshops, starting with outlining the network chart covering all possible actors needed in value creation (in PLANET, for a specific use case). Then value generation is analysed from the perspective of the following currencies: goods and revenue, knowledge and intangible benefits [12].

Value networks have the following elements:

- Network nodes: roles played by the participants in the network (not specific organization names) who provide contributions and carry out functions. Participants have the power to initiate action, engage in interactions, add value, and make decisions.
- Exchanges: each directional arrow is a value transaction between roles. Solid lines are formal contract exchanges around product and revenue, while the dashed lines depict the intangible flows.
- Deliverable: the labels on the lines describe the specific way in which the value transaction takes place. Deliverables are the actual "things" that move from one role to another. A deliverable can be physical (e.g., a document) or it can be non-physical (e.g., a message or request). It can also be a specific type of knowledge, expertise, advice, or information about something.

Figure 20 presents a general example using the Project stakeholders identified in D5.1.

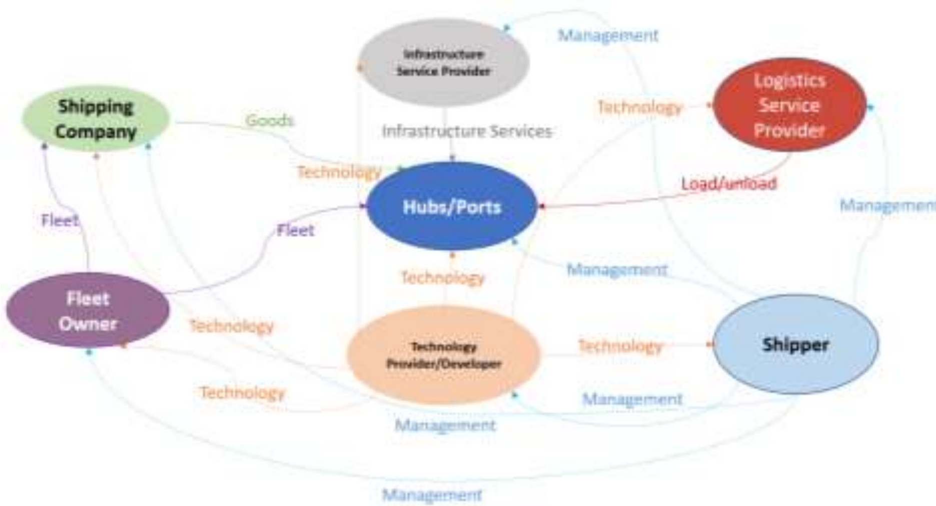

Figure 20: General Example of value network applied to a Transport & Logistics environment (based on PLANET's D5.1)

Once created the Value Network, individual value chains can arise. The template shown in Figure 21 gathers the required information.

Value Chain/network activities	Actors	Value creation	Value capture/needs	Supportive activities

Figure 21: Template for the value chain/network analysis (from [8])

Phase 3: Analysis of the prospective value networks and chains.

In this phase, the connections between the actors are analysed considering opportunities and advantages as well as supporting needs. According to the methodology followed, this is done using a **Multi-level perspective approach (MLP)**. The MLP identifies three levels within societal systems (e.g., the transport system): niches, in which radical innovation emerges; the regime, which comprises dominant institutions and technologies; and the landscape, which represents macro-level trends and contextual drivers and barriers to change. This approach allows to understand the complexity of the future systems and the multiplicity of the actors involved in this transition. It has been successfully applied before in sustainable transport research [13, 14] and it is generally applied to transitions towards sustainability and resilience [15].

In practice, the outputs from the previous phase are analyzed against the MLP framework and the changes required to enable the transition are derived.

8.2 Value Network Analysis of selected use cases

As stated in the previous section, the VNA in PLANET adapts the methodology previously described in the literature [8] to the specific context of the project to understand what is needed for the EGTN adoption by EU T&L actors and communities in the future, for selected use cases. Since the analysis will be done at Use Case level, the starting point will be the definition of the network objectives (for example upgrading a terminal to PI-node following the EGTN principles).

The identification of additional external networking opportunities, networks for the project to link up and use cases will be done mainly in the framework of WP5. Specifically, in conjunction with the workshops organized under T5.3-Business Models and Commercialization Strategy. However, this activity will also look into other project activities where the involvement of stakeholders is expected, such in ST2.4.1 Multi-Actor Multi-Criteria Analysis (MAMCA) DSS. When a new use case is identified, a VNA will be developed, starting with the Port of Sines use case. The reporting of the activities will be done in D3.8, at M36.

9 Conclusions and way forward

The purpose of this deliverable was to define the elements and components of the EGTN Generic Use Case and the Digital Clone based on it.

The Generic Use Case combines generic elements from the three Living Labs and makes use of the tools and services that the Open EGTN platform will offer to the different T&L actors. This document presents those initial generic elements and offers a first analysis of the services hosted by the Platform, with a special focus on how collaboration will be articulated.

It will also incorporate the findings from T1.2 regarding the impact of new trade routes on the TEN-T. Moreover, a new element on the network is considered: the (cargo) hyperloop.

The preliminary list of tools and services that the Open EGTN platform will offer to the different T&L actors and how collaboration will be articulated is also presented. It is essential to properly model the Generic Use Case and understand what will be the impacts of PLANET innovations.

The EGTN Generic Use Case will be also used to produce a Digital Clone to explore the effect of introducing the EGTN concept along complete corridors. The Digital Clone is defined as data-driven simulations accessible to the different T&L actors. It will be accessed through the EGTN platform, and will provide a dynamic model of EU-Global T&L Network or sub-Network utilizing the EGTN (PLANET) models.

Simulation will be utilized to represent and compare different scenarios based on the generic components of the EGTN. The results will be studied and compared through a set of generic Key Performance Indicators which will allow the Generic Use Case impact assessment on a standard and common basis.

The initial list of scenarios considered is: S1- the transport processes in the corridors as they are currently carried out (base scenario or AS IS), S2-AS IS and 2030 projected flows, S3- 2030 projected flows + EGTN innovations; S4-2030 projected flows + TEN-T evolution, and S5-2030 EGTN innovations + TEN-T evolution.

After checking applicability, the Generic Use Case will be later used in the Port of Sines Use Case developed in ST3.4.2.

This deliverable also addresses the identification and engagement of interested agents, complementary networks and use cases. VNA will be applied to understand what is needed for the EGTN adoption by EU T&L actors and communities in the future, for selected use cases. The identification of such cases will be done mainly in the framework of WP5. Specifically, in conjunction with the workshops organized under T5.3-Business Models and Commercialization Strategy. However, other project activities where potentially new use cases can arise are also identified.

A high-level plan for the remaining work is presented in section 6.1.3. This plan, that also shows the interdependencies with other project outputs, will guide the developments of ST3.4.1.

The final version of this deliverable (D3.8-M36) will be based on an iteration of the current version and will include the simulation of selected TEN-T corridors covering financial, business, economic and social impacts. It will also include the VNA of the Port of Sines use case and other new use cases identified.

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