Creating Business Value through Intelligent Supply Chain Collaboration
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Controlling data sharing from security and business perspectives

SELIS
Shared European Logistics Intelligence Space

BACKGROUND

The European Commission strategy for Smart, Green and Integrated Transport and Logistics (T&L), highlights the need for a single logistics information space in Europe, that is accessible by actors in the transport sector, its users and public authorities. The aim is to boost the competitiveness of European T&L industries and to achieve a European transport system that is resource-efficient, environmentally-friendly, as well as safe and seamless for the benefit of all citizens, the economy and society.
T&L represents approximately 15% of global GDP annually, with substantial potential for innovation-led initiatives that can drive new value imperatives. For example, with only 10% of the logistics services represented by pure transport services, the balance of 90% is represented largely by inefficiencies in matching demand and supply of goods and low utilisation of T&L resources (such as empty journeys, idle times, loading and unloading).

ICT driven innovation is hindered, for some time now, by legacy T&L ICT management systems and solutions (thousands) which frame a highly fragmented cross-sectoral logistics ICT story. Typical T&L ICT solutions are deeply rooted in legacy technologies and EDIs that have incrementally evolved over many years, and have not been designed in the context of anticipating or supporting collaboration logistics models. Today's T&L actors have to contend with multiple tools and solutions covering different aspects of the supply chain, as well as patchy views of their logistics businesses which are difficult, or perhaps impossible, to reconcile and unify in to one consolidated business perspective.

Thus, the evolving T&L landscape sets the scene for creating innovative collaboration-driven Supply Chain optimisation, supported by services that take into account network status and service level agreements (SLAs) for optimising cargo flows against throughput, cost, speed, time, utilisaton and environmental KPIs.

Supply Chain actors across Europe and globally, need a secure and trusted vehicle to share data and information for better horizontal and vertical supply chain collaboration, management, insights and optimisation. These include Producers, Retailers, Shippers, Logistics Service Providers, Authorities etc.

All these actors are seeking ways to extract value from shared industry data, in ways where they maintain full control over their commercially sensitive data, including:
- whom they share data with
- the duration of time data is shared
- the ways shared data is used, managed and exploited.

Currently available solutions in the market fail to one or more of the above criteria, while, those claiming to fulfil such needs, have serious limitations when placed under the microscope and are often based on closed/proprietary implementations with significant costs for integration with existing or third-party IT systems. Further, SMEs who are inevitably cost sensitive and expenditure constrained, cannot justify the expenditures and efforts for their acquisition, integration and deployment.

SELIS’s vision is to address these shortcomings by delivering a “Pan-European Logistics Intelligence-Sharing Platform”, that unifies business, technology and capacity across the broader EU Transport & Logistics sector in support of green, efficient and profitable T&L.
Information sharing for collaborative sustainable logistics

Supply Chain Community Nodes (SCNs)

SELIS addresses the T&L sector needs by providing a trusted platform that offers easy plug-and-play ways to share and analyse supply chain industry data in a neutral and privacy preserving manner, enabling the fulfilment of intelligent collaboration across the broader T&L sector. The platform is developed as a network of Supply Chain Community Nodes (SCNs) [patent pending], designed for superior business-relevant configurability and customisability.

Out of the box, each Supply Chain Community Node combines, collaboration, connectivity, communication, privacy & data protection, analytics and visualisation tools, enabling end-to-end visibility across value chains and the management of KPIs related to:

- Key ‘Green Logistics’ goals such as freight consolidation, CO₂ reduction, route optimisation, etc.
- T&L resource management, utilisation, optimisation.
- SLA driven performance, including SC responsiveness and SC Quality of Service (QoS).
- Business KPIs related to efficiency in ordering, processing, stock control, cargo movement, warehousing, prediction, demand forecasting, etc.

SCNs support easy instantiation of Collaboration Logistics Models typically used by Logistics Communities, thus termed Supply Chain Appliances (SCAs). Built on IBM cloud computing fundamentals, open standards and state of the art technologies, they enable the implementation of configurable Collaboration Logistics Models that match SC Community profiles. A Knowledge Graph captures primarily the semantics of the SC Community actors and their relationships and dependencies.

Collaboration Logistics Models (CLMs)

Collaboration Logistics Models are templated instances of a SC Appliance pertaining to a specific Logistics Community’s use case. Each use case, specifies collaboration actors, KPIs, information sharing requirements and machine learning algorithms for identifying optimisation opportunities or providing insights to the participant’s Decision Support Systems.

The Collaboration Logistics Models (CLMs) Repository includes metamodels, models and ontologies supporting collaboration and interoperability, based on:

- UN/CEFACT and Common Framework (ISO/IEC 19845) standard-based information exchanges,
- SCOR KPIs for (a) Reliability, (b) Resilience, (c) Agility, (d) Costs and (e) Assets Management metrics, automatically linked and retrieving information from data models at the operational level,
- the SELIS European Green Logistics Strategies (EGLS) (Fig.1),
- The SELIS Supply Chain Excellence Score [patent pending].
CASE STUDIES

Application Domains

FOCUS AREAS

- Synchro-modality - Optimisation of T&L resources
- Pooling and integration for urban distribution
- Retailer-centred stock optimisation
- E-compliance
- SC financials optimisation

Fig 2: The Supply Chain Community Node (SCN) concept represents the evolution of a longline of research in this area
SELIS Knowledge Graphs

SELIS Knowledge Graphs (KG) are produced automatically to capture the semantics of all entities and relationships associated with the Collaboration Logistics Models (Fig.3). All defined concepts in CLMs, can be exported, stored, enhanced and accessed in a graph DB. The Knowledge Graph organizes design and tuning guidance for collaboration, connectivity adaptors, content-based routing and SC performance optimisation. It is possible to introduce additional semantic content to the Knowledge Graph, to further enhance and enrich the modelled information on CLMs.

A Supply Chain Appliance (SCA) is built with three subsystems (Fig.4):

A. The Supply Chain Collaboration Engine enables multiple stakeholders in a Logistics Community to collaborate in the context of simple or complex end-to-end value chains. Provides CLM and appliance configuration tools, governance rules, security & privacy policies, and collaboration monitoring linked to trust building.

B. The Publish-Subscribe Engine accommodates real time updates (events streaming) and delivers messages to interested subscribers using content based routing [patent pending]. Tools include adaptor building, mapping to a Common Data Model and a Data Hub including an events log.

C. The Big Data Analytics and Machine Learning (ML) Subsystem which is capable of:
   - Incoming message ingestion.
   - Storing and processing at a Big Data Volume and Velocity.
   - Use SELIS recipes (configurable predictive and descriptive analytics algorithms), taking into consideration the dynamics of the ecosystem it is built for.
   - Handling efficient data querying from DSS applications and generates alerts when interesting things happen.
SELIS, for all intents and purposes, is the “Intelligent DropBox” for T&L, allowing data to be injected, shared in a common data form, thus aligning a common vocabulary for Supply Chain Actors.

**Intelligent Data Sharing**

A SC Appliance benefits from a centralized Data Hub, configured for the needs of a specific community’s Collaboration Model, aggregating information flows in various formats. Such information is generated by the operational systems of the logistics participants, including IoT devices and event-based data flows.
The Big Data Solution for optimisation of overall SC and individual company performance, provides a suite of available descriptive and predictive algorithms to meet key KPIs for specific logistics domains. It is designed to operate in a number of different cloud environments ranging from public clouds such as IBM Cloud to private cloud setups that support the widely adopted OpenStack API.

A semi-automatic mapping tool supports data pre-processing, through a specialized ML learning algorithm. The hub provides a central control facility for the mediation and sharing of data - data is always under the exclusive ownership and management supervision of the data owner. A content based routing engine ensures that users are always informed of events relevant to their roles [patent pending].

**SELIS Big Data Solution**

The Big Data Solution for optimisation of overall SC and individual company performance, provides a suite of available descriptive and predictive algorithms to meet key KPIs for specific logistics domains. It is designed to operate in a number of different cloud environments ranging from public clouds such as IBM Cloud to private cloud setups that support the widely adopted OpenStack API.
Configuration Tools
to address specific business needs

During setup and deployment, generic community specific models are enabled using the Supply Chain Appliance Configuration and Dashboard Tools to match the unique needs of a given community, protecting privacy and security, while offering and extending existing competitive advantages of its members.

The Big Data Solution provides APIs to allow users to define relevant data that will be used as initial training sets to build the required models/algorithms, which will then be utilized in a real-time upon data arrival to perform the necessary classifications/predictions for the optimisation of the overall supply chain performance.

A highly ‘intelligent’ and innovative approach to set-up and optimise supply chain networks.

Monitoring
always in control

The Supply Chain Appliance is linked to a monitoring platform, supervising non-functional attributes such as security, performance, scalability and uptime.
## LOGISTICS COMMUNITY

### SHARED DATA EVENTS

**KPIs**

- Improve cost management
- CO₂ footprint reduction

### CONNECTIVITY TECHNOLOGIES

- Machine Learning enabled data integration & harmonization

### VALUE ADDED SERVICES

- Predictive SC optimisation, prediction of how a new situation could affect cost structure
- Predictive situational awareness, order forecast and transport patterns, Advanced Capacity Planning based on time and capacity constraints
- Predictive analysis to enable dynamic selection / synchronisation of modes of transport, calculation of inland transport (SC)

### Selis Communities

**SELIS COMMUNITIES USE CASES**

A strong consortium of 38 European logistics stakeholders and ICT providers are leveraging EU IP from over 40 projects to create proof of concept of a Common Communication and navigation platform for pan-European logistics applications, deployed in 8 Living Labs, representing the principal logistics communities. SELIS embraces a wide spectrum of logistics perspectives and creates a unifying operational and strategic business innovation agenda for Green Logistics, with a clear path towards 30% reduction of energy consumption and greenhouse gas emissions. The project is coordinated by Inlecom.

### 38 EU partners

18 million funding

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**LOGISTICS COMMUNITY**

- **Synchro-modality - Optimisation of T&L Resources**
  - **FREIGHT FORWARDERS (FF, Subcontractors, Clients)**
    - Customer data
  - **CONTAINER HINTERLAND TRANSPORTS (Ports, barge operators, LSPs)**
    - Status of container bookings - availability, vessel schedules, Barge position
  - **PORTS / CONTAINER COMMUNITY (Ports, Terminals, Hinterland LSPs, Shippers)**
    - Reliability (of transit time) related data

**SHARED DATA EVENTS**

- **Customer data**
- **Status of container bookings - availability, vessel schedules, Barge position**
- **Reliability (of transit time) related data**
- **SC Visibility data across modes**

**KPIs**

- Improve cost management
- CO₂ footprint reduction
- Modal shift (%), improve load factors, reduce CO₂ emissions
- Transport reliability models and standards, Content based Publish/Subscribe for reliability, tracking, and capacity data flows
## LOGISTICS COMMUNITY

<table>
<thead>
<tr>
<th>SHARED DATA EVENTS</th>
<th>KPIs</th>
<th>CONNECTIVITY TECHNOLOGIES</th>
<th>ANALYTICS VALUE ADDED SERVICES</th>
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<tr>
<td>RAIL &amp; SEAPORTS</td>
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<tr>
<td>(Inland terminal, Rail Operators, Seaports)</td>
<td>Container location and ETA</td>
<td>wagon-set utilization, delays at terminals, CO₂ emissions</td>
<td>Adaptors for legacy systems, Content based notifications of transport events such as 'arrival to a terminal', or irregularities</td>
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### Pooling and Integration for Urban distribution

#### URBAN DISTRIBUTION
(Food/Pharma LSPs, Shippers)

- Order data
- Route planning transport events
- (GPS position, temperature)
- Load factor transport reliability
- Client satisfaction
- Cost savings
- Content based routing of info regarding opportunities for urban logistics pooling; Integration of green reverse logistics actors
- Intelligent WMS Adapter system, Pub/Sub including contract negotiation with Regional Agents and SLAs monitoring
- Prediction of pooling opportunities, gain/cost-sharing mechanisms for cost-allocation between partners in dynamic collaboration networks

#### 3PL NETWORK
(Regional Agents)

- Order data, trucks status, SLAs
- Reduction of operational costs
- Load factors; QoS
- Intelligent WMS Adapter system, Pub/Sub including contract negotiation with Regional Agents and SLAs monitoring
- Automate the transport-price vs delivery date negotiation among the Regional Agent and the 3PL

#### LPS NETWORK
(Vertical collaboration with LSPs)

- Orders, delivery status and available truck capacity
- Load Factor, warehousing handling times, CO₂
- Adapter for WMS & TMS system, Content based routing for broadcasting available transport / warehousing capacity
- Predictive optimization of loading/unloading related resources, real time synchronization of trips & warehouse working processes

### Other Application Domains: e-Compliance & Retailer-centred stock optimisation

#### AUTHORITIES & SC ACTORS
(Customs, Cross-border Agencies, Shippers, LSPs)

- Pipeline data exchange structures (PDES) utilizing ongoing standards such as UN/CEFACT
- Modal shift (%), Load Factors, CO₂
- Extraction and transmission of standardized data in the context of cross-border movements & regulatory compliance, Multiple-filing enabling increased data quality & consistency
- Adaptor for sales forecasting and manufacturing plan applications
- Predictive analysis for optimization of time and costs related to cross-border control and inspection planning; analytics-enabled identification of inconsistencies in reporting data

#### RETAIL
(Retailers, suppliers)

- Sales forecast, available stocks and production plans
- SC performance reduced waste, reduced stock holding
- Adaptor for sales forecasting and manufacturing plan applications
- Predictive analysis and ML algorithms to identify alarming situations, proactive notification of under/over stocking and possible actions promotional forecasting is created
Use Case: Retailer-centred stock optimisation

Use Case: Pooling and integration for urban distribution
PROJECT PARTNERS


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