

Identifying Logistics Requirements for Enterprise Interoperability and Collaboration: A European Project Case

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Abstract— The logistics industry is one of the several domains addressed by the COIN (Enterprise Collaboration and Interoperability) European Project. The main goal of the COIN Project is to provide an Evolutionary and Pervasive Service Platform, realizing a collaborative Digital Ecosystem that allows providers of business services to publish their offers, and potential customers to easily locate themselves and access the services that best suit their needs. In this paper, we position the COIN service platform as a technology enabler for developing and offering collaboration and interoperability services for the logistics domain.

Index Terms— Enterprise Interoperability, Enterprise Collaboration, Logistics Industry.

I. INTRODUCTION

By two thousand twenty, enterprise collaboration and interoperability services will become an invisible, pervasive and self-adaptive knowledge and business utility at disposal of the European networked enterprises from any industrial sector and domain in order to rapidly set-up, efficiently manage and effectively operate different forms of business collaborations, from the most traditionally supply chains to the most advanced and dynamic business ecosystems.

COIN (Enterprise Collaboration and Interoperability) is an integrated project [1, 2] in the European Commission Seventh Framework Programme. The mission of the COIN Project is to study, design, develop and prototype an open, self-adaptive, generic information and communication technologies (ICT) integrated solution where Enterprise Collaboration (EC) and Enterprise Interoperability (EI) services will be an invisible, and self-adaptive knowledge and business utility at the disposal of the European networked enterprises to support the above two thousand twenty vision. Following this mission, one of the main objectives of COIN project is to demonstrate, experiment, trial and assess the project results into realistic industrial scenarios offered by the test cases. Turkish Logistics Association LODER is one of the COIN project partner for industrial implementation. In this paper, we present the

initial findings of the LODER as the pilot implementation of COIN project services for logistics domain.

The rest of this paper is structured as follows: In section 2 we give a short description of the available EI and EC services of COIN project. Section 3 describes the identified use cases and related requirements for logistics domain. Finally, Section 4 gives some concluding remarks.

II. ENTERPRISE INTEROPERABILITY AND COLLABORATION SERVICES OF COIN PROJECT

A. Enterprise Interoperability Services

The COIN EI services aim at supporting the elimination or reduction of the incompatibilities among enterprise systems involved in a collaboration scenario (being long- or short-term). Such interoperability gaps to be removed are generally at the level of organizational structures, business processes, enterprise applications/services and data formats/content, while EI services use model transformations and semantic reconciliation techniques to solve them according to the integrated, unified and federated interoperability form.

According to Elvesaeter et al. [3] and Facca et al. [4], COIN project identified following categories of EI services.

- **Model-driven interoperability services.** Model driven software development (MDD) paradigm envisions usage of standards and specifications to support the description of enterprise and domain models. Interoperability services can play crucial role in *model mapping and transformation, metamodel alignment, language and method engineering*.
- **Enterprise modelling interoperability services.** Enterprise modelling contributes to the understanding and improvement of the organizations through the development of enterprise models. Specific interoperability services can facilitate *enterprise modeling, enterprise models interchange and deployment, and maturity assessment*.
- **Business process interoperability services.** Business Process Management environment targets to support complete business process life cycle around the notion of process model by applying set of analysis, modeling, management and monitoring tools. The interoperability services in this area cover *cross-organizational business process modeling, semantic business process modeling, semantic business process management, and business process analysis and monitoring*.
- **Semantic mediation interoperability services.** This category of services is concerned with the application of ontology-based techniques for semantic mediation, such as

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semantic reconciliation of business documents. The services cover *ontology engineering and maintenance, semantic annotation, semantic transformation rules building, semantic reconciliation engine as well as assessment of semantic mappings and monitoring of reconciliation execution.*

- **Data interoperability services.** The services from this category manage the communication between different and heterogeneous data sources by extracting the information from a specific data format and transforming it into another format. The interoperability services target *data mapping, business document modeling, business document interchange, and business document process integration.*

B. Enterprise Collaboration Services

The COIN EC services aim at supporting industrial enterprises (and SMEs in particular) in the collaborative processes regarding the creation and management of long-lasting clusters and networks (e.g. supply chains, collaborative networks, business ecosystems), as well as the creation, management and dissolution of short-term enterprises aggregations, called Virtual Enterprises or Virtual . More specifically, Sitek et al. [5] and Facca et al. [4] identified following categories of EC services:

- **Enterprise collaboration preparation services.** Maintaining capabilities of the potential business partners and detecting new market opportunities represent prerequisites to any collaboration possibility. *Service for maintaining competencies* and *Service for identifying business opportunities* are typical representatives of these categories .

- **Enterprise collaboration formation services.** Formation of a Virtual Organization is preceded by the identification of matches between the required and offered assets, as well as selection of trustable partners. The collaboration services in this area are *Service for matching competencies with business opportunities*, and *Partner selection and EC formation service.*

- **Enterprise collaboration management and operation services.** Services from this phase of Virtual Organization life cycle should support monitoring of delegated activities, resource consumption and partner behavior. These tasks are covered by the *Service for tracking capacities*, *Service for tracing progress*, and *Service for product management.*

- **Enterprise collaboration dissolution services.** After answering to the market opportunities, VO dissolves thus leaving knowledge gathered during the previous phase, and products to be supported under the warranty time. Additionally, partners may reward each other regarding the collaboration satisfaction (which can affect future partner selection). This behavior is covered by *Service for customer support*, *Service for maintaining knowledge and training*, and *Partner rewarding service.*

- **Basic Services for human interaction.** All the VO phases should be supported by a various communications channels at the partner's disposal. The typical services used are comprised of the *Email service*, *Instant messaging service*, and *Notification service.*

C. Innovative Interoperability Services

Interoperability Space is a set of services whose purpose

is to take into account all the possible kind of data transformation which can be applied to documents. Data Interoperability can be divided into two big branches: **Payload interoperability** (refers to the transformations applied to the *content* of the documents), **Schema interoperability** (refers to the transformations applied to the *structure* of the documents). Schema interoperability, in turn, can be divided into two braches according to the approach that we want to follow for the transformation: **Unified approach** (implies the use of a reference meta-model for managing the transformations), **Federated approach** (implies the absence of a reference meta-model for managing the transformations).

For each of the three main groups (payload, unified and federated) COIN has developed a set of services [7].

- The **Innovative Services for Semantic Reconciliation** group in a unified environment a set of functionalities to provide an effective automatic support to the definition and execution of expressive mappings between heterogeneous resources, with the aim of providing a reconciliation framework for eBusiness resources exchange.

- The **Data Payload Interoperability Service** works on the content of the documents and is used in the negotiation process of UBL orders.

- The **Innovative Services for Federated Interoperability** work on the structure of the documents and propose an approach where no reference meta-models are available, but instead the users are free to provide personal transformations.

III. LOGISTICS USE CASES CONTEXTUALIZATION

A. Turkish Logistics Association (LODER) and Turkish Logistics Sector

Turkish Logistics Association LODER (www.loder.org.tr) was founded in 2001, representing 450 individual members including academicians, professionals working both in logistics services providers and logistics service recipients companies, information technology experts and armed forces members. 40% of the members are receiving logistics companies (mostly SMEs) and the other 40% of the members are sender logistics companies (mostly SMEs) and 20% of the members are composed of academics. LODER carries out its activities with the vision of being the leader for providing adoption of the approach of the supply chain management. LODER focuses on the professional development of its members. LODER whose mission is to increase effectiveness and efficiency of logistics operations under the concept of Supply Chain Management, has a board from various logistics companies, SMEs and also academicians. The combination of the stakeholders in board and members supports the logistics industry to develop itself innovatively by achieving LODER's mission.

The Logistics Sector in Turkey created its infrastructure through the investments in the areas of land, air, marine, rail and combined transports between the 1980's and 1990's and broke through in the 1990's. In Turkey, total Logistics Sector Business Volume is € 70 Billion and Total Logistics & Transportation Companies Business Value is € 40 Billion. According to the Turkey Logistics Sector Research in 2008,

the value of the market of Turkey Logistics Services is \$ 59 billion and the value of the market of the logistics service providers \$ 22 billion. 37% of the market volume belongs to service providers and 63% of the market volume belongs to usage of logistics equity of service areas. Logistics expenses have been increased by 3 times in the last 5 years in Turkey and the share of outsourcing logistics services has been increased by 5%. According to the Gross Domestic Product values in 2009, transport, storage and communication sub-sectors constitute 13% of total GDP value. There are approximately 280,000 companies under the sub-sector of road transport in Turkey. Besides of this, there are 1,500 companies within the international road transport, 350 companies as the freight forwarders, 500 companies within the warehousing business and 95% of all of these companies is considered as the SME. In Turkey, the usage of information technologies in the logistics sector, especially in the category of SMEs, is in extremely low level. The processes are generally carried out by the office programs, fax and e-mail. When the company begins to grow, the accounting and payroll programs, the track and trace systems, hand terminal systems, transport management softwares, warehouse management softwares and optimization softwares are begun to be used.

B. Scenario Definition and Business Processes

The scenario is defined in the Chemical/Paint sector and addresses the subject of the collaborative transportation of paints from paint manufacturer to its customers. The objective of this scenario is to increase the customer services to the highest level by decreasing the logistics costs. The case was selected regarding the availability with high level of knowledge of the SMEs. In this scope, Dincer Lojistik which is an SME and a member of LODER was selected. Dincer Lojistik is located in İstanbul and provides logistics services in all over Turkey. The case contains the relation between Dincer Lojistik and its clients, clients of clients and

the carriers. The clients of the Dincer Lojistik have strong legacy systems such as SAP, LOGO MS, AXAPTA, AS/400 and Dincer Lojistik uses LATMS software. The integration between LATMS and the other legacy systems is provided by the interfaces and the web services in the business processes during data transferring. The business processes of the case include 13 steps within the constraints of logistics as domestic transport, packaged goods (IBS) and a process without storage. (See Figure 1).

In the scope of the business processes of the case, First of all, Dincer Lojistik makes an agreement with its clients and during this agreement it carries out the each project management. Before the order-delivery processes, contract management between Dincer Lojistik and its clients is realized. In this scope Dincer Lojistik prepares a work plan in MS project and generates the address list of the clients of the clients. Then contract management between Dincer Lojistik & Vehicle Owners and the clients of clients is made by the contract documents. After the order-delivery processes, the clients make the performance measurement controls and reports according to the performance indicators. After the contract managements, the order-delivery processes begin: Dincer Lojistik receives the orders from its clients (e.g. Polisan, Kayalar) and groups the orders by date and by location. Then Dincer Lojistik plans the freight and routing according to its own properties and rental vehicles and sends the vehicles to the Client's loading place.

The vehicles depart from the client by receiving the deliveries. In the meanwhile Dincer Lojistik tracks and traces the vehicles. When the vehicles arrive to clients of clients' (such as distributors, construction market chains, hard ware dealers and construction yards) delivery place, they are unloaded. If there are any returned and empty containers, they are seperated. In the next step, Dincer Lojistik reports to its clients about the delivery and then prepares and sends the invoice. The business processes end when the clients send the payment to Dincer Lojistik. (See

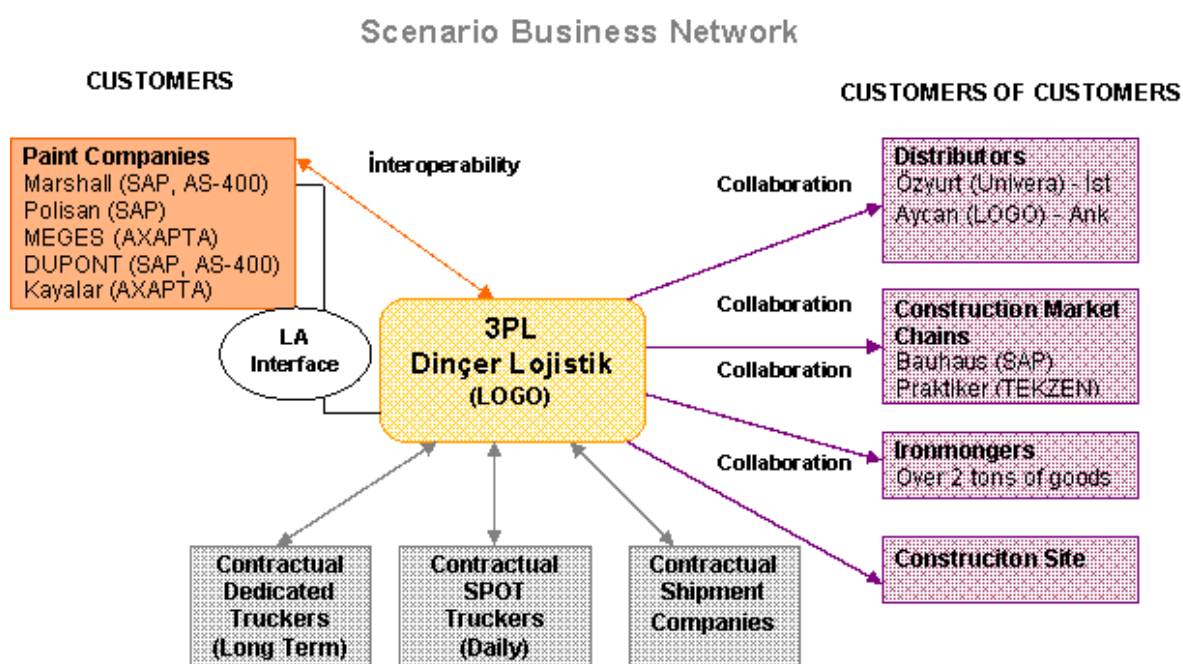


Figure 1. Business Network for Collaborative Transportation of paints from paint manufacturer to its customers

Figure 2).

From the whole case, 6 use cases which have the strong requirements for interoperability and cooperation were separately defined. These use cases address the business network between two clients of Dincer Lojistik, Kayalar and Polisan, with Dincer Lojistik.

The selected use cases are: 1) Project Management, 2) Receive the order of Polisan/Kayalar, 3) Plan the freight and routing and send the vehicles to the Polisan's/Kayalar's loading place, 4) Load the vehicles and receive the deliveries and vehicles depart from Polisan/Kayalar, 5) Track and trace the vehicle and 6) Unloading the vehicles in the delivery place and reporting to Polisan/Kayalar.

These use cases will be handled both Polisan and Kayalar because every client of Dincer Lojistik uses different systems so that the business processes between Dincer Lojistik and its clients differ according to the used systems. Therefore, implementation of COIN services for different clients will be more useful and effective to solve the problems in the business processes. On the other hand, when taking into account the risk plan, working with the two clients is more reliable in case one of them changes the system or business processes.

Use Case 1 – Project Management

• **Use case recall :** Dincer Lojistik makes the agreement with Polisan/Kayalar before the business processes from the order to delivery and carries out the each project management by the end of the agreement. The contract management between Dincer Lojistik and Polisan/Kayalar is realized. In this scope Dincer Lojistik prepares a work plan in MS project and generates the address list of Polisan's/Kayalar's clients. Contract management between Dincer Lojistik & Vehicle Owners and Polisan's/Kayalar's clients is made by the contract documents. After the order-delivery processes, Polisan/Kayalar makes the performance measurement controls and reports according to the performance indicators.

• **Consideration about the use case:** The agreements between the actors (Dincer Lojistik, Polisan, Kayalar, The

clients of Polisan and Kayalar and Vehicle Owners) are made by coming together of the actors and making the negotiations on it. After the negotiations, the contract documents are sent by post and the discussions on the documents require coming together of the actors in a meeting again. Since the agreement must be made before the order-delivery processes, the project management process is important to be able to begin the other business processes in the shortest time. The most important things in the project management process are time performance, cost performance and defect rate performance. Since the success of the business processes depends on the success of the project management process, this use case is important and it requires to be carried out in a more collaborative management tool.

• **Services Selected and gaps in relation of the scenario :** Since the agreements between the actors are made by several physical meetings, it becomes time consuming and costly, especially when the negotiation process takes place. To negotiate on the contract documents, the actors need to have a physical meeting again. On the other hand, when an urgent case occurs, it is not possible to reach to the responsible person instantly so solving the problem about the urgent case takes longer time. Therefore, an online management tool for the project management process is needed. The Collaboration for Project Management (Coll4PM) will be used for this use case. In terms of the Coll4PM, the actors will share the contract documents and make the discussion in the same platform. Also when an urgent case occurs, the actors will contact with the online person to get help. The actors will be informed about last changes on the management instantly. This service will provide to save the time and reduce the cost during the project management [8].

Use Case 2 – Receive the order of Polisan/Kayalar

• **Use case recall :** This use case begins when the Polisan/Kayalar (the clients of the Dincer Lojistik) plans the transport orders in order to send to Dincer Lojistik which will deliver the paints to the clients of Polisan/Kayalar. Polisan plans the transport orders in SAP system and

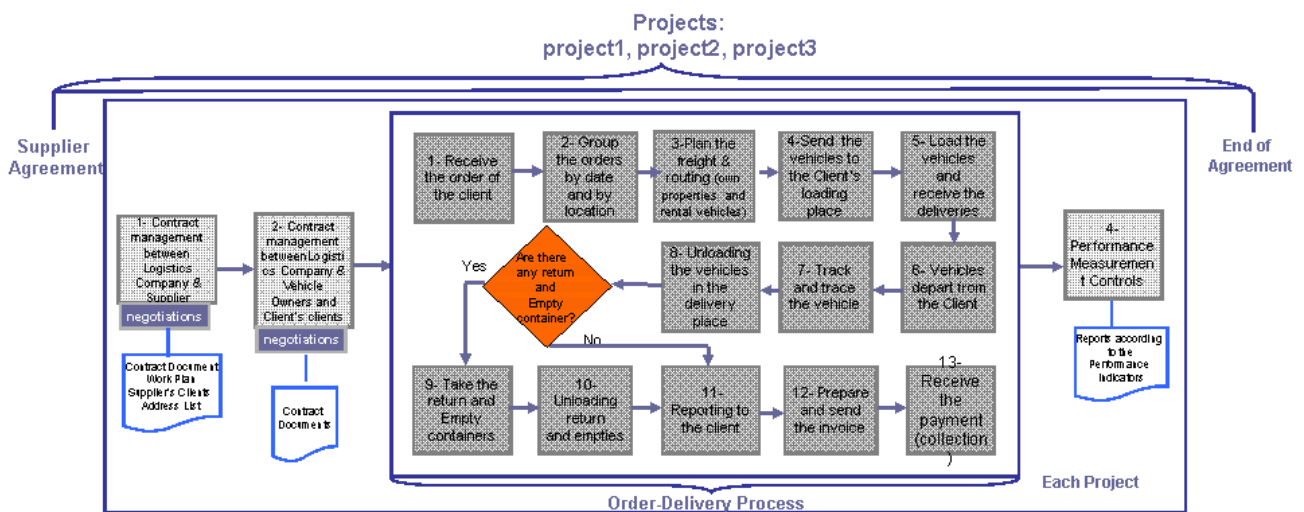


Figure 2. The General Business Processes

converts it into an XML file. Kayalar plans the transport system in AXAPTA system and converts it into an XML file like the same way Polisan does. Dincer Lojistik receives the XML files through a web service and transfers them into Logistics Associates Transportation Management Software (LATMS) system. Then the files are converted into the data tables in LATMS.

- **Consideration about the use case:** Since Dincer Lojistik and its clients (Polisan and Kayalar) use different services, there are two different formats of the orders and they need to be converted twice while transferring the orders. This file converting process obviously causes time losses. Therefore, this problem can be solved with the COIN EI services to receive the files with the automatic transformation.

- **Services Selected and gaps in relation of the scenario:** MDIS for format transformation and ISS to provide negotiation on top of an UBL order will be used. The COIN services must be compatible with the legacy formats of Dincer Lojistik and Kayalar in order to provide the integration with COIN services and the systems of Dincer Lojistik, with Kayalar and Polisan

- **Requirement description:** It requires the integration of the MDIS for format transformation and ISS to provide negotiation on top of an UBL order to the existing legacy systems, LATMS, AXAPTA and SAP and the realization of automatic transformation of the files. On the other hand using Turkish characters and different typing cause wrong information matches when providing the integration between AXAPTA, SAP and LATMS. Also it requires to remove this character problem with using COIN services.

Use Case 3 – Plan the freight and routing and send the vehicles to Polisan’s /Kayalar’s loading place

- **Use case recall:** Dincer Lojistik makes the freight and routing planning to deliver the orders by own vehicles and rental vehicles. Dincer Lojistik has an office in Kayalar and in Polisan where the own Shipping Unit Managers works for the planning of the freight and routing. If the orders are planned to be delivered by own vehicles of Dincer Lojistik, The Shipping Unit Managers arrange their own vehicles informing by telephone. However, if the orders are planned to be delivered by the rental vehicles, The Shipping Unit Managers call the transport companies by phone located in each city for making them to plan and arrange the vehicles. The responsibility of sending rental vehicles to the loading place belongs to the transport companies in each city.

- **Consideration about the use case :** The communication in this use case is really important to be delivered and receive the transport information correctly. Sometimes only using telephone causes misunderstandings about the orders and the time information. Therefore, the workflows are required to be supported with more reliable and verifiable communication tools.

- **Services Selected and gaps in relation of the scenario:** Since the communication is carried out only by phone, the risks on getting the missing information and forgetting or misunderstanding the information arise. It requires using alternative communication tools where the information should be recorded in order to be tracked afterwards. The same communication service shall be used between the

Dincer Lojistik’s central units and The Shipping Unit Managers in the clients and also between The Shipping Unit Managers and the transport companies. The messages should be visible for all actors in order to track the processes. In this scope, COIN Communication Services will be used to support these workflows such as the baseline services of email-skype-IM-etc. Therefore the most suitable services to be selected are the EC Baseline Services CS-ES/IMS/NS/CP/SWS.

Use Case 4 – Load the vehicles and vehicles depart from the Polisan/Kayalar

- **Use case recall:** In this business use case, the paints are loaded to the vehicles in Polisan’s/Kayalar’s loading place and Polisan/Kayalar prepares the dispatch lists for each products. Polisan prepares the dispatch list using the information of products in SAP system and Kayalar prepares the dispatch list using the information of products in AXAPTA system. Dincer Lojistik prepares the dispatch lists in LATMS systems according to the information of orders which are received from the web services of SAP and AXAPTA. Dincer Lojistik prepares only one dispatch list for products of the clients to be transported for legal purposes. This use case ends when the vehicles depart from Polisan’s/Kayalar’s loading place to the delivery place of their clients with all dispatch lists.

- **Consideration about the use case:** In this business use case, Dincer Lojistik prepares the dispatch lists for legal purposes and prepares them in different methods according to its clients (Kayalar and Polisan). There are two important issues in this case. Firstly, in terms of the interoperability services, receiving the information of the dispatch lists automatically from the Polisan/Kayalar will be more useful for Dincer Lojistik. Since the clients of Dincer Lojistik use different systems, there will be no need to create interfaces for each client of Dincer Lojistik by means of these EI services. Secondly, it is important to prepare the dispatch lists rapidly. So that Dincer Lojistik can receive the information of dispatch lists simultaneously once its clients prepare the dispatch lists.

- **Services Selected and gaps in relation of the scenario:** Data-interoperability services will be selected to provide format transformation for the dispatch lists. The legacy formats of Dincer Lojistik and Polisan and Kayalar must be compatible with the COIN services in order to provide the integration with COIN services and the systems of Dincer Lojistik with Kayalar and Polisan.

- **Requirement description:** Since Dincer Lojistik prepares the dispatch lists of the products of Kayalar in LATMS system according to the information of orders which are received from the web service of AXAPTA, they enter the information of the dispatch list as manual. It causes time losses and it requires the creation of the interfaces between AXAPTA and LATMS. The clients matching problem arises using different tax numbers for the same clients. Therefore, it requires to generate and share a master data set for each client to prevent the wrong matches.

Use Case 5– Track and trace the vehicle

- **Use case recall:** In this business use case The Shipping Unit Managers tracks and traces the vehicles during the transportation through the delivery place of Polisan/Kayalar in order to deliver the orders on time. The Shipping Unit

Managers only track its own vehicles by telephone and provide a web service of LATMS and give a username and password to the transport companies' responsables in each city for tracking the loads on the route. The transport companies' responsables in each city track the vehicles and update the delivery status of them in this web service. Thus, The Shipping Unit Managers can track and control the delivery status of rental vehicles.

• **Consideration about the use case:** The communication in this use case is really important to deliver and receive the transport information correctly. Sometimes only using telephone causes misunderstandings about the orders and the time. Therefore, the workflows are required to be supported with more reliable and verifiable communication tools.

• **Services Selected and gaps in relation of the scenario:** The same communication service shall be used between the Dincer Lojistik central unit and The Shipping Unit Managers located in the clients and also between The Shipping Unit Managers and the transport companies. The messages shall be visible for the all actors in order to track the processes. In this scope, Communication Services will be used to support these workflows such as the baseline services of email-skype-IM-etc. Therefore the most suitable services to be selected are the EC Baseline Services CS-ES/IMS/NS/CP/SWS.

Use Case 6 – Unloading the vehicles in the delivery place and reporting to the Polisan/Kayalar

• **Use case recall:** The orders are unloaded from the vehicles in the delivery place of the Polisan/Kayalar and the dispatch lists of them are delivered to their clients. Dincer Lojistik takes the reports including the delivery information as an XML file from LATMS and converts it into an XLS file and sends it to Polisan/Kayalar by email. Polisan converts this XLS file into its SAP system and Kayalar converts it into its AXAPTA system. Dincer Lojistik sends weekly reports as XLS files to Polisan/Kayalar about the delivery by e-mails and Polisan/Kayalar control the reports and can make the performance measurements by using them

• **Consideration about the use case:** Since Dincer Lojistik and its clients (Polisan and Kayalar) use different services, there are two different formats of the reports and they need to be converted twice while transferring the reports. This file converting process obviously causes time losses. Therefore, this problem can be solved with the COIN EI services to receive the files without any necessity of converting.

• **Services Selected and gaps in relation of the scenario:** MDIS and data-interoperability services will be selected to provide format transformation for orders. The legacy formats of Dincer Lojistik and Kayalar must be compatible with the COIN services in order to provide the integration with COIN services and the systems of Dincer Lojistik, with Kayalar and Polisan

• **Requirement description:** It requires the integration of the MDIS and ISS services to the existing legacy systems, LATMS, AXAPTA and SAP and since the reports need to be converted twice it requires the realization of automatic transformation of the files.

IV. CONCLUDING REMARKS

One of the main objectives of COIN project was to demonstrate, experiment, trial and assess the project results

into realistic Industrial Scenarios offered by the test cases. To implement COIN project services in logistics domain, 6 business use cases are defined where the supply chain network consists of 1 logistics SME, 2 clients which are chemical-paint producers, more than 2-3 delivery places (warehouses) and more than 1 truck companies and vehicles. In this case, there is a strong need of interoperability between the logistics SME and its clients as well as strong need of collaboration between logistics SME and its partners and delivery places. Additionally, the case also includes the whole process of project management where COIN innovative services will also take place on the pilot.

In this case, there will be COIN baseline, innovative services and project management services to be implemented where new developments according to the requirements identified will be done. Thus, the new developments according to the requirements will be defined and developments that are mainly on integration will be tested and format transfer and customization will be adapted to the logistics sector where LODER will also develop GUIs by making localization for the logistics sector needs.

The sectors which will be affected will not be only logistics sector but also, their clients using some integration interface tools and also the logistics software developers. It is expected that these sectors will gain a new knowledge on the innovative interoperability and collaborative processes and get used to web services usage. LODER as having members from different organizations and professionals like logistics SMEs, logistics software developers and industrial engineers, academicians, will disseminate the results of the pilots to the sector through its members.

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