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D.2.3

Cluster Community System preliminary requirements and architecture

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Legal Disclaimer

Abbreviations and Acronyms

The following are the main acronyms and abbreviations used in current document.

Acronym	Definition
3PL	Third Party Logistic Service Provider is a firm, which provides multiple logistics services for use by customers. Preferably, these services are integrated or "bundled" together by the provider. These firms facilitate the movement of parts and materials from suppliers to manufacturers, and finished products from manufacturers to distributors and retailers. Among the services, which they provide, are transportation, warehousing, cross-docking, inventory, management, packaging, and freight forwarding.
4PL	Fourth Party Logistic Service Provider differs from third party logistics in the following ways; 1) 4PL organization is often a separate entity established as a joint venture or long-term contract between a primary client and one or more partners; 2) 4PL organization acts as a single interface between the client and multiple logistics service providers; 3) All aspects (ideally) of the client’ s supply chain are managed by the 4PL organization; and, 4) It is possible for a major third-party logistics provider to form a 4PL organization within its existing structure. The formal definition of the term is "A supply chain integrator that assembles and manages the resources, capabilities, and technology of its own organization with those of complementary service providers to deliver a comprehensive supply chain solution."
AP	Access Point
AS4	Applicability Statement 4. AS4 is an open technical specification based on OASIS ebMS 3.0 for the secure and payload-agnostic exchange of data using Web Services. It was chosen by the EU Member States participating in the e-SENS Large Scale Pilot (LSP) as the primary protocol for B2B, B2A, A2B and A2A message exchange.
CluCS	Cluster Community System (CluCS) is an IT platform supporting the governance of Proximity Terminal Networks (PTNs) and operations through the efficient management of information: cargo flows and assets within the nodes of the PTN and in relation to the surrounding logistics nodes. This allows a coordinated management of multiple terminals with different specializations. The CluCS is an attempt to establish co-ordination and collaboration between neighbouring and regional terminals on the one side and pooling cargo under coordinated processes on the other side.
EC	European Commission
ETD	Estimated Time of Departure
GA	Grant Agreement
GTS/GTS Rail	General Transport Service. GTS is a leading company in Italy and Europe in intermodal transport. GTS Rail is the GTS Group Spa railway company that operates in the liberalized market since 2008.
ITU	Intermodal Transport Unit. These are the cargo units utilized in intermodal transport. They can be Maritime Containers, Swap Bodies or Semitrailers.

LSP	Logistics Service Provider. Companies that provide any single type of Logistics Service. Can be divided in the following general categories: • Road Carrier • Rail Operator • Maritime Line • Terminal • Warehouse / Depot • 3PL • 4PL
MTO	Large multi-sector logistics operator, which includes at least the activity of shipper and 3PL. It represents the traditional answer to the need for one-stop-shopping, which today is also satisfied by the 4PLs.
NSW	National Single Window
PCS	Port Community System
PO	Project officer
TBD	To Be Defined
TEN-T	The Trans-European Transport Networks (TEN-T) are a planned set of road, rail, air and water transport networks in the European Union. The TEN-T networks are part of a wider system of Trans-European Networks (TENs), including a telecommunications network (eTEN) and a proposed energy network (TEN-E or Ten-Energy). TEN-T envisages coordinated improvements to primary roads, railways, inland waterways, airports, seaports, inland ports and traffic management systems, providing integrated and intermodal long-distance, high-speed routes.
TOS	Terminal Operating System
UR	User Requirements
WP	Work Package

Terminology

The following are the main terms used in current document.

Acronym	Definition
Cargo Consolidation	Combining two or more shipments in order to lower transportation rates. For example, a train carrying containers from different shippers to the same destination.
Cargo Flow	The logistics process of transporting goods from origin to destination including all the involved actors.
Cargo Pooling	The practice of combining shipments from multiple shippers into a truckload (swap body, container or semitrailer – ITUs-) in order to reduce shipping charges by improving the cargo units (ITUs) fill rate.
Depot	See *Warehouse.*
E-Sens	It is a completed pan-European project with the aim of strengthening the EU digital single market and facilitate public services across borders. It has been completed on 31st March 2017.
Intermodal transport	Transport that uses two or more transport modalities with a cargo change between these modes. It usually utilizes maritime containers, swap bodies or semitrailers, also called ITUs that can be easily changed from one transport modality to another without deconsolidating and reconsolidating the goods contained.
Logistics Process	All the logistics operations involved in a particular cargo flow.
Logistic Services	Classically, the transportation of goods from point A to point B. Other services

	are cargo handling (terminals), temporary storage, cargo consolidation and cargo pooling.
Maritime Container	A single, rigid, sealed, reusable metal box in which merchandise is shipped by vessel, truck, or rail. Designed specifically for maritime intermodal transport. Container types include standard, high cube, hardtop, open top, flat, platform, ventilated, insulated, refrigerated, or bulk and the most utilized sizes are 20 feet or 40 feet (long).
Maritime Line	Maritime (vessel) logistics service provider.
Node	Terminals within the PTN.
PTN Manager	Third party entity that coordinates the PTN, aiming for an optimal utilization of resources and assets within the terminals by which it is formed. In order to achieve this, it is supported by the CluCS.
Rail Operator	Rail (train) logistics service provider.
Road Carrier	Road (truck) logistics service provider.
Semitrailer	Separate part of the truck used to transport the goods, usually identified by a license plate.
Shipper	The party who originates a shipment of goods. The sender of a freight shipment, usually the seller.
Swap body	A swap body is one of the standard freight containers for road and rail transport. Swap bodies take advantage of the large number of trailers used to carry standard ISO containers. The design of swap bodies is optimized to minimize empty weight, saving on trucking fuel cost (less dead weight to be transported). Consequently, swap bodies do not have upper corner fittings, are not stackable, and must be lifted by the bottom frame, unlike the more widespread shipping containers (ISO containers). This makes them unsuitable for ship-based overseas transportation. Because they are not stackable and are lifted by the bottom corners, they require special handling when transported by rail.
Terminal	Cargo handling logistics service provider. Terminals are usually points in which the intermodal process takes place. Road to Rail, Road to Maritime, Rail to Road, Rail to Maritime are examples of intermodal change operations.
Warehouse	Storage place for products. Principal warehouse activities include receipt of product, storage, shipment, and order picking. Also named Depot.

Clusters 2.0

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Executive Summary

The current document is intended to building up Cluster Community System (CluCS) tools for Cluster management in order to improve overall performance and provide smart specialized services as a Cluster of hubs.

The document is organized as follows:

Chapter 1 reports on the purpose of the document and the addressed audience.

Chapter 2 analyzes CluCS requirements to draft CluCS concept and design:
it starts from the analysis of Proximity Terminal Networks (PTN) and Logistics Clusters developed in Deliverable 2.1 and 2.2, follows with its basic logic and architecture and concludes with potential applications of CluCS and its expected benefits.

Chapter 3 analyzes CluCS users, their needs and the AS IS situation of the logistics market with the aim of shaping CluCS features and capabilities to guarantee full visibility and operation management capabilities in all the terminals in a certain cluster.

Chapter 4 details CluCS main components (communications network and web interface) and the software modules reporting the interoperability with CargoStream over-system.

Chapter 5 defines CluCS functional / user requirements of each module and outlines the process workflows for the creation of cargo consolidation, cargo pooling and intermodal booking services.

Chapter 6 details the electronic messages to be exchanged between CluCS nodes for the implementation of the offered services (cargo consolidation, cargo pooling and intermodal booking services).

Chapter 7 gives an overview on the Port Community System (PCS) of the Port of Trieste to outline the similarity of the approach with CluCS as it may contribute to fine tune the implementation of the CluCS.

The document is closed by chapter 8, that summarises the main findings and outcomes of the deliverable, giving input for CluCS tool development which is realized in task 2.4.

1. Introduction

1.1 Purpose of Document

The document focuses on the Cluster Community System (CluCS) requirements and architecture. It is devoted to building up tools for Cluster management to improve overall performance and provide smart specialized services as a Cluster of hubs.

More in detail, it analyzes CluCS requirements detailing user needs and the AS IS situation of the logistics market. Then, it defines the proposed architecture of the CluCS and its main components (Communications Infrastructure and Web Interface) describing the main services provided by CluCS (Intermodal booking, Cargo Consolidation and Cargo Pooling) and its interfaces with sub-systems and over-systems such as CargoStream platform.

This document serves as input for CluCS tool development which is realised in task 2.4.

1.2 Intended audience

The intended audience of this document are the Clusters 2.0 project partners.

With regard to the functional aspects, the document aims to address:

- all the supply chain roles that can be involved in the development of the Cluster Community System in practical terms, with a focus on the need for collaboration in a competitive environment;
- all the actors of the supply chain that could benefit from operational advantages and positive impacts from the Cluster Community System development.

2. Cluster Community System functional requirements and design

This section starts from a brief definition of Clusters 2.0 project objective and Cluster Community System (CluCS). Then, it develops the outcomes of the analysis of the previous WP2 deliverables (D2.1 and D2.2) in which the concepts of Cluster and Proximity Terminal Network were analyzed. The aim of this analysis is understanding the functional requirements of CluCS platform. Finally, it explores CluCS design giving a list of the main stakeholders will be involved, a practical application of CluCS and its expected benefits.

2.1 Clusters 2.0 project

Clusters 2.0 is an EU project financed under Horizon 2020, the EU Framework Programme for Research and Innovation, running from May 2017 to April 2020 and deployed by a consortium of 29 partners.

The main objective of Clusters 2.0 project is to advance on co-operation of actors and connectivity of clusters in the context of an integrated European Transport System.
The project aims to reach a significant step forward in the role of nodes driving sustainability and competitiveness for their regions, especially on transport efficiency and modal shift to rail and other more environmentally friendly types of transportation.

Terminals operating in one region usually work independently of other terminals without cooperative management tools to improve overall performance and provide smart specialized services as a cluster of nodes.
Nowadays, terminals are focused on moving cargo with a point-to-point approach, without having a network approach driven by intermodal nodes optimizing logistic flows. This fragmented approach leads to sub-optimal solutions, as terminals do not have overall overview of the cargo flows in the network.

2.2 Cluster Community System (CluCS)

CluCS is intended to be an IT platform supporting the governance of the Proximity Terminal Network (PTN) and operations through the efficient management of information: cargo flows, assets within the nodes of the PTN and in relation to the surrounding logistics nodes, especially ports configured as the Cluster. Such platform provides full visibility and operations management capabilities in all the terminals in a certain cluster functioning as connector between the different sub-systems. This allows a coordinated management of multiple hubs with different specializations, creating synergies and linking the Cluster to different TEN-T corridors.

The CluCS is a unique and first attempt to establish co-ordination and collaboration between neighboring and regional terminals on the one side and pooling cargo co-ordinated processes on the other side. It transfers advances methods and research results as developed in the context of Port Community Systems (PCS) towards a cluster context (advancing beyond iCargo, eMAR, GET Services, CONTAIN, EcoHubs).

The approach is to connect:

i) The Proximity Terminal Network (PTN) i.e. main Emilia-Romagna regional terminals (Interporto Bologna, Piacenza), and
ii) The Cluster of the PTN, including the influential ports (Trieste), thus connecting road, rail and sea.

Having said that, there have been some changes in PTN terminals project involvement: when the project was written, about two years ago, it was planned to involve Parma and Marzaglia terminals but the programmed rail connections have never been realized. As a result, it was decided to involve Piacenza terminal, instead of the Parma and Marzaglia terminals, as there are active rail connections between Bologna and Piacenza terminals on which the CluCS requirements analysis and the test of the platform can be done.

The CluCS should optimize the functioning of the PTN within the Cluster and enhance efficiency and competitiveness for the logistics actors operating in the region.

This platform aims at increasing the engagement, performance and coordination of nodes in the cluster. This will be done through the efficient management of the information related to cargo flows and assets within the nodes of the Cluster.

2.3 Logistics Cluster and Proximity Terminal Network features for the definition of CluCS requirements

In order to understand CluCS requirements, this section clarifies the features of Logistics Cluster and Proximity Terminal Network developed in D2.1_*Scoping Logistics Clusters* and D2.2_*Cluster Building Blocks: the Proximity Terminal Network Potentialities*.

The main stakeholders in a logistics cluster, a community of companies that come together to share logistics expertise and know-how, are:

- Firms providing logistic services – (4PLs, 3PLs, carriers, forwarders, warehousing);
- Logistics operations of retailers, manufacturers and distributors;
- Operations of companies for whom logistics is a large part of their business.

Moreover, there are also companies that provide services to logistics companies such as maintenance operations, software providers, international financial service providers, law firms etc. All the actors within a logistics cluster can compete or cooperate with one another.

The activities performed in the logistics cluster are:

- Cargo handling activities – loading, unloading, transshipment;
- Transport activities – the cluster is a part of a transport chain;
- Logistics activities - storage, re-packing, assembling;
- Manufacturing activities – assembling, customizing products for retail, repairing and refurbishing of return (some firms are located in the cluster in order to reduce transport and logistics costs);
- Trading activities – commodity trade.

The most integrated activities in the cluster are cargo handling, logistics and transport. There are numerous examples of horizontal cooperation between cargo handling, forwarding and transport firms in logistics clusters. In horizontal cooperation two or more companies of the same industry and in the same stage of production work together. These companies belong to the same supply chain stage and normally produce or trade the same products.

A successful logistics cluster is a relevant player in the supply chain, because it can lead to time reductions and agile and quick responses (Elbert and Schonberger, 2009). Thus, it can increase the innovation ability and productivity of companies: the actors within the cluster can profit of the market positions of the cooperative partners and develop new markets on their own. On the other hand, inter organizational cooperation may require a stronger coordination

and organization of activities. The lack of confidence and reputation of actors may lead to opportunistic behaviors in the cluster's network and require thus higher safety precautions.

The cooperation between the actors within the logistics cluster is fundamental and it can be improved by the availability of IT applications capable for cooperation, such as Cluster Community System (CluCS), which can increase also the confidence between each other.

The intervention directions to realize the cooperative relationships in a logistics cluster are:

- Interventions in **willingness to invest and cost benefit distribution** to support vertical cooperation, between different stakeholders;
- Interventions to **realize "mixed" vertical-horizontal cooperation** by sharing assets;
- Interventions to **realize an improved ICT solution like a shared virtual information platform (Cluster Community System) is**, held by a third party, which gathers and provides shipment information from actor to actor;
- Interventions to establish a **cooperative governance framework based on the established business network**, which will enforce the trust and commitment between the partners

Therefore, the factors that play crucial roles in the success of cooperation are (Smart Rail, 2017):

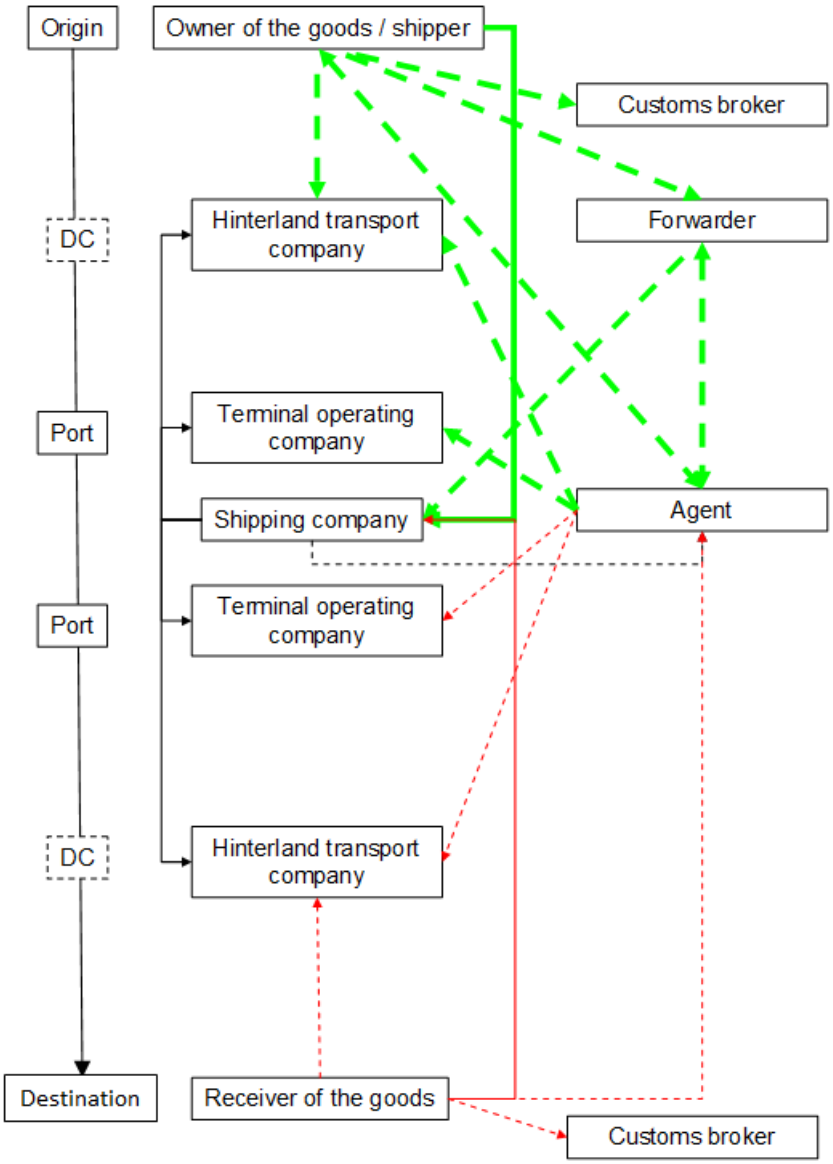
- Information sharing;
- Relationship management;
- Contracts.

Having said that, one of the main CluCS requirements is to satisfy the need, within the cluster, for the exchange of appropriate and reliable information. Generally, there are two types of information, internal and shared. Internal information is necessary for each company to manage its own activities and should only be accessible to the company's own employees. The shared information should be available to all participants in cooperation. If partners do not share this information, they will lack knowledge about each other's operational planning, and their activities will not be harmonized. This will cause no optimal benefit to the cooperation.

One of the best model of cooperation to create potential forms of cooperative relationships between the actors in the logistics cluster is diagonal cooperation that aims to gain more flexibility by combining and sharing capabilities in both vertical and horizontal manner.
It means that it involves both different stakeholder/s of different stages (vertical) of the supply chain and few companies belonging to the same segment (horizontal). This, as a strategic component associated with a network strategy is the extension of cooperative processes with stakeholders operating on the same level of the supply chain (horizontal) but also who are upstream or downstream in the vertical network. It enables the end-to-end integration as well. This type of cooperation can provide faster and more reliable supply of goods and reduce physical and information disruptions. However, in this case it is necessary to take into account potential cooperation complexity reflected in a large number of actors involved. For this purpose, an information sharing-platform (cloud based to enable the dynamics in the cooperative network) would be very useful to support today's planners in supply chain optimization and the fulfillment of the shipper's requirements for supply chain visibility.

From a maritime supply chain perspective, this interaction expands from the origin of the goods (the shipper) until the port (the terminal operators), including stakeholders such as freight forwarders, hinterland and maritime carrier, shipping agents, depots or warehouses (figure 1).

Figure 1: Illustration of the maritime supply chain



Source: Meersman et al. (2010)

The spread of data in the supply chain between these multiple stakeholders is a key need in which the (Port) Authorities act as facilitators, the logistics Providers as Integrators whereas the Suppliers, manufacturers, wholesaler, distributors, retailers and users are the beneficiaries.
The information sharing between shippers and carriers is an essential element of inter-organizational relationships among the members of the supply chain. Information sharing determines the way and magnitude of the material flow such as finished product from suppliers to end users and also the product return and repairs from the end user. The information flow may include the exchange of data, coming from product manufacturing to customer feedback.

Nowadays, there are limited solutions that link track & trace solutions with the cargo handled. A clusters' data communication platform, such as CluCS, can offer more visibility over the supply chain operations as a result of increased collaboration between shippers and carriers. Moreover, an integrated ICT clusters platform will extend the role of nodes beyond

transshipment (e.g. storage, handling, packaging, pooling, consolidation and cleaning) to serve as main actors of logistics clusters. Such clusters could integrate current activities with more advanced logistics services.

The Cluster has to provide two main functionalities:

a) to facilitate the most efficient matching of supply chain stakeholders demand and supply and;
b) to enable the resource sharing, infrastructure and utilities as the means to minimize costs and maximize efficiency.

Cluster establishment could start from identified building blocks. Such building blocks can be terminals, nodes and Proximity Terminal Networks: they are able to play a territorial role and integrate various actors and economic components combining basic freight transport functions (such as transshipment, resource sharing for maintenance and handling, etc.) and advanced integration services to extend the roles of involved parties and stakeholders and enlarge the Cluster caption/influence area/zone.

The Proximity Terminal Network (PTN) can be considered as a “regional” network of intermodal terminals part of a logistics Cluster: it has a central aim to leverage synergies on freight planning and execution between the involved nodes by means of resources and assets sharing.

Cargo consolidation by road among terminals in the PTN is also considered, in order to achieve the critical mass to boost the performing frequent rail services to/from the PTN.
Therefore, a PTN increases engagement, performance and coordination of terminals and hubs within a Cluster. Beyond PTN, Cluster relates to a more extended concept that involves also port/s and government, industry and manufacturers, being “de facto” a value creator for the whole extended region which relates to, thanks to a mix of good intermodal connections, logistics platforms and large freight volumes moving inside and to/from it.

The Cluster Community System (CluCS) supports the governance of the Proximity Terminal Network (PTN) and Cluster operations through the efficient management of the information related to cargo flows and assets within the nodes of the Cluster.

The terminal data registration has a mechanism that facilitates their incorporation to any freight transport management system, thus allowing their interaction with any transport Service Providers reaching the specific terminal.

Interested stakeholders, and in particular the Cluster Community System Manager, could access the inserted data in order to plan their transport chains. This way they can discover terminal services and use the information to compose their transport chains. On their turn, node and terminal managers can constantly update the information related to their premises and have them published to reach a wide market.
To face this, more visibility to transport chain execution is needed, that could lead to update planning as well as to adapt to unexpected events.
Enhanced terminal visibility can improve the whole intermodal transport performance, also allowing proper communication to all transport chain actors, that could on their turn re-plan / re-direct their transport chain.
Through increased visibility and enhanced capacity for facing unexpected events at PTN level, service provision is dynamically adapted to the events themselves.
Against this background, the CluCS approach can contribute to the dynamic provision of services, serving a broader approach than the individual PTN and widening the scope of existing individual IT systems serving single nodes/PTNs.

2.4 CluCS (WP2) concept

In Clusters 2.0 context, the WP2 includes, among other things, the analysis, design and development of the Cluster Community System platform.
The CluCS is an IT platform conceived to provide a solution to the challenges stated before. It supports the governance of Proximity Terminal Networks (PTNs) and operations through the efficient management of information about cargo flows and assets within the nodes of the PTN and in relation to other surrounding logistics nodes, especially ports, in this way interacting at a cluster level. This will allow a coordinated management of multiple terminals with different specializations within the PTN.
The CluCS aims to 1) establish co-ordination and collaboration between neighboring and regional terminals and 2) pooling cargo under coordinated processes. It should be able to provide interaction capabilities between various PTNs, expanding the logistics network further.

In the case of Bologna Freight Village's PTN, CluCS should provide full visibility and operation management capabilities in all the terminals in the cluster, functioning as connector between the different existing sub-systems. It should enable integrated management of the available resources in the cluster and the synchronization of the logistics operations.
The approach is to connect:

i. The Proximity Terminal Network (PTN) formed by Interporto Bologna Main Terminal and Piacenza Terminal
ii. Industries and other logistics services clients in the PTN area (Shippers)
iii. LSPs operating in the PTN area
iv. The Cluster of the PTN, including the influential Port of Trieste
v. The future possibility to interact with other PTNs

In this manner connecting the transport modes road, rail and sea, will provide a full intermodal solution to the shippers.

CluCS can be defined as a "physical platform", as it offers services strictly related to physical facilities (PTN and Cluster) and within defined geographical boundaries. This is an innovative approach compared to existing platforms to match logistics services demand and offer. These are "virtual platforms" as they normally operate on global level regardless of where terminals and facilities are located.

Each terminal within the PTN can offer its particular services to the whole PTN. In order to do this, a PTN Manager, aided by the CluCS tool can coordinate rail and maritime cargo consolidation, ITU cargo bundling and intermodal logistics services booking.
The PTN Manager is a third-party entity that coordinates the PTN, aiming for an optimal utilization of resources and assets within the terminals by which it is formed. CluCS should become the main tool for the PTN Manager to achieve its goal. In the case of Bologna Freight Village's PTN, the role of PTN Manager could be held by IBI (Interporto Bologna Innovation).

The PTN acts as a collaborative business network in which the communication and information sharing between the actors is essential. This means that the information sharing between the actors that constitute this collaborative value network needs to be timely, detailed and reliable. Timely because up-to-date information permits the users to make more efficient decisions; detailed because many particulars and specificities are needed to make the information complete and useful to the users; and reliable because small errors in communication can result in big problems in the logistics process.

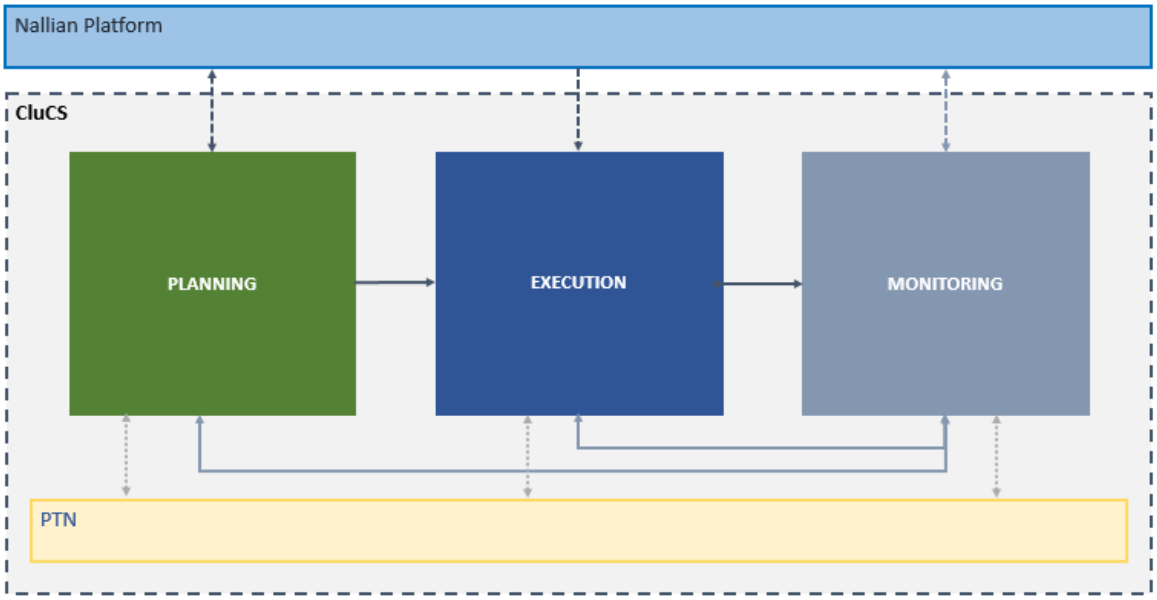
Information exchange between nodes of the PTN is a necessary condition for the functioning of the CluCS. This means that interoperability problems that arise when different stakeholders use different data formats need to be solved and managed by the CluCS.

Summarizing all the previous concepts, the main requisites CluCS should have and provide solutions for are the following:

- Support the governance of the PTN;
- Enable efficient management of information regarding:
  - Cargo flows between nodes (real time supply chain visibility by cooperation of PTNs stakeholders);
  - Offered logistics services (terminals and LSPs).
- Intermodal logistics services booking capability;
- Allow coordinated management of multiple nodes with different specializations, achieving an efficient sharing of resources and assets;
- Enable the interaction of all stakeholders with value added services providers, such as cargo bundling and cargo consolidation to reach the critical mass needed to switch cargo flows between nodes or out of the PTN to rail and at the same time boost the rail services offer.

After discussing CluCS requirements, now the operative viewpoint is analyzed.
The CluCS should be able to aid the PTN Manager in all of the Supply Chain phases: Planning, Execution and Monitoring.
Figure 3 shows the CluCS basic logic regarding these three functionalities.

Figure 2: CluCS basic logic



Planning

In CluCS, planning functionality should cover the possibility for the shippers to visualize and find a solution for their logistics service requests and book them. On the other side, the Logistics Service Providers have the interest to publicize their services and make them available to the widest potential audience and then to receive bookings from shippers.
Therefore, for the planning phase the following features are needed in a functioning Cluster environment:

- Available logistics services publication (Catalog of available logistics services in all the nodes of the PTN);
- Logistics service request (Ability for CluCS users to request a determined logistics service and the correspondent response proposed by the system);
- Logistics service booking capability (Ability for the CluCS users to book one -or a combination- of the logistics services published by the LSPs);
- Service planning and coordination with other sections (following of previous) of the supply chain (intermodal logistics services options from a combination of different LSPs).

Execution

The Execution phase must be considered a dynamic process, capable to take into account the possibility of enhancing the services offered through real time adaptation to supply chain conditions. For instance, in this phase, CluCS should aid the PTN Manager in finding opportunities for the creation of cargo consolidation and cargo pooling processes. Also keeping the logistics services catalog updated, CluCS should let involved parties know when an alteration or modification concerning a certain cargo flow is made in its corresponding logistics services. This means it must interact constantly with the Monitoring phase, which on its turn also has to be linked to the Planning phase to keep an updated status of published services.

In this manner, Execution functionalities should offer the following features:

- road transport cargo pooling
- rail / maritime cargo consolidation
- terminal operations visibility
- adaptation to changes in service catalogs by monitoring the status of offered services

Monitoring

Monitoring is a dynamic phase of the logistic process, capable of interacting with both the Planning and Execution phases to keep the status of the available services within the Cluster constantly up-to-date and letting the involved actors know of alterations and changes of the service catalog. This means that when monitoring “detects” an alteration to the offered services catalog, it interacts with the Planning phase, changing the service catalog that is made available to shippers. At the same time, it interacts with the Execution phase, letting know all involved actors in current logistic processes of modifications in the logistic services catalog offered by the LSPs.

Basic functions for Monitoring are then:

- real time monitoring (Logistics services catalog update)
- link with Planning and Execution
- full visibility of the logistics services offer

Involving all stakeholders in the Planning, Execution and Monitoring process allows understanding how they should interact with the CluCS.

2.5 Potential applications of CluCS (examples)

2.5.1 Intermodal service booking

In the following example the actors involved are:

- **Shippers:** TBD;
- **MTO**: GTS;
- **LSPs:** GTS Rail (Rail Operator);
- **Terminals:** Piacenza Local Terminal and Bologna Main Terminal.

At first instance, LSPs share their service catalogs with all CluCS users via CluCS platform. This means that, among others, CluCS has information about the offered logistics services by GTS Rail (Rail Operator). GTS Rail mission is to provide rail traction services both in the world of goods and passengers with high quality and efficiency standards.

In the planning phase, GTS as MTO uses GTS Rail as LSP and shares the availability of slots not yet used in specific rail traction service in the CluCS platform. This means that, among others, CluCS has the indication of how many slots are still available for each daily train schedule.

The shippers interested in Piacenza-Bologna link, through CluCS platform, can fill their service request detailing quantity and information about containers and desired departure times. CluCS verifies the compatibility of the request with the remaining slot availability of the service offered by GTS Rail and in case of positive checks, it suggests the possibility to request a booking. In case the shipper proceeds with the booking, it will be checked and, if no anomalies arise, it will be approved by GTS. Consequently, the service will be executed, so the execution phase starts.

Simultaneously, the monitoring phase takes place, keeping updated all logistics services catalogs and informing involved actors when modifications take place. Returning to the example, after the booking confirmation, the availability of slots decreases in quantity in CluCS platform.

2.5.2 Cargo consolidation and cargo pooling

In the following example the actors involved are:

- **Shippers:** Ceramiche Caesar and Procter & Gamble;
- **LSPs:** Captrain (Rail Operator) and Autamarocchi (Road Carrier);
- **Terminals:** Marzaglia Local Terminal, Parma Local Terminal, Bologna Main Terminal and Trieste Port Main Terminal.

At first instance, LSPs share their service catalogs with all CluCS users via CluCS platform. This means that, among others, CluCS has information about the offered logistics services by Captrain (Rail Operator) and Autamarocchi (Road Carrier).

Ceramiche Caesar is a ceramic tile manufacturer and has a service request of transporting goods from its industrial plant in Modena Area to a final destination in Turkey. Ceramiche Caesar enters its service request in the CluCS detailing quantity and information about containers, desired departure times and frequency of shipments (once a month).

Procter & Gamble is a mass consumption products company and has an industrial plant in Parma Regional Terminal area. It has a service request for transporting goods to a final destination in Turkey. It enters its service request in the CluCS detailing quantity and information about containers, desired departure times and frequency of shipments (once a month).

CluCS responds to these logistics services requests according to the information it has about the logistic services catalog of all LSPs in the PTN and its extension at Cluster level.

In the case of Ceramiche Caesar, CluCS proposes an intermodal solution: a road carrier (Autamarocchi) will get the containers from Ceramiche Caesar's industrial plant and transport them to the Marzaglia Regional Terminal, where cargo will be handled by the terminal operator and loaded into a train operated by Captrain, going to Bologna Main Terminal and then to Trieste Port Main Terminal, where it will be loaded into a vessel departing from EMT terminal with destination to a Turkish port.

CluCS also offers an intermodal solution for Procter & Gamble: a road carrier (Autamarocchi) will get the containers from Procter & Gamble's industrial plant and transport them to Marzaglia Regional Terminal, where cargo will be handled by the terminal operator and loaded into a train operated by Captrain, going to Bologna Main Terminal and then to Trieste Port Main Terminal, where it will be loaded into a vessel departing from EMT terminal with destination to Turkey.

In this example, both logistics solutions are basically the same, but it is useful to explain the concept of Cargo Pooling.

At this point, both Ceramiche Caesar and Procter & Gamble decide that the proposed logistics service solution fills their logistics service request and decide to go ahead with CluCS to book the mentioned services. This concludes the planning phase.

Now, CluCS proceeds to inform all involved actors in these two logistic flows (Autamarocchi, Captrain, EMT, Marzaglia Regional Terminal, Bologna Main Terminal and Trieste Port Main Terminal) about the need to execute the services booked by the shippers (Ceramiche Caesar and Procter & Gamble). Also, in the execution phase, CluCS aids the PTN in looking for the optimization of opportunities.
In this case, combining volume of Ceramiche Caesar, that produces goods that are very heavy with a low volume (e.g. ceramic tiles) and Procter & Gamble, that produces goods that have a very high volume but with a low weight (e.g. toilet paper or similar products) allows optimization.

Ceramiche Caesar has the problem that when filling container and arriving to the maximum permitted weight, the utilized volume is only a part of the total, while Procter & Gamble has the opposite problem: when filling a truck or a cargo unit and arriving to the maximum possible volume, the utilized weight capacity is only a part of the total.

Considering the previous problems, a possible solution arises: pooling cargo from Ceramiche Caesar and Procter & Gamble, optimizing container volume and weight fill rates.
CluCS identifies this opportunity and presents it to the PTN Manager through the platform, who can now contact both shippers in order to offer an optimized logistics solution involving the process of cargo pooling in the Marzaglia Regional Terminal (this service is offered in this example).
CluCS will also aid the PTN Manager in the optimization of logistics flows through Cargo Consolidation.

As said before, CluCS has visibility of logistics flows within the PTN, and in this example, two findings can be formulated: first, the train used by Ceramiche Caesar and Procter & Gamble has an important quantity of idle capacity (empty wagons) in the section from Bologna Main Terminal to Trieste Port Main Terminal; second, the shipper Procter & Gamble is using CluCS to book road carrier services to transport goods from another plant near Bologna to a destination in Trieste. CluCS identifies an opportunity and presents it to the PTN Manager,

who can now contact the shipper and offer an optimized logistics solution involving Cargo Consolidation at the Bologna Main Terminal. In this possible solution, Procter & Gamble ships its cargo via road carrier to Bologna Main Terminal, where a terminal operator loads it in the same train used by Ceramiche Caesar and the other plant of Procter & Gamble with a final destination in Trieste Main Terminal. This concludes the execution phase.

At the same time, the monitoring phase takes place, keeping updated all logistics services catalogs and informing involved actors when modifications take place. Returning to our example, Automarrochi updates its logistics service catalog with the cancellation of all road services in the Modena Area for a period of two weeks due to syndical problems. CluCS detects that these two weeks coincide with the date of one of the monthly combined shipments by Ceramiche Caesar and Procter & Gamble, so it informs the shippers about this change in the schedule and in the service.

2.6 CluCS Expected benefits

The before-mentioned functionalities of CluCS will bring a wide set of optimization benefits to all the stakeholders of Bologna – Trieste Cluster. Terminals should see an increase in the amount of freight handled with the current infrastructure as they will be more efficient and able to be more competitive, achieving in this way a better utilization of their operative capacity. This will increase the amount of freight handled per surface unit, with a logical decrease in the unused space and capacity for cargo handling operations in the terminals.

Because of an increased competitiveness and efficiency of intermodal operations, Terminals should also see an increase in door-to-door operations, previously operated in an all-road modality, with an increasing number of shippers turning to intermodal solutions using terminals within the Cluster. This switch to intermodality in door-to-door cargo flows will contribute to a decrease in logistics process energy consumption, bringing also a reduction of CO2 emissions in transport and cargo handling operations, being the cargo consolidation and cargo pooling essential factors of this optimization process.

Both mentioned added value practices will be important causes of a decrease in end-to-end logistics costs, always aiming for the optimization of the utilization of logistics lanes and terminals.

The visibility and intermodal booking capabilities provided to stakeholders by CluCS should work in the direction of a more synchronized intermodal logistics process, allowing terminals to achieve a decrease in operating times for cargo handling, including improvements in waiting times for cargo arriving or departing from them. Also Rail operators, as a result of a Cluster optimized logistics process, should be able to provide a better service in terms of saving time and reliability.

3. CluCS users and their role

For the successful implementation and function of the Cluster Community System there are three main users with different functions and tasks:

- Shippers: In a way, they are the “main users” of the platform services. Shippers within the PTN and the Cluster benefit from the possibility to book intermodal logistic services departing from the cluster and with destination both intra and extra cluster. The platform also keeps an updated status of all services, letting know shippers when a booked service has been cancelled or delayed.

- Logistic Service Providers (LSPs): The platform allows LSPs to publish their services to a wide audience of shippers, both in the local PTN and in the Cluster. These transport services are bookable via platform. LSPs’ main task is to communicate to CluCS their Logistic Services Catalogs (information about the offered services) and keep them updated in case of changes or cancellations, allowing in this way CluCS to provide up to date information to the rest of the users.

- Cluster Community Manager: This role is performed by an independent third party, whose main function is to provide shippers and LSPs with optimization suggestions in base of the data provided by CluCS. Cargo consolidation (based on information provided by CluCS) between points united by rail services should be promoted by the Cluster Community Manager in order to follow the Clusters 2.0 main guidelines. Cargo pooling opportunities among shippers that have expressed (published in the platform) their will to “bundle” sub optimal recurring cargo flows should be encouraged and sponsored by the Cluster Community Manager.

3.1 Client/user needs

As we explained in the previous paragraph, CluCS' main users are shippers/forwarders, Logistics Service Providers (and terminals, partially) and Cluster Community Managers.

3.1.1 Shippers and forwarders' needs

Regarding shippers and forwarders active in the Cluster, CluCS potential customers are all companies moving goods through the cluster's network of ports and terminals (Proximity Terminal Network).
In the LL1 (Living Lab 1) the interested geographical area is between Piacenza, Bologna and Trieste, with the related PTN's infrastructures and facilities.

Table 3 focuses on shippers and forwarders' needs and also on the solutions that can be adopted by CluCS.

Table 1: Shippers and forwarders' needs vs. solutions

Needs vs. Solution	
Target User needs	**Solution's benefits**
Reduce logistics costs	Services booked through the CluCS cost less because: Consolidation of shipment on PTN level allows a better use of available capacity; CluCS providers own the PTN facilities and can offer them at discounted prices.
Shorter lead times	Through the CluCS synchronised multimodal solutions will be offered, resulting in a comprehensive reduction of multimodal transport lead-time up to a reduction of 20% compared to the all-road option.
Increase volumes	As a result of the PTN and CluCS implementation, the shippers will be able to move more goods, so to increase usage of the terminal surfaces for handling their operations.
Increased reliability	CluCS visibility and monitoring functions allow to pre-emptively handle any delay or problem.

3.1.2 LSPs and Terminals needs

LSPs and Terminals are all the companies providing the services to move goods through the cluster's network of ports and terminals, so they function as organizing nodes of the PTN and Cluster.
LSPs function as "vectors" uniting the nodes (terminals) within the PTN and the Cluster, providing the core logistics services, transport of goods in all its modalities and with all of the differentiated characteristics needed to satisfy the shippers needs.
Terminals find in CluCS an essential tool that allows them to fulfill their role as aggregators of cargo flows in view of optimizing intermodal transport by processes of cargo consolidation and cargo pooling.

Table 4 focuses on cluster LSPs and Terminal's needs and also on the solutions that can be adopted by the CluCS.

Table 2: LSPs and Terminals needs vs. solutions

Needs vs. Solution	
Target User needs	**Solution's benefits**
Decrease in waiting times	Overall cargo flows visibility will reduce waiting times due to an optimized data management.
Reduce logistics costs	LSPs will reduce costs related to idle waiting times to access terminals. Terminals will reduce costs related to access management due to timely and reliable information about cargo flows from and for them.
Wider audience reach	LSPs and terminals benefit from the access to a wider set of potential clients by the publication of their services in CluCS and the possibility to book these services using the platform.

3.1.3 Cluster Community Managers' needs

As it regards to cluster community managers, CluCS potential customers are all entities owning, administering and managing the key logistic infrastructures in the cluster area, i.e., authorities and other organizations managing the cluster's network of ports and terminals. They need an improvement/development of reliability of data in order to manage at global level and providing the traceability (Sharing information, updated information).

The target customers are individuals with investment power inside the managing organizations of important logistic nodes on regional or continental level (e.g., managers of large ports, airports, inland terminals and other relevant infrastructures).

Table 5 focuses on cluster community managers' needs and also on the solutions that can be adopted by the CluCS.

Table 3: Cluster Community Managers' needs vs. solutions

Needs vs. Solution	
Target User needs	**Solution's benefits**
Increase infrastructure utilization	Coordinated management of terminals and capacity optimization will allow to increase freight volumes managed in the Cluster.
Introduce added-value services	Support added-value synchronized activities, like cargo pooling, consolidation, late product differentiation, assembling and testing.
Increase intermodal transport share	Enable well-coordinated intermodal transport services with enhanced performances, competitive with all-road solutions.

Specifically, CluCS will support the Cluster Community Manager in the identification of optimization opportunities regarding the cargo flows within the PTN and Cluster. This will be achieved by the identification of particular cases in which practices of Cargo Consolidation and Cargo Pooling could take place. As CluCS has overall information about all cargo flows within the PTN and also data regarding all offered logistic services, it will search for cases in which the ITUs fill rate is not optimal (Cargo Pooling opportunity) or trains with high idle capacity (Cargo Consolidation).

4. CluCS components

The logical architecture described in 2.4 sub-section can be made explicit in the software two main components (communications network and web-based application) and in the modules described below.

4.1 Communications network

Through the implementation of the CluCS communication network each actor of a regional or supra-regional PTN could become a node using standard transport protocol and security policies. The communication network of CluCS guarantees a secure and reliable exchange of documents and data (structured, non-structured and/or binary): each node of CluCS to exchange information has to be conformant to the same technical rules.
As mainly consequence of developing the CluCS communication network is that existing IT systems could start to communicate once they are connected to their own CluCS node. In other words, CluCS communication network could be seen as an interoperability layer among heterogeneous systems rising their security offered by internet. Furthermore, offering high capability of scalability and performance: the number of nodes could grow easily as well as the number of exchanged messages.

CluCS communication network is an e-SENS AS4 conformant solution and the main characteristics are:

- Interoperability
- Security
- Scalability & Performance
- Accountability

In this way, CluCS supports a standardized message exchange protocol that ensures interoperable, secure and reliable data exchange: AS4 is an open technical specification for the secure and payload-agnostic exchange of data using Web Services. According to OASIS, the AS4 protocol is the modern successor of the AS2 protocol.
In 5.5 section user requirements for the communications network will be explained.

4.2 Web-based application

The web application of the CluCS is held by the Central Node and has the scope of providing CluCS users with the services of:

- Cargo consolidation
- Cargo pooling
- Intermodal services booking

The web-based application allows also to non-Cluster users to take advantage of high value-added services offered by the Cluster. It also allows to give visibility of the overall status of the Cluster promoting an anonymized and impartial offer of services.

The three services mentioned before aim to meet the project's core demands regarding visibility of cargo flows, interoperability and intermodality between terminals in the PTN and Cluster and the optimization of the logistics flows and asset utilization.

Shippers are able to access a web interface in which they select a departing and destination point and detail all the cargo units involved in the desired logistics process.
Based on the logistics services catalogs (provided by the LSPs), CluCS offers a set of solutions for the received request. These solutions are anonymized and include (in the

necessary cases) all the intermodal combinations needed to reach the destination point.
At this point, the shippers can opt for one (or none) of the solutions presented. When the acceptance takes place, CluCS informs all Involved actors (LSPs – Terminals) about the booked services to be provided. A final confirmation is sent to the shipper that has booked the service in the first place when the LSPs acknowledge the booking of the logistics services.

4.3 CluCS Modules

In this section the software modules are described.

4.3.1 Planning, Execution and Monitoring Module

This is the transversal module that underlies the planning, execution and monitoring phases of the processes of:

- Cargo consolidation
- Cargo pooling
- Intermodal services booking

4.3.1.1 Cargo Consolidation

The Cargo Consolidation Process is defined as the combining of two or more shipments in order to lower transportation rates. An example within the Cluster could be a train carrying containers from different shippers to the same destination.

CluCS aids the PTN Manager in the identification of opportunities of optimization of logistics flows through Cargo Consolidation processes, in this manner trying to reduce road traffic in benefit of rail traffic. As said before, in the planning phase CluCS has visibility over the Logistics Services Catalogs provided by the LSPs and over the logistics flows within the Cluster, as shippers use the platform to book intermodal services. CluCS aims to find rail idle capacity (empty wagons) and tries to match it with road cargo flows to reachable destination by train.
CluCS identifies these opportunities and present them to the PTN Manager, who can now contact the shippers and offer an optimized logistics solution involving Cargo Consolidation (execution phase).
Regarding the monitoring phase, CluCS adapts to changes in service catalogs monitoring the status of offered logistics services.

4.3.1.2 Cargo Pooling

One of the main scopes of the Clusters 2.0 project is the reduction of idle cargo capacity in the Supply Chain. This means that vehicles and cargo units (containers, semitrailers, swap bodies, etc. -ITUs-) should be optimized, aiming for a decrease in the number of vehicles utilized.

There are two principal factors to be considered when trying to optimize a truck / cargo unit idle load factor:

- Volume
- Weight

In fact, if the goods are very heavy with a low volume (e.g. ceramic tiles) when filling a truck or a cargo unit and arriving to the maximum permitted weight (e.g. toilet paper or similar products), the utilized volume is only a part of the total. Vice versa for high volume goods but with a low weight (e.g. toilet paper or similar products) when filling a truck or a cargo unit and arriving to the maximum possible volume, the utilized weight capacity is only a part of the total.

In planning phase CluCS works in the identification of this opportunities optimization and present it to the PTN Manager, who, in turn, should contact the shippers to make the proposal for cargo pooling. If the shippers accept, the execution phase starts (cargo pooling agreed process).
Regarding the monitoring phase CluCS updates the service catalogs, if there are some changes, monitoring the status of offered logistics services.

4.3.1.3 Intermodal Services Booking

As explained before, CluCS gives the opportunity to their users to book the services offered by terminals and Logistics Service Providers. Nodes communicate with each other sharing information of intermodal services available, that is, the Logistic Services Catalogs published and updated by the LSPs. With this information at hand, users can also decide to use the platform to book a combination of intermodal services in order to reach the desired destination for their cargoes (planning phase).
Regarding the monitoring phase, CluCS will adapt to changes in service catalogs monitoring the status of offered logistics services.

4.3.2 Interoperability with CargoStrem platform

This is the module implementing the communication with the CargoStream platform.
The CargoStream platform anonymizes and aggregates the logistics needs of multiple shippers, and makes these data available to LSP's and terminals, who can analyze, optimize, and generate collaborative proposals that benefit the community, always aiming to an enhanced use of the logistics assets involved in the transport processes.

This module allows Piacenza-Bologna-Trieste Cluster's users to interact with a network of other clusters at European level, all aggregated in the CargoStream platform, permitting in this manner the organization of optimized cargo flows to and from destinations outside the Cluster. These aggregated data will be then anonymized and shared with external trustees or Cross Chain Control Centre that will provide suggestions for bundling and collaborative transport by making use of optimization tools for logistics network design, finding then the best possible combination of flows and new services to meet the aggregated demand. As a result, bundling, shift to rail/waterways and short sea recommendations will be given as well as new potential services.

CargoStream platform will be open for third parties. Users will keep their own IT-systems and share information via an API. Based on the transport needs from shippers connected to the CargoStream platform, the Matchmaker Engine will look for collaboration opportunities and propose these matches via the platform to the corresponding shippers. Shippers that want to develop the suggested match, can give positive feedback and start a collaborative exercise.

Following this logic, CluCS has to share information with CargoStream about logistics flows originating from inside Bologna-Trieste Cluster and with a destination outside it specially in other European clusters.
For example, all rail, road or intermodal cargo flows from Trieste to the rest of Europe will be communicated by CluCS (tool that has been used to book them in the first place) to CargoStream, providing the detailed data with which then this platform will be able to generate proposals for logistic flows optimization processes such as cargo pooling or cargo consolidation.
For this to happen, information shared with CargoStream will have to be detailed in the ITU level (container, swap body, truck, train) and also in the level pertaining the cargo (packages weight and size, ITU fill rates, etc.), allowing cargo pooling or cargo consolidation processes to be envisioned.

5. CluCS modules functional requirements

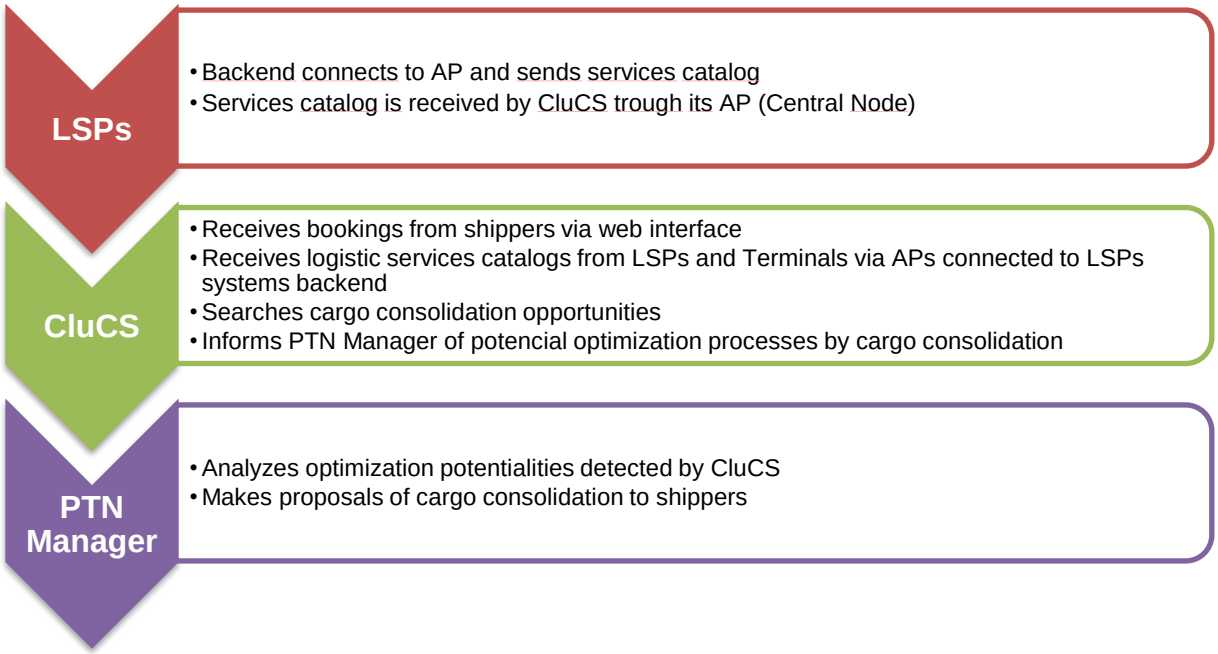
This chapter explains the functional / user requirements of each module described above and defines the process workflows for the creation of "cargo consolidation", "cargo pooling" and "intermodal booking" services.

5.1 UR_01 – Management processes

The software will offer the functionalities to carry out the following explicit processes, followed by high-level flow diagrams. Alongside each activity the reference to the detailed functional requirement is reported.

5.1.1 UR_01.01 – Cargo Consolidation Process

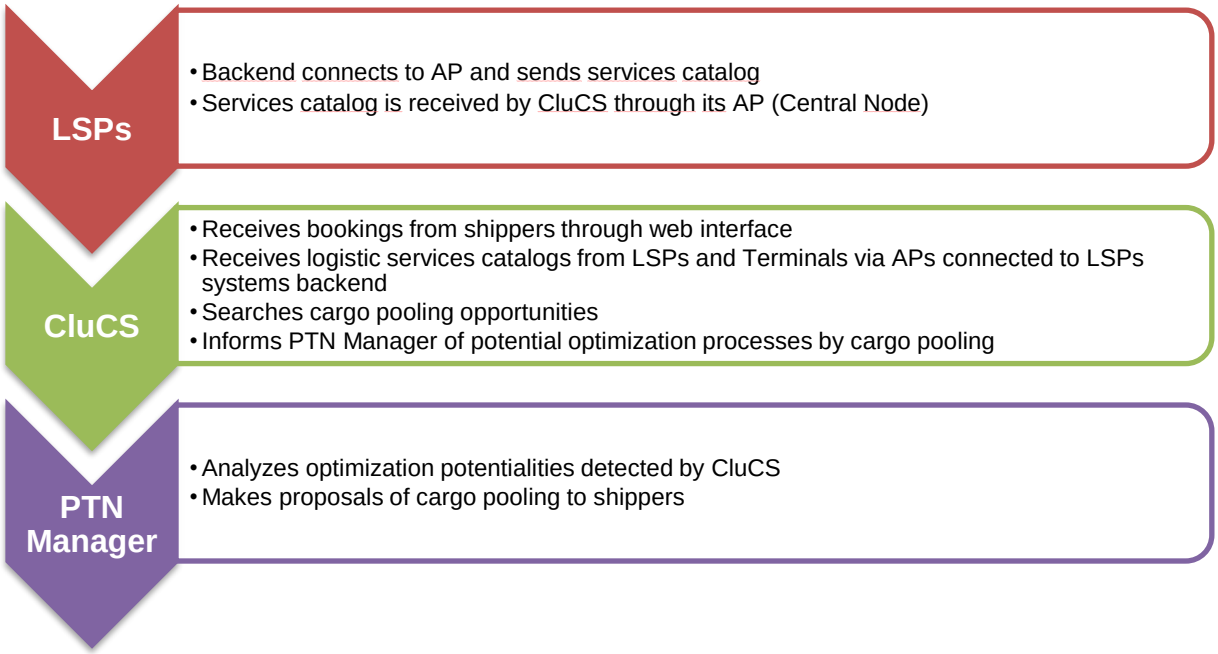
Figure 3: UR_01.01 – Cargo Consolidation Process



The Cargo Consolidation Process is defined as the combining of two or more shipments in order to lower transportation rates. An example within the Cluster could be a train carrying containers from different shippers to the same destination.
CluCS aids the PTN Manager in the identification of opportunities of optimization of logistics flows through Cargo Consolidation processes, in this manner trying to reduce road traffic in benefit of rail traffic. As said before, CluCS has visibility of logistic flows within the Cluster as shippers use the platform to book intermodal services. Furthermore, it has visibility of the Logistic Services Catalogs provided by the LSPs. CluCS aims to find rail idle capacity (empty wagons) and tries to match it with road cargo flows to destinations reachable by train.
CluCS identifies these opportunities and presents them to the PTN Manager, who can now contact the shippers and offer an optimized logistic solution involving Cargo Consolidation.

5.1.2 UR_01.02 – Cargo Pooling Process

Figure 4: UR_01.02 – Cargo Pooling Process



As already said, there are two principal factors to be considered when trying to optimize a truck / cargo unit idle load factor:

- Volume
- Weight

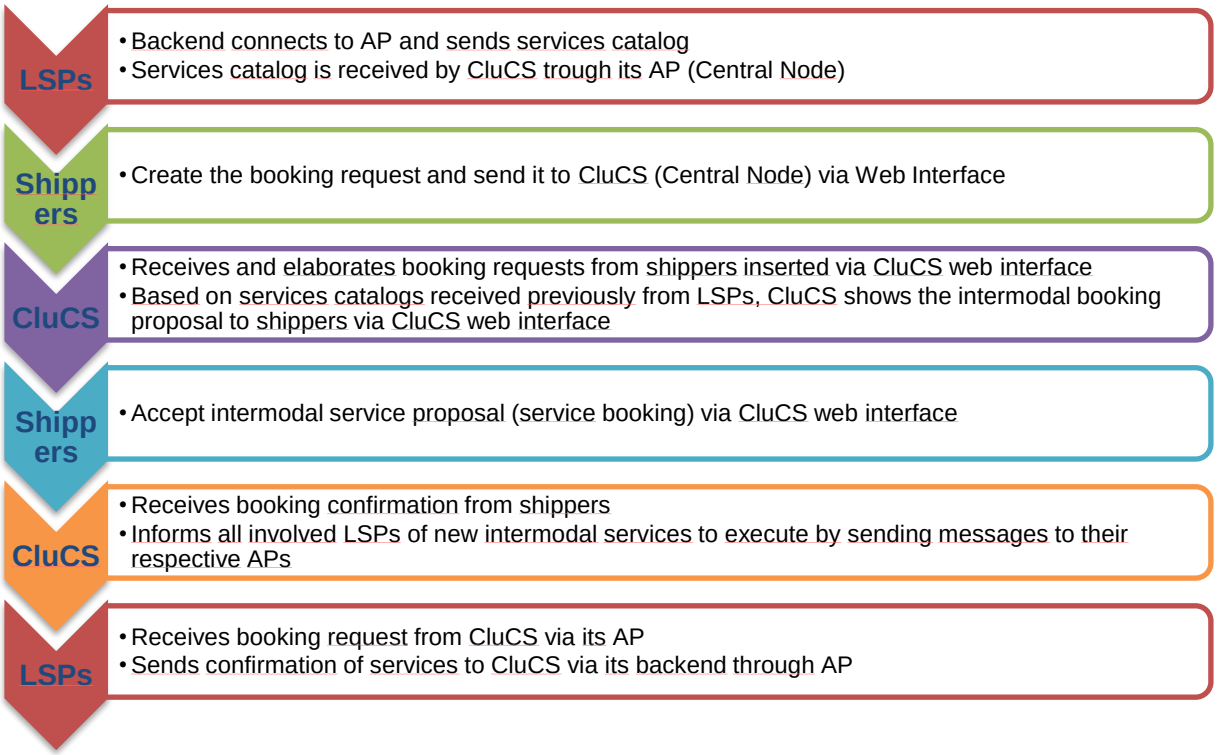
In Bologna PTN these two principal factors are present:

- Industries like P&G are likely to ship very light goods wasting weight capacity;
- Industries like Ceramiche Caesar are likely to ship very heavy goods wasting volume capacity;
- Local and Main Terminals within the PTN can act as service providers in charge of the activity of pooling cargo;
- LSPs acting in the PTN can provide the transport services needed;
- CluCS can function as a tool to identify cases of potential load factor optimization and getting in contact the different stakeholders involved.

Central Node makes the PTN Manager notice of the potential match between two or more shippers. At this point, the PTN Manager should contact the involved shippers and propose the optimized cargo pooling logistic solution.

5.1.3 UR_01.03 – Intermodal Logistic services Booking management

Figure 5: UR_01.03 – Intermodal Logistic services Booking management



CluCS offers their users the ability to book services offered by terminals and Logistics Service Providers. As explained before, nodes communicate with each other sharing information of intermodal services available, that is, the Logistic Services Catalogs published and updated by the LSPs are transmitted to the central node of CluCS. With this piece of information at hand, users can also decide to use the platform to book a combination of intermodal services in order to reach the desired destination for their cargoes.
Following this logic, the communication process for the booking process between nodes should be as follows:

- LSPs backend connects to AP and sends services catalog to CluCS central Node through its AP.
- Shippers send a Booking Request via CluCS web interface indicating information about desired dates, departure, destination and type and quantity of cargo.

At this point, the Central Node has information about:

1) Shippers Booking Requests
2) All terminals and LSPs Services Catalogs

With this piece of information, the Central Node can decide the best option to fulfill the shipper's logistic needs.

- CluCS (central node) receives and elaborates booking requests from shippers inserted via CluCS web interface. Based on services catalogs received previously from LSPs, CluCS shows intermodal booking proposal to shipper's via CluCS web interface.

At this point, the shipper has to decide whether the offered service fulfills its needs and accept

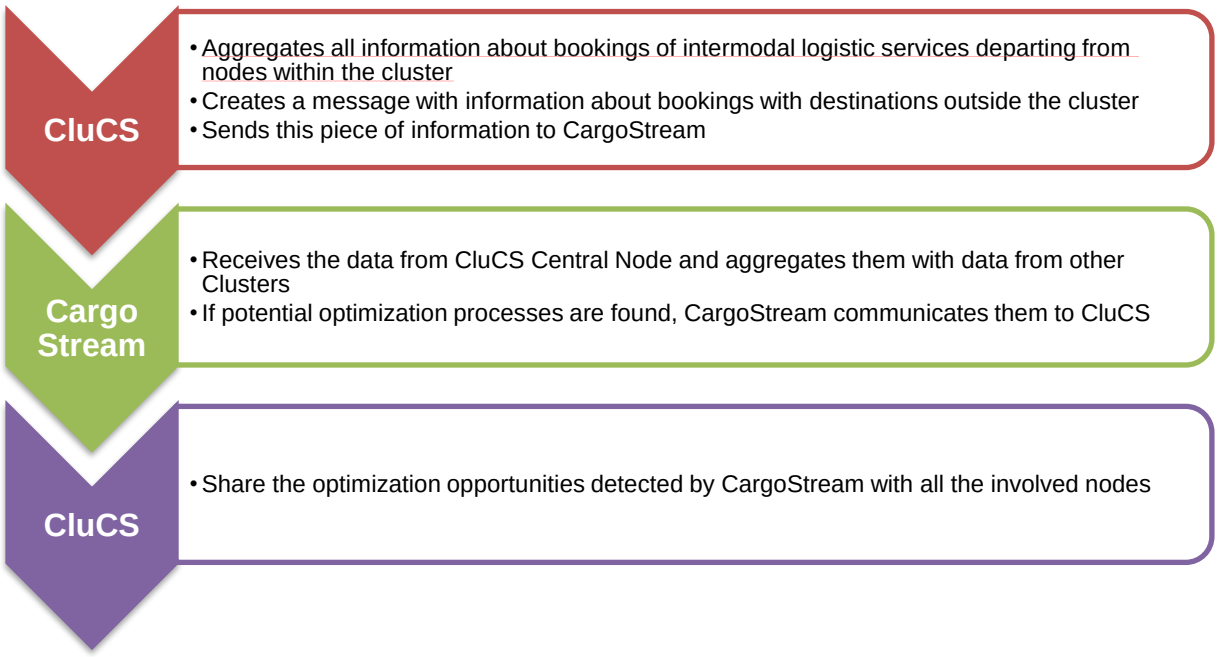
or decline the booking. If the shipper accepts, the communication continues as follows:

- Shippers now can accept (or refuse) intermodal service proposal (services booking) via CluCS web interface.
- If accepted, CluCS receives booking confirmation from shippers and then proceeds to inform all involved LSPs of new intermodal services to execute sending messages to their respective APs.

Finally, LSPs receive booking requests from CluCS via their AP and send confirmation of services to CluCS via their backend through their AP.

5.1.4 UR_01.04 – CluCS and CargoStream communication process

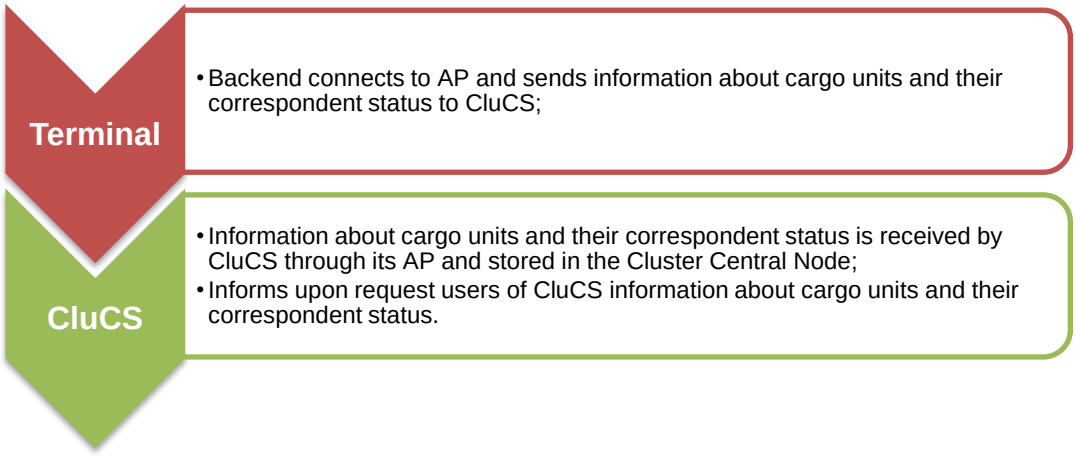
Figure 6: UR_01.04 – CluCS and CargoStream communication process



The communication process between CluCS and CargoStream platform could be implemented as follows: CluCS share information with CargoStream about logistics flows originating from inside Piacenza-Bologna-Trieste Cluster and with a destination outside it, especially in other European clusters.
CargoStream platform looks for collaboration opportunities and shares these matches to CluCS that, on its turn, shares them with all involved nodes.

5.1.5 UR_01.05 – Terminal Operations Visibility

Figure 7: UR_1.05 – Terminal Operations Visibility



In this case, CluCS offers the possibility to its users to see the specific status of their own cargo units.
The screen shows a list of cargo units relevant to each user (users can see only their own cargo units, whereas the Cluster Community Manager can visualize all cargo units handled by the system).
By accessing one particular unit, the user should see detailed information about it, such as status, ETD and additional notes from the Terminal.

5.2 UR_02 – CluCS Communication Network

5.2.1 UR_02.01 – Regional PTN implementation and their aggregations (Cluster)

The software platform has to implement the concept of PTN and Cluster (as aggregation of multiple PTNs) allowing the creation of regional, national and inter-national networks. WP2 foresees, at least, the creation of a Cluster between Bologna Interporto and Port of Trieste and also an integration with Nallian platform. Moreover, CluCS communication network must be designed in such a way to allow an easy addition of new nodes to an existing PTN, to aggregate many PTNs together or to create new ones.
To satisfy the concept of *"collaborative network with consolidated flow via cluster network"* every node belonging to a PTN or more in general of the Cluster has to respect the following simple but very important rule: *each node at a certain level (4PL, LS, etc.) will be able to "dialogue" (as information exchange) between nodes of the same level, with the upper node (father) and with all the nodes of a lower level (children)".*

The communication between two nodes has to be single or double direction; the registration of a node must permit to specify the displayed services (one or more) and which nodes, respecting the constraints mentioned above, will be able to use them.

The message exchange between two nodes of the Cluster has to satisfy the requirements detailed in the following table using the e-SENS profile of the ebMS3 and AS4 OASIS Standards. Moreover, the communication trust will have to be enabled using digital certificates according to ETSI standard.

Table 4: Message exchange requirements for Regional PTN implementation and their aggregations (Cluster)

Interoperability		Security		Scalability & Performance		Accountability	
I1	Possibility to use any (one or more) XML-based standards	S1	Integrity: data and documents are secured against any modification.	SP1	Possibility to exchange data file larger than 50 MB	LAA1	Data and documents must be delivered once and only once
I2	Possibility to exchange attachments in addition to messages (XML documents)	S2	Confidentially: documents are encrypted during transmission	SP2	Easy handling of increasing messaging loads in a day, hour, etc.	LAA2	Messages must be delivered even if the channel is temporarily unavailable[1]
I3	Possibility to execute synchronous and asynchronous request-response	S3	Trustworthy of origin and destination	SP3	The network is able to adapt to an increasing of nodes	LAA3	Through signature must be guaranteed the non - repudiation of receipt and/or origin for every exchanged message

5.2.2 UR 02.02 – PTN / Cluster nodes implementation

The nodes that participate in the establishment of the Cluster, due to their nature, are heterogeneous in terms of features (e.g. Bologna and Piacenza) and information systems already in use (e.g. SAP Train used by Interporto Bologna and ERP used by GTS Rail).
For this reason, the design of the Cluster has to guarantee the possibility to decouple the communication network from the implementation of the services exposed by each node and the integration of them with the existing back-end systems.

5.2.3 UR 02.03 – PTN / Cluster nodes service discover

A node of the Cluster in order to deliver the message correctly needs to know about the other connected nodes and the participants they support: the implementation of CluCS has to support the use of a centralized service that identifies all trusted CluCS nodes and also configure the communication point-point. Moreover, each node, that represents a Cluster participating organization, has to support the possibility to publish its receiving capabilities (delivery addresses, business processes and document types supported, etc.) using an additional service.

Discovering and publishing services has to satisfy the requirements detailed in the following table according to OASIS BDXL standard.

Table 5: PTN/Cluster nodes service discover requirements

Interoperability		Security		Scalability & Performance	
I4	The kind of message, protocols, etc. supported	S3	Trustworthy of origin and destination	SP3	The network is able to adapt to an increasing of

[1] all messages, if the communication channel is not available for some reason, have to be saved locally (basically by AP) and processed as soon as the connection becomes available again.

	by each node is easily discoverable.				nodes
I5	Possibility to change and discover the registered address of nodes.				

5.2.4 UR 02.04 – Cluster Central node

The term Cluster Central Node (CCN) defines a particular node of the cluster characterized by not having a parent node. This particular node which, by definition, arises as a central node of the Cluster does not find a mapping in a physical entity (e.g. Terminal, Port Authority, etc.) but more naturally a connotation of the Trust and Independent Authority.

5.2.5 UR 02.05 – Data anonymization

CluCS must guarantee the anonymization of the data by revealing the participants only at the time of finalization of the requested service (e.g. booking confirmation during the cargo consolidation process) or when necessary to perform the requested service.

5.3 UR_03 – Web-based application

This section describes the web-based application requirements that will permit CluCS users to interact between each other and access to Intermodal Logistics Services offered in the PTN and the Cluster.

5.3.1 UR_03.01 – Web-based applicative access

The system has to guarantee user's authentication and authorisation. For this, there is a login screen where users are able to enter their credentials (provided at first instance by the Cluster Community Manager). Once this accreditation takes place, users, depending on their roles, are able to access CluCS different functionalities.

5.3.2 UR_03.02 – Cluster's high value-added services visualization interface

As explained before, CluCS objective is to provide its users with three main functionalities: Intermodal Logistic Services Booking (for shippers), Cargo Consolidation opportunities (for Cluster Community Manager) and Cargo Pooling opportunities publication (for Shippers and the Cluster Community Manager). It follows a brief description of graphic users interface GUI requirements:

Main Screen

The main screen shows a brief presentation of the CluCS and its functionalities and it provides access to the Intermodal Logistic Services Booking screen and the Cargo Pooling screen.

In addition to this, it permits users to access to "contact us" page in which contact data of the Cluster Community Manager are displayed.

Intermodal Logistic Services Booking screen

This screen is accessible through the Home Screen. Users can visualize a set of dialog boxes that permit them to enter the details of the logistic service desired such as departure point, destination point, number of ITUs, Type of ITUs, desired departing date, desired arrival date, etc. Once all information is entered, CluCS looks for possible solutions for the shippers and presents them in a new screen in form of a list, listing first the options that involve a higher percentage of the transport process executed by a rail service provider. Next to each presented option, there is a button that permits the user to "book" the selected solution.

The users that have already booked a logistic service visualize a list of previously booked

services.
In the case of the Cluster Community Manager, when enters this screen, it visualizes a list of all the logistic services booked in the platform.

Cargo Pooling Opportunities screen

This screen is accessible through the Home Screen. When accessing this screen, users visualize two main parts. The first is a list of all present cargo pooling opportunities published by other users. The second is a set of dialog boxes that permit users to enter the details of the sub optimal logistic flows they wish to share. This happens in order to find another shipper to bundle cargo together, indicating data such as, departure point, destination point, number of ITUs, type of ITUs, number of packages inside ITUs, weight of packages, volume of packages, desired departing date, desired arrival date, etc.
Once all data is entered, users will be able to click the “publish” button, and the provided information will be available to all users.
In the case of the Cluster Community Manager, when accessing this screen, it visualizes a list of all present cargo pooling opportunities published by other users.

Cargo Consolidation Opportunities screen

This screen is accessible through the Home Screen. The only user of this screen is the Cluster Community Manager. It shows a list of booked logistic services by truck that cover routes in which a rail service is present and available. The Cluster Community Manager visualizes the above-mentioned list with the newest entries at the top.

5.4 UR_04 – Planning, execution and monitoring modules

This section presents CluCS functionalities from Planning, Execution and Monitoring processes point of view.

5.4.1 Planning and Execution

Intermodal Logistic Services Booking

CluCS offers their users the possibility to book services offered by terminals and Logistic Service Providers. Nodes communicate with each other sharing information of intermodal services available, that is, the Logistic Services Catalogs published and updated by the LSPs are transmitted to the central node of the CluCS. With this information at hand, users can also decide to use the platform to book a combination of intermodal services in order to reach the desired destination for their cargoes.

Following this logic, the communication process for the booking process between nodes should be as follows:

- LSPs backend connects to AP and sends services catalog to CluCS central Node through its AP.
- Shippers send a Booking Request via CluCS web interface including information about desired dates, departure and destination and type and quantity of cargo.

At this point, the Central Node has information about:

1) Shippers Booking Request
2) All terminals and LSPs Services Catalogs

With this piece of information, the Central Node can decide the best option to fulfil the shipper's logistic needs.

- CluCS (central node) receives and elaborates booking request inserted via CluCS web interface from shippers. Based on services catalogs received previously from LSPs, CluCS shows intermodal booking proposal to shippers via CluCS web interface.

At this point, the Shipper has to decide whether or not the offered service fulfils its needs and accept or decline the booking. If the Shipper accepts, the communication continues as follows:

- Shippers accept (or refuse) intermodal service proposal (services booking) via CluCS web interface.
- If accepted, CluCS receives booking confirmation from shippers and then proceeds to inform all involved LSPs of new intermodal services to execute by sending messages to their respective APs.

Finally, LSPs receive booking requests from CluCS via their AP and send confirmation of services to CluCS via their backend through their AP.

Cargo Pooling information

Cargo pooling is a very complex logistic operation by which two (or more) different shippers put their cargoes together to optimize the utilization of an ITU, taking into consideration volume and weight utilization. CluCS offers the possibility to shippers to voluntarily share information about regular shipments that are sub-optimal in any way and that they're willing to "pool" with other shippers. The Web Interface should offer shippers the functionality to insert information about their sub-optimal cargo flows, indicating departure, destination, time of departure, weight of the cargo and volume of the cargo (also number of packages and individual

volumes). Once this information is entered, it should be displayed to other shippers in a specific section of the web interface. In this way, if another shipper finds an opportunity for pooling cargo, it can contact the shipper that has published the information first.

Cargo Consolidation Opportunities

CluCS aids the PTN Manager in the identification of opportunities of optimization of logistic flows through Cargo Consolidation processes, trying to reduce road traffic in benefit of rail traffic. CluCS has visibility of logistic flows within the Cluster, as shippers use the platform to book intermodal services, and it has also visibility of the Logistic Services Catalogs provided by the LSPs. Therefore, CluCS aims to find rail idle capacity (empty wagons) and match it with road cargo flows which have reachable destinations by train.

CluCS identifies these opportunities and presents them to the PTN Manager, who can now contact the shippers and offer an optimized logistic solution involving Cargo Consolidation.

In a strict sense, CluCS analyzes all bookings made in the platform by the users and check if for the same routes there is rail service availability. If so, CluCS informs the Cluster Community manager who, in turn, contacts the involved shippers to offer this service.

Moreover, the cargo consolidation process is aided by CluCS in the logistic services booking phase. When requesting a booking, the shippers visualize a list of possible solutions which fulfil their needs. CluCS should display first the solutions with a higher percentage of the path covered by rail transport

5.4.2 Monitoring

The monitoring process should be able to interact with both Planning and Execution phases to keep the status of the available services within the Cluster constantly up-to-date and letting the involved actors know about alterations and changes of the service catalog. This means that when monitoring “detects” an alteration to the offered services catalogs, it interacts with the Planning phase changing the service catalog that is made available to shippers.

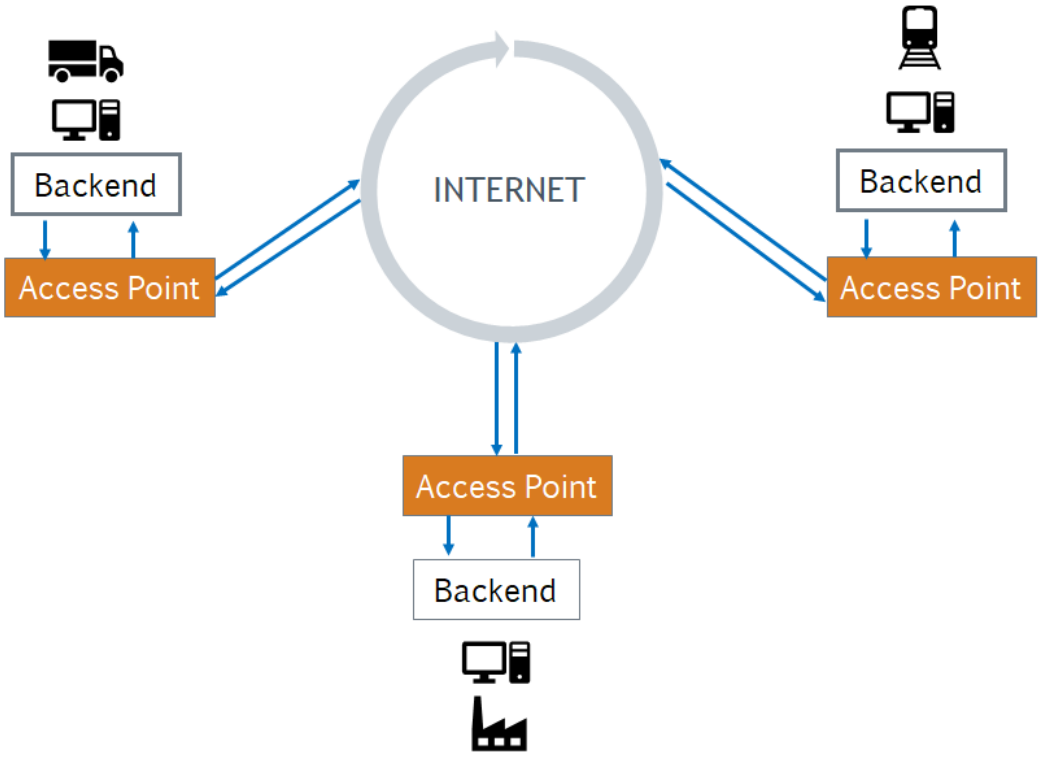
At the same time, it interacts with the Execution phase, letting all involved actors know about modifications in the logistic services catalogs offered by the LSPs.

In a strict sense, when an LSP knows one or more of the services previously shared and published in CluCS will suffer changes or will be cancelled, it should send an update of these services to CluCS (indicating cancellation or modification). This updates the LSP service catalog. In the case that the modification in the catalog includes a logistic service that has already been booked but not yet executed, CluCS should inform all involved parties (Shipper and other LSPs involved in the Logistic Chain) of this modification.

5.5 UR_05 – CluCS interfaces with sub-systems (terminal / hub) and over-systems (CargoStream platform)

CluCS communication network implements a standardized message exchange protocol that ensures interoperable, secure and reliable data exchange according to e-SENS AS4 protocol. The technical architecture of the CluCS communication network is based on a conceptual model called 'four-corner model'. This means that Backend systems do not exchange messages directly with each other, but via Access Points, in any given exchange, playing the sender or receiver role.
According to this specification, all sub-systems (e.g. LSP) and over-systems (e.g. CargoStream) have to implement their Access Point conformant to the same technical specification to be therefore capable to communicate inside the CluCS network (figure 9).

Figure 8: CluCS communication network



6. Electronic Message Exchange

For the implementation of the previously mentioned processes (Intermodal Logistic Services booking, Cargo Consolidation, Cargo Pooling), a set of messages containing specific information needs to be exchanged between CluCS nodes. In this section there is the definition of the detailed messages for every process.

6.1 Intermodal Logistic Services booking process messages

As explained in 5.1.3 section (UR_01.03), CluCS offers users the ability to book logistic services (single or combined) directly from its web interface. The following are the messages involved in the process.

6.1.1 LSP to CluCS – Service Catalog

Each LSP participating in the platform keeps informed CluCS about the provided and offered Logistic services.

- Company Name
- Company Type
- Service N°#1
    - Service Type
    - Service Departing Point
    - Service Arrival Point
    - Service Departing Time
    - Service Arrival Time
    - N° of spaces for ITUs
        - Deck / Wagon / Trailer Type N°#1
        - Deck / Wagon / Trailer Type N°#2
        - Deck / Wagon / Trailer Type N°#3
        - Deck / Wagon / Trailer Type N°#N
- Service N°#2
    - Service Type
    - Service Departing Point
    - Service Arrival Point
    - Service Departing Time
    - Service Arrival Time
    - N° of spaces for ITUs
        - Deck / Wagon / Trailer Type N°#1
        - Deck / Wagon / Trailer Type N°#2
        - Deck / Wagon / Trailer Type N°#3
        - Deck / Wagon / Trailer Type N°#N
- Service N°#N
    - Service Type
    - Service Departing Point
    - Service Arrival Point
    - Service Departing Time
    - Service Arrival Time
    - N° of spaces for ITUs
        - Deck / Wagon / Trailer Type N°#1

        - Deck / Wagon / Trailer Type N°#2
        - Deck / Wagon / Trailer Type N°#3
        - Deck / Wagon / Trailer Type N°#N

6.1.2 Shipper to CluCS – Logistic Service Request (via web interface)

In this moment, a single Shipper accesses CluCS web interface to enter a Logistic Service Request.

- Company Name
- Company Type
- Requested Service Departing Point
- Requested Service Arrival Point
- Requested Service Departing Time
- N° of spaces for ITUs
    - ITU Type N°#1
    - ITU Type N°#2
    - ITU Type N°#3
    - ITU Type N°#N

6.1.3 CluCS to Shipper – Logistic Service Proposal (via web interface)

CluCS, having information of LSPs offered services and Shipper's particular needs, builds a proposal for the booking of Intermodal Logistics Services to be executed. There are as many transportation modalities as needed to reach the desired destination in an optimal way.

- Service Type N°#1
    - Service Departing Point
    - Service Arrival Point
    - Service Departing Time
    - Service Arrival Time
    - N° of spaces for ITUs
        - Deck / Wagon / Trailer Type N°#1
        - Deck / Wagon / Trailer Type N°#2
        - Deck / Wagon / Trailer Type N°#3
        - Deck / Wagon / Trailer Type N°#N

- Service Type N°#2
    - Service Departing Point
    - Service Arrival Point
    - Service Departing Time
    - Service Arrival Time
    - N° of spaces for ITUs
        - Deck / Wagon / Trailer Type N°#1
        - Deck / Wagon / Trailer Type N°#2
        - Deck / Wagon / Trailer Type N°#3
        - Deck / Wagon / Trailer Type N°#N

- Service Type N°#N
    - Service Departing Point
    - Service Arrival Point
    - Service Departing Time
    - Service Arrival Time
    - N° of spaces for ITUs

        - Deck / Wagon / Trailer Type N°#1
        - Deck / Wagon / Trailer Type N°#2
        - Deck / Wagon / Trailer Type N°#3
        - Deck / Wagon / Trailer Type N°#N

6.1.4 CluCS to Shipper – Booking of Logistic Services

When the Shipper accepts the proposed logistic solution and “books” the services, CluCS contacts all involved LSPs in the beforementioned solution.

- Requesting Company Name
- Requesting Company Type
- Requested Service N°#1
    - Service Type
    - Service Departing Point
    - Service Arrival Point
    - Service Departing Time
    - Service Arrival Time
    - N° of spaces for ITUs
        - Deck / Wagon / Trailer Type N°#1
        - Deck / Wagon / Trailer Type N°#2
        - Deck / Wagon / Trailer Type N°#3
        - Deck / Wagon / Trailer Type N°#N
- Requested Service N°#2
    - Service Type
    - Service Departing Point
    - Service Arrival Point
    - Service Departing Time
    - Service Arrival Time
    - N° of spaces for ITUs
        - Deck / Wagon / Trailer Type N°#1
        - Deck / Wagon / Trailer Type N°#2
        - Deck / Wagon / Trailer Type N°#3
        - Deck / Wagon / Trailer Type N°#N
- Requested Service N°#N
    - Service Type
    - Service Departing Point
    - Service Arrival Point
    - Service Departing Time
    - Service Arrival Time
    - N° of spaces for ITUs
        - Deck / Wagon / Trailer Type N°#1
        - Deck / Wagon / Trailer Type N°#2
        - Deck / Wagon / Trailer Type N°#3
        - Deck / Wagon / Trailer Type N°#N

6.1.5 LSP to CluCS – Confirmation of booked Logistic Services

Once the LSP receives the booking from CluCS, it needs to confirm that the services will be effectively executed and that were successfully booked.

- Requesting Company Name
- Requesting Company Type
- Requested Service N°#1

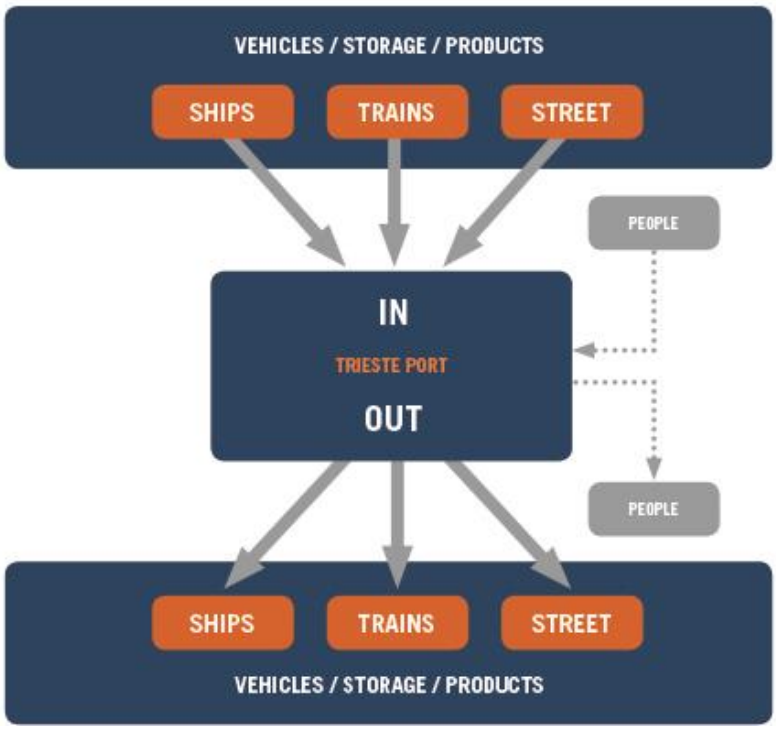
    - Approved (yes / no)
- Requested Service N°#2
    - Approved (yes / no)
- Requested Service N°#N
    - Approved (yes / no)

7. PCS of Trieste as conceptual model of CluCS

The CluCS concept mirrors the approach followed by the Port of Trieste in the elaboration of its Port Community System. Although with different scope and objectives – by law the port of Trieste cannot perform commercial activities such as cargo bundling – the two tools share the same basic structures.
Therefore, understanding how a PCS works may contribute to fine tune the implementation of the CluCS.

The Port of Trieste manages cargo and logistics units that arrive and depart by ship, train and road, according to the following flow:

Figure 9: PCS of Trieste: data flows



In order to efficiently manage, monitor and evaluate this flow, which is dynamic over time, it was recognized that a dedicated ICT based tool might have to be provided with a Port Community System (PCS).

7.1 What is a Port Community System?

The Port Community System (PCS) is a technological platform able to connect different actors-organizations that make up the Community of a port. Its aim is to guarantee a single window based system and the interoperability necessary to combine different ICT platforms, digitizing and optimizing all the operations related to port traffic management.

The 'Sinfomar' is the name of the PCS used by the Port Network Authority of the Eastern Adriatic Sea, Port of Trieste. It is an on-line software platform designed for the management of administrative, tax and customs procedures related to the port logistics chain. In the design of the 'Sinfomar' platform, the specific legislative nature of the Port of Trieste was taken into consideration in all its peculiarities and areas - Old Free Zone, New Free Zone, Timber Terminal Free Zone, Mineral Oils Free Zone and Industrial Free Zone.

From the structural perspective, the Port areas are divided into common areas (under the

management of the Port Authority) and concession areas (under the management of private terminal operators), including the areas related to the wider port domain and its logistics system as in the case of the Inland terminal of located in Fernetti (15 km from Trieste).

The 'Sinfomar' project planning phase involved the entire local and regional maritime industry stakeholders. In particular, having regard to the public authority actors, the following stakeholders were involved: Harbor Masters, Customs Agency, Financial Police, and Maritime Health Authority. Among the private operators, the following main stakeholders were involved: shipping agents, terminal operators, freight forwarders, inland terminal operator (starting with the main port intermodal terminal of Fernetti). Furthermore, the collaboration included the main railway operators, such as Alpe Adria (Regional Multimodal Transport Operator), Rail Cargo Austria and Adriafer (railway companies). The development also included research institutions as the case of the University of Trieste (specifically interested in the analysis of statistical data concerning the Port traffic).

Figure 10: Stakeholders connected to Sinfomar

7.2 Reason for implementing the PCS Sinfomar

The Italian Customs Agency calculates that "to carry out an import / export operation in the Italian national territory, private operators must submit, in addition to the customs declaration, up to 68 instances to 18 different administrations". These procedures result in multilevel administrative burdens, for the private sector, to respond to all the requested forms, which often require papers based processes in order to obtain the authorizations and licenses necessary for the release of goods. Thus, resulting in an increased expenses and long waiting times and storage of goods in the terminal areas. From the perspective of the competent public authority, the growth in traffic volumes registered in the international traffic in the last decades entails the treatment of an ever-increasing volume of documents to manage, which requires the availability of a considerable number of human resources to process.

Moreover, the absence of common shared standards, combined with the lack of coordination, causes delays in the flow of goods, severely limiting the competitiveness of the country as a whole. In light of these considerations, and in synergy with the international and European Union interests related with the strategic value of ports, the digitalization of the sector in the national territory revealed the priority to achieve an overall optimization through the deployment of single window systems. The main objective is the progressive dematerialization of procedures with the adoption of shared standards in the information flows among the various actors.

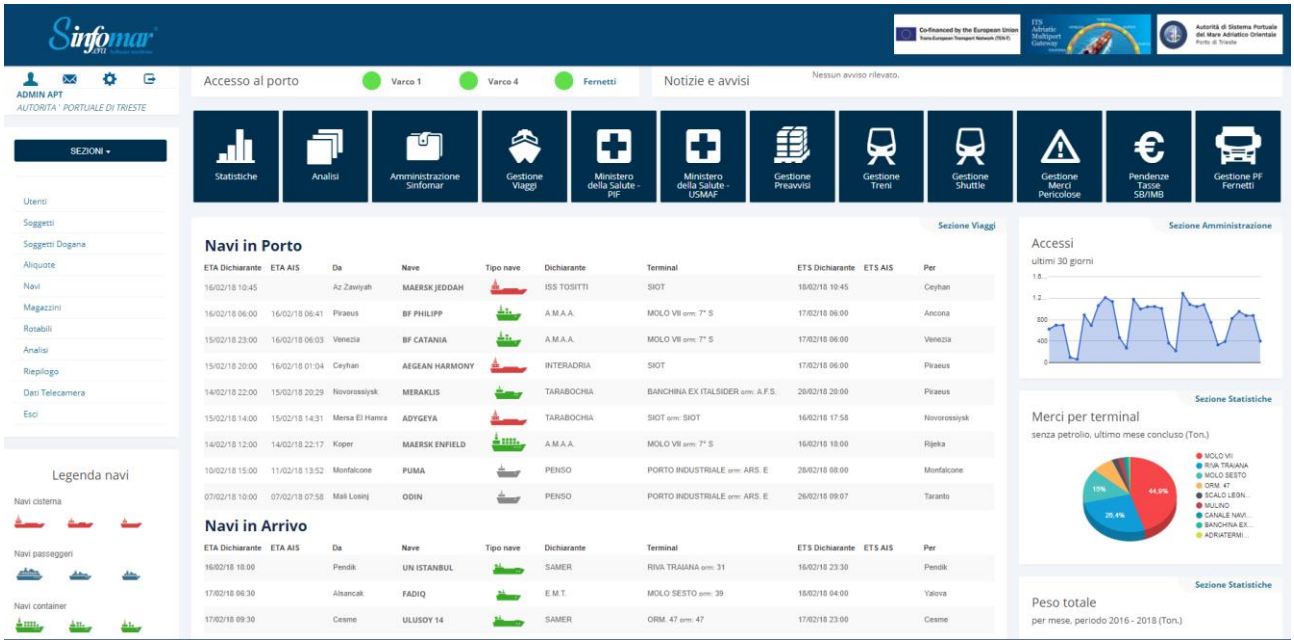
The 'Sinfomar', thanks to its architecture developed on the base of the specificities of the Free Zones of the Port regulatory framework specificities was the first PCS in Italy to exchange Customs related data, through the ICT system implemented in 2003 by the Customs Agency and called 'AIDA' (IT system of the Italian Customs Agency).

With the implementation of the AIDA platform in 2003 and Italian Customs Agency's advanced approach in this field ensured the development of the single window, biding the concerned public authority to integrate their processes in a "single window system – single interface point where all the information is declared once and available to the various public/private actors.

7.3 Main Features of the PCS Sinfomar

Developed initially with the ITS Adriatic Multiport Gateway project, co-funded by the European Commission under the TEN-T program, the 'Sinfomar' has been active since 2014 with the aim of improving the efficiency of port traffic as well as important tool for the monitoring and evaluation activities.
The data elaborated by the 'Sinfomar' are updated in real time by the private operators, and then validated through the inspection activities carried out by the competent public authorities, such as the local offices of the Customs Agency and the Fiscal Police certifying the reliability of the system data.

Figure 11: Sinfomar – Main screen



From the architecture perspective, the 'Sinfomar' is structured in modules and sub-modules based on code languages and international Open Source standards. In particular technologies related to web-services through the use of XML.

An important aspect of the software is that of being in constant development in order to guarantee the full compliance of its functionalities/features to the dynamics of change related to the modern international maritime transport domain and the capability to elaborate high volumes of data characterizing the Port of Trieste traffic growth rate. The constant commitment in the adaptation capability of the 'Sinfomar' is also one of the main objectives of the Port in order to ensure the system compliance with the current relevant national and EU applicable standards/rules regarding international standards.

Among the main features, the 'Sinfomar' allows:

1. The management of all data related to a cargo unit, both arriving or leaving the port area and any type of transport mode used (ship / train / truck), including key information on traceability and immediate identification on the port terminal of reference;
2. The automation of the procedures related to the transit access through 'single window' concept, thus making administrative and bureaucratic procedures related to port traffic more efficient and faster and ensuring the possibility of inserting data to the system without the need of manual entry;
3. to provide for the possibility of making electronic based declarations that progressively invested all the actors of the port community such as Customs, Port Authorities, Fiscal Police, Maritime Agencies, Freight Forwarders, Terminal Operators, Railway Companies and Freight Forwarders;
4. to provide aggregate and disaggregated comparative analysis and statistical data, without the need to refer to external platforms for setting up a database;
5. to guarantee interoperability with ICT platforms implemented by relevant external stakeholders, both public and private sectors, for the management and optimization of the transport logistics chain. These systems include: AIDA (Customs), PMIS2 (Port Authorities), the TROVATORE (Customs), i-Gate software (Porto Digitale - Digital Port), which today converges into the wider Vigate platform (Vitrociset SpA), the TOSs (Terminal Operating Systems) used by relevant realities such as the NAVIS platform (Trieste Marine Terminal) and SINFOSEC of Trieste (Fernetti);
6. to manage data by adopting international standards (including ISO - International Organization for Standardization, TARIC - Integrated Tariff of the European Union, HS - Harmonized System, ILU - Intermodal Loading Units in Europe, BIC - Bureau International des Containers and Transport Intermodal, UIC Union Internationale Des Chemins De Fer) in order to standardize the data and make it comparable to each other while referring to different realities and modes of transport (e.g. ship and train). Indeed, the 'Sinfomar' is able to process codings generated by systems developed by third parties transforming them, if necessary, into standard codes;
7. to manage and optimize the logistics / security / customs processes of the Port of Trieste and its Free Zones.

System Components

The 'Sinfomar' architecture is designed in series of operating component-modules:

1. Pre-Arrival-Departure Notification Module;
2. Ship Module;
3. Cargo Module;
4. Vehicle Module;
5. Trains Module;
6. Statistics/Analysis Module;
7. People Module;
8. Maritime Heath Authority Module;
9. Dangerous Goods Module;
10. Taxes on Loading and Unloading Procedures Module;
11. External Free Zone Terminal-Area Module.

According to the following general scheme:

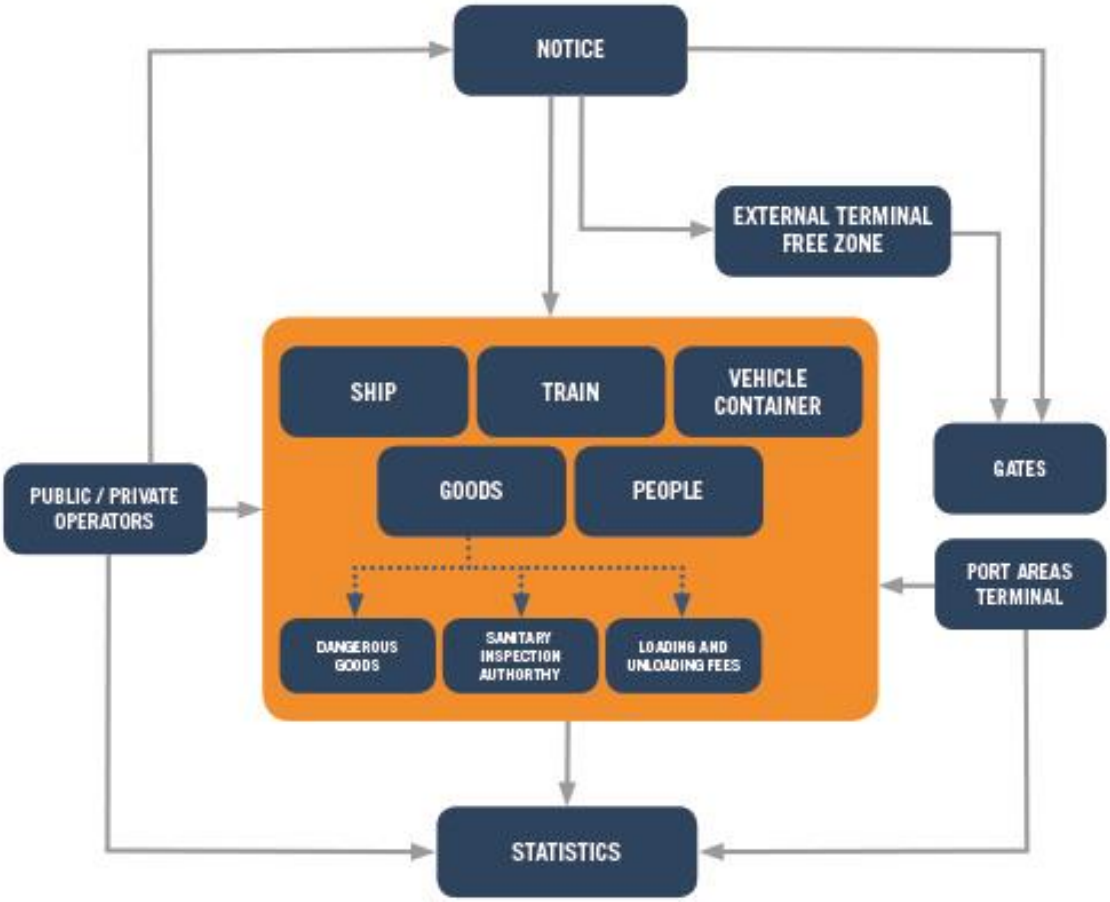


Figure 12: Sinfomar: modules

The structure of the PCS of the Port of Trieste may feed the structure explained in section 2.4 and the CluCS IT tool development to be developed in D2.4.

8. Conclusion

This report, elaborated within WP2, defines CluCS requirements and its architecture, building up tools for Cluster management in order to improve overall performance and provide smart specialized services as a Cluster of hubs.

Cluster Community System (CluCS) is an IT platform supporting the governance of Proximity Terminal Networks (PTN) and Clusters and operations through the efficient management of information related to cargo flows and assets within the nodes of the Cluster. This allows for the coordinated management of multiple hubs with different specializations, creating synergies and linking also the Cluster to different TEN-T corridors.

CluCS goes beyond the lack of interoperability between PTN actors that have already defined their own specifications and implementation guidelines to exchange documents. It promotes trust between PTN and Cluster actors adopting an e-SENS AS4 standardized message exchange protocol that ensures interoperable, secure and reliable data exchange. Moreover, CluCS implements the interaction with over-systems, such as CargoStream platform, permitting in this manner the organization of optimized cargo flows to and from destinations even outside the Cluster.

The main services CluCS provides its users are cargo consolidation, cargo pooling and intermodal service booking. These three services aim to meet the project's core demands regarding visibility of cargo flows, interoperability and intermodality between terminals in the PTN and Cluster and the optimization of the logistics flows and asset utilization.

Furthermore, the report gives an overview on the Port Community System (PCS) of the Port of Trieste which may contribute to fine tune the implementation of the CluCS.

CluCS specifications, which include the elaboration of Client needs and the final release of Requirements Analysis to configure the modules of the CluCS system, are improved and upgraded in joint cooperation with task 2.4. Therefore, this document serves as input for CluCS tool development realised in task 2.4.

9. References

Clusters 2.0 Description of Action

Clusters 2.0 D1.1 Market & Business Ecosystem Analysis

Clusters 2.0 D2.1 Scoping Logistics Clusters

Clusters 2.0 D2.2 Cluster Building Blocks – Proximity Terminal Networks Potentialities

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9.1 Actual standards

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OASIS Standard - AS4 Profile of ebMS 3.0 Version 1.0. Available at: http://docs.oasis-open.org/ebxml-msg/ebms/v3.0/profiles/AS4-profile/v1.0/os/AS4-profile-v1.0-os.html