D2D

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Executive Summary

Objectives

The major objective of D2D was to demonstrate how to efficiently organise and manage intermodal door-to-door transport chains, in which shipping plays a major role, by using logistics management and communication systems. Such demonstrations would serve the European transport policy and inspire the European industry to make greater use of intermodal transports with strong shipping elements. The focus of the project was the use of information and communication technology with the introduction new elements in the Intelligent Transport System.

Some of the main results D2D aimed to produce were:

(a) A generic business model for transport chain management
(b) An open data model covering all aspects of intermodal transport
(c) A technical solution for a commercial Freight Transport Monitoring Services
(d) A technical solution for a commercial Transport Chain Management System
(e) Samples of "smart" transport equipment and software illustrating the potential for smart technologies to improve the competitiveness of intermodal transport

Achievements

The project has demonstrated how to accomplish efficient transport chain management with the assistance of advanced information and communication technology, and it has provided examples of new elements in the Intelligent Transport System. The main results of the project comprise a transport chain management system available as a web based application available on the Internet, a monitoring system, the efficient implementation of a system integration tool (communication platform), simulation and service profiling technology and tracking and tracing technology. Another important element was the methodology that were developed to show how to implement such systems efficiently in five transport chains based on the generic business model for transport chain management that was developed.

The results after completion of the project are:

- Documentation of five demonstrator business models including a description of current business processes with respect to roles, actors, responsibilities, activities, decision points, transport documents, information systems and flows.
- Development of a generic business model describing the role and responsibilities of a Transport Chain Manager in a door-to-door transport. The model also includes a description of how the new D2D systems are used in order to support the Transport Chain Manager.
- Development of re-engineered demonstrator business models describing how the future business processes may be organised and performed. The re-engineered models include the new role termed the Transport Chain Manager and a description of how the new D2D systems may be used in order to support management of the chain.
- Development of a state-of-the-art report for freight monitoring. The report includes an up-to-date review of the most well known technologies and systems currently in use for tracking and tracing in intermodal freight transport, as well as an assessment of a various applications for such T&T systems in the D2D demonstrators.

- Development of a state-of-the-art report for door-to-door transport chain management. The report includes an analysis of the state of the art in TCMS and ERP systems, definition of existing functionality and current interaction techniques.
- Specification of TRIM (Transport Reference Information Model – a data model) in Together Soft, including automatic generation of database entities.
- Establishment of user requirements to Tracking and Tracing information (based on WP1 results) and design of Freight Transport Monitoring System (FTMS) functionality.
- Development of a FTMS software solution with core tracking and tracing modules and a visibility and status user interface.
- An organisation to operate the FTMS under real life condition has been designed. Special focus has been put on making it generic and adaptable to any user-defined transport chain.
- Development of FTMS documentation that can serve as a promotion tool and guide new FTMS users from the transportation industry.
- Functional requirements for a Transport Chain Management System (TCMS).
- Development of a fully operational TCMS software solution with enhanced functionality according to feedback from the actors in the demonstrator chains (hierarchical load units, dynamic transport chains, etc.).
- Development of user documentation required for the efficient use of the web based TCMS.

- Development of the D2D Communication Platform based on a software solution already developed by TRD International. This platform handles the communication between TCMS/FTMS and the outside world.
- Development of most XML messages based on EDIFACT required for communication with actors in the demonstrator chains (additional development still required for some chains).

- Development of an integrated D2D Software Solution Prototype, combining the FTMS, the TCMS and the D2D Communication Platform.
- Demonstrated D2D software in all five transport chains, and shown that there are real benefits both in the efficient use of information and the operational accuracy and effectiveness.

- A service profiling program SPPG has been developed for statistical evaluation of the quality and reliability of transport services by comparing planning and operational data.
- Completed a development plan for IPSI related technology for physical handling and started to evaluate possible application of this technology in the D2D chains.
- An analysis has been made of the points where the D2D chains could be improved in the area of monitoring and chain visibility with "smart technology".
- A detailed analysis has been made for the application of smart monitoring technology to the Elkem chain.
- Tested satellite tracking and/or GSM bar code scanner feeding position data into a D2D visibility solution developed by CLS in the John Deere and Elkem chains.
- Showed that it is possible to use a simulation software tool like Arena to simulate the progress of transport in the John Deere chain.

Exploitation plans

An important aspect of the project is to convince relevant persons, companies and institutions, that intermodal door-to-door transport is a viable alternative to road transport.

The outcome of the project is new, efficient transport operations and knowledge about how to operate and how to improve efficiency in multimodal transport. Another outcome is the D2D system, comprising two major building blocks (TCMS and FTMS). TCMS and FTMS are developed into integrated operational software, ready for commercial exploitation. The TCMS already exists as a commercial software application.
A detailed Exploitation Plan is included in the form of an electronic Technological Exploitation Plan.

Dissemination of the project results has been carried out through publication of articles and participation and speeches in conferences and seminars. A short video presenting the project has also been produced. Two PhDs will be based partly on the work in D2D.

1 Introduction

The Final Report provides an overview on objectives and results achieved for each of the work packages included in the D2D project. In the table below, a short overview of each work package is given. This version of the report contain evaluations of partners and cost and time consumption and is therefore "Confidential".

Table 1 Overview of Work Packages

Work Package	Content
WP1: Business modelling	Define the business models and requirements to be supported by the D2D systems.
WP2: Development of Freight Transport Monitoring System (FTMS)	Develop an integrated European door-to-door intermodal Freight Transport Monitoring System (FTMS) for loading units, goods and transport equipment.
WP3: Establish the global door-to-door management system (TCMS)	Establish the global management system for door-to-door intermodal transport operations.
WP4: Future solutions with "smart" intermodal transport technologies	Investigate and demonstrate how "smart" intermodal transport technologies and equipment should be utilised in order to improve the efficiency and quality of intermodal door-to-door transport solutions.
WP5: Demonstrating management of door-to-door transport chains	To demonstrate "an integrated management and communication system for door-to-door intermodal freight transport operations" and the effect of "smart" technologies in the logistic chain.
WP6: Evaluation, dissemination, exploitation, and standardisation	Evaluation and assessment of the benefits obtained by all project and Demonstrator participants. Promote standardisation. Develop a plan for dissemination of the knowledge and exploitation of the project results.
WP7: Project Management	Ensuring efficient use of project resources in achieving the project objectives. Promoting the project and the project results as the project is being developed. Reporting the project status and monitoring progress and expenses against the budget. Providing technical coordination and quality assurance.

Five different transport chains have been analysed and re-engineered with basis in the introduction of the new role of the transport chain manager and the use of the D2D Solution. This is actually three software solutions which communicate with each other and with the outside world. The TCMS is the Transport Chain Management System, a system used for the effortless creation of new transport chains and efficient execution of the transport. The FTMS is the Freight Transport Management System, a system which collects status information and provides estimates of arrival times and alerts in case a cargo should be re-organised. The Communication Platform is the third part of the solution, and this system facilitates all communication between the various systems.

The five chains are called: The John Deere chain, the Volkswagen chain, the Elkem chain, the Nutasa chain (also called the Portuguese chain) and the Pamesa chain (also called the Spanish chain).

The John Deere chain consists of transport of John Deere farming equipment from Mannheim, Germany to final destinations in inland Australia. This demonstrator combines transport on inland waterways, road, and ocean for exporting high value cargo from Europe. (Chain manager: Wallenius Wilhelmsen)

The Volkswagen chain is designed for transportation of cars from Wolfsburg in Germany to final destinations in Mediterranean countries. This demonstrator combines transport on rail, road, and short sea shipping for exporting cars from Europe. (Chain manager: ATG Autotransport Logistics)

The Elkem chain consists of the intermodal transport chain for ferrosilicon from Salten in Norway to Rheinfelden in southern Germany. Degussa in Rheinfelden uses Elkem's products for the production of chemical products. (Chain manager: Euro Nordic Logistics)

The Pamesa (Spain) demonstrator represents transportation of floor and wall decorative tiles from the Pamesa factory in Almazora (Castellón) to the Cegrisa warehouse at Telde (Gran Canaria) in Spain and has a strong focus on an efficient transportation of the empty containers. From the point of the transport chain manager, the actual process starts when the empty container leaves the Valencia Depot and ends when the container is back at the same Depot. (Chain manager: Cetemar)

The Nutasa (Portugal) chain is the shipping of animal food with the Nutasa/Unifac group from the Nutasa plant on the Portuguese mainland, via the port of Lisbon and the port at Ponta Delgada, to the receiver on the Azores Islands. (Chain manager: Fresti)

Below is a schematic overview of how the chain analysis in work package 1 provides the basis for the development transport chain management and visibility systems and assessment of "smart" technologies, which were demonstrated in the five demonstrators.

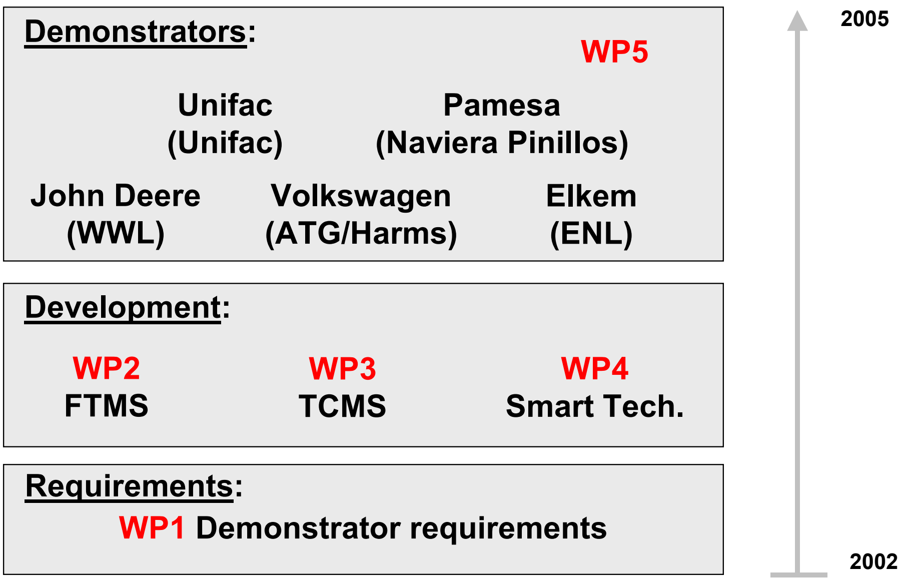


Figure 1 Work Package Hierarchy

2 Objectives and strategic aspects

In a highly competitive, global market, efficient logistics is of paramount importance to European industry. In the last 20 years, the road share of European freight transport has increased from 30% to almost 45% whilst rail has decreased from 21% to 8%. The transport users evidently prefer truck transport, but this causes problems for society in the form of congestions and a high death toll on European roads.

The desired solution is to optimise the use of transport resources totally, utilising all forms of transport: road, rail, inland waterways and short sea shipping. If multimodal transport is to become a serious alternative to truck transport, multimodal transport must be similarly efficient and as easy to use. A reduction of environmental externalities will be highly positive for the quality of life and the mobility of people and freight.

The aim of the D2D project was to analyse five multimodal transport chains, assess the activities required for efficient chain management and then assess existing technology and develop new systems that could support these activities. Thereafter to develop a generic business model for transport chain management, which incorporated the functionalities of such technology. The final objective was to demonstrate how to use such processes and systems in the five transport chains.

The main results foreseen were:

1. Analysis of the five transport chains
2. Assessment of current technology for monitoring of tranports
3. Assessment of systems for transport chain management
4. Development of a generic business model for transport chain management
5. Development of a transport monitoring system
6. Development of a transport chain management system
7. Development of re-engineered models for the five transport chains, showing how new technology could be used
8. Demonstration of systems in the five demonstrator chains
9. Assessment and implementation of “smart” technologies to support the activities in the five transport chains and reduce bottlenecks

Integration between all transport modes is one of the key objectives in the Growth Work Programme. This project seeked to demonstrated such integration in real transport operations by developing and testing systems and technology that would support this integration, and facilitate easier organisation of complex multimodal transport chains.

By showing that such technology could be used to increase the integration and to build and manage complex mutlimodal transport chains more easily, it would show that the competitiveness of such transport chains could be increased, in comparison to single mode transports, like trucking. This would promote multimodal transport chains as viable, not only from a social and environmental point of view, but also from a pure business perspective.

The figure below illustrates the D2D objective.

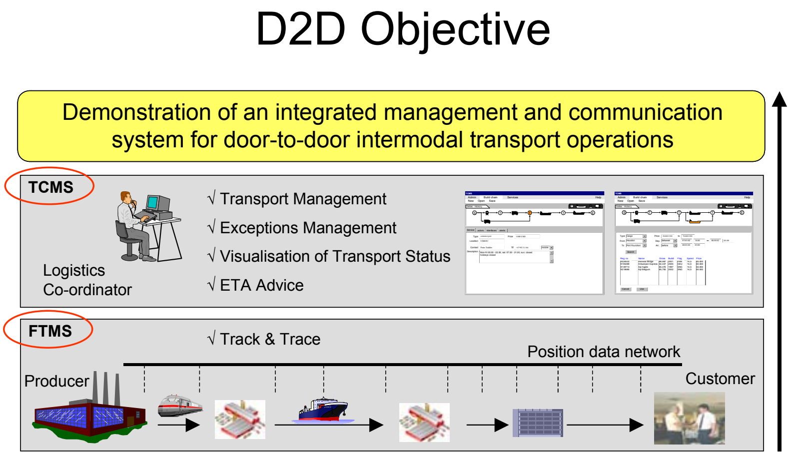


Figure 2 Illustration of the D2D objective

In order to achieve its objective, the D2D project would map and prioritise real-life transport chain requirements to derive necessary requirements for logistics management systems. The requirements would serve as input for development of the systems. The aim was to show solutions that could be used by any operator (shipper/forwarder) responsible for an intermodal chain or parts of it, without having to make major changes to relevant information systems already in use.

The FTMS would provid intermodal tracking and tracing information and ETA. It should integrate existing systems, new technologies and standards that would enable a global network of data collection nodes.

The TCMS should be used by the chain manager to organise, monitor, and control the intermodal transport chains under his responsibility. TCMS would send, receive and store information related to the parties involved.

It was further an objective to make use of emerging “smart” technologies both in terms of ICT and equipment, which promise to improve the efficiency of the intermodal transport chain through automation of processes.

It is important to note that the approach of this project was an open system that could be utilised and adapted by all types of actors in the transport chain to satisfy their varying requirements. The competing approach is the development of proprietary systems like those being used by companies like FedEx and UPS. One effect of using proprietary systems is that it will limit the widespread use of intermodal transport for all kinds of cargo.

The ultimate success of this project would be that a great number of actors in a great number of transport chains would implement a D2D software solution and together as a well organised team to increase their ability to efficiently arrange, monitor and re-arrange complex multimodal transport chains.

3 Introduction to Scientific and Technical results

In the next chapters the work packages present their results. The project management are especially satisfied with the scientific results and the innovations related to WP1 Business modelling, WP3 Transport Chain Management System and WP4 “Smart Technologies”. These work packages are innovative in different ways. WP1 brings to the table a more comprehensive explanation of the role of the Transport Chain Manager in the deliverable D3.1 A Generic Model for Transport Chain Management. This model rests on the results of a number of previous projects and on the analysis of the five transport chains included in this project. The result is an excellent structured overview of the different activities a transport chain manager would undertake.

The Freight Transport Monitoring System and the Transport Chain Management System build on the results of the analysis in WP1. WP3 succeeded beyond expectations to provide a system that is believed to be unparalleled in its ability to facilitate fast creation of transport chains from pre-defined building blocks. In addition it is built on the Transport Reference Information Model (TRIM), which is further enhanced for the use in this project. The result is an extremely flexible system, with ability to manage numerous complex transport chains, provide efficient control of service providers, provide transport alerts and keep track of the re-arrangements of the chain and follow cargoes on multiple levels (hierarchical load units).

WP4 is innovative in many ways, but in particularly in its attempt to make transport simulation and tracking of service provider performance available to an operative transport management environment. A number of tracking devices were tested and in order to achieve further control along the chain, possibilities for integration between TCMS and traffic information was investigated and to a certain extent developed.

Generally it is the opinion of the project management that even with some set backs related to some lack of support from actors in the chain, the project partners have developed new and innovative concepts and solutions that will definitely have long term benefits for improved control of multi modal transport chains. The methodology used in this project has also developed substantially over these 36 months and will no doubt be used by the project partners in their future work.

4 Business Modeling (WP1)

4.1 Method and generic business model

The generic business model incorporated the project wide agreed main terminology and structured the transport chain management functionality by applying this terminology. The generic business model provided an overview of the complex and comprehensive work pattern a TCM has to exercise.
Structuring transport chain management functions in a hierarchical way:

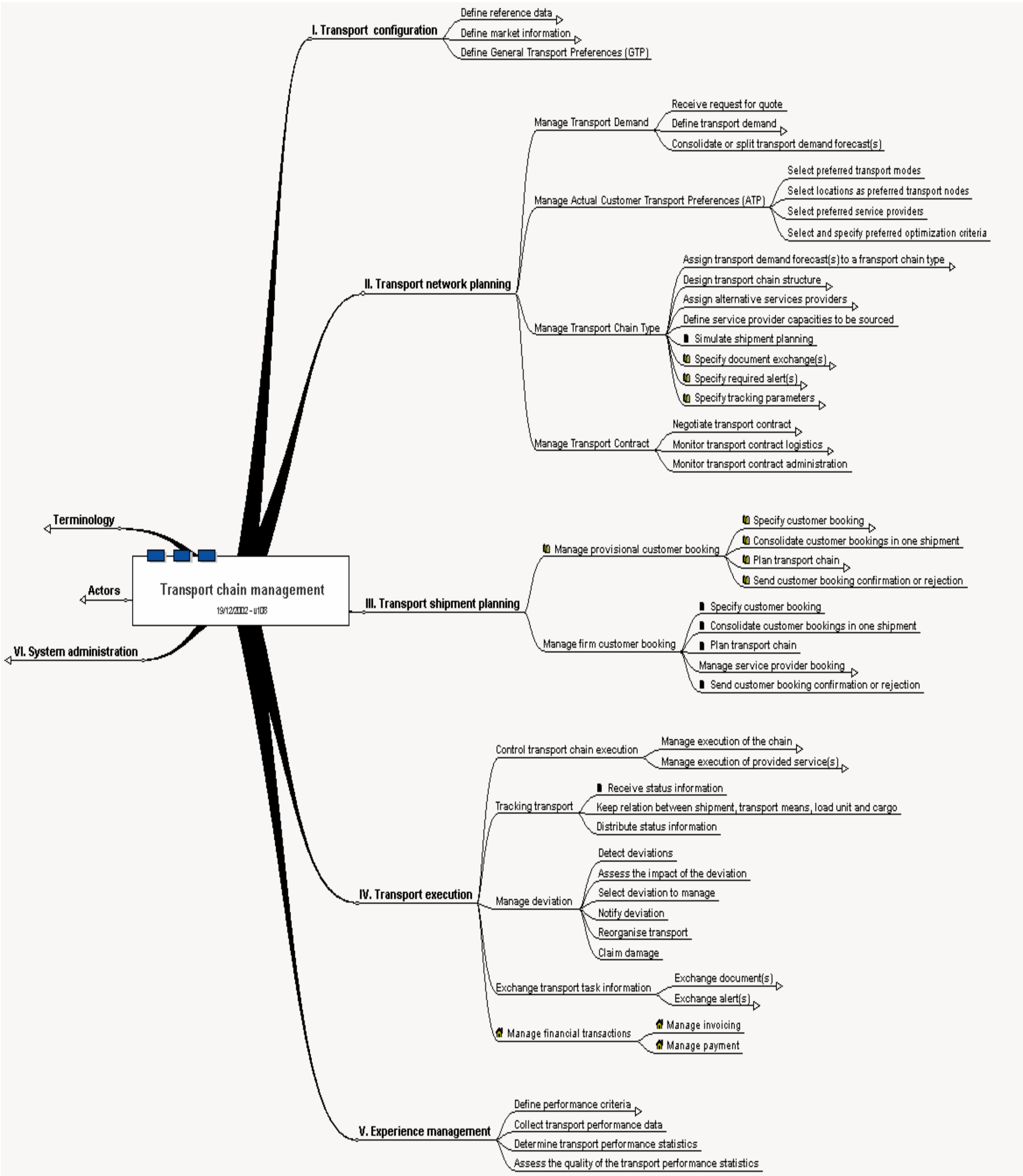


Figure 3: Hierarchical structure of transport chain management

Using Qualiware Lifecycle Manager (QLM) as the modelling tool for the generic business model as well as for the demonstration of the “as-is” and “to-be” business models within the demonstrators, the presentation features as well as the generic structure were explained.

The generic business model explained the relations between the main results from the D2D project: the D2D-system and the involvement of the Transport Chain Manager.

The structural decomposition from the hierarchical diagram was deployed in the generic business model. The QLM-description was used to demonstrate the main responsibility areas of the transport chain manager and its breakdown in individual activities:

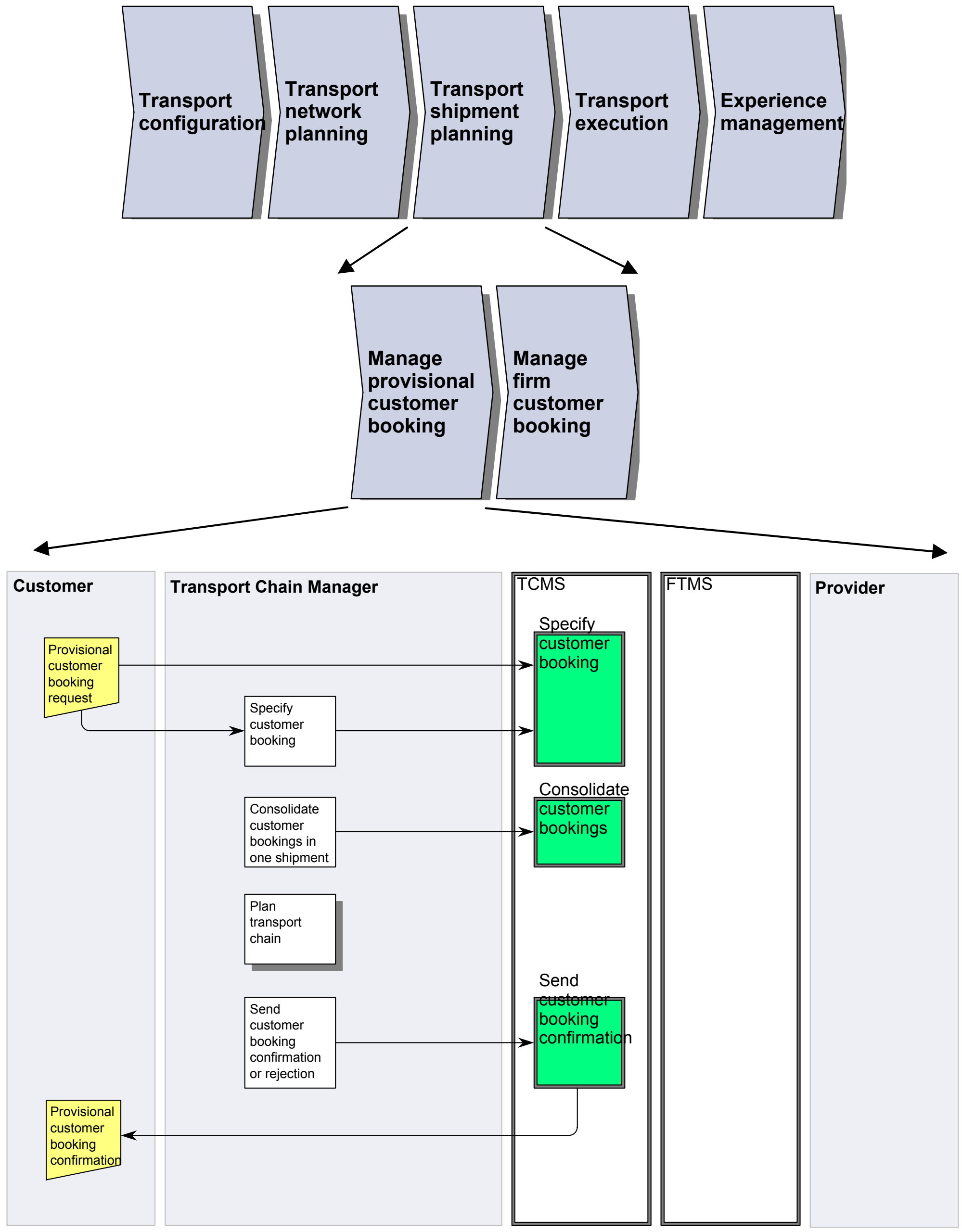


Figure 4: Structural decomposition from the mind map diagram

The final layer in the QLM model was used to demonstrate the workflow elements within a process:

- The flow information is indicated by the yellow document symbols
- The direction of an information, respectively physical flow is shown by the arrows
- These activity paths function like a finish/ start type, i.e. the triggering activity must be finished, before the next activity can start
- An activity by an actor is indicate by the white boxes
- An function of the D2D system is presented by the green body within the functionality of the D2D system, e.g. the TCM
- A shaded activity of an actor indicates a link to an information flow diagram

4.2 Problem areas revealed

The modelling and analysis of the five transport chain "as is"-situations provided a comprehensive overview of each intermodal transport chain's critical problem areas. These problem areas found were of comparable type in all five cases and served mainly for the following:

- starting points for re-engineering of transport chains
- modelling of "to be"-situations
- basis information for development of the D2D system

	Demonstrators					
Problem areas	John Deere	Volks-wagen	Elkem	Pamesa	Nutasa	Score
Lack of statistics						3
Missing status information						3
No central TCM						3
Redundant workflow						2
No deviation management						2
Very low transparency						2
No follow-up on performance						2
Inefficient tracking						2
Information mismanagement						2
Low EDI integration						2
No ETA notifications						2
Low IT-standards						2
No central data base						2
Bottlenecks in transport chain						1
Too many actors						1

Table 2: Revealed problem areas

The score per problem area is the sum of entries, i.e. in how many transport chains a particular problem area has been revealed. Five is the highest possible score meaning that in all five demonstrators the same problem area was revealed.

In WP1 the lack of **a central TCM** (score = 3), **clear distribution of responsibilities** in conjunction with an installation of a **central Transport Chain Manager** (3), the **possibility of statistical analysis** and **missing status information** (3) were revealed as the most critical problem areas in intermodal transport chains.

4.3 Key performance indicators and D2D-system functionality

The generic business model was validated during the modelling of the “as is”-situations as well as the re-engineering of the “to be”-situations concerning the five transport chains. As a fundamental requirement the relevant planning and execution activities for each case had to be captured and modelled correctly.

The mapping of business processes and workflow regarding the transport chains as well as quality assuring procedures were based on workshops and interviews with managers who were commercially and operationally involved in the transport chains. Each stage of work was approved by the responsible actors and by the future transport chain managers.

A major achievement of WP1 and therefore an outcome of the preparatory work for the following WPs was the identification of key performance indicators (KPI). KPIs drive the transport chain planning and execution and were the backbone for development of the D2D system. I.e. the KPIs were used to define the basic set of required functionality of the (generic) D2D-system, which should develop into real life demonstrators.

	Demonstrators					
Key performance indicators	**John Deere**	**Volks-wagen**	**Elkem**	**Pamesa**	**Nutasa**	**Score**
Costs						**4**
Reliability						**3**
Delivery precision						**3**
Transparency						**3**
Throughput time						**2**
Flexibility						**2**
Lead time						**2**
Information exchange						**2**
Frequency						**1**
Quality management						**1**
Utilisation of resources						**1**
Control of performance						**1**
Safety						**1**

Table 3: Key performance indicators

The score per KPI is the sum of entries, i.e. in how many transport chains a particular KPI has been stated. Five is the highest possible score meaning that in all five demonstrators the same KPI was indicated.

As a result of WP1 indicates that **costs** (score = 4) are the most important key performance indicator followed by **precise delivery** (3) which includes punctuality and delivery without damages, **reliability** (3) covering some similar aspects as delivery precision but additionally damage ratios and availability. Finally **transparency** (3) throughout the transport chain was indicated as an important KPI.

4.4 Functionality of the D2D-system

Among potential D2D-system users and relevant transport chain actors an evaluation was done concerning required functionality. The interviewees were asked to rank their requirements regarding the priorities of 1 = high importance to 4 = low importance.

The outcome of this prioritised evaluation regarding the required functionality highly supported and guided the development of the (generic) D2D-system as well as further planning of the demonstrations, i.e. the required D2D-system functionality were transferred into the main focus areas for the re-engineering and implementation of the D2D-system**.**

	Demonstrators						
Functions of D2D-system	**John Deere**	**Volks-wagen**	**Elkem**	**Pamesa**	**Nutasa**	**Score**	**weighted score**
Track and trace	**1**		**1**	**2**	**1**	**4**	**1,25**
Information exchange			**1**	**2**	**1**	**3**	**1,33**
IST integration			**1**	**2**	**1**	**3**	**1,33**
Forecast handling/costs	**1**	**1**				**2**	**1,00**
Process management			**1**	**2**		**2**	**1,50**
Performance monitoring	**3**		**2**		**3**	**3**	**2,67**
Deviation management		**3**	**3**		**2**	**3**	**2,67**
Pre-defined alerts/routing	**2**		**3**			**2**	**2,50**
Statistics			**3**		**3**	**2**	**3,00**
Cost reporting (real time)		**1**				**1**	**1,00**
Booking of services	**1**					**1**	**1,00**
Web based access					**1**	**1**	**1,00**
Resource management		**2**				**1**	**2,00**
Lead time calculation	**2**					**1**	**2,00**
Invoicing/ payment flows	**4**					**1**	**4,00**

Table 4: Required D2D-system functionality

Here the score per function of the D2D-system is twofold:

1. **The score per D2D-system function is the sum of entries, i.e. in how many transport chains a particular D2D function was stated. Five is the highest possible score, i.e. in all five demonstrators the same function was mentioned.**
2. **The weighted score per D2D-system function is the quotient of the sum of priorities divided by the score - the lower the weighted score the more important the D2D- system function.**

The work in WP1 defined **tracking and tracing** as the most desirable D2D-system function (score = 4; weighted score = 1,25). An effective **exchange of information** (3; 1,33) and an easy **integration of IST** (3; 1,33) are even highly desired functionality of the D2D-system. Aspects like forecasting handling and costs (2; 1,00) as well as process management (2; 1,50) are of (very) high importance for a small number of demonstrators. Performance monitoring (3; 2,67) and deviation management (3; 2,67) are welcome for relatively many transport chains, but of lower importance.

4.5 Conformity with WP objectives

In WP1 the achievements concerning the five demonstrators are in conformity with the WP1 objectives. The set WP1 goals were summarised in the D2D project work description. They functioned as a kind of skeleton for the structuring and proceeding of the work load.

	Demonstrators					WP1
WP objectives	**John Deere**	**Volks-wagen**	**Elkem**	**Pamesa**	**Nutasa**	**generic**
Define of business models						
Define workflow						
Define information needs						
Map physical + info. Flows						
Define events affecting chain						
Identify KPI						
Identify problem areas						
Depict re-engineering needs						
Extract business rules						
Build generic business model						
Define D2D-system function						
Model to be processes						
Determine customisation						
Lay basis for following WPs						

Table 5: Conformity with WP objectives

4.6 Exploitation of WP1 results

The methodology applied in the D2D project - in particular in WP1 - for mapping and modelling of workflow and business processes is strongly based on the functionality of the modelling tool Qualiware Lifecycle Manager (QLM). BMT has deployed QLM for further developing this modelling and analysis method in-house and within European research as well as "growth" projects such as TRAPIST respectively MARQUAL.

The completed European 6 FP "growth" project TRAPIST – Tools and Routines to Assist Ports and Improve Shipping aimed at providing management support tools primarily small-to-medium ports (SMP). The modelling methodology and the QLM-tool were used to develop an Information Analysis Manual and a complementary Planning Guide for a standardized analysis method of information and physical flows in ports/terminals. In a port adequate information about the cargo is required for controlling the physical flow, for the related administrative processes and for managing the resources required for its handling. Information and communication is crucial to guide the internal processes and to be able to interact with customers and other external parties.

The European 6 FP "growth" project MARQUAL[1] aims at a better understanding, documentation, and communication how modelling of business processes in the maritime sector contributes to adapting such operations to meet the requirements from users of waterborne transport in door-to-door transport chains. At the same time, shipping should be made profitable ventures for operators and the society. In particular, appropriate quality operations were modelled with the QLM-tool applying the methodology developed in the D2D-project as well as examined to demonstrate current best practice.

The D2D-partners involved in WP1 envision the methodology developed and the insights gained a tool for providing consultancy services in the area of deploying door-to-door management systems. Additionally, BMT has been busy further developing the modelling and analysis methodology and BMT applied the QLM-tool commercially as well as within European and national (German) research and consultancy project.

[1] Improving Quality of Maritime Operations through Modelling Business Process in Shipping

5 Development of Freight Transport Monitoring System (WP2)

5.1 Analysis of solutions

A review, analysis and assessment of the most advanced T&T solutions implemented in the freight transport world was performed in order to identify alternatives that will lead to the formulation of a relevant framework to guide the system architecture work for a novel FTMS. Tracking and Tracing (T&T) systems, services and products available in the market today include: short-range identification technologies (e.g. barcodes, RF tags, ISM, DECT), position determination systems (e.g. GNSS, GSM, PMR), position reporting systems (e.g. GSM, Satellite; PMR) and telemetry Reporting Systems.

The review of the T&T technologies revealed significant difference in complexity between T&T systems. A full tracking and tracing system would require the deployment of relatively sophisticated equipment embedded in containers, trucks and ships and the adoption of a standard that benefits from a network and infrastructure to ensure sufficient coverage, irrespective of the transport route and operator.

Regarding tracing in transport, the requirements are very specific: should be of very low cost and very easy adoption/ use. These requirements demand a specific reporting technology (such as Bluetooth) and the necessary network. Whilst such a solution is technically feasible, the difficulty of selecting a universally acceptable technology and its significant deployment expense are likely to place such an initiative beyond the reach of industrial actors, unless state funding were provided.

The alternative is to operate with a less than ideal technology (higher cost, limited performance), but take advantage of an existing system (such as GSM) that is economically justified by other existing applications. The development of portable devices such as telephones and computers (PDA) for the mass B2B market and their necessary supporting infrastructure will undoubtedly progress the technology underlying GSM to a point that it is capable of meeting the requirements of the transport industry. Given the rate of such developments, it is difficult to justify a specific separate development. Even today, certain tracing applications are able to justify the costs incurred and the limited performance obtained using current GSM or satellite technology.

5.2 Assessment of technology for the demonstrators

The demonstrator models examined do not currently provide tracing functions, confirming the general observation that many transport chains are not able to justify it. It is therefore important to identify a suitable tracking-only system that allows costs to be minimised, thereby maximising the chances of its successful adoption in a highly competitive environment.

The analysis of the constraints imposed on electronic and automatic T&T has revealed a feasible tracking-only concept that can be summarised as follows: identify all items in the transport chain in a manner that allows packing and loading information to be generated automatically; track all transport units of interest when they move. Avoid tracking inner item or transport items that do not move and collect all raw packing, loading and tracking information. Process the information in order to maintain up-to-date associations between items, infer the position of goods. The concept is well suited to intermodal transport, allowing each transport operator to generate tracking information in the most appropriate manner for the transport unit concerned, even allowing the use of proprietary systems that are incompatible with adjacent segments, provided that the relevant information can be delivered.

An essential difference between tracking and tracing is that tracking may refer to specific legs of a transport chain implementing different types of identification, positioning and communication technologies, while tracing refers to the chain as whole, since the determination of the transport status (position, condition, etc.) on a given schedule covers the entire chain. Therefore, while tracking embodies a more technological character for positioning purposes, tracing entails a more functional and business character in order to extract useful information about the whereabouts, status and other useful information (direction, condition, ETA, deviations, etc.) of significant importance for all parties involved. As a result, tracking and tracing should be considered as complementary processes in the sense that tracking obtains and feeds tracing with the positioning information that tracing will further use for determining whether the cargo follows the predefined schedule.

Overall, it was concluded that the selected technology should be adopted throughout the chain in order to ensure widespread compatibility at the lowest possible cost and that the selection, implementation and use of electronic and automatic tracking and tracing technology should be modelled closely on existing practices.

In addition, long, international and open system supply chains experience a long lasting hurdle in the area of monitoring the cargo and the vehicle in order to undertake dynamic operational reflections and overcome incidents and disturbances along the way. Two major problems were identified in this process:

- The issue of data sharing and security, confidentiality etc. implications;
- The harmonization and economy of the interfacing among the numerous nodal points generating status information.

5.3 FTMS system design

The FTMS (Freight Transport Monitoring System) was built to address the problems that long international supply chains face. In particular, the FTMS is able to:

- Identify the key concerns of the representative transport chains participating in the project,
- Provide specifications for an open, simple and low cost solution,
- Implement the best practice solution, and
- Promote the idea for full scale adoption in the D2D market place.

A break down of the key elements composing the FTMS solution follows.

- *FTMS Functional Specifications*

The FTMS Functional Specifications include the necessary information, guidelines, directions that allow the technical team to develop the various functional components of the FTMS and their interaction in terms of data flows. Three types of models have been developed that compose the FTMS Functional Specifications:

1. The **FTMS Hierarchical Model**, providing the functionality of the FTMS classified at various levels of detail.
2. The **FTMS Functional Model**, analysing the functions of the FTMS and their interaction in the form of information flows both internally as well as between the functions and external to the system entities.
3. The **FTMS Dynamic Model**, incorporating in the functional specifications the dimension of "time sequence", demonstrating the various modules sequential operation.

- *FTMS Information Specifications*

  The FTMS Information Specifications model the data organization and administration delivering a schema of the FTMS database that will support all processes of the system. The information handling is the core part of the FTMS, since the system must be fed with information provided from different sources (PDPs and TCMS), perform a series of validation and calculation processes, and finally disseminate (through TCMS) the results to the parties concerned. Therefore, particular attention has been placed on the FTMS Information Specifications delivering a Data Model (Database Schema) and associated Data Stores specifications, which serve the information needs and requirements of both the end-users and the system itself.

- *FTMS Physical Specifications*

  The FTMS Physical Specifications define the technological equipment that was used to operate the system and allocate the various processes of the system to the physical units. The specifications are represented as a network of physical components (hardware) appropriately connected also including all the individual software modules, for the entire system effective functioning. These specifications are finally accompanied by the allocation of the functions of the entire system to the physical units presented in the diagram (network of physical components).

It is important to notice that FTMS stands alone as an autonomous product, serving the needs of any kind central actor in integrated logistics chains. Although its core contributors are the Position Data Providers, it finds its full potential when integrated with TCMS, which is its natural customer towards a complete e-business solution in the transport sector see Figure 1 below).

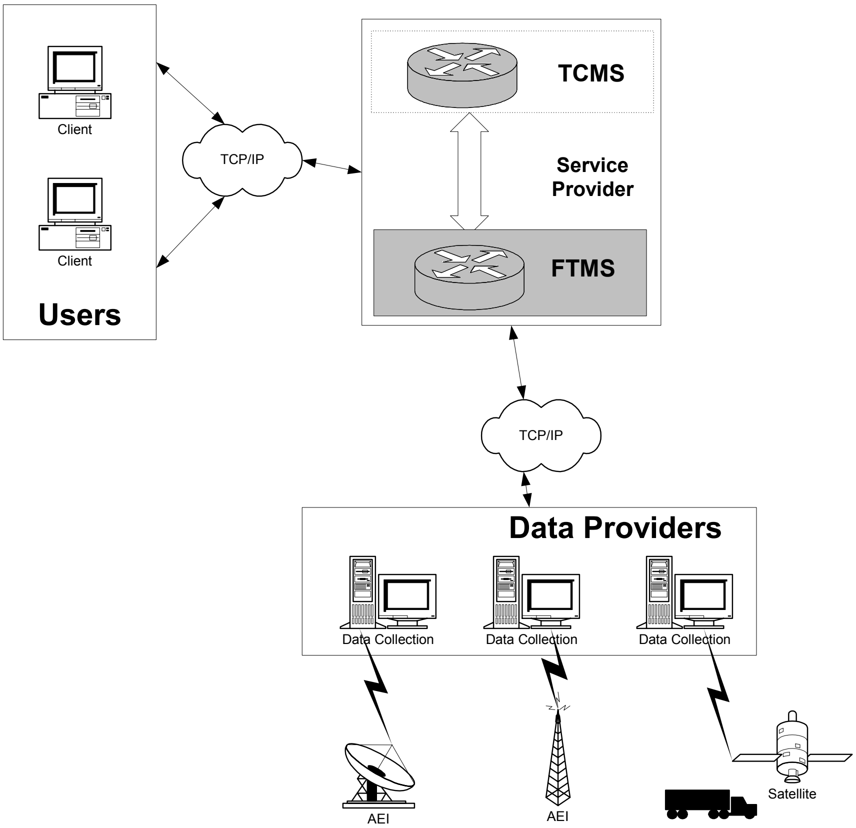


Figure 5: FTMS Overview

5.4 Communication platform

The establishment of a European network of Position Data Providers (PDPs) linking different types of identification points to a central system is met through the Integrated FTMS System Architecture and the D2D Communication Platform Architecture. The prime goal of these Data Providers is to communicate status information of the cargo and the transport means to the system that monitors the freight transport activities along the transport chain (i.e. FTMS). Within the context of the network of position data providers, the D2D Communication Platform can be considered as an intermediate system connecting the FTMS (also TCMS) with the PDPs. In particular, the PDPs communicate their status messages to the platform, which in turn undertakes a first validation and subsequently communicate them to the FTMS. Equally, the platform connects all actors involved in the organization and execution of the transport chain with the TCMS. The platform's architecture includes the main functionalities of the platform, the information specifications, the messages handled, the interfacing specifications with the FTMS and the TCMS (see Figure 2).

In particular, the communication platform has three functional levels: the platform itself, through which all parties involved electronically collaborate; the interfaces, through which each party communicates with the platform and all the parties' local IT systems. The internal applications are the initial generators, as well as the final recipients of the information. The platform's communication architecture was analysed in four layers with distinctive roles, following the incoming information flow direction: communication layer; conversion layer; message administration (issuing/reception) layer and presentation layer.

Within the D2D project, the platform had mainly an administrative role (incoming and outgoing messages handling; data storage and access control) facilitating the interchange of messages and information through the two systems TCMS and FTMS, while all the operational part of the transport chain had been allocated to the two systems. The platform was equipped with the necessary mechanisms and technological instruments allowing the communication of messages between parties with different computerization infrastructure. Therefore, the platform gave to all parties the flexibility to participate in the D2D initiative without worrying about their technological infrastructure.

The platform was not developed from scratch for the needs of the project. The project made use of an Internet based software platform for information/ message communication, a product developed by TRD International S.A. This product had a similar business orientation and technical approach with the platform described above and was customised to the specific characteristics of the D2D. Another important reason for choosing this product to play the role of the D2D Communication Platform was that the product served the particular needs of the parties involved in the D2D transport chain activities and fitted to the technical concept proposed by D2D.

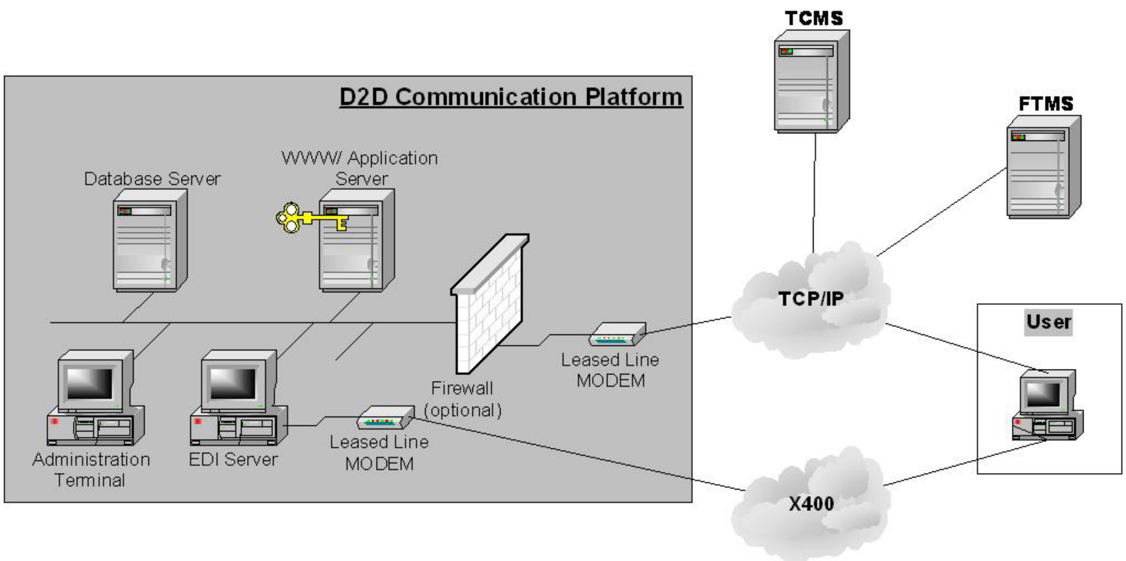


Figure 6 The physical architecture of the D2D communication platform

The FTMS Communication Architecture entails the structure of the XML messages exchanged between the FTMS and its cooperating systems, the description of actions enabling the TCMS-Platform-FTMS communication via web services, etc. Therefore, the FTMS communication specifications enables the Integrated FTMS System Architecture, which in turn provides a complete and comprehensive picture, at the design level, for the monitoring of the freight activities along intermodal door-to-door transport chains.

5.5 FTMS organisation and position data network

The Freight Transport Monitoring System is a useful tool to all actors requesting freight transport status information. In order to deliver such a service with high quality, an organisation operation was established, which will gradually promote the expansion of the networks as well as commercially market the information generated on a European scale.

An analysis of the existing structures in the 5 transport chains that were used for implementation and demonstration within the D2D project showed that there are several actors with several roles and responsibilities and that the way of communication and the information flow looks like a net, while the cargo moves physically forward in a line. Hence, the communication and information flow shall be supported by the FTMS in order to make them easier to handle. In serving the above requirements, the FTMS has several functions, e.g. status message control, incident detection. The actors can use a communication platform to create messages and to get/give information about the status of the transport chain. It is important that the actors are involved properly in the FTMS in order to make it a useful tool for them. However, none of the FTMS functionalities can be realised under the current organisational situation, unless the transport chain and the actors' organisation change.

These organisational and information structures as well as the distinction of the several actors relevant in the processes were the basis for the description of the organisational operation. The system operational roles included: raw status data collection (either a person or a sensing system); status information providers (either a person or a system); reference information providers; the TCMS operator; the processed status information recipients; the FTMS system administrator and the Communication Platform operator. The new structure was able to detect the vulnerability points and optimise the organisational operations of FTMS and, thus, contribute to the benefits that the actors/users can get from the FTMS. It was also able to allow several of FTMS service providers simultaneously on the market making use of (in some cases) the same reporting network. The possibility of simultaneous use of the reporting network by a great amount of actors with different information systems and level of automation was ensured (to ensure an information exchange without changing its original meaning).

The organisation operation was designed in such a way as to enable the effective (and efficient) operation of the FTMS under real life conditions. In addition, the optimisation of the FTMS organisation can be done independently from the hierarchies and functions developed in the FTMS Architecture, so that changes in the Architecture will not imply changes in the organisation. The FTMS Organisation Operation Description was mapped without reference to specific applications from the demonstrators, so that this Organisation Description can be adapted to any user-defined transport chain. The interconnectivity between the central points of various networks facilitates the expandability of the system and operational flexibility of the actors involved in constructing virtual networks compatible with their business chains.

5.6 Conformity with overall project objectives and WP objectives

Overall, we have shown that the FTMS as a part of the D2D solution can lead to time and cost reduction, improve delivery accuracy (time), improve cargo delivery quality, improve monitoring throughout the whole transport chain, enhance communication and information exchange/flow and enhance the flexibility from the chain (e.g. re-routing units in transit).

In order to realise the FTMS according to the work package objective, a prototype of the solution was developed, incorporating the requirements and expectations of the demonstrators and the experience of their technical team. However, since it is an open system, wide applicable and accessible to all kind of SME's, it was able to incorporate experiences from other business cases too. To become fully operational and the end product to be fully compatible between the parties involved, an operational and organisational consensus among the actors was reached. The experience and the results from the SITS project were used allowing full compatibility between the three systems, FTMS, TCMS and the communication platform.

5.7 Exploitation of WP results

In order to help future interested clients appreciate the D2D system advantages and fully comprehend the FTMS and the D2D Communication Platform technical characteristics and operation, a complete information set was produced. This documentation can be used as a guide for potential new customers from the Freight transport industry. It is a "promotion" tool addressing to the companies business/ technical personnel. It describes in a more technical/ operational way the functionality of the platform (examples are given regarding categories of clients, type of messages, interfacing, message submission) the FTMS (examples are given regarding the level of complexity in terms of simple monitoring, incident detection and forecasting) and the interface between FTMS and platform, FTMS and TCMS and FTMS and visualizer. The importance of the FTMS and platform and its usability/ applicability was demonstrated through the demonstrations (John Deere and the VW chains).

6 Establish the global door-to-door management system (WP3)

The final technical description for WP3 is divided according to the work tasks specified in the Technical Annex:

- Task 3.1: TCMS System architecture
- Task 3.2: Specifying interface needs
- Task 3.3: TCMS realisation

The WP3 partners have been: MARINTEK (WP3 leader), LogIT Systems, Sequoyah, and SINTEF.

The first task, 3.1, had two deliveries; D3.1 State-of-the-art report for door-to-door transport management, and D3.2 TCMS System Architecture. Task 3.2 has one delivery, D3.3 TCMS Interface description, while the last tasks, task 3.3 have two deliveries; D3.4 A Transport chain management system, and D3.5 TCMS documentation.

6.1 State of the art report

This document makes an inventory of state-of-the-art applications in the area of supply chain management and transport chain management, including adjacent area's. Applications are selected based on research and based on quotations given in representative media.

D3.1 resulted in a report that gave an analysis of the state of the art in TCMS and ERP (Enterprise Resource Planning) systems, definition of existing functionality and current interaction techniques. The delivery was performed mainly by Sequoyah but with assistance from MARINTEK and SINTEF. The results gave us a good overview of needed functionalities to be developed in to the TCMS system. Another benefit from the delivery was that it played an input role into the generic-business-process model developed jointly between WP1 and WP3.
The figure below presents a schematic overview of the application areas that are relevant for logistics, either directly or indirectly. In the subsequent paragraphs each of these areas is detailed through identification of the main suppliers/packages in that area:

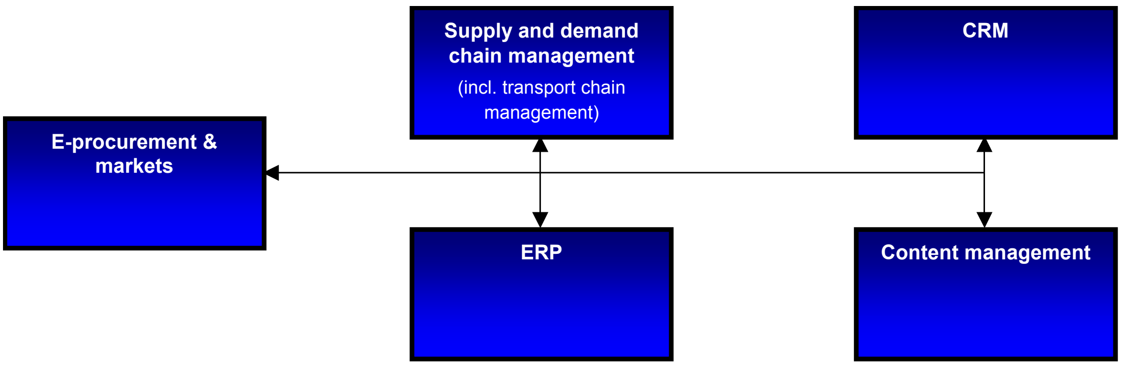


Figure 7 Schematic overview D3.1

The right side in the diagram shows the "sell side", the area involving customers. The left side shows the "buy side". The individual area can be described as follows:

Content management: This is the system (mostly an internet site) on which the products and services of a company are being presented. It is an electronic catalogue, and in many cases more than that. Although a catalogue offers "one-way" communication only, (potential) customers may also enter orders, request for information, send his opinions, and all other types of information that in the old days was collected by a salesman through personal contact only. Hence, today's content management systems not only provide information, they also gather information that can be processed into actions or analyses that are valuable for the business.

Customer relation management (CRM): Through the increased interaction possibilities with customers, the CRM area has gained considerable importance. The internet customer does not have to be anonymous and in most cases values individual service. This is only possible if the business is able to gather information about its customers in an intelligent manner, process the information, and use it as a basis for the next customer interaction. A broad range of CRM-packages has been developed for that purpose.

Enterprise resource planning (ERP): These classic systems are aimed primarily at the internal integration of logistics within a single organization. Furthermore they strongly support the efficient execution of various logistics processes, like customer order processing, production control, product sourcing and procurement, and the planning and control of production schedules, inventory mutations, and transport orders. These systems get less attention because of the internet revolution, but they are still at the heart of the logistics operation.

E-procurement and e-markets: A very strong development is going on in this area, beyond the procurement functionality of ERP systems. This is not so much a business application (i.e. for a single business), but (esp. with e-markets) a mechanism for organizing joint procurement facilities around databases that are accessible via the Internet. The focus is on crossing boundaries between individual organizations.

Supply- and demand chain management: This includes APS (Advanced Planning and Scheduling). These packages contain a series of functionalities aimed at planning, order entry, and execution over the borders of individual businesses. It requires additional functionality on top of ERP systems. In addition to traditional ERP suppliers, also relatively new system providers like i2 and Manugistics are active in this field.

6.2 TCMS System Architecture

D3.2 is the TCMS System Architecture report. The D3.2 delivery has been split into three parts:

- Part I (the main part) is the overall system architecture that the TCMS system builds its architecture platform on.
- Part II (appendix) is the user specification describing the needs for functionality from a user perspective.

- Part III (appendix) is the system design that organizes the user specification into a logical data structure where TRIM is used as the data architecture.

The reports specify the integrated architecture of the TCMS subsystems. We could see that the system architecture would change during the development phase, because of new and changed requirements that would emerge from the system testing. We therefore decided to deliver a first version of D3.2, and thereafter update the report during the project life time, before concluding and deliver a final and slightly modified report at the end of the project, even if the report as such was approved at an earlier stage. The partners involved in D3.2 have been MARINTEK, SINTEF and LogIT Systems.

The purpose of D3.2 – Systems architecture, is to provide a guideline for the technical architecture design, development and evolution of the overall D2D Technical Solution; with focus on the TCMS subsystem and the loose integration with FTMS and other peer systems. FTMS internal architecture is not covered.
Focus is on the relevant architectural decisions for detailed design and implementation. This approach to system architecture description leverages the existing referenced literature / documentation which are both extensive and easily available for this type of architecture.
The process for creating D3.2 draws on input from a number of methodologies for software engineering; the most important being:

- *DAIM* – Product family architecture design for the ubiquitous internet
- *ATAM* – The Architecture Trade-off Analysis Method
- *Published design/architecture Patterns* (re-useable solutions)
  - J2EE Blueprints
  - J2EE Core Patterns
  - Bitter J2EE (anti-patterns)

D3.2 specifies the integrated architecture of the TCMS subsystems. The first part of the report provides a high level overview discussing design decisions and architectural implications and their solutions. The last part of the report contains system design of selected components using UML models and published or described blueprints for design (patterns). This includes the domain model, TRIM, and the system architecture of the TRIM façade and TRIM physical database.

In the appendix we have included a part called User Specification. This specification explains the user requirements to the functionality of a TCMS system. The first part gives a general introduction to the TCMS, the next chapter describes the main relations and the group of functions, and one chapter describes messages to be used. The last part is dedicated to describe "monitoring" functionality and will also reflect some FTMS functionality. The process for creating D3.2 User Specification has been to interview user groups, look into existing systems, and to look at standard messages and codes used in the industry, and we have had a close dialog with the end users where the needs have been analyzed. Valuable experience from other work packages, especially WP1, has also been used for the benefit of this report. Prototypes have in some cases been developed and presented, showing screen layout examples and demonstrating contents and functionality.

Another part of the delivery is dedicated the System Design part of the TCMS system. The purpose of the System Design is to show the process of the System Architecture with focus on technical application development. The target audience for this part are system developers, who will get a good overview of the data structure and how the applications can be realised.

6.3 Interface description

This document (D3.3) describes the design of the user interfaces to TCMS, and the interfaces between TCMS and other information systems.

The user interface description provides a historical review of the design where a separate chapter is dedicated to support for flexible transport chains. The description of interfaces to other systems addresses the interaction with FTMS (Freight Transport Monitoring System), and the use of the Wallenius Wilhelmsen Lines (WWL) booking system (SAGA), as an example of TCMS communication with a third party system.

This deliverable describes the development of TCMS in the D2D project. The results from previous projects (like INFOLOG) resulted in the development of a demonstrator that was used in the project for discussion on the user interface and key functionalities in TCMS. A mind map of all TCMS functions was developed during one of many workshops. The interactions with the TCMS that involve the exchange of messages with FTMS were described using goal-driven use cases.

This report presents the guidelines underlying the user interface and describes the screens available to the chain manager. The communication with other sub-systems is described in separate chapters. One of the chapters concerns the use of the services provided by FTMS, which is the system providing key information for the monitoring of the transport chains.

The user interface to TCMS has undergone a major revision during the project. This development is documented by describing the initial user interface and a separate chapter documenting the main changes and new functionalities.

The authors of this document have been MARINTEK, but with a great support from LogIT Systems, and partly from TREDIT (FTMS responsible).

6.4 Transport Chain Management System for intermodal freight transport (TCMS)

D3.4 is the TCMS prototype computer system. The previous deliveries have been used as input to the realization part and have been the guideline for today's version of TCMS.

The developers have been using different mechanisms during the development of the application. Firstly we agreed on a design structure where rules for development, change control and testing was described. For the testing part we have been using a tool called iTrack where all tests and verifications has been logged. The internal design rule document focused on different layers in the implementation and how the process of hand-overs between the involved persons should be done. The different layers were from the bottom; the business layer containing the business logic and the data base interactions, the middle layer with orchestration of the TCMS, and finally the presentation layer. TCMS also focused on communication with other systems, like SAGA and FTMS, and therefore had support for XML messages.

Final delivery in D3.4 was the TCMS prototype that was installed on a server at LogIT Systems in Norway. We have run through different scenarios where the TCMS application has been tested, in alliance with WP5. The figure below summarizes the TCMS functionality that has been developed and demonstrated:

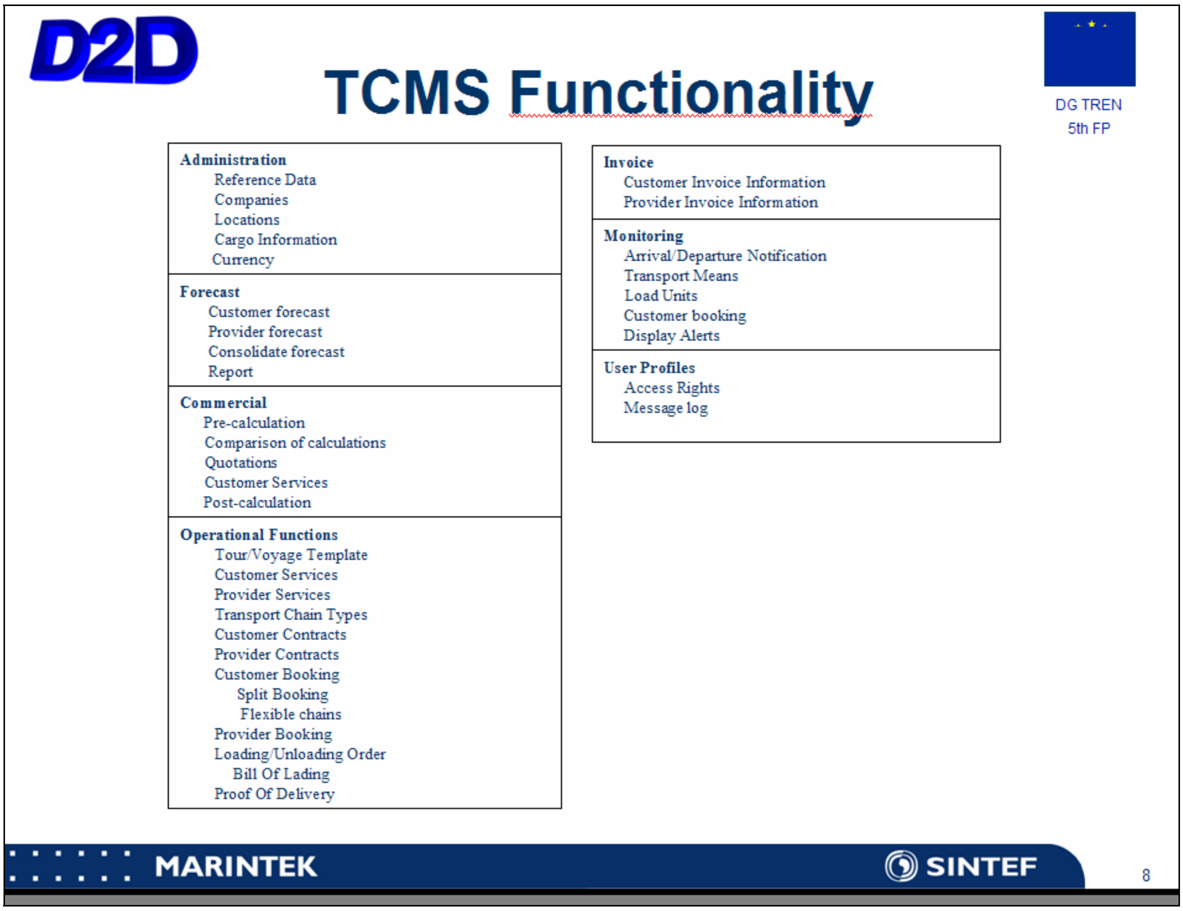


Figure 8 - TCMS functionality

6.5 TCMS documentation

The D3.5 document is built up by a complete walkthrough from transport configuration (reference-data), through shipment planning and execution (including deviation management), to invoicing and payments.

Since TCMS is only a part of the D2D solution, we have also described the relation to FTMS and the communication-platform. In the walk-through, only reference is given to information-exchange with FTMS and the communication-platform.

The document has primarily been developed by LogIT Systems, but it reflects the demonstrations in WP5, where also the FTMS and the D2D communication platform were involved.

D3.5 describes the various functions in TCMS and the related sequence of activities the user may follow. One such function is handle customer booking and another one is handle deviation and re-organize transport. The figure below provides an overview of the functional process for building a transport network.

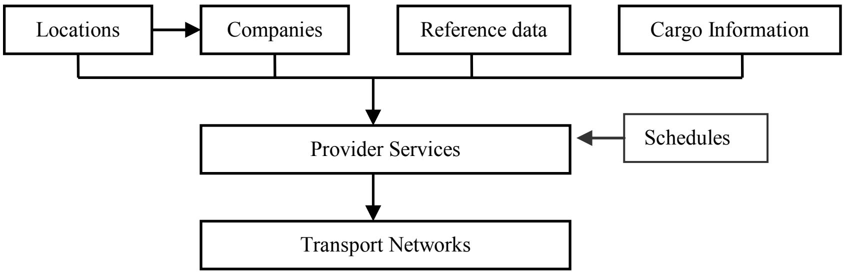


Figure 9 - TCMS functionality step-by-step

6.6 Conformity with overall project objectives and WP objectives

It is our opinion that WP3 has produced the deliverables described in the work package description and even delivered beyond what was expected in terms of functionality and stability of the Transport Chain Manangement System. WP3, in co-operation with WP5, has secured that real data has been used to show that the system is working according to plan. WP3 has been a vital contributor to the achievement of the overall project objectives with successful development and testing of one of the main systems in the D2D project.

6.7 Exploitation of WP results

The system developed in WP3 has reached a level of completeness that is acceptable for a commercial software solution. LogIT Systems owns the intellectual property rights related to the TCMS and is now marketing the system towards potential customers. Sequoyah is responsible for marketing in the Benelux area, while Cetemar is responsible for marketing in Spain. LogIT systems are also working with other D2D partners to establish additional formal sales channels. Wallenius Wilhelmsen has already used a number of results from WP3 for the development of a new logistics service for John Deere.

7 Future solutions with "smart" intermodal transport technologies (WP4)

7.1 Work package objective

The objective of WP4 was to investigate and demonstrate how "smart" intermodal transport technologies and equipment should be utilised in order to improve the efficiency and quality of the multimodal door-to-door transport solution (on top of results achieved by WP2 and WP3).

The word "smart" does not refer to technology alone. It refers to the combination of existing or developed technologies in new innovative ways in order to cope with real-life problems. Technologies can be encapsulated into easy-to-use services in a smart way in order to make real-life use possible. It's all about the smart USE of technology.

The following drivers were identified for the work to be done in WP4:
- WP1: Analysis of chains and resulting bottlenecks.
- WP2/3: Identification of area's within FTMS/TCMS that would benefit from extended specifications.
- Autonomously driven by expert area's of involved partners.

This resulted in the following needs:
- Need for advance planning support.
- Need for dynamic transport chains (managing deviations, automation).
- Need for increased visibility.
- Need for short transshipment times.

We have modularized the work in WP4 in a number of area's that can be linked with the sections mentioned in the Technical Annex:

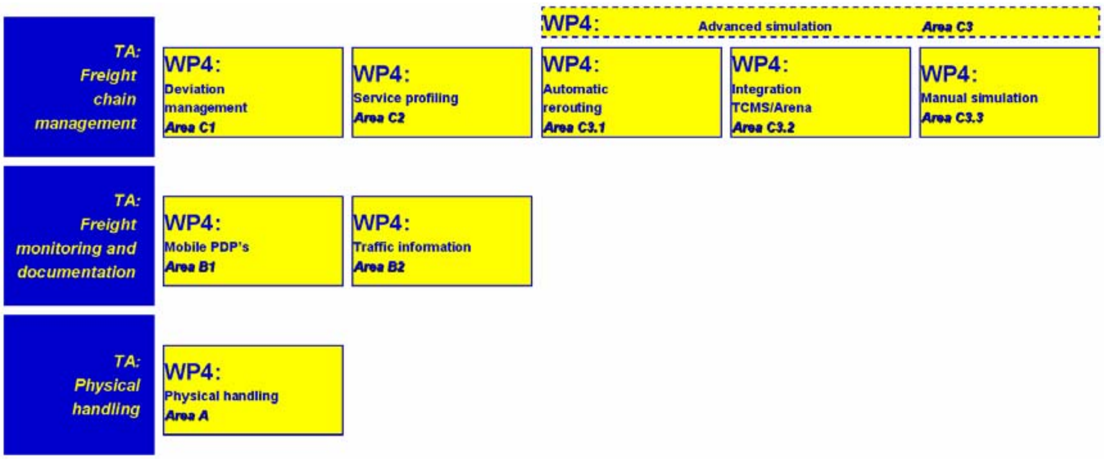


Figure 10 Box diagram of WP4 sections

WP4 area's of work are closely related to WP2 and WP3, as is shown in the following figure:

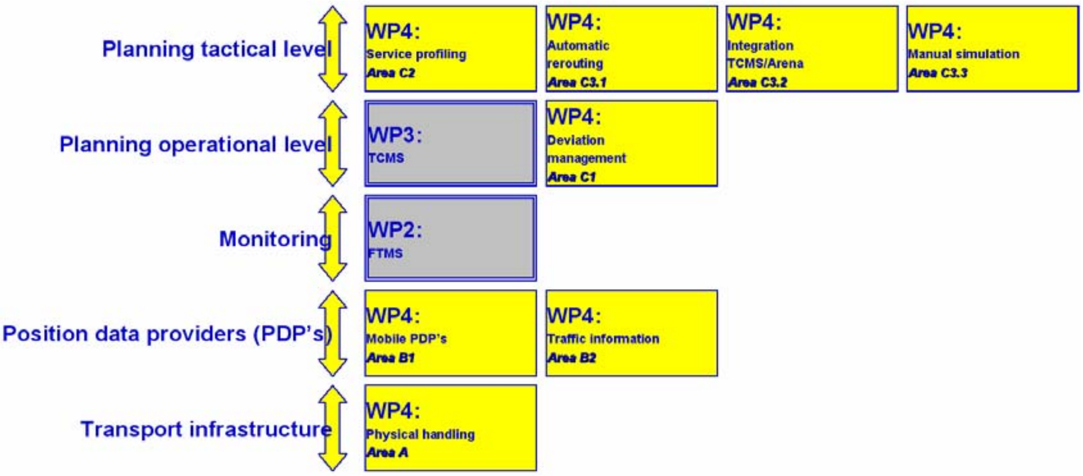


Figure 11 Box diagram of WP4 links to other work-packages

7.2 Area A: Physical handling

Work in this area is related to the further development of the IPSI terminal concept. The results are as follows:

(i) Development of cargo handling equipment:

- Cassette
- Trailer trestle

(ii) Checked the applicability in physical transport chains:

- Elkem
- Unifac
- Pamesa

(iii) Developed business cases for the application of the developed technology:

Elkem - Norwegian coastline:
- 6 ports/week
- RFR € 658 (required freight rate)

- Margin (to market price) 2.2

Unifac - Portugal to the Azores:
- 3 ports/week
- RFR € 652
- Margin 2.15

Pamesa - Spanish coastline to the Canary islands:
- 4 ports/week
- RFR € 781
- Margin 2.05

7.3 Area B: Freight monitoring and documentation

7.3.1 Area B1: Use of advanced mobile devices

Objectives of this work area were as follows:

- Definition and identification of Smart Technologies available
- Analysis of the various chains and proposal of Smart Technologies to implement for a demonstration
- Development and preparation of the systems to be deployed during the demonstrations

The first subtask focussed on the inventory of available smart technologies. Smart technologies within the D2D project are a mix of wireless telecommunication and computing technology to facilitate the information flow. The following groups of technologies were identified:

- Black-box type: No human intervention required.
- Database access type: Allows a person to remotely update a database.
- Some examples:
  - ⇒ Tags: RF-ID or passive tags can be used as identification
  - ⇒ Satellite tracking: GEO satellite (Inmarsat C, D+, Vistar, Spacechecker) or LEO satellite (Orbcomm) provide tarcking and monitoring services
  - ⇒ Smart phones: connected PDAs or smart phones to fill in a form and upload it
  - ⇒ Tablet PCs: several ruggedized tablet PCs with GPRS available for access to a database

Two chains were selected for implementation of smart monitoring technologies, the Elkem and the John Deere chains. After analysis, the proposed technologies in the Elkem chain were as follows:

Chain node	Messages	Smart Technology	NRE costs (WP4)	Operating costs (WP5)	Note
Harbor in Norway	7	PDA with GPRS	Around 2500€ + software development + operator training	Less than 100€/month	Probably not worth it
Short Sea Transport	41, 13	Inmarsat C, DNID download	None	Less than 100€/month	Easy to implement
Rotterdam harbor	18	N/A	N/A	N/A	Not critical for transport
Barge transport	42, 38, 45	SpaceChecker	Around 1000€	Less than 50€/month	
Rhein am Weil	27, 35, 44	Symbol or HHP device	Around 2500€ + software development(*) + operator training	Less than 100€/month	Used for several documents, software development needs to be assessed
Road transport	34	MiniC+Wescor	Around 2000€ + software adaptation (around 5 days) + Installation + driver training	Less than 100€/month	Easy to implement, can be used to offer other services (Tracking & Tracing + communication)

Table 6 Proposed smart technologies for the Elkem chain

Implementation was done end of summer 2004:

- No hardware to install on board the ship, thanks to the Inmarsat DNID upload possibility.
- Inmarsat account set-up via France Telecom Satellite Services for the M/V Emma that sails from Salten to Weil am Rhein. The ship reports its position and heading every 6 hours.
- Account set-up the Novacom platform including a surveillance that generates messages as soon as the ship leaves or arrives in Rotterdam.

After analysis, the proposed technologies in the John Deere chain were as follows:

Chain node	Smart Technology	Comment	Note
Mannheim plant handling	RFID Tag PDA with GPRS Gotive Symbol or HHP device	RFID Tags are difficult to implement for a demonstration. Other technologies are unpractical for a demo	No demo planned
Shuttle service Manheim (from JD plant to barge terminal)	Symbol or HHP device Gotive	Bar code scanning could be performed to transmit loaded/unloaded status	Easy to implement ; Gotive to be used
Terminal handling Mannheim	Symbol or HHP device Gotive	The barcode of the tractor is scanned to have a notification for the tractor arrival at the terminal and once it is loaded on the barge	Easy to implement ; Gotive to be used
Barge transport (Mannheim to Antwerpen)	SpaceChecker Globalwave	Tracking information can be useful to get status information as well as updated ETAs	Easy to implement ; many tracking black boxes available
Terminal handling Antwerpen	Symbol or HHP device Gotive	Unloaded status information could be made available	No demo planned
Road transport to Zeebrugge	MiniC+Wescor Tablet PC with GPS/GPRS	Status information at this level is not so critical	No demo planned
Transport to Australia	Various satellite technologies	Position information and ETA can be provided	No demo planned because of the difficulty to organize this.

Table 7 Proposed technologies for the John Deere chain

Implementation resulted in the following activities:

(i) Terminal handling in Mannheim: Application of the Gotive H41 device:

A small software component was developed that allows to:

- Scan the barcode on the tractor
- Choose the status info between “Loaded”, “Unloaded” and “Problem”
- Send this information via SMS

Typical output received by Novacom:

Asset	Action	ID
GOTIVE	LOADED 17/02/2005 09:30:26	01453915457022 17/02/2005 09:30:26
Asset	Action	ID

This can be sent out in XML to the D2D System (FMTS/TCMS).

(ii) Barge transport from Mannheim to Antwerpen: Application of the Globalwave device:

A Globalwave device was installed on the barge that reports it position and speed every hour.

Typical output received by Novacom:

Asset	LOCATION ° ' "	POWER SUPPLY V	SPEED km/h
MT2000	43°32'57"N 1°29'11"E 16/02/2005 12:21:12	7,125 16/02/2005 12:21:12	0 16/02/2005 12:21:12
Asset	LOCATION ° ' "	POWER SUPPLY V	SPEED km/h

This can be sent out in XML to the D2D System (FMTS/TCMS). Messages can be generated upon arrival/departure to/from Mannheim and Antwerpen

Conclusions drawn are the following:

- Smart technologies are more and more available: Many products and ways to transmit information.
- With availability, prices will come down to make the ROI faster.
- Impact on transport chains in difficult to measure, however organizations using this type of products are more efficient.
- Overall, smart technologies was not part of the core of the D2D project; however it was an add-on depending heavily on the willingness of the partners and chain actors to deploy new technologies: more could have been done, should time have permitted.
- Novacom/CLS will develop standardized message exchange mechanisms for other EEC projects that can be reused to exchange data with the D2D system: Another step towards more deployments.

7.3.2 Area B2: Use of traffic information

We analysed two types of public traffic information systems on their usability for logistics purposes. One was SafeSeaNet, and the following restrictions were identified:

- Only data exchange between SSN and Member States.
- Information available for next port of call, not for the voyage in its totality.

Analysis of RIS gave the following restrictions:

- Only data exchange between ships (or their representatives) and authorities.
- Voyage information (incl. timing) relevant for transport management is only provided to authorities.
- Arrival notification and position report is not yet dealt with in detail.
- Support for transport management: Competent authority should design their information systems such that data flow between public and private actors is possible.

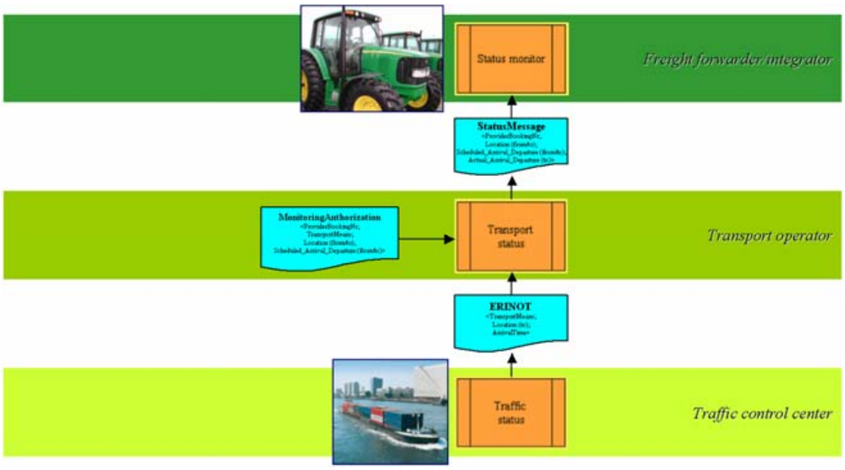
Concerning the legislative context, we looked at two aspects that might hinder the distribution of such traffic information

- *Privacy of information:* This seems to be less a problem since no personal information is involved, on the basis of which natural legal entities can be identified.

- *Sensitivity of commercial information:* Confidentiality of data exchange in a RIS needs to be ensured. In cases where logistics information is provided by systems operated by a competent authority, this authority should take the necessary steps to ensure the protection of confidentiality of commercial information. When confidential data are provided to third parties, privacy regulations have to be taken into account.

Based on this we executed an artificial demonstration (since the public traffic systems are not providing logistics information to private entities at this moment, see above) that shows how an authorization concept can guarantee that information is only being distributed to parties that are entitles to receive that information.

Figure 12 Flow of traffic information using authorization control



7.4 Area C: Freight chain management

7.4.1 Area C1: Deviation management

A deviation management methodology has been developed and a specification for supporting TCMS enhancements has been written and partially implemented. A summary of that methodology is sketched below:

<u>Step 1</u>. The transport chain is in execution or in booking process.

- Customer booking has been received
- Transport chain is scheduled
- (Some or) all providers services for that transport chain are booked
- These provider bookings have been confirmed (or rejected)

Step 2. Once the transport chain has started: Collect basic state information about delays of transport means and damages to cargo units or transport means.

Step 3. Calculate derived state information. From such basic state information we have to calculate derived state information about customer bookings, transport chains, and provider services.

Step 4. Visualize state information to support detection, location, and assessment. TCMS should visualize the status in such a way that the chain manager can have a cockpit view on all customer bookings (and transport chains) he is dealing with. This enables him to:

- Detect an warning/alarm state of a customer booking (or transport chain).
- Locate the warning/alarm state in order to find the affected transport service, transport means or cargo unit.
- Assess the deviation.

Step 5. Isolate cargo/load unit(s) or transport means for which you want to reorganize the transport chain, since not all cargo units and/or transport means need to be affected:

- Isolate cargo/load units to reorganize.
- Define the point from which the reorganization has to take place.

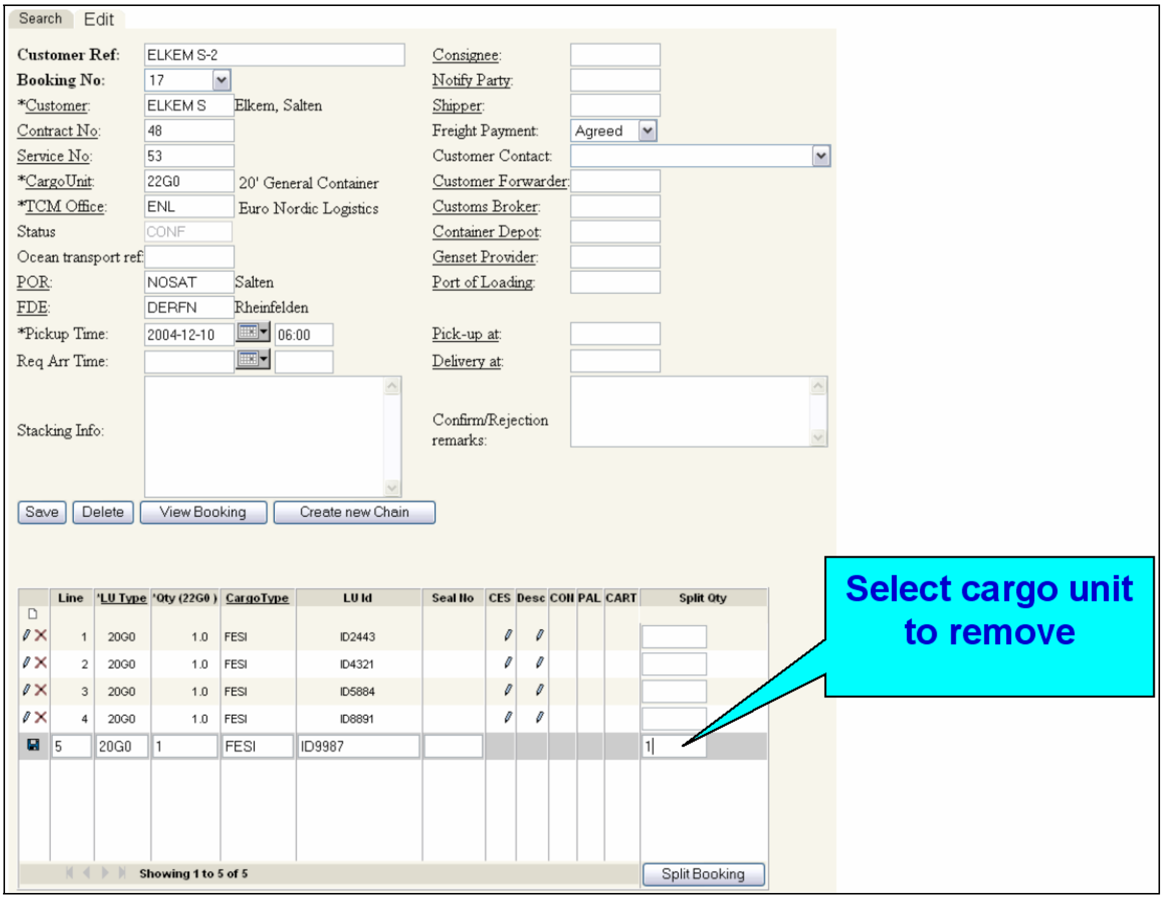


Figure 13 TCMS screen shot of split booking

Step 6. Reorganize the transport chain. Based on the specific deviation taking place the chain manager will reorganize the transport chain.

Step 7. Maintain audit trail between versions of chains: After reorganization the TCMS has to maintain a link between the old and the revised transport chain in order to provide for an audit trail.

Step 8. Update provider booking process: As a final step in the reorganization, the chain manager has to take care that all provider services not needed anymore are cancelled, and that additional provider services will be booked.

7.4.2 Area C2: Service profiling

A service profiling program SPPG has been developed with the following functionalities:

- Statistical evaluation of the quality and reliability of transport services by comparing planning and operational data.
- Bridging the gap between the D2D System and the simulation tool.

The use of the tool involves the following steps:

- Definition of evaluation profiles.
- Input from flat files or database access describing historic information as captured in TCMS.
- Generation of statistical values like mean, variance and deviation.
- Export statistical values to flat file or database towards TCMS.

The status of the development is as follows: SPPG has been developed in Delphi, it is working properly, and tests have been performed. A demonstration has taken place based on a limited set of historical information received from WWL (regarding the execution of provider services in the John Deere chain). The WWL demo only allowed limited evaluations since:

- Both planning and operational data are required
- No planning data were available except schedules (and not detailed enough)

7.4.3 Area C3.1: Automatic rerouting

Work in this area focussed on establishing a specification (and partially implementing) transport chain management functionality on the following subjects:

- Hierarchical structuring of transport chain types
- Grouping, branching and alternative provider services
- Reorganisation of transport chains: This involved the automatic reorganisation of transport chains based:
  - ⇒ Assessment of the status of transport service instances;
  - ⇒ Applying reorganisation rules;
  - ⇒ Defining when a reorganisation will take place;
  - ⇒ Defining which reorganisation method will be used;
  - ⇒ Applying reorganisation in actual transport chains.

As a result we established a dynamic rerouting philosophy which makes transport chains robust and flexible. In an actual transport chain such rerouting is then based on:

- Understanding its present position (either active transport leg or passage point);
- Understanding its status and the applicable deviation type;
- Deciding on what to do;
- Interrupting a transport chain at its present position;
- Constructing a new transport chain which is an extension of the already executed part of the present transport chain.

7.4.4 Area C3.2: Integration TCMS/Arena

An important work area concerns the assessment of the expected performance of transport chain templates. One way of doing it is by manually setting up a simulation model (see next paragraph). Another method is to electronically transfer the transport chain data towards a simulation environment. As a result the chain manager can simulate the transport chain behaviour without extensive expertise required to build up his own simulation model. After selection of the Arena simulation tool, we developed an interface between TCMS and Arena based on the following approach:

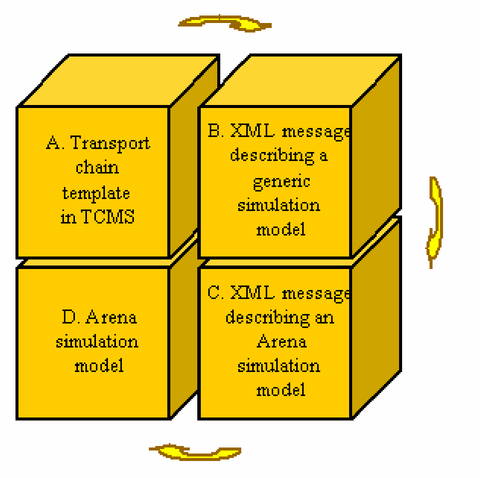


Figure 14 Using Arena for automatic simulation

The implementation of this transfer of transport chain data between TCMS and Arena is based on a series of representations that are being used to describe a (simulation model based on a) transport chain template:

- Representing a transport chain template and service profile information in TCMS
- Representing a generic simulation model in TCMS
- Representing a generic simulation model as an XML Schema
- Representing an Arena specific simulation model as an XML Schema
- Representing a simulation model manually in Arena

Transformations between these representations are the following:

- Transforming a transport chain template into a generic simulation model in TCMS
- Transforming a generic simulation model in TCMS into a generic XML file
- Transforming a generic XML file into an Arena specific XML file
- Transforming an Arena specific XML file into an MS Access database
- Transforming an MS Access database into an Arena simulation model

We demonstrated the interface, and the use of simulation itself has been demonstrated by the manual simulation (see next paragraph).

7.4.5 Area C3.3: Manual simulation

This work area created a simulation model in Arena for the John Deere chain. In visual mode, the model is described in the following figure:

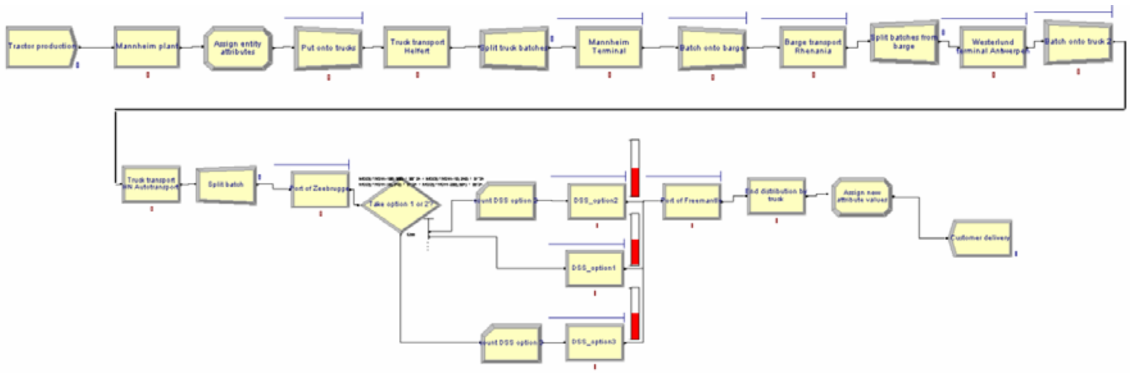


Figure 15 Manual simulation in the JD chain

With such a simulation model we wanted to get insight into the impact of variations in provider service performance on the performance of the overall chain. Demonstration was based on the John Deere chain. The demonstration was not aimed at delivering reliable performance estimates, because the John Deere chain (as well as others) showed a lack of historic information being available to determine the average performance of the different provider services used and the variations therein.

7.5 Comparison of initially planned activities and work actually accomplished

The following figure shows the different work area’s in WP4. All of the important topics were covered. For some work area’s further implementation steps are required:

Figure 16 WP4 work areas

7.6 Exploitation

The following table summarizes the different work area’s in WP4, and what the involved partners have indicated as being their exploitation approach.

Physical handling *Area A*	TTS: IPSI system is currently being marketed and sold both as a package with the complete system for cargo handling with a RORO solution. As an alternative is the system also being marketed as a handling system for containers in large container terminals. Some of the components are also sold separately to be used in conventional RORO-ships.
Mobile PDP's *Area B1*	CLS: On a midterm perspective, CLS/NS could get some leads out of D2D. Developments done in the project and after will lead to new solutions that CLS/NS will promote, especially all solutions providing standardized connectivity through XML exchange between heterogeneous IT systems
Traffic information *Area B2*	Sequoyah: Concept development and XML message definition. To be used in future projects and assignments on integration of transport and traffic information.
Deviation management *Area C1*	LogIT Systems: Further enhancement of the TCMS based on the specifications drafted by Sequoyah increase the commercial opportunities of the TCMS product.
Service profiling *Area C2*	ISL: Established SW methods to assess the performance of transport services. To be used in future performance profiling projects and assignments. Potentially as add-on to TCMS.
Advanced simulation *Area C3*	Sequoyah: Concept development and specification. XML message definition for TCMS side. To be used in future simulation projects and assignments. Exploitation as simulation add-on module to TCMS.
Automatic rerouting *Area C3.1*	LogIT Systems: Further enhancement of the TCMS based on the specifications drafted by Sequoyah increase the commercial opportunities of the TCMS product.
Integration TCMS/Arena *Area C3.2*	Marintek: Established SW methods to transfer information into Arena through a programming interface. XML message definition for Arena side. To be used in future simulation projects and assignments.
Manual simulation *Area C3.3*	BMT-TS: The transport chain simulation expertise is marketed as one aspect of a broader consulting offer that includes the analysis of exsiting work and information flows as well as the specification and implementation support of transport chain managment systems.

Figure 17 Indicative exploitation of WP4

The D2D demonstrators expressed that the functionality of WP4 components is very relevant for their chain management activities, and deployment is being considered on an individual basis.

7.7 Conclusion

We conclude that WP4 has been a successful work package, despite the complex situation of many partners contributing bits and pieces. Realistic demonstration of WP4 results may require additional implementation efforts as well as availability of historic information on transport service performance.

8 Demonstrations (WP5)

WP5 has been responsible for demonstrating the D2D system in five intermodal transport chains. Further, WP5 has demonstrated the use of "smart" technology elements in selected chains.

The John Deere chain consists of transport of John Deere farming equipment from Mannheim, Germany to final destinations in inland Australia. This demonstrator combines transport on inland waterways, road, and ocean for exporting high value cargo from Europe.

WP5 is divided according to the work tasks specified in the Technical Annex:

- Task 5.1: Plan and budget for demonstrator installations
- Task 5.2: Organising pilot company participation
- Task 5.3: Interfacing and implementation
- Task 5.4: Demonstration

The WP5 Core Team was responsible for planning, co-ordination and follow-up of the five demonstrators. The core team included also, as far as possible, recommendations from other work packages regarding business processes, system functionality and smart technologies.

Name	Company	Role
Bengt Ramberg	WWL	Project Manager (WP5)
Jan Tore Pedersen	LogIT Systems	TCMS (WP3)
Rune Høiseth	LogIT Systems	TCMS (WP3)
Manos Shinakis	Tredit	FTMS/Communication platform (WP2)
Frank Knoors	Sequoyah	Smart technology/business requirements (WP1/WP4)
Kay Fjørtoft	MARINTEK	Technical co-ordination (WP3)

Table 8 The WP5 Core Team

The deliverables of the different tasks are listed in the table below:

Task	Deliverable
T5.1 Plan and budget for demonstrator installations	D5.1 Plan and budget for demonstrator installation
T5.2 Organising pilot company participation	D5.2 Report on demonstrator organisation
T5.3 Interfacing and implementation in each chain	D5.3 Report describing the installation for each chain (detailed plan) D5.4 The actual TCMS and FTMS installation and integration into the various chains
T5.4 Demonstration	D5.4 Demonstration report – Describing the activities performed and the results achieved

Table 9 Overview of WP5 tasks and deliverables

8.1 Plan and budget for demonstrator installations (Task 5.1)

The first task in WP5 was to prepare a generic plan (D5.1) for how to succeed with implementation and demonstration of the D2D system in the transport chains and provide an overview of the type and amount of resources required. The ambition level was decided based on resource-, cost- and time constraints within the project.

The generic plan was the basis for more detailed plans developed in D5.2 and D5.3. The content of the plan was subject to updates as the WP5 activities started and deviations occurred during the project.

Originally our goal was to demonstrate the TCMS and the FTMS in as many demonstrators as possible, but a number of requirements and constraints made it clear that we would probably not manage to demonstrate both systems in more than 2 or 3 of the demonstrators.

In WP1, existing business processes for each of the chains were mapped and analysed in terms of need for D2D systems functionality. Together with input from a couple of planning workshops in WP5, WP1 requirements formed the basis for the demonstrator scope, including the need for smart technologies.

Finally the practical scope for demonstration was influenced both by the technical achievements in WP2, 3 and 4 and by the interest of the various actors in the chain to get more or less involved.

8.2 Organising pilot company participation (Task 5.2)

Task 5.2 aimed at prepare participating companies for the demonstrations and the result. The objective was to secure that all participants had a clear understanding of their role and which tasks to perform at which time. Task 5.2 was based on the plan and budget for demonstrator installations as described in D5.1. Of particular importance is the ambition level for each of the demonstrations. The report on demonstrator organisation was based on a number of workshops held with key members in the project team as well as meetings with key operational people involved in the day-to-day operations of the five transport chains. The task continuously evolved throughout the project period, as WP5 activities were carried out.

Each of the demonstrators had specific requirements related to systems, business processes and operational issues and a transport chain manager was appointed for each of the demonstrators. The demonstrator teams, including the transport chain manager, communicated closely with the Core Team in order to make all actors in the chains understand their roles and responsibilities.

The conclusion of this work was that it was only possible to organise the demonstrations as so called shadow demonstrations. Because the systems were new and not thoroughly tested the various chain managers decided that it was necessary to run the existing manual processes for managing the transport chains in parallel with the testing of the D2D Solution. Generally it was agreed to use the D2D Solution with real transport data and simulate the transport. Therefore we were later positively surprised by the chance to actually use the system operationally in the Portuguese chain, although all existing systems for management of the chain were still in place in order to secure that everything worked correctly. All actors in the Portuguese chain were involved and did their part in the management of this transport.

In the John Deere and the Volkswagen chain both transport operators were heavily involved in the demonstrations, with support from the other members of the core team. In the John Deere chain, the present chain manager, the logistics team and the ocean services division of Wallenius Wilhelmsen were involved in the preparation for the simulation. Both representative of WWL and ATG got some training, but more widespread training was only required in the Portuguese chain, because of all the different actors involved. During execution of the John Deere demonstration only logistics and IT were involved.

8.3 Interfacing and implementation in each chain (Task 5.3)

In task 5.3, the practical installations and interfacing of the D2D software and equipment along all the transport chains were carried out. Task 5.3 was based on the plan and budget for demonstrator installations as described in D5.1. The first deliverable of task 5.3 was a report describing the installations to be made (D5.3). The report was a detailed, technical plan describing functionality to be demonstrated and the required systems integration. The second deliverable of task 5.3 was the actual implementation and testing of TCMS and FTMS in the five demonstrator chains. This was the installations and integrations themselves and not a report.

The systems were actually installed in the offices of the three software providers. The FTMS and the Communication Platform were installed in Athens, while the TCMS was installed in Grimstad in Norway. All systems communicated with each other and other systems in the John Deere and the Volkswagen chains over the Internet using XML and EDIFACT messages. In the Spanish, Portuguese and the Elkem chains there were no use of system integration. All actors, including the chain manager were using web forms available through the Internet to communicate with the system.

8.4 Demonstration

In task 5.4, the actual demonstrations were carried out. The final deliverable was D5.5 Demonstration report – describing the activities performed and the results achieved.

The demonstrations were realised through a number of challenging tasks and requirements; practical installations, interfacing and linking relevant internal systems of each of the participating organisations, implementation of the D2D software and provision of specialised equipment along the transport chain. Further, in the D2D project the ability to organise team work and handle cultural differences in a competency development environment shoved to be very essential.

For each demonstrator, a detailed transport scenario was developed, describing the events taking place. The D2D system was implemented as an Internet application in the five demonstrators. The technical and functional focus was different in each of the demonstrations according to available resources and industrial commitments.

The most extensive demonstrations were performed in the John Deere and Volkswagen chains, while the most real life demonstration with the use of web interface took place in the Portuguese chain.

Demonstrator	Systems and technologies involved
John Deere	FTMS, TCMS, Communication platform, Automatic and manual simulation with Arena, Service profiling, Satellite tracking of barge
VW	TCMS, FTMS, Communication platform
NUTASA	TCMS, all actors involved, operationally testing
PAMESA	TCMS, limited shadow demonstration
ENL (Elkem)	TCMS, FTMS, Satellite Tracking of vessel using Inmarsat C
WP4: TTS	Business Plans for all Demonstrators, physical handling equipments, loading cassettes for automatic handling

Table 10 Systems and technologies involved in the demonstrators

In all of these demonstrations, real service providers and systems were involved, although it was only in the Portuguese demonstration that a real shipment was managed with help from the systems. Communication between chain actors took place both automatically by means of electronic messaging between systems and manually based on input via web interface in the John Deere and the Volkswagen chains, while only web interfaces were used in the other three chains.

A TCMS installation that can be accessed by the European Commission and their evaluators through the Internet has been provided and the web address for this TCMS version is:
http://demo.logit-systems.com/D2DTCMSDEMO

User Name: d2ddemouser
Password: d2ddemo

8.4.1 Demonstration in the John Deere chain

The results of WP1 analysis revealed a number of weaknesses of this transport chain. Most of them were related to the fact that the same information had to be typed in manually in many systems and there was poor visibility of the chain.

Important facts of the as-is situation:

- 58 documents are used within the whole chain
- About 192 different activities are performed by 16 different actors
- 13 different and in some cases out-dated information systems are in use
- Six main actors are involved in the JD chain.

The main weaknesses were:

- The information and communication flow is not streamlined
- Limited use of EDI, but in development/test phase
- No central database/register containing relevant information
- No (real time) track and trace, poor visibility/transparency throughout the chain
- Limited updates of ETA and communication to suppliers
- No overall Transport Chain Manager

For the John Deere chain, the planning and scheduling of the transport chain is very important. The planning of the pre-during-post operations of the different transport legs also includes the booking process of service providers and fleets which are used in the transport chain.

Customer service is another main goal within the re-engineering of the business model. Therefore administration and management of order data, such as customer preferences, history, status and delivery requirements, as well as warehouse data, transportation data and delivery data has to be made available. Furthermore, tracking and tracing and post delivery service should be included in this work area.

For the John Deere Demonstrator, target audience for the regular demonstrations was the employees at WWL responsible for planning and managing the John Deere transport, technical staff, and representatives from the Commission and WWL managers evaluating the use of IT systems such as the D2D solution.

Several demonstrations were carried out, with exchange of electronic messages and deviation handling. The final demonstration used two video projectors in order to show; TCMS and SAGA (WWL ocean system) user interface and the flow of messages and the monitoring of the transport chain. The demonstration showed that TCMS can be used to perform a provider booking with Saga by using the messages IFTMBP and IFTMBC. TCMS can receive updated sailing schedules from Saga as IFTSAI messages. FTMS can receive status information from Saga as IFTSTA messages describing the loading and unloading of vessels.

Not all parts of the demonstration were to the full satisfaction of the WP5 team. There were a number of problems related to the ttrequest message that was sent from the

TCMS to the FTMS. Eventually it looked like it worked, but a proper testing of various notification messages from FTMS was not carried out.

The following figure is a representation of the sequence of the exchange of messages between the different parties in the John Deere chain:

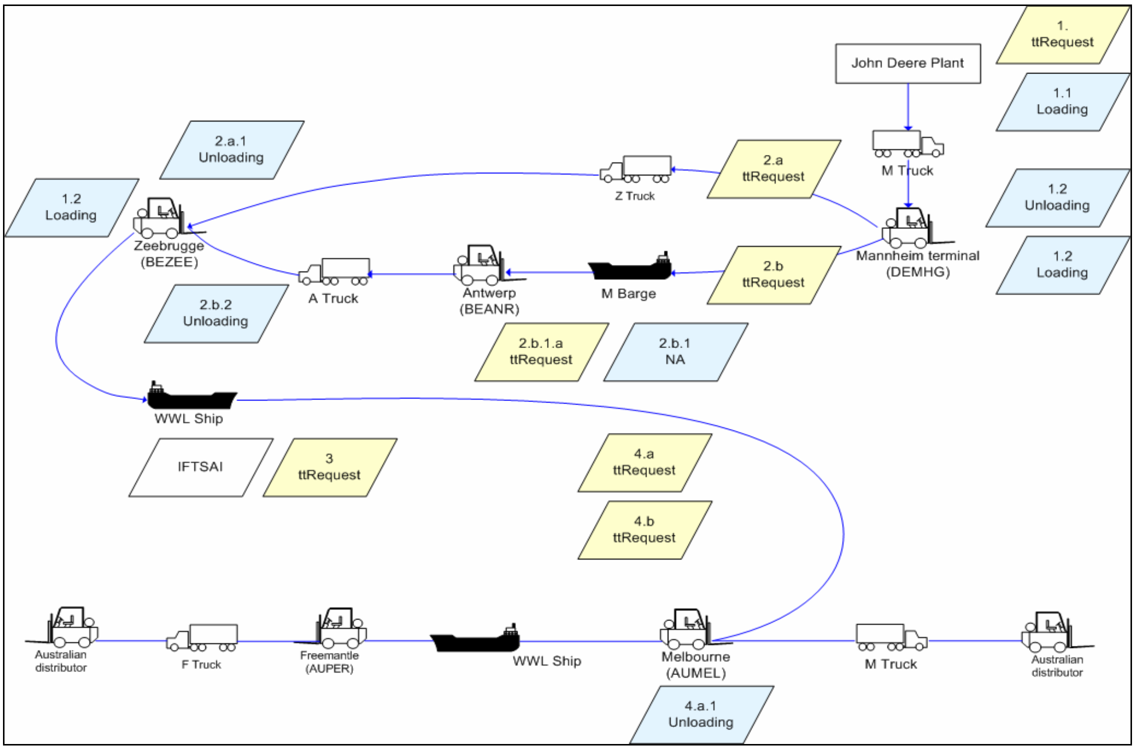


Figure 18 Sequence of electronic messages in the JD demonstrator

The demonstration of the D2D Solution with the new re-engineered set-up indicated the following business benefits:

- One central co-ordination point provides better control
- More streamlined workflow (less redundancy)
- Positive impact on costs
- Positive impact on lead time
- Positive impact on reliability
- Positive impact on delivery precision
- Positive impact on transparency
- Positive impact on flexibility
- Positive impact on quality management

Further, the testing of the Service Profiling and the Automatic Simulation tool indicated a possibility for a simple and less time consuming way of improving forecasting and thereby achieve better planning and scheduling.

8.4.2 Demonstration in the Volkswagen chain

The Volkswagen transport chain also revealed many of the same problems as in the John Deere chain. There are 12 actors in the chain and they are also typing in much of the same information into different systems.

The main weaknesses were:
- Bottlenecks in the physical and information flow
- Many activities and actors involved
- Several types of information being entered multiple times by various actors

A strong integration need was recognised between planning and control of operations on the one hand and financial/accounting systems on the other hand. It was important to create facilities for planning and simulation.

The demonstrator for the VW chain was also very extensive. However, this demonstrator differed somewhat from the John Deere demonstrator in terms of putting a stronger focus on requirements related to "box-in-box" functionality.

The main objective was to show (i) the integration of the D2D solution and the Atlas and Diva systems operated by Volkswagen and ATG, and (ii) the capabilities of the D2D system to plan, monitor, and control transport chains.

The demonstration used a transport chain where the Harms system provided information about the customer booking (Transport Order) and about cars that arrived on the car terminal of the Port of Koper (Vehicle Check-In), and the ATG Diva system provided information about the progress of the rail transport between the VW plant in Wolfsburg and the Port of Koper (Rail Monitoring Message).

The demonstration of the D2D Solution with the new re-engineered set-up indicated the same business benefits as for the John Deere chain:
- One central co-ordination point provides better control
- More streamlined workflow (less redundancy)
- Positive impact on costs
- Positive impact on lead time
- Positive impact on reliability
- Positive impact on delivery precision
- Positive impact on transparency
- Positive impact on flexibility
- Positive impact on quality management

8.4.3 Nutasa, Elkem and Pamesa demonstrations

A live demonstrator was carried out for the Nutasa (Portugal) chain. The D2D system was applied in the chain during a limited time for a more efficient planning and execution of the transport chain. No electronic messages were implemented, but all actors used the system through the Internet (web interface).

For the Elkem chain a limited demonstration with TCMS and FTMS was carried out with transport data from Euro Nordic Logistics. ENL was not involved in the last demonstration. The use of satellite tracking with the help of CLS was facilitated through connection to the landbased Inmarsat C position database. The position and sailing track of the vessel Emma could be seen graphically when logging on to the Novacom D2D visibility tool.

In the Pamesa chain a limited demonstration of TCMS was carried out with real transport data. No system integration was implemented, only web screens were used to update the system and show results.

8.5 Comparison of initially planned activities and work actually accomplished

Following the demonstrations all participants share the same opinion that the D2D project has been very successful in terms of demonstrating the true values of the D2D system. This included improved planning, execution and follow-up of transport chains, links to internal systems in the participating organisations and the initiation of several new projects and business ideas. There are also ambitious plans for the commercialisation of the software solutions. Further, the demonstration of smart technology in some of the chains uncovered several opportunities for enhancement of the core D2D functionality.

The various demonstrations focused on different aspects, reflecting budgets and industrial commitment. Detailed transport scenarios were developed for each of the demonstrations, describing the activities and events taking place. Although we had wished for several more substantial and real life implementations of the D2D Solution we don't see that this was required according to the Description of Work (Technical Annex).

The D2D Solution was implemented as an Internet application and applied in the five demonstrators in different ways, providing extensive results for evaluation. The different demonstrators included all aspects from setting up the transport chain templates, executing the transport, monitoring the transport, obtaining real time transport status including ETA and handling of deviations.

Although tracking technologies were tested in two chains, we think it was unfortunate that we were not able to integrate this technology with our D2D Solution in a way that would have been more appropriate. The best method for this integration should have been through the FTMS, rather than through the Novacom front end solution. One of the reasons for this was that we were unable to use the tracking devices in the Elkem chain and the Volkswagen chain the way we had planned, but it was also difficult for TRD and LogIT Systems to agree on the exact method for how this should happen and how such information should be communicated between the systems.

8.6 Conclusion

We could see indications of very similar improvements by implementation of the D2D system in the two most comprehensive demonstrations, John Deere and Volkswagen. The improvements achieved in the three small demonstrations were somewhat more difficult to assess, but provided all parties were expedient users of the web based system, we should see many of the same benefits.

The economical and organisational environments as well as the history of the transport chains influenced the willingness and the usefulness of process re-engineering. The higher level of integration in the chain, and the less complex the transport chain, the less motivation for changing processes and/or implement the D2D system.

The cost of this type of technology will come down and make it easier for the industry to make the required investments. In the long run we believe the return on investment is positive for even relatively small investments in this area, but the problem is that all parties in a chain have to agree to provide their share of the information, at least indirectly. Some employees, who are heavy users of proprietary software solutions, may think that such systems and technology is a threat to their job security. Others may resist implementation of open systems as they feel a need to defend their own proprietary systems and own position.

Through the demonstrations, the following technological capabilities and functionalities of the D2D system have been shown:

- Easy to create new transport chains and modify existing ones
- Improved planning due to easy access to schedules and automation of tasks
- Improved execution and follow-up of transport chains
- More efficient order management towards customer and suppliers due to system integration (no need to re-write orders into proprietary systems)
- Full status visibility and ETA (Estimated Time of Arrival) advice of cargo
- Improved statistics for supplier monitoring and follow-up
- Dynamic planning capacity (exceptions management) based on predefined rules and alerts
- In-transit visibility
- Invoicing and claims support

Through application of such functionality and systems, the demonstrations have indicated the following business benefits:

- One central co-ordination point provides better control
- More streamlined workflow (less redundancy)
- Positive impact on costs
- Positive impact on lead time
- Positive impact on reliability
- Positive impact on delivery precision
- Positive impact on transparency
- Positive impact on flexibility
- Positive impact on quality management

As regards application of smart technologies in order to further enhance the core functionalities and benefits of the D2D system, the following should be considered:

- Many smart technologies are available that can be used to enhance visibility and control of transport chains
- The main two obstacles may be the lack of knowledge about how to integrate such technologies into operational software solutions and the requirement for a certain size for an implementation to be cost-effective
- Prices may come down and make “critical size” of an implementation smaller
- Impact on transport chains is difficult to measure, however organisations using this type of products seems to be more efficient
- Simple and cheap SMS/GPS solutions are available, but are not widely used as they are perceived inefficient and difficult to use

9 Evaluation, dissemination, exploitation, and standard-ization (WP6)

9.1 Evaluation (Task 6.1)

The D2D system basically fulfils the need for a system to manage information flows that intermodal transport chain leaders are faced with. Organising an intermodal transport chain results in frequent communication between all parties that are active in the chain, mostly between the chain leader and other parties. In order to plan and monitor the intermodal chain and these information flows efficiently, the transport chain leader needs an integrated information system.

9.1.1 Results of the demontrators

The demonstrator chains have all seen demonstrations of the D2D system, in the form of shadow demonstrations using real data. The Portuguese demonstrator was even performed as a shadow operation in real time, with the actual chain actors involved.

Based on the demonstrations, the D2D system may indeed be expected to cater for the needs of the demonstrator companies. Strong features are:

- Using the D2D system facilitates planning and managing intermodal transport chains, so that also smaller freight forwarders can structure their work and become involved in intermodal transport.
- Better planning and control: data only needs to be entered once and after that is available for planning or simulations of chains, which greatly enhances transparency.
- The system is very accurate in making provider bookings, or changes to these bookings. Long numbers such as VIN numbers or booking codes only need to be entered once, reducing the chance on errors to a minimum and saving on time needed for entering the information into several systems.

- The visibility throughout the chain improves significantly, greatly enhancing the options for keeping the customer informed, thus resulting in higher customer services.

9.1.2 Business and economic evaluation

The main reason to invest in the D2D system is formed by the expected strategic impacts:

1. Opportunities for creating higher chain efficiencies by enhancing transparency
2. Opportunities for improving customer services and enlargement of the customer base by providing accurate information services and transport services.

Other benefits are in the operational and tactical field:

3. Information only needs to be entered once: time saving and reduction of errors (operational)
4. Fleet utilisation rates may go up due to more efficient planning (tactical).

The operational and tactical benefits can be quantified based on estimations, the strategic benefits are much harder to quantify. A cost-benefits analysis taking aboard those impacts that could be quantified shows that the operational impacts alone can only pay back the investment in case a company is large enough, but then again, the operational impacts are not the only benefits to be gained form the D2D system. It also showed that, although the D2D system is an SME-friendly system with its low cost solution character and specific SME price setting, a certain scale is still necessary to be able to profit from the investment. The chain leader accumulates by far the largest part of the benefits, the chain partners can be expected to experience some benefits too. They may be asked for a small contribution in the investment for this reason.

9.1.3 Other project results

Though the demonstrators are the most visible project result, it is not the only result of the D2D project. Other results that have been discussed in this report are:

- Chain modelling: the project has contributed to developing a systematic and detailed way of modelling transport chains, which can be a useful tool for companies to re-engineer their transport business processes.
- Tracking and tracing by RFID: using RFID scanners to track cargo along the transport chain has the advantage of being warned about deviations from planned schedules in an early stage. It does however require a management by exception approach.
- Simulation and service profiling: the value of the D2D system as a simulation tool that can be used to calculate the effects of changes to the transport chain has been considered. Also the possibilities of using it as a service profiling tool to keep track of service provider’s performance as been discussed.
- Standardisation: the role of standardisation is successful D2D implementation has been considered and project participants have brought in D2D standardisation issues

in standardisation initiatives such as CEN working groups and other research initiatives (ARKTRANS and TRIM).

9.1.4 Contribution to EU-policy

Obviously, the main contribution of the D2D system to EU-policy lies in the field of transport policy. It takes away an important barrier to intermodal transport: the complexity of organising the physical and information flows is greatly reduced. Thus, the D2D system can help:

- Preventing congestion by promoting modal shift
- Contributing to sustainable mobility by supporting the use of less polluting modalities
- Improving the quality of transport services by providing an innovative system for intermodal transport chains.

Other policies that the D2D system may be expected to contribute to are:

- Cohesion: the Spanish and Portuguese demonstrators show how the D2D system helps organising intermodal transport chains to peripheral areas of the EU.
- Qualification and working conditions: the D2D system may improve working conditions of transport company personnel by relieving them of some of their most stressful tasks, and may also result in a need for a higher qualified personnel by enhancing quality and accuracy of information flows in the chain.
- Environment: shifting from road transport to intermodal transport will resulting less air pollution, reduction of noise and less energy consumption.

Quality of life and health and safety of the citizens: reducing pollution and noise will have a positive impact on the quality of life and health of the citizens. Quality of life may also be improved by relieving congestion. The modal shift will also have a positive effect on safety.

9.2 Dissemination (Task 6.2)

A draft plan for dissemination during the project was developed during the starting phase of the project and presented as a part of the project handbook. A more detailed and comprehensive dissemination plan is presented in deliverable D6.3(a). Dissemination activities were carried out according to this plan during the project's lifecycle. Completed dissemination activities are reported in deliverable D6.3(b).

The dissemination efforts resulted in the following activities:

1. Project websites: to websites were developed, an internal one that served to exchange documents and information between the project participants, and an external site that informs external parties about the background, objectives, organisation, status and progress of the D2D project (http://www.d2d.no).
2. Newsletters: these have been developed in electronic form and were published through the website. The newsletters are aimed at informing about specific project achievements and progress.

3. Conferences: papers on D2D or specific project topics were submitted and related presentations were made at a number of conferences and other occasions:
    - E-Mar conference, 06/2002, presentation made by Fresti
    - DG Transport & Energy, Barcelona, 11/2002, presentation made by WWL.
    - E-Mar conference, Nice, 06/2003, presentation made by WWL/Fresti.
    - ICCE, Madeira, 07/2003, presentation made by WWL/Fresti.
    - Frame-Net conference, Madrid, 11/2003, presentation made by SINTEF.
    - ITS World congress, Madrid, 11/2003, presentation made by BMT.
    - ITL, Rotterdam, 11/2003, presentation made by MARINTEK.
    - Transportforum, Linköping, 01/2004, presentation made by BMT.
    - REALIZE workshop, Setubal, 03/2004, presentation made by WWL.
    - FARGIS, Oslo, 03/2004, presentation made by WWL.
    - Logistics Exhibition, Barcelona, 05/2004, presentation made by Cetemar/WWL, LogIt.
    - ITS Europe, Budapest, 05/2004.
    - Logistics 2004, Poznan, 05/2004, presentation made by Sequoyah.
    - Maritime IT Forum, Oslo, 09/2004, presentation made by WWL/LogIt.
    - IT Tinget, Tønsberg, Norway, 09/2004, presentation made by LogIt.
    - Transport Users Association, Norway, 10/2004, presentation made by LogIt.
    - ITS World congress, Nagoya, 10/2004, presentation made by BMT.
    - ITL, Copenhagen, 11/2004, , presentation made by WWL/LogIt.
4. Newspapers and magazines: a number of articles were published in newspapers and magazines:
    - Estudios de Construcciòn y Transportes, 92/2001.
    - Routes Online, WWL publication, 11/2002.
    - Moderne Transport, Norway, No.4/2003.
    - Havneavisen, Norway, 11/2003.
    - TFK-Nytt, 01/2004.
    - Scandinavian Shipping Gazette, October, 2004
5. Academic journals: one academic article was published:
    - *Perceived Benefits of Improved Information Exchange-A Case Study on Rail and Multimodal Transport,* Inger Gustavson (BMT) and Johanna Törnquist, in: *Where Theory and Practice Meet: Innovations and Case Studies in Assessing the Economic Impact on ITS and Telematics*, Elsevier Science.
6. Project video: Wallenius Wilhelmsen provide an overview of the D2D system applied in business cases as part of their new company video.
7. Cooperation with other EU projects:
    - Presentation given at REALIZE, Setubal, 03/2004, WWL
    - Presentation given at FARGIS, Oslo, 03/2004, WWL
    - ADVANCES
    - Presentation given THEMIS conference, Brussels, 05/2003
8. Demonstrator days: at the ITL conference in Copenhagen, 11/2004, a full fledge demonstration of D2D functionality and business benefits was given.

9.3 Exploitation (Task 6.3)

The project has generated three different exploitable results, which are all discussed in detail in the E-TIP. The summaries are presented in the sections below.

9.3.1 Transport Chain Management System (TCMS)

The Transport Chain Management System (TCMS) is designed to manage single- or multimodal transport chains. The idea about TCMS is to provide computer support to a company that offers door-to-door transport services to its clients, i.e. a ”One-Stop-Shop”. A transport chain is defined as the combination of provider services that need to interact in order to get the cargo safely from origin to destination as agreed with the Customer.

TCMS handles all types of information related to managing door-to-door transport operations efficiently and to handle all type of documents that are necessary to perform the transport and to evaluate the performance over time. This means that the TCMS database handles any type of document related to the transport that the transport chain manager would like to include. TCMS also handles the challenge of ensuring that all participants along the chain receive relevant information in a timely manner.

The business processes supported by TCMS are:

- Shipment planning. This is the process of receiving and reacting to transport bookings from customers (in some cases also called transport orders). The bookings may be either preliminary or firm. The reactions consist of investigating which transport chain that is most useful for the purpose of the transport in question and booking the required provider services. The result should be fully planned transport operations and confirmation of the booking to the customer.
- Transport Execution means doing everything needed in order to ensure that the transport reaches its destination as agreed with the customer, or transport user. This includes issuing instructions to providers regarding the goods to be handled, receiving and acting on information regarding the fact that goods is ready for loading, and monitoring the progress of transport. If progress is not according to schedule, or if other events occur, the appropriate actions need to be taken. The transport operations are completely transparent, which means that transport users at all times may inquire about the status of the relevant operations. Invoice and payment facilities deal with producing background for generation and checking invoices and payment for customer services and the provider services. As the transport is in progress, the invoices to customers are prepared and issued so that the transport may be paid before the cargo is released to the receiver. After the completion of the transport, all services providers are examined to ensure the correct payment to providers. Transport configuration constitutes defining the background information required for TCMS to operate. Examples are: locations, transport means type, transport means, load unit types, service categories, etc. This is static information that only needs to be entered into TCMS once.
- Establish Customer relationships constitute the process of agreeing the services that the TCMS organisation is to perform for the Customers and related contracts. One possible element in this process is to obtain forecast for the volumes that the

Customer needs to move from given origin to given destinations over a period of time (one month, one season, one year,).

- Transport Network Planning consists of agreeing which provider services should be included in the offering of the TCM operation and related provider contracts. In the basis of the available provider services, the transport network planning process results in the establishment of those transport chain types that may be used in the shipment planning process.
- Handle claims is the process of ensuring that any claim is properly documented, that the claims are being investigated, and the issues connected with the claims are properly resolved.
- Analyse transport performance comprising performing post-calculations to see whether the transport cost was according to budget and performing an analysis of the performance of transport service providers.

9.4 Freight Transport Monitoring System (FTMS)

In order to manage a transport chain properly, it is important that the status of the transport is monitored at all times, and that the status information is made available to those who need it on a real-time basis. The objective of the Freight Transport Monitoring System (FTMS) is to ensure that such real-time information is available in all D2D transport chains.
FTMS provides intermodal tracking and tracing information and ETA based on traffic information, making use of numerous technologies for providing transport status information all over Europe and also facilitating global coverage. It integrates existing systems, new technologies and standards enabling a global network of data collection nodes. The designed technical and organisational solution enables commercial operation and competing service providers. Interfacing to all responsible for operating intermodal door-to-door transport operations will be possible. The FTMS receives information about the movement of the cargo through a position data network utilising a number of different sensors (Automatic Equipment Identification – AEI, positioning sensors for cargo units and/or transport means, etc.). Furthermore, it provides information about the transport status in the appropriate format, for example as an XML message. FTMS functionality can be divided into two main areas from the point of view of the communication of FTMS with various entities:

1. FTMS – TCMS This is the "internal" integration area between the two basic and complementary components of the integrated D2D system. Apart from its own extensive functionality, TCMS generates and transmits the necessary reference information required by the FTMS, in providing useful and valid status information regarding the cargo and corresponding transport mean. This information is included in the transactions undertaken between the various users and the TCMS, (e.g. the Bill of Lading).
2. FTMS – Position Data Providers This communication link is critical for the performance of the entire system, since effective and reliable mechanisms (interfaces) have to be adopted ensuring the interoperability and compatibility between the system and the various types of data providers.

FTMS is a modular system composed of several components. A small part of the FTMS functionality is operating at the PDPs MIS environment aiming at collecting the status information that will further be processed in the FTMS. This status information may have several formats, as for example raw position data, loading/ unloading reports, stuffing/stripping reports, damage reports, etc. The common denominator of all these reports is that they report status data, providing no further information crucial for drawing conclusions with regard to the effectiveness of the chain activities. This is exactly the role of the FTMS. Therefore, the components of the FTMS can be divided into the following two areas executing the functionalities described below:

FTMS - PDP level:

- Production of standardized messages with status information
- Communication of messages to the FTMS, via the D2D Communication Platform FTMS
- Incoming messages parsing and archiving • Calculation of projected data (ETA, ETD, etc.)
- Calculation of deviations and incidents (alerts)

Communication with TCMS in order to receive reference data and report on the status data as well as the calculated projected data FTMS is composed of several software components executing various processes. Information provided by the TCMS and the PDPs (through the D2D communication platform) are extensively processed resulted to a series of information sets, which are communicated to the TCMS for further processing and dissemination. Therefore, corresponding components have been identified in order to allow serving the increased needs in terms of information handling. FTMS is divided in three top-level functional areas:

1. The Validation function receives status information stored in the FTMS database and reference data from TCMS and calculates deviations and alerts provided to TCMS for further actions by the Transport Chain Manager.
2. The Short Term Prediction function is constantly fed with the results of the “Validation” functional area and calculates projected data about the remaining transport chain stages. Such representative data is various projections regarding the cargo/transport means transport progress to their destination (e.g. ETA and ETD). Apart from the results provided by ”Validation”, these calculations are also based on predefined schedules and constraints/ parameters provided by the TCMS.
3. The Administration function handles security controls, messages’ parsing, messages creations and validations, data maintenance, etc. Additionally, this functional area undertakes the interaction between the FTMS and both the TCMS and the D2D communication platform.

9.5 Transport Chain Simulation System

I) Scientific result:

Simulation mechanisms are being developed for designing a transport chain type for a long-term customer contract. Based on the availability of information on the forecasted transport demand, as well as the availability of performance information on individual transport services, the expected performance of door-to-door transport chains (that are executed under that customer contract and using the designed transport chain type) can be evaluated.

II) Commercial result:

- Key innovative features: When we take care that the performance profiles of individual transport services (and if possible also the forecasted transport demand) are characterized by a “statistical signature” we are able to simulate a large number of shipments in a short time and as a consequence we are able to determine the expected performance of the door-to-door transport chain by calculating the average of all simulated shipments.
- Expected (commercial) benefits: We expect that the results impact the following 4 KPI’s positively which were identified as main performance criteria for logistics chains: Costs, lead time (~ duration), reliability (of the delivery time), quality (~ absence of damages), and external costs.
- Potential applications: The potential applications are in the following area’s: - Assessment of options within a (group of) transport chain type(s) – which encompasses the transport chain structure as well as the capacities used. - Assessment of the impact of changing the (group of) transport chain type(s) used. - Use the same analysis to assess actual transport chain type performance and compare it with potential alternatives regarding, for example, lead time, cost, quality, or utilization. The following events happening in commercial transport chains can be evaluated: - Normal variation or randomness of duration and quality (damages/loss) of services - Shipments that do not follow the average profile (peak volumes, starting times) - Changes in input volume/frequency/distribution - Disruptive events (catastrophes, strikes, accidents blocking routes) - Discontinuities (different national bank holidays) - Seasonal effects (e.g. occurence of ice in the Baltic Sea).
- Types of use: The following potential uses are being identified, all of them applying to a transport chain manager (TCM): - Decision support for the TCM when defining good/appropriate Transport Chain Types (TCT’s) including their Transport Chain Structure: Determine which routing, modes, and provider service options to use in the definition of a transport chain type. - Decision support for the TCM to investigate whether or not a TCT with selected provider services meets the customer criteria (expected overall lead time and costs). - Decision support for the TCM to evaluate sensitivity/robustness of a TCT through “what-if” scenarios to predict the consequences of a changing conditions. - Decision support for the TCM to assses interactions and mutual constraints of different TCT’s. This can relate to constraints of service provider capacities like contractually determined capacities, fleet size, constraints of capacity of selected means of transport (train or ship capacity). The application is used preferably within an operating environment because this supplies the simulation application with input data on actual provider service performance. If not all these data have to be collected manually.
- Use potential: The applications can be used by all transport chain managers that manage transport chains of a certain minimum complexity (several segments in the intermodal chains managed) and performance/cost requirements. The use of such applications reduce the costs and improve the reliability of logistics chains and thereby improve the long-term performance/cost ratio. In such situations the application provides a better solution than the current state-of-the-art. Reason being that existing application focus on strategic level simulation, not embedded in the actual operating environment and therefore lacking essential input data to safeguard results that can be deployed in operating environments.

III) Social result: Through the improvement of logistics chain performance we also reduce the use of resources per ton kilometer. No quantifiable results are available yet.

IV) Possible obstacles to use and market introduction: Obstacles are expected regarding to awareness in the market concerning the essence of intermodal transport chain management (as opposed to a shipping line's or a fleet manager's activities), and what kind of results may be achieved with simulation.

V) Dissemination: No dissemination has taken place yet. VI) Current status and use of the result: Currently the detailed specifications and design of the results is being undertaken, followed by software implementation.

9.6 Standardisation (Task 6.4)

D2D is a demonstration project that sets out to demonstrate how intermodal door-to-door transport can become a true alternative to truck transports by using logistics management and communication systems. Such a system will serve the European transport policy and inspire European industry to utilize potentials by combining different transport sectors in the transport performance.

One important contributing factor to integrated D2D management and communication systems is that they can be installed without major changes to the current installations in companies and organisations wishing to utilize such a system. The number of companies involved in a typical D2D installation is quite high and so is the number of logistics activities undertaken. In the example of the John Deere demonstrator case there are sixteen companies involved and 192 different actions have been identified along the demonstrator chain (for details see deliverable 5.2 e.g. of the D2D project). A successful D2D type system does not only require well designed TCMS or FTMS systems, but also

- the development of accepted business rules and procedures
- standardized messages and communication
- standardized interfacing with existing IT systems

One could go further and suggest standards for entire transport chain management systems. While in the future this may be considered useful it is not feasible today. Chain management systems are in their infancy and it would be premature to "over-standardize" at this early stage. Standardization should be undertaken once a number of (technically or commercially) competing systems have been tested for some time in the market. Only then sufficient know-how is available to build successful standards. Otherwise a standard would limit useful possible developments.

For D2D it is thus important to promote its results in areas where standardization is already required or where it is to be considered very useful. Fortunately the listing given above coincides with various standardization activities already available or under way. D2D has very limited resources available for explicit work in standardization. Rather than actively participating or initiating D2D's own normalization work it was thus necessary to piggyback on related work in other projects as much as possible. D2D has thus directed its standardization work toward monitoring existing work. It has also examined the ongoing work towards its usefulness for D2D chain management systems. This report focuses on areas which are of particular interest to the project.

D2D's more indirect work falls in two broad categories:

1. Monitoring and supporting strategic standardization
2. Work on particular topical subjects

On the strategic side in particular the horizontal THEMIS project had an active role. Many of its recommendations are of value for D2D. Due to a certain overlap of staff in both projects quite some synergy was generated in areas such as:

- The development of freight management architectures
- The work in the European standardization organization CEN, in particular in its structure TC278
- D2D's contributions to standardization and cross-fertilization with other EU supported projects
- The emerging consolidation of standardization the for intermodal transport

In the second area, the work on specific subjects the focus is on regional and national projects. It is an effective continuation on the work of Scandinavian researchers in such domains as web services and related security, XML definitions, business processes and business collaboration. The TRIM database and the ARKTRANS project are core undertakings in which D2D participants play a leading role.

10 Result and Conclusions

The major objective of D2D was to demonstrate how to efficiently organise and manage intermodal door-to-door transport chains, in which shipping plays a major role, by using logistics management and communication systems. The project has developed and demonstrated how to accomplish this with the assistance of advanced information and communication technology, and it has provided examples of new elements in the Intelligent Transport System. The main results of the project comprise a transport chain management system available as a web based application available on the Internet, a monitoring system, the efficient implementation of a system integration tool (communication platform), simulation and service profiling technology and tracking and tracing technology. Another important element was the methodology that were developed to show how to implement such systems efficiently in five transport chains based on a generic business model for transport chain management.

The five demonstrations have in our opinion supported the European transport policy by focusing on how to efficiently organise and manage multimodal transports. By introducing advanced systems for easy creation of complex transport chains and facilitate efficient communication with many service providers, the complexity of organising both the physical transport and the information flows is greatly reduced. The introduction of advanced tracking technology and automatic simulation and service profiling, will assist in reducing waiting time along the chain and thereby increase the competitiveness of such chains. This way the project has promoted technology that supports a shift from single modal "only truck" transport to multimodal transport utilising train, inland waterways and ocean transport.

Appendix 1 - Comments on Exploitation and Dissemination

The electronic Technological Implementation Plan is the actual final Exploitation Plan. Although not all partners have written their own part of this it does not mean that they will not exploit the results. Some of the thoughts of how the different partners could exploit the results were collected and are presented in the table on the next page. Now at the end of the project it is still unclear to what extent all of these uses of results will actually materialize, but it is clear that the benefits of the project continues to emerge from the results produced.

The targeted direct user group of this system will be those actors in the transport & logistics branch that are responsible for organizing and managing transport and supply chains. Transport operators of various transport modes and shippers/consignees will be interfacing to such a system.

Parties with a possible interest in the D2D Solution are:
- Supply chain managers such as forwarders, intermodal operators
- 3rd and 4th party logistics providers.
- Shippers and transport operators
- Research and consultancy firms (especially those involved in EC projects)
- Leading European and global research journals
- System suppliers
- Government Authorities (wanting to facilitate intermodal transport chains)

(See table on next page.)

Appendix 1 continued

The table below shows how the different participants in the D2D project aim at exploiting the D2D results.

Table 11: Exploitation interests.

Category	Partner	Exploitation interest
Developers	LogIT Systems	Primarily TCMS and secondarily FTMS. Expertise to expand business
	CLS	Link to FTMS (and TCMS) for expanding the use of satellite sensors
	Sequoyah	Strategic planning of logistics, and the concept as basis for new activities
	TRD	Primarily FTMS, secondary TCMS
	TTS	Technology for rapid exchange of cargo between land- and waterborne transport
Actors in demonstrators	WWL	Use of TCMS and FTMS to offer door-to-door transport services globally
	Norw. Coast. Dir.	Experience to improve service level to waterborne transport
	E. H. Harms	Use of TCMS and FTMS to offer European door-to-door transport services
	Port of Koper	Use of D2D technologies to improve service level
	ATG	Use of TCMS and FTMS to offer European door-to-door transport services
	ELKEM	Use of TCMS and FTMS to improve customer service level
Research institutions and consultants	SINTEF	Use D2D experience as a basis for further R&D projects
	MARINTEK	Use D2D experience as a basis for further R&D projects
	CETEMAR	Use D2D experience as a basis to expand consulting activities
	FRESTI	Use D2D experience as a basis to expand consulting activities
	BMT	Use D2D experience as a basis to expand consulting activities
	ECORYS	Use D2D experience as a basis to expand consulting activities
	ISSUS	Use D2D experience as a basis for further R&D projects

Appendix 2 - D2D consortium of participating companies

Below is an updated list of participating companies and main contact persons in the D2D consortium:

Project Co-ordinator:	Wallenius Wilhelmsen Lines a.s (NO) Co-ordinator (WP7): Olav Espeland WP-Leader (WP5): Bengt Ramberg	Telephone +47 6758 4675 +47 6758 4426
Contractors:	Sequoyah International Restructuring (BE) WP-Leader (WP4): Frank Knoors	+32 14 570600
	CETEMAR (ES) Jesus Carbajosa	+34 932 240 412
	TFK / BMT Transport Solutions (DE) WP-Leader (WP1): Inger Gustafsson	+49 4036 4780
	Euro Nordic Logistics b.v. (NL) Siebe Kramber	+31 180 441 133
Assistant Contractors:	Norwegian Coastal Directorate (NO) Reidar Kjennbakken	+47 5273 3200 +47 9151 9585
	Norwegian Marine Technology Research Institute, MARINTEK (NO) WP-Leader (WP3): Kay Fjørtoft	+47 7359 5500 +47 73 59 57 55
	CLS (F) Marc Leminh	+33 56 139 4700
	LogIT Systems (NO) Jan Tore Pedersen	+47 3729 5290 +47 6493 0735
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	ATG (DE) Heiner Gerstenberg	+49 61 969 2552
	Port of Koper (SI) Damjan Janezic / Joran Vran	+386 5665 6172
	FRESTI (P) Joao Abreu	+351 212 949 610
	TRD International / TREDIT (EL) WP-Leader (WP2): Manos Shinakis	+302 10 654 7797
	ECORYS (NL) WP-Leader (WP6): Eric van Drunen	+31 10 453 8800
	ISSUS (DE) Sabine Husted	+49 40 428 11 3255
	TTS Ships Equipment (S) Mikael Jogvall	+46 31 725 79 00
	ANCO (EL) Miltiades Anastasiades	+30 210 920 9300
	SINTEF Telecom & Informatics (NO) Marit Natvig	+47 7359 7073
	ISL (DE) Frank Arendt	+49 421 2209 619

Appendix 3 - Glossary of abbreviations

Abbreviation	Explanation
ARKTRANS	Research program sponsored by the Research Council of Norway
D2D	"Demonstration of an integrated management and communication system for door-to-door intermodal freight transport operations"
DB	Data Base
DECT	Digital Enhanced Cordless Telecommunications
EC	European Commission
DG TREN	Directorate General for Energy and Transport, EU Commission
ERP	Enterprise Resource Planning
ETA	Estimated Time of Arrival
FTMS	Freight Transport Monitoring System. System for providing real-time information regarding freight transport
INFOLOG	Intermodal Information Link for Improved Logistics. EU project
ISM	International Safety Management
JD	John Deere
LAN	Local Area Network
MARSIKT	Maritime Cooperation on Information and Communication Technology – ICT (Research program sponsored by the Research Council of Norway)
OCR	Optical Character Recognition
PDP	Position Data Providers
PMC	Project Management Committee
QLM	Qualiware Lifecycle Manager
RFID	Radio Frequency Identification. Electronic devices for tracking units with radio signals.
TCMS	Transport Chain Management System. Software system for managing door-to-door transport operations
TCP/IP	Internet Protocol
Themis	EU-funded Thematic Network in Optimising the Management of (Intermodal) Transport Services
TRIM	Transport Reference Information Model. Data model that contains all relevant information regarding door-to-door transport in single or multimodal transport chains
SOAP	Simple Object Access Protocol
VW	Volkswagen
WP	Work Package

For other terminology and acronyms please refer to the following web sites:
http://www.inttra.com/Products/shippingglossary.asp Shipping Glossary
http://www.tli.gatech.edu/apps/glossary/ Logistics Glossary
http://www.ciltuk.org.uk/process/glossary.asp Logistics Glossary