FITS-publications 25/2003

Freight Transport Telematics Architecture
Final Report

FITS Publications 25/2003

Freight Transport Telematics Architecture

Final Report

ISBN 951-723-886-X
FITS Publications
Helsinki 2003

Julkaisija

fits

KUVAILULEHTI

Julkaisun päivämäärä

Tekijät (toimielimestä: toimielimen nimi, puheenjohtaja, sihteeri)

Jani Granqvist (VTT), Harri Hiljanen (VTT), Antti Permala (VTT), Pasi Mäkinen (CGE&Y), Valtteri Rantala (CGE&Y) ja Aki Siponen (CGE&Y)

Julkaisun laji

Toimeksiantaja

Liikenne- ja viestintäministeriö

Toimielimen asettamispäivämäärä

Julkaisun nimi

Tavaraliikenteen telematiikka-arkkitehtuuri. Loppuraportti

Tiivistelmä

Kansallinen järjestelmäarkkitehtuuri on tavoitearkkitehtuuri, jonka avulla liikenne- ja viestintäministeriö tukee liikennetelematiikan kansallista kehitystä, arvioi yksittäisten hankkeiden hyödyllisyyttä ja arkkitehtuurin noudattamista. Tavaraliikenteen telematiikka-arkkitehtuuri on osa liikenne- ja viestintäministeriön FITS-ohjelman horisontaalista hankealuetta “Liikennetelematiikan palvelujen edellytysten kehittäminen”.

Arkkitehtuurin tavoitteena on antaa organisaatioille mahdollisuus parantaa kilpailukykyään markkinoilla tehokkaamman toiminnan, monipuolisemman palvelutarjonnan tai paremman yhteensopivuuden muodossa. Arkkitehtuuri kuvaa toimijoiden välisten järjestelmien avoimia rajapintoja sitoutumatta tiettyihin teknologioihin ja puuttumatta yritysten sisäisiin järjestelmiin. Yritys voi verrata nykyistä toimintaansa kansalliseen käsitykseen tavoitetilasta lähtökohtana oman toiminnan, toimijakohtaisen arkkitehtuurin tai yksittäisen järjestelmän kehittämiselle. Aikatähtäin on vähintään 10 vuotta ja keskeisiltä osiltaan arkkitehtuuri on ’ikuinen’.

Tavaraliikenteen telematiikka-arkkitehtuurin näkökulmana on tavaran ja siihen liittyvien tietojen kulkeminen lähettäjältä logistiikkaketjun läpi aina vastaanottajalle asti. Arkkitehtuuri keskittyy tavaroiden kuljettamiseen suoranaisesti liittyviin prosesseihin ja näiden prosessien tietovirtoihin. Arkkitehtuuri kattaa eri kuljetusmuodot sisältäen tie-, raide-, vesi- ja ilmakuljetukset. Arkkitehtuuri on kuvattu kuljetusmuotoriippumattomasti siten, että prosessikomponenteista voidaan koota erilaiset tosielämässä esiintyvät kuljetusketjut.

Arkkitehtuuriin on määritelty tavaran lähettäjän, vastaanottajan, logistiikkapalveluiden tuottajien ja julkishallinnon roolit. Kuvatut tavaraliikenteen prosessialueet ovat suunnittelu, ohjaus, toimitus sekä seuranta ja jäljitys. Tietovirrat käsittävät tavaratilauksen, kuljetussopimuksen, kuljetustilauksen, lähetysluettelon ja kuormanerittelyn ohjaustietoja, seuranta- ja muita tietoja. Looginen arkkitehtuuri sisältää tieto-objektien ja näistä johdettujen tietopalveluiden kuvauksen ja tietojärjestelmäpalveluiden kuvauksen. Tietomalli on kuvattu relaatiokaaviona. Relaatiokaavio kuvaa tietojoukot ja niiden väliset pysyvät suhteet.

Tutkimuksessa on tarkasteltu nykytilanteen puutteita ja tarpeita kuvattuun tavoitetilaan nähden. Esille nousi kolme kehittämisaluetta: tietoinfrastruktuurin kehittäminen, tunnistuksen kehittäminen ja prosessien kehittäminen.

Eurooppalaisen KAREN-arkkitehtuurin alueen 8 kuvaukset käsittelevät maantieliikenteen osalta samaa ongelma-aluetta. KAREN-arkkitehtuurikuvauksia on käytetty tarkistuslistana sekä toimintojen että tietovirtojen osalta.

Avainsanat (asiasanat)

telematiikka, arkkitehtuuri, logistiikka, tavaraliikenne, prosessit, standardointi, viitekehys, kehittäminen

Muut tiedot

Sarjan nimi ja numero	ISSN	ISBN
FITS Publications 25/2003		ISBN 951-723-886-X

Kokonaissivumäärä	Kieli	Hinta	Luottamuksellisuus
123	englanti		julkinen

Jakaja	Kustantaja
VTT Rakennus- ja yhdyskuntatekniikka	Liikenne- ja viestintäministeriö

The publisher

fits

DESCRIPTION

Date of publication

Authors (from body, name, chairman and secretary of the body)

Jani Granqvist (VTT), Harri Hiljanen (VTT), Antti Permala (VTT), Pasi Mäkinen (CGE&Y), Valtteri Rantala (CGE&Y) and Aki Siponen (CGE&Y)

Type of publication

Assigned by

Ministry of Transport and Communications

Date when body appointed

Name of the publication

Freight transport telematics architecture. Final Report

Abstract

The national architecture system is a reference architecture through which the Ministry of Transport and Communications supports the national development of the transport telematics, estimates the usefulness of the individual projects and monitors how the architecture is applied. The freight transport telematics architecture is a part of the horizontal project area of the FITS programme "Prerequisites for ITS Services".

The objective of the architecture is to provide organisations with the opportunity to im-prove their competitive ability on the market through more efficient operations, a wider range of services or better compatibility. The architecture describes open interfaces between the actors without binding them to specific technologies and without intervening in the internal systems of companies. An organisation can compare its present operations with a national vision of the target conditions as a starting point for development of its operations, actor-specific architecture or individual systems. The time horizon is at least 10 years and the central parts of the architecture are 'eternal '.

The viewpoint of the architecture is the freight and related information flowing through the logistics chain from sender to receiver. The architecture focuses on the processes that are directly related to the transport of goods and on the information flows of these processes. The architecture covers the different modes of transport including road, rail, water and air. The process description is independent of transport mode, so that the process components can be combined in many ways to form all the transport chains that exist in real life.

The architecture contains role definitions for the sender, the receiver, the logistics service providers and the public administration. The described process areas of the freight transport are planning, management and control, supply chain operations, and tracking and tracing. The information flows comprise management data, track and trace data and other data related to the goods order, transport agreement, transport order, dispatch note and load specification. The logical architecture contains the description of information objects and the information services that are based on these as well as the description of information system services. The data model has been described as an entity-relationship diagram. This relationship scheme represents the data groups and the permanent relations between them.

The study identifies the deficiencies and needs of the present situation compared to the future vision. Three areas for development were defined: information infrastructure, identification and processes. The descriptions of area 8 of the European KAREN architecture describe the same problem area for road transport. The KAREN architecture descriptions have been used as a checklist for both functions and data flows.

The study has been granted European Community financial aid in the field of Trans-European Networks - Transport.

Keywords

Telematics, architecture, logistics, goods transportation, processes, standardisation, framework, development

Miscellaneous

Serial name and number		ISSN	ISBN
FITS publications 25/2003			ISBN 951-723-886-X
Pages, total	Lanquage	Price	Confidence status
123	English		Public
Distributed by		Published by	
VTT Building and Transport		Ministry of Transport and Communications	

Foreword

The freight transport telematics architecture is a part of the horizontal project area "Prerequisites for ITS Services" of the FITS programme, initiated by the Ministry of Transport and Communications. It continues the work that began with the freight transport telematics architecture feasibility study. The project began in early autumn 2002, and the upper-level architecture description is now complete.

Freight transport telematics is the production, processing and distribution of information needed in shipment, transport, terminal and receipt operations as well as the planning and management of these operations utilising information and data transfer technology.

The freight transport telematics architecture describes the general freight transport process, focusing on the movement of goods and the associated information from the consigner to the consignee through the logistics chain. The process description is independent of transport mode, so that the process components can be combined in many ways to form all the transport chains that exist in real life. A central part of the description is the modelling of data flows associated with freight transport, as well as the modelling of data, its source and its owner.

The study examines the shortcomings and development needs of the current situation in comparison to the described process and objectives, and forms prioritised development plans for these.

The study was carried out by a working group consisting of Pasi Mäkinen, Valtteri Rantala and Aki Siponen of Cap Gemini Ernst & Young, and Jani Granqvist, Harri Hiljanen and Antti Permala of VTT Building and Transport. This report has been checked by Senior Engineer Seppo Öörni of the Ministry of Transport and Communications and research scientist Mikko J. Lehtonen of VTT.

The project has been supervised by a management group consisting of Lassi Hilska and Helena Vänskä of the Ministry of Transport and Communications, Henric Bladh (Danzas), Kari Litja (Finnish Association of Logistics), Mikko Melasniemi (Confederation of Finnish Industry and Employers TT), Sven-Gustaf Lindroos (EAN Finland), Pertti Pietikäinen (Finnish Trucking association SKAL), Markku Tilli (AIM Finland), Hannu Vaarama (Vikingline), Sirkka-Leena Holmberg (VR Cargo), Klaus Katara (Federation of Finnish Commerce and Trade KKL), Pekka Rautiainen (EP-Logistics Oy), Ilkka Tirkkonen (Kiitolinja), and Juha Boman (TNT Finland).

Helsinki, March 2003
Lassi Hilska
Senior Adviser, Director of Goods Transport Unit

The study has been granted European Community financial aid in the field of Trans-European Networks - Transport

CONTENTS

SUMMARY

The freight transport telematics architecture is a part of the horizontal project area “Prerequisites for ITS Services” of the FITS programme, initiated by the Ministry of Transport and Communications.

The European transport telematics framework architecture KAREN describes the eight operational areas of road transport telematics, one of which is transport and fleet management. National framework architectures have been and are being developed in various European countries on the basis of the KAREN architecture. In Finland, this development has been carried out in two stages: the TETRA programme study ”The Finnish National System Architecture for Transport Telematics – TelemArk” described passenger transport telematics services, while this study describes services for freight transport. This transport telematics architecture is more extensive than the road transport and fleet management section of the KAREN architecture, as it covers all modes of transport.

The architecture aims for efficiency

Freight transport telematics is the production, processing and distribution of information needed in shipment, transport, terminal and receipt operations as well as the planning and management of these operations utilising information and data transfer technology.

The objective of the architecture is to provide organisations with the opportunity to improve their competitive ability on the market through more efficient operations, a wider range of services or better compatibility. The architecture describes open interfaces between the actors without binding them to specific technologies and without interfering with the internal systems of companies.

The architecture focuses on the processes that are directly related to the transport of goods and on the data flows of these processes. It looks at these from the viewpoint of the movement of goods and the associated information from the consigner to the consignee through the logistics chain. The process description is independent of transport mode, so that the process components can be combined in many ways to form all the transport chains that exist in real life. A central part of the description is the modelling of data flows associated with freight transport, as well as the modelling of data, its source and its owner.

Vision

When the objectives defined in the freight transport telematics architecture have been reached:

- Real-time information about the location, contents and conditions of identified shipments, goods items, parcels and transport vehicles can be collected in a controlled manner.
- The collected information can be combined with planning information and refined appropriately to be used during various parts of the process and distributed efficiently and timely to actors.
- By collecting, refining and distributing information efficiently organizations can improve the efficiency of their goods transport logistics processes, lower their operational costs and improve their portfolio of logistics services.

The time horizon of the architecture is at least 10 years, and the central parts of the architecture are ”eternal”. The architecture therefore describes activities and operational requirements in an ideal situation.

Architecture as a management tool

The architecture should first and foremost steer and enable; it provides the basis for the development of (sub)architectures for individual sectors and transport modes and steers actors in the field to develop their operations in accordance with the architecture.

The national architecture system is a reference architecture through which the Ministry of Transport and Communications supports the national development of transport telematics, assesses the usefulness of individual projects and monitors how the architecture is applied. And organisations can compare their present operations with the national vision of the target conditions as a basis for developing their operations, actor-specific architectures or individual systems.

The development of freight transport telematics services is made more challenging by the global nature of the field, the rapid pace of international standardisation and harmonisation, and the large number of actors. A national architecture may especially ease the transition of small and medium-sized firms into a part of the expanding freight transport information network. The successful deployment of the architecture is significantly affected by how prepared the parties involved are to commit to its development and use.

The freight transport telematics architecture especially supports the processing and development of the organisation’s general operating concept and system architecture, but also provides a limited number of guidelines for individual systems.

The architecture describes the freight transport process

The actors examined in the architecture are the consigner, consignee, logistics service providers and public administration. The transport processes described are Planning, Management, Delivery and Tracking and Tracing.

The Delivery process describes the operations associated with the transport of goods within the Shipment-Transport-Transshipment-Receipt chain. By combining the Transport and Transshipment processes, one can construct processes to describe a number of different supply chains. The interfaces between subprocesses also mark the points where responsibility for the transported goods is handed over.

The Management and Delivery processes are very closely connected, and both use the same process component division. The Management process is, however, supplemented with the process component Supply Chain Management.

The Planning and Tracking and Tracing processes describe the processes of both the logistics service provider (transport operator or terminal operator) and the operator responsible for the whole supply chain.

The material and data flows have been divided between two processes: the material flow travels within the Delivery process from one actor to the next, while a corresponding data flow (consignment note / load list) travels from actor to actor within the Management process. In addition to this data flow, adjacent actors within the process also exchange management information: they make a management contract to ensure the controlled release and acceptance of the material flow among the actors. It is essential for the functioning of the process that the information contained in the consignment note data flow is accurate. The consigner carries much responsibility; after all, most of the information is produced within the Shipment process.

The Planning, Management and Tracking and Tracing processes are hierarchical: their contents are clearly divided between the actor responsible for the entire supply chain and the actor responsible for individual services (transport legs and terminal services). This division helps distinguish between the operator focusing on the optimisation of the use of the means of transport (logistics service provider) and the one focusing on the optimisation of the entire transport (supply chain service provider).

The data flows between the main processes have been divided into groups according to their contents. The data flows have been divided into

- data flows containing goods order and transport agreement information. Most of these data flows originate outside the freight transport process area.
- data flows containing transport order information.
- data flows containing consignment note and load list information.
- data flows containing management information. Management information mostly consists of the internal data flows of processes/actors.
- data flows containing tracking data.
- other (unclassified) data flows.

The information and functionality of information systems is described as a service architecture

The logical architecture contains descriptions of the information architecture, the data sets and the information services derived from them, and the information system services. The logical architecture describes the framework that fulfills the requirements defined and modelled in the conceptual architecture; the aim is to enable ideas described on a conceptual level (in the processes) in the architecture to be defined as separate entities to be realised through the use of different information systems. Technological solutions are not evaluated, but the functional and information contents of an overall solution are described.

The information architecture describes the data sets and their relationships with each other and with the process data flows and real-world concepts, such as a consignment note. The levels of confidentiality of the information contained by the data sets and the relationship between the advance information and the information obtained on the carrying out of transports are also described.

The collecting and processing of tracking data is crucial for the realisation of the target vision. Tracking data consists of all the collected content, location, condition and event information. The design of the information model is such that the content information helps minimise the need for collecting location, condition and event information. Content information need only be collected at specific locations where the contents may change. It should be noted that content information should be collected on all types of tracking unit: the means of transport, transport units and parcels.

The target is still far away

The study identifies the shortcomings and development needs of the present situation compared to the desired target. Three areas for development were defined: information infrastructure, identification and processes. Interviews and workshops helped map out all factors that are missing or require futher development in order to reach the objectives described in the architecture.

The shortcomings and development needs of individual processes were combined to form development programmes. Often this involved finding a common vision and committing to realising it. Suitable responsible actors and other parties involved in initiating and carrying out of the development programmes were also sought.

1 INTRODUCTION

1.1 Basis for the project

The ”Transport Telematics Architecture” study is a follow-up to the Freight Telematics Architecture Feasibility Study[2] from the spring of 2002. It is a part of the horizontal project area “Prerequisites for ITS Services” of the FITS programme, initiated by the Ministry of Transport and Communications. This project, meanwhile, continues the work begun with TETRA projects number 7 (multimodal transport information system), 8 (development of prerequisites for ITS services) and 9 (architecture and standardisation activities).

The TETRA study ”The Finnish National System Architecture for Transport Telematics – TelemArk” described eleven telematics services for passenger transport. The TETRA programme also proposed the main architectural standards, ranging from interfaces to the relaying of traffic data. In statements and workshops concerning the architecture, several organisations proposed that the national architecture should be expanded to also include freight transport.

The prestudy on the development of a freight transport telematics architecture began in the spring of 2002 with the aim of finding out whether there was a need for a national architecture, and what were the required level and the focus areas of the architecture. It was considered important to describe the basic freight transport processes, terminology and interfaces between actors. The findings of this feasibility study led to the decision to formulate the actual architecture. The study began in September 2002, and the report was completed in February 2003.

What makes the planning of the architecture especially challenging is the diversity of the logistics operations network. Since the architecture aims to describe the operating processes and telematic requirements of road, railway, maritime and air transports, finding the right balance between the level of abstraction needed and the concrete nature of the descriptions pretty much defines whether the result is successful.

The task is made more challenging by the global nature of the field, the rapid pace of international standardisation and harmonisation, and the large number of actors. A national architecture may especially ease the transition of small and medium-sized firms into a part of the expanding goods transport information network. The successful creation of the architecture is significantly affected by how prepared the parties involved are to commit to its development and use.

[2] MinTC. 2002. Freight telematics architecture. Feasibility study. FITS Publications 10/2002.

1.2 Architectural process

The architectural process had three stages:

- The Project Preparation stage involved the finalisation and approval of the project work plan as well as preparation for process development and the interviews. The preparation for process development included the receipt of information from the writers of the feasibility study.

- The Process Development stage saw the project group draw up descriptions of the target processes on the basis of descriptions of the current situation. These process descriptions were checked at two workshops in December and January.

- The Architecture stage saw the work divide into two: a description of the differences between the current situation and the target to find out what were the areas that required development, and the finalisation of the descriptions of the target processes and drawing up of the actual architecture. Development programmes were also formulated.

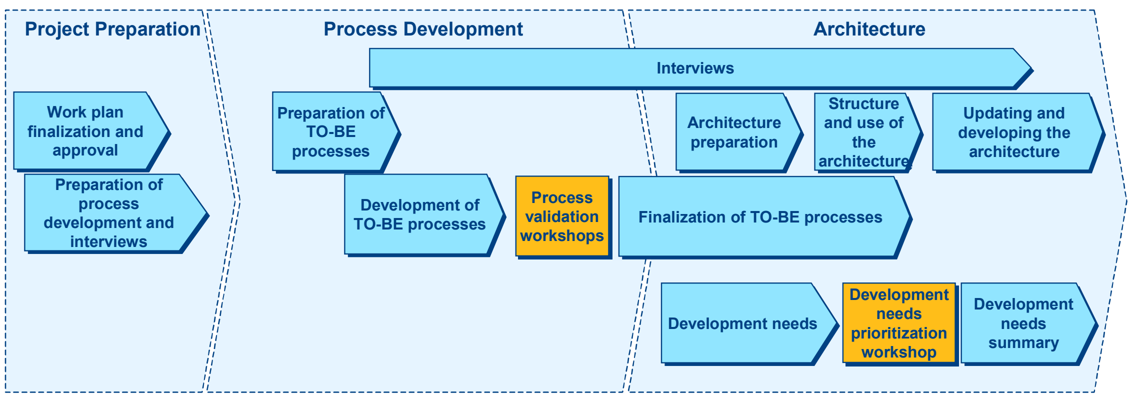


Figure 1.1.Architectural process.

The interviews were a means to collect the views of some of the main actors on the current situation and the objectives. This helped fine-tune the vision.

1.3 Connections with other projects on transport telematics architecture

1.3.1 The Finnish National System Architecture for Transport Telematics TelemArk

The Finnish National System Architecture for Transport Telematics, TelemArk[3] describes road traffic processes and telematics services. At least the TelemArk processes

[3] MinTC B 1/2000. The Finnish National System Architecture for Transport Telematics. Summary.

of ***Incident management***, ***Hazardous goods management***, ***Information to drivers***, ***Demand management / Access control*** and ***Road traffic management*** have a direct link with the processes described in this study as far as road transport is concerned. It also seems that the TelemArk process descriptions could very easily be modified to fit other modes of transport, so the TelemArk descriptions, then, can also be considered the as basis for the general, transport mode-free process descriptions. However, The TelemArk descriptions will not be expanded in this study.

1.3.2 The European Transport Telematics Framework Architecture KAREN

The European transport telematics framework architecture was originally formulated in the EU project KAREN. This has been followed up with two projects: FRAME-NET, aimed at providing all European architectural projects with the opportunity to exchange experiences and data, and FRAME-S, responsible for updating the European architecture, and providing training and up-to-date advice on the use of the architecture.

KAREN[4] describes the eight functional areas of transport telematics, one of which concerns freight transport. KAREN focuses on road traffic.

Area 8 in KAREN involves transport and fleet management using the resources of a centralised logistics service centre. The architecture models the operations, the data flows between them and the necessary data storage as hierarchical diagrams. Area 8 is divided into three parts. Sections ***8.1 Manage Logistics and Freight*** and ***8.2 Manage Commercial Fleet*** concern logistics service centre operations. The use of other transport modes besides road transport has also been modelled, but only at the interface level. Section ***8.3 Manage Vehicle/Driver/Cargo/Equipment during Trip*** describes data flows and information needs during transport.

The operations have been described in relative detail on four levels. The data flow descriptions are also hierarchical.

The descriptions in area 8 of the KAREN architecture deal with exactly the same issues as this study as far as road transport is concerned. The KAREN descriptions have been used as an operation and data flow checklist.

1.3.3 Other projects and studies

The development of electronic data transfer in hazardous goods transport is looked at from the authorities' viewpoint in a study funded by the Ministry of Transport and

---

MinTC B 2/2000. The Finnish National System Architecture for Transport Telematics. The Development Plan.

[4] European Communities. 2000. KAREN – European ITS framework architecture. CD-ROM.

Communications that was published in the summer of 2001[5]. The study examines the benefits to the private sector of a hazardous goods transports monitoring and enforcement system. The report also evaluates the structure of the hazardous goods transport monitoring system and the division of responsibilities among the actors.

The Logistics Chain EDI Project study[6] examined the overlapping and consequential redundancy of goods trade and transport documents, and whether the number of documents could be cut. This study was mainly used to help define the contents of the process data flows.

One of the bases of this report is the target document information content described in the report Logistics Chain EDI Project - Increasing the Efficiency of Trade Data Exchange.

[5] MinTC A 34/2001. The Development of Electronic Data Exchange in Hazardous Goods Transportation.

[6] MinTC A 37/1998. Logistics Chain EDI Project - Increasing the Efficiency of Trade Data Exchange.

2 BASIS AND OBJECTIVES OF THE ARCHITECTURE

This chapter describes the vision, objectives, application area and process map of the freight transport telematics architecture.

The vision outlines the future-state of freight transport processes and the consequences after a total implementation and deployment of the architecture.

The objectives guide the development process by defining the usability, quality, contents and limits of the results.

The freight transport processes have been described in the architecture application area diagram and process map. The architecture application area illustrates the operating environment of the freight transport process area and the limits of the project. The process map is a list of the upper-level processes, their functions, limits, preconditions and possible indicators for operations monitoring.

2.1 Vision for freight transport telematics architecture

The vision outlines the future-state of freight transport processes and the consequences after a total implementation and deployment of the architecture. The vision is outlined in the figure below (Figure 2.1).

Vision for Transport Telematics Architecture

- **Real-time information about the location, contents and conditions of identified shipments, goods items, parcels and transport vehicles can be collected in a controlled manner.**
- **The collected information can be combined with planning information and refined appropriately to be used during various parts of the process and distributed efficiently and timely to actors.**
- **By collecting, refining and distributing information efficiently organizations can boost their goods transport logistics processes, lower their operational costs and improve their portfolio of logistics services.**

Figure 2.1. Vision for freight transport telematics architecture.

The vision is based on the identification of individual goods items and products, shipments, parcels and transport vehicles and on the collection of information on their location, contents and condition.

By refining this data, organisations can provide more efficient operations, lower operative costs and a wider range of logistics services. The vision does not state how the improvements in efficiency and services should be measured. Different actors can therefore measure improvements in different ways. Industry, trade and other companies that use transport services can measure their success in purely economic terms as well as in terms of throughput times and a decrease in the number of unnecessary transports. Public administration measures success e.g. in terms of longer terms of use for their infrastructure, a decrease in traffic's hazardous environmental impacts and a general improvement in the quality of life, all due to increased efficiency in freight transport.

2.2 Objectives and limits of the architecture

The objectives of the architecture are outlined in the figure below (Figure 2.2). These objectives steer the development process by providing guidelines and limits and by listing things to take notice of and the effects the architecture is hoped to have.

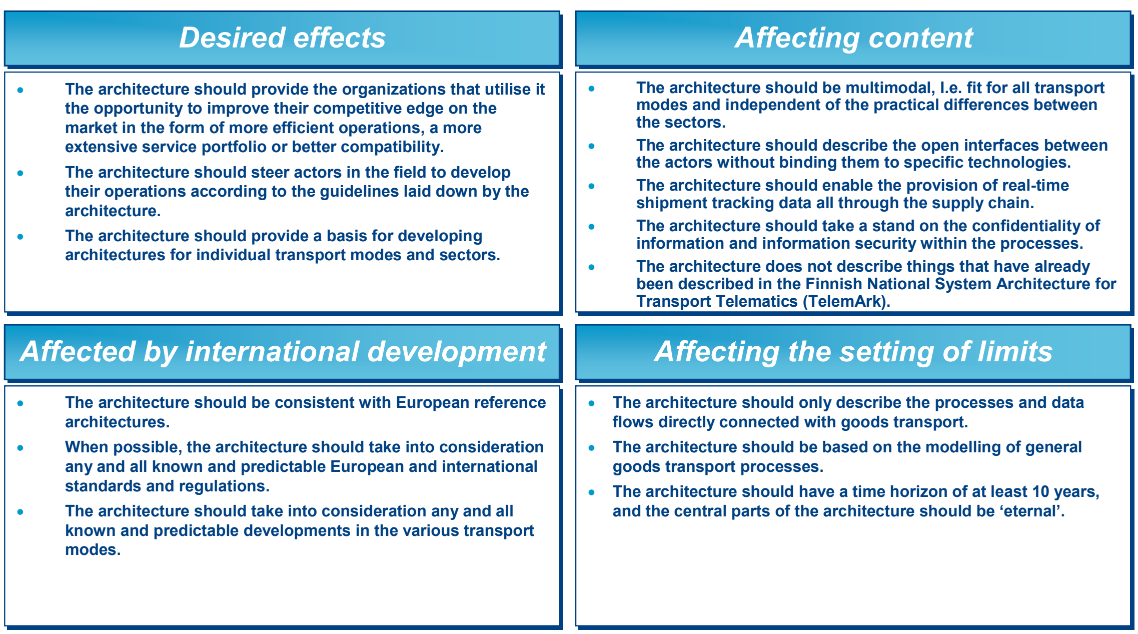


Figure 2.2. Objectives of the freight transport telematics architecture.

The architecture should first and foremost steer and enable; it should provide the basis for the development of (sub)architectures for individual sectors and transport modes and steer actors in the field to develop their operations in accordance with the architecture.

The architecture should focus on the processes that are directly related to the transport of goods and on the information flows of these processes.

The content and form of the architecture is greatly affected by the time horizon, which should be at least 10 years; the central parts of the architecture should be ”eternal”. The architecture should therefore describe activities and operational requirements in an ideal situation.

2.3 Logistics trends[7]

The following is an assessment of development trends in logistics as they affect the construction and utilisation of the telematics architecture. The three biggest influences are co-operation, transparency and outsourcing. These affect the ways companies operate, and outsourcing also affects the division of tasks among the companies.

Co-operation, Collaboration, Partnership

The most significant new applications in the field of supply chain management (SCM) are various acts aimed at improving collaboration and co-operation. Co-operation is estimated to increase significantly in the coming years. Examples of methods for improving partnership in logistics include CPFR (Collaborative Planning, Forecasting and Replenishment) and VMI (Vendor Managed Inventory). The basis for all this is the sharing of information, processes and resources within the network of actors. For example, predictions and transportation and storage capacity can be shared within the supply chain. Successful partnership calls for standards and models, which are partly provided by the telematics architecture. Collaboration helps improve the competitive ability of companies within the network e.g. by lowering costs, cutting throughput times and producing better services. Technological tools to aid partnership include e.g. Internet portals.

Transparency, Supply Chain Visibility

Transparency means that the location of deliveries and goods items within the supply chain is visible, and that data is visible to all parties. Transparency aids supply chain management, as goods deliveries can be controlled, planned and monitored thoughout the supply chain. The speed and efficiency of deliveries is increased, and the whiplash effect is levelled off. Incident and exception management is easier when the entire chain is visible. Benefits also include increased efficiency of network operations, e.g. costs, throughput times and storage levels.

Strategies – Outsourcing

All companies differ in structure and operations. The process of outsourcing continues, as companies focus on their central tasks and areas of expertise, while outsourcing operations, including logistics. The architecture should be based on the objectives set for

[7] CLM Annual Conference 2002. www.clm1.org

actors and processes, not on company operations, as company interfaces within the networks differ from one another and change constantly.

2.4 Examples from abroad[8]

Centralised information management can be seen in many European projects to develop information infrastructure and information management methods. A common trait in these is telematics architecture and centralised information management. The following gives three examples of projects dealing with harbours (maritime transport), inland waterway transport and intermodal road/railway transport.

The ***IP (Intermodal Portal)*** project aims to increase port integration through transport chains. IP includes the harmonisation of administrative procedures. Information technology tools and services have also been constructed to improve the availability of essential information and data distribution within chains. The central idea of IP is that all information can be found in one place (Single Desk). Information is available e.g. on hazardous goods, shipping agent data, port service orders, ETAs, truck transport orders and definitions of XML messages. IP is an EU research project.

The ***Also Danube*** project aims to improve the management of inland waterway transports using a new information system, the Common Source Logistics Database. The system combines logistics and traffic management, and includes e.g. order management, chain planning, monitoring, and incident and exception management. Since May 31 2003, the system has also included agreement management, container management, hazardous goods management and transport chain optimisation.

Cesar is a web-based technology platform for intermodal transport management. The system has been built ”onto” the existing information systems of the companies involved. Cesar is a common web-based user interface for customers. It includes data on transport orders (booking), tracking, exceptions and schedules. It is all based on agreements between parties. A company has been founded to run the system.

[8] EUTP Clustering 12.12.2002 Rotterdam, www.eutp.org

3 STRUCTURE AND USE OF THE ARCHITECTURE

This chapter describes the structure of the architecture, what descriptions the architecture contains, what kind of descriptions these are, what they represent, how they can be interpreted, and what conclusions can be drawn from them. The associated terminology is also defined here. The chapter also outlines how the descriptions could possibly be utilised in companies and communities.

The architecture describes a general, transport mode-free freight transport process mainly from the viewpoint of the transported goods and the customer.

The descriptions included in the architecture are process descriptions, data descriptions (information architecture, information model), a description of the information system services and a description of the data storages. These are outlined in greater detail later.

3.1 Process descriptions

The architecture application area (Chapter 4.1) describes both the processes included in the architecture and the processes excluded from it.

The process descriptions are hierarchical: the subprocesses of the upper-level processes have been described in the more detailed process descriptions, which outline the processes and second level subprocesses. Some third level subprocesses have also been outlined, but not in great detail. The process components have been numbered according to their level (Figure 3.1). This report uses the terms process component and subprocess interchangeably.

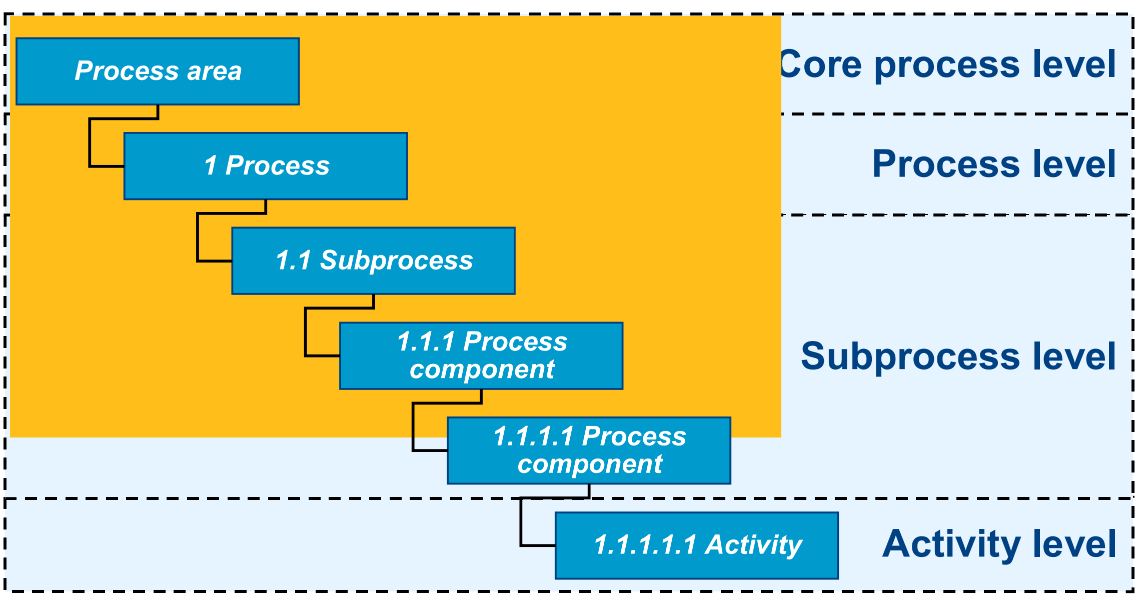


Figure 3.1. Process hierarchy and process levels within the architecture.

The terms used in the architecture and descriptions are given in the table below (Table 3.1), as are common synonyms for them. This report aims to use the specified terms, but a synonym may be used if there is no risk of confusion.

Table 3.1. Definitions of terms used in the descriptions.

Term	**Description**	**Synonyms**
Information object	A collection of information attributes that describe a physical or an abstract object.	Data object, data collection, entity.
Instance	An identifiable realization of an information object. An instance of an information object has a life-cycle. For example, an information object Vehicle may have an instance: a truck with the licence number ABC-123.	
Information model	An information model describes relationships between information objects. It is a static model describing permanent relationships, e.g. a train may have zero or more carriages.	Relationship model, data model, entity-relationship diagram
Subprocess	Subprocesses form a hierarchical construction. The lowest level subprocess contains activities and the data flows between them. Upper level subprocesses consist of groups of lower level subprocesses.	
Process	A group of subprocesses forming a logical entity. A process [usually] has well-defined starting points and end points as well as inputs and outputs.	
Process map	A table describing process components, their starting points, end points, inputs, outputs and possibly other information.	
Process component	A general term for a process or a subprocess.	
Role	A person, group of persons or organisational entity responsible for a certain activity or process. This is an abstract construction: the same physical actor can have several different roles in a process. Roles clarify process diagrams, give visibility to the internal structure of processes and show how processes can be developed. A device or an information system can also have an independent role in a process.	
Data flow	A collection of information transferred between two process components.	
Actor	A physical entity: an organisation or a person acting in a certain role in some process. This report uses the term Actor to refer to physical actors and the term Role to refer to abstract or logical actors.	
Activity	A logical group of actions performed consecutively by a single actor in a single role. Activities are the smallest building blocks of processes.	

All process descriptions consist of a process map and a process description.

The process map is a table outlining a process component, its input and output points and possible other information. The input and output points might not be stated, if they are ”obvious”. The table below (Figure 3.2) is an example of a process map.

ID	Name	Description	Starting point	End point	Notes
1	Delivery	Transporting goods from the departure point and consigner to the destination and consignee as per the transport order.	The transported goods exist. A transport plan exists.	The goods and data are ready for use by the consignee during the next stage of the production process.	All stages of the delivery process may produce shipment tracking information (content, location and condition information).
1.1	Shipment	Preparing goods for transport and releasing them to the transport operator.		The delivery lot (goods) and the responsibility for them are given to the transport operator.	The process may entail loading procedures at the loading site and by the means of transport.

Figure 3.2. Example of a process map.

The process description is a diagram illustrating the process components, the data flows between them and the roles ***responsible*** for each process component. The process description is supplemented by a table verbally outlining the data flows. The figure below (Figure 3.3) is an example of a process description.

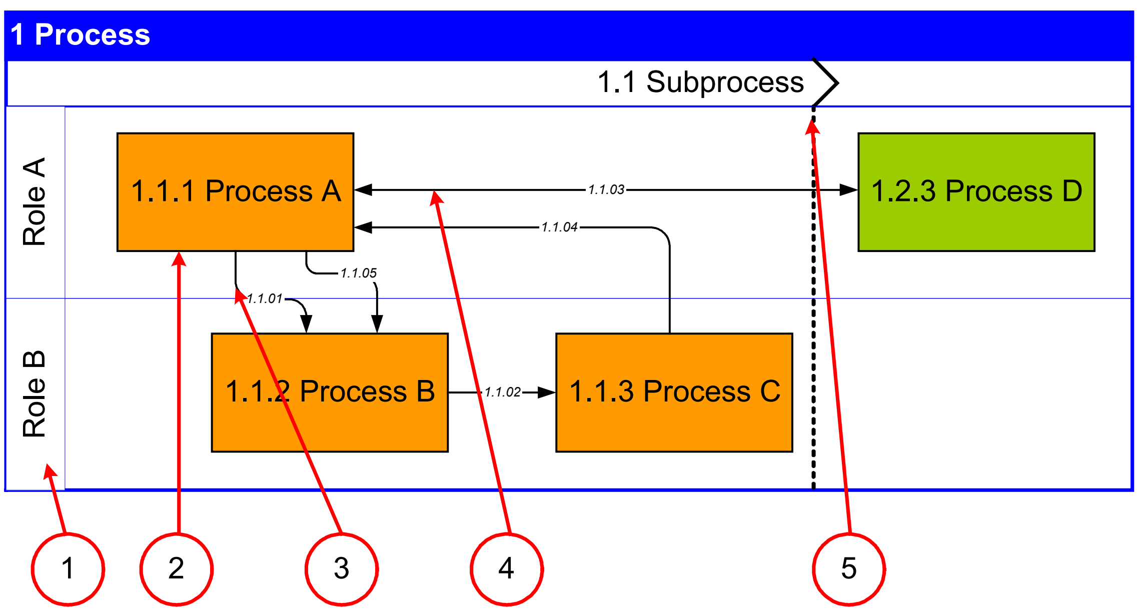


Figure 3.3. Example of a process description.

The following table outlines all the parts of the process description.

Table 3.2. Explanation of the process description diagram.

No.	Description	What the diagram doesn't show
1	The roles are named on the left side of the diagram. The process components a role is responsible for are located to the right of it. The role thus essentially illustrates who is responsible for realising the process components and the data flows produced by them.	
2	The process components are numbered and named. The colour of the components may also signify something. This is always explained in the individual descriptions. The temporal order of the process components, if one can be determined, goes from left to right.	The time duration of the process components cannot be directly determined from the diagram. Relative starting times have been illustrated as well as possible, but the end times are in many cases impossible to show. The process components are all drawn the same size. For example, according to the data flow arrows, process component 1.1.1 lasts at least until 1.1.3 has begun. It may last all the way until 1.1.3 ends, but the precise end time cannot be determined on the basis of the diagram.
3	The data flows between process components are represented by consecutively **numbered** arrows. The data flows between subprocesses are numbered according to the subprocesses that initiate them (usually the first consigner). The arrow shows which way the data flows. Data flows leaving a process component tend to be illustrated moving down and to the right, while data flows coming to a process component come from the upper left side. If possible, the order of the data flows is shown by having the earlier data flow begin higher up or more to the left. The colours of the data flows may represent some of their properties.	The temporal order of the data flows cannot be completely determined on the basis of the diagram. It also cannot be determined how many times a data flow takes place between two process components. For example, data flows 1.1.01 and 1.1.02 may take place first as advance information even several times and then finally once as realisation information.
4	If a data flow runs in both directions, both are shown in the diagram. The arrows are drawn with the originator of the data flow usually shown higher up or more to the left. In any case, the data flow arrow is shown starting at the lower or right-hand side of the process component.	
5	Upper-level process stages are represented by an identified dashed line. These stages, if shown, are always in temporal order.	

3.2 Data descriptions

The information architecture is outlined with an information model and a list of data sets.

The information model describes the data sets and permanent relationships between their concepts. It is thus a static model. The structure of the information model is outlined in Chapter 5.1.1.

The information architecture includes not only an information model and a description of the data sets, but also the relationships between the data sets and real-world concepts.

3.3 Description of information system services

The information contained by the information system services is outlined using information system service descriptions and a distribution model.

The distribution model shows where the information system services will be located within various organisations when the target has been reached. It is thus a static model. The conceptual model is outlined in greater detail in Chapter 5.2.

3.4 Description of data storages

The information service data is outlined using verbal descriptions of the data storages and an information service primary information model.

The primary information model describes the relationship between the architecture's main data sets and logistics data storages. The model is outlined in greater detail in Chapter 5.3.

3.5 Interpreting the architecture

In general

Actors in the freight transport sector have different tasks to carry out and objectives to reach while implementing transport telematics. An organisation that provides logistics services may be interested in the creation of an efficient management information system to help optimise its fleet management operations, while a track & trace service provider may be interested in the development of efficient information gathering and transfer and the standards associated with these.

The highest conceptual description in the architecture is the freight transport telematics upper-level process diagram (Figure 4.3). It outlines the transport telematics architecture processes, their actors/roles, and the interprocess connections. The diagram is meant to help organisations identify their own roles as well as roles that are essential for their operations.

The process component descriptions and input and output points are partly arbritrary. The limits of the components are chosen according to certain principles to ensure that as much as possible can be determined based on them. One could have chosen differently in many places without altering or negatively affecting the processes as a whole.

The process description is quite abstract, in that it uses the same process to describe all transport modes and various sizes of transport, from a shipment of nuclear waste from Japan to Great Britain to a goods delivery from a wholesaler to a retailer or an intermodal car-train-ship-car transport from Kempele to Great Britain.

What is crucial is how the process components can be combined to form real-life transport chain processes. Indeed, this should be the way to check the accuracy and applicability of the process descriptions: can these building blocks and data flows be used to describe a real-life process and its actors, and what kind of conclusions can be drawn about a process on the basis of its description.

Freight transport telematics processes

Transport telematics services are outlined using process diagrams of the target state. These target state process diagrams illustrate the division of tasks among the processes as well as the connections between the processes.

An organisation that plans to use the architecture should identify its own role(s) within it. The organisation should identify the processes it operates in, the roles it has, and the process components it is responsible for. Having doen this an organisation can identify the organisations and connections it will need to carry out its operations. The organisation will also be able to assess how well its operations correspond with the objectives set in the process description and plan its development operations by identifying the most important development targets.

Logical architecture

The logical architecture describes the information system services and data storages needed to carry out the transport telematics' function processes. The architecture describes the functional and information content of the overall solution without stating what kind of technology should be used to implement this solution. The functions include the information systems, subsystems, servers or other hardware responsible for information monitoring, gathering, processing and distribution.

The logical architecture also includes integration descriptions of the information system services. These describe the information system functions that support the process components of one or more function processes, integrated into logical entities. The components of the information system functions are information monitoring, gathering, logical processing, distribution and presentation.

An organisation using the architecture can use the integration description to identify which information technology functions belong to which process / process component and thus to its responsibilites as an actor.

3.6 Uses for architecture applications

3.6.1 Organisation producing freight transport telematics services

The freight transport telematics architecture especially supports the development of an organisation's general operating concept, but also provides a limited number of guidelines for individual systems.

An organisation carrying out transport telematics operations should use the national system architecture

- to assess the current status of its own system by comparing it to the national target.
- as the basis for developing its own operations, an actor-specific architecture or an individual system.

The assessment of the current status goes as follows:

1. The organisation has an overview or documentation of a function for which telematics is applied it wants to compare with the national architecture
2. Select a TARKKI process description or group of processes associated with this function
3. Reduce the function to its basic components to match the TARKKI processes
4. Assess which process components or connections the function covers, and whether the function is missing any process components or whether the process components include everything the function does
5. Assess which connections with other organisations are needed according to the TARKKI process description. Assess which connections already exist and which do not, and whether the current connections need development.
6. Assess the current status of the process components of other organisations. Find out whether these process components are sufficient for a connection between the organisations to be successful. The process deficiencies and development needs defined in the development plan (Chapter 7) can be used to assist this process.

The national system architecture can be used as the basis for the organisation's development operations as follows:

1. Select a TARKKI process description or descriptions that deal with the planned operating concept (the transport telematics architecture of an organisation, region or certain services) or an individual transport telematics function
2. If the development plan involves an existing function, the function's current status is assessed as outlined above
3. Start off the development process by selecting those process components from the TARKKI process description that the organisation will want to implement to create the function
4. Find out which interorganisational connections listed in the architecture are needed
5. Assess the current status of the process components of other organisations. Find out whether the processes of these organisations are sufficient for maintaining successful connections.
6. Check the TARKKI development plan for how important it is to follow international or national standards in the processes or connections. If the development plan states that a common standard is needed, but one does not exist, the organisation's development plan should state whether it is possible to utilise findings from the development project to create a new national standard.
7. Use the TARKKI development plan to assess possible problems that may occur during function development. The problems may involve e.g. administration, legislation or markets-realted issues. The development plan also proposes possible solutions or follow-up actions for dealing with these problems.
8. Select information system functions and their definitions that support the process components under examination from TARKKI logical architecture descriptions. Highlight these functions on the distribution map. This will give a general idea of the system being developed.
9. Compile data sets associated with the information system functions by using the information system function cross-referencing table. The data sets can be used as the basis for conceptual data modelling during system development.
10. Compile information system components that correspond to the information system functions, and highlight these components on the information system component distribution map. This provides the basis for the structure of the system.
11. Check the significance, data security and telematics dependence classifications given to the process components. They help pinpoint the data security and system management requirements of the system being developed.

3.6.2 The owner of the architecture, the Ministry of Transport and Communications

The national system architecture is a target architecture the Ministry of Transport and Communications uses

- to promote the national development of transport telematics
- to assess the usefulness and correspondence with the architecture of individual projects

Promoting the development of transport telematics

The architecture can be used to pinpoint the deficiencies and main development needs of an existing system. It can also be used to identify any administrative or organisational problems that may hinder development. This assists the planning and carrying out of freight transport telematics development tasks.

One part of the architecture is the outlining of the aforementioned actions to promote the development of freight transport telematics. The deficiencies and development needs are outlined in Chapter 6. The deficiencies have been pinpointed by comparing the current status of the system with the targets set in the architecture. Chapter 6 also proposes some of the main ways freight transport telematics processes can be developed and e.g. the organisational and administrative problems can be solved.

Assessing individual projects

The Ministry of Transport and Communication uses the system architecture while evaluating and steering individual projects it is involved in. The development of the systems and architectures of individual organisations is steered to make sure they correspond with the national architecture. The Ministry uses the system architecture to assess

- how useful a project is in bringing about the objectives set in the system architecture
- how well a project fulfills the main requirements of the system architecture.

Development processes are steered by comparing them with the national architecture.

1. There is a description or an idea for a development intiative
2. Select the TARKKI process description that applies to this project
3. Assess which process components or connections are covered by the project
4. Assess how well the project implements missing parts of the process or solves problems related to the process. This helps assess the significance of the project for national development.

5. Assess which parts of the process should follow national or international set solutions, such as standardised interfaces between process components. Evaluate how well the project has utilised standardised solutions and how well the project promotes their development.

Based on this comparison, projects are given feedback about how well they fulfill the requirements set in the architecture and how useful they are for the overall system. Further actions are also proposed to steer the projects' development towards the targets set in the architecture.

Resource allocation

The Ministry of Transport and Communications steers the implementation of the national system architecture through resource allocation. Resources are given to projects that are important for the architecture and which are implemented according to the principles set in the architecture.

4 PROCESS DESCRIPTIONS

This chapter outlines the architecture application area and process descriptions. The processes are described first through upper-level process maps and a main process diagram and then through descriptions of the subprocesses. Each process description consists of a diagram illustrating its (third level) process components and the data flows between them and between process components and outside parties.

4.1 Architecture application area and process map

The architecture application area (Figure 4.1) shows the limits of the architecture: which processes are described within it and which are not.

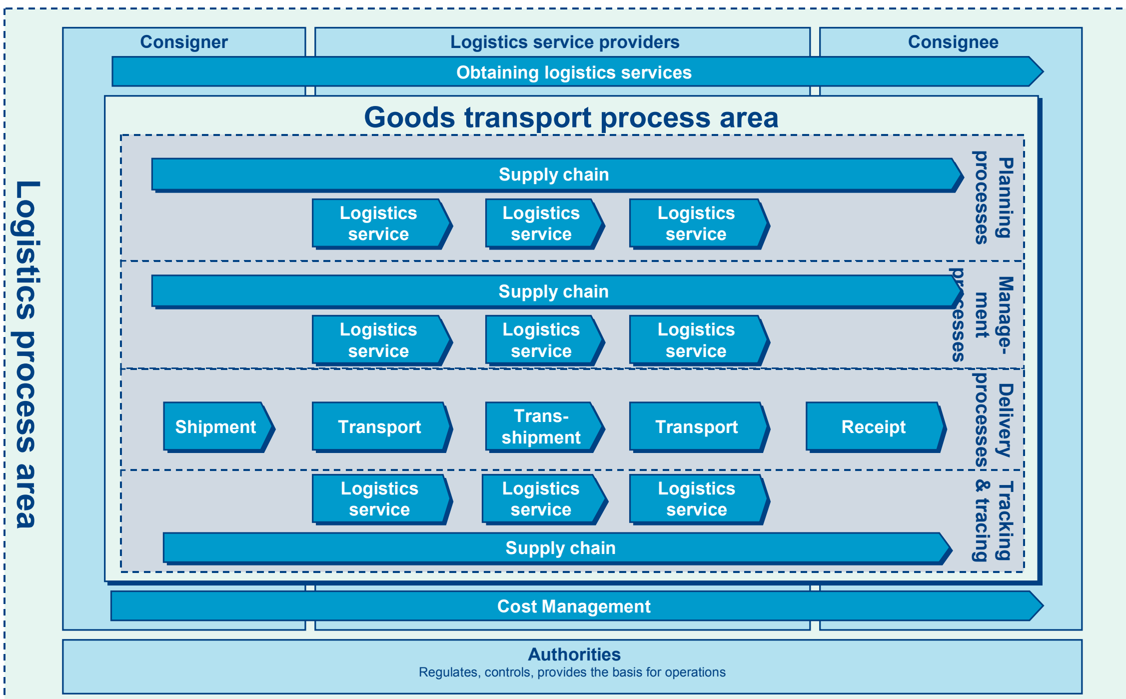


Figure 4.1. The freight transport telematics architecture application area.

The actors included in the architecture are the consigner, consignee, logistics service providers and the authorities.

The logistics process area limits the architecture to Freight Transport processes; the described processes are the Planning, Management, Delivery and Tracking and Tracing processes within the Freight Transport process area. Verbal descriptions of these are included in a supplementary table (Table 4.1).

The Purchase of Logistics Services process is not described here, apart from its interfaces and connections with the Freight Transport process area. The Cost Management process is also not described, apart from its interfaces with the other processes. However, descriptions of these two processes are included in the process map, mainly to clarify their boundaries. The actual process descriptions (diagrams) present the Purchase of Logistics Services subprocesses as identified external processes.

Descriptions of the target processes are based on the assumption that the freight transport process will not change significantly: the process will always center around physical goods and their transport from a starting point to a destination using some means of transport.

The Planning, Management and Tracking and Tracing processes are hierarchical: their contents are clearly divided between the actor responsible for the entire supply chain and the actor responsible for individual services (transport legs and terminal services). This division helps distinguish between the operator focusing on the optimisation of the use of the means of transport (logistics service provider) and the one focusing on the optimisation of the entire transport (supply chain service provider).

The result of this is that fleet use optimisation is carried out individually for each transport mode and operator. There is no common fleet use optimisation function that covers all modes of transport or all supply chains.

The optimisation of transports is carried out according to the needs of the customer in each individual supply chain, or if the customer has no special needs, each logistics service provider will optimise its own fleet use. The entire supply chain can be optimised to fit the needs of the customer, taking into consideration economic considerations, rate of delivery, delivery reliability, environmental impacts and other factors.

Table 4.1. Upper-level process map.

ID	Name	Description	Starting point	End point	Notes
0	Trade				
1	Delivery	Transporting goods from the departure point and consigner to the destination and consignee as per the transport order.	The transported goods exist. A transport plan exists.	The goods and data are ready for use by the consignee during the next stage of the production process.	All stages of the delivery process may produce shipment tracking information (content, location and condition information).
2	Planning	Planning goods transport supply chains and logistics services. Planning the shipment supply chain and the associated logistics services.	The need for transport is identified.	The delivery / transport of goods begins.	Planning takes place before goods transport begins. Activity during goods transport falls under the Management process.
3	Management	Managing the goods shipment supply chain and logistics services. Controlling and enforcing the shipment supply chain and the associated logistics services, and responding to exceptions.	The delivery / transport of goods begins.		
4	Tracking and tracing	Collecting and recording tracking data, and distributing it to users. Carrying out tracking and tracing on request.	The need for tracking and tracing is identified.	Tracking data is deleted.	
5	Infrastructure and traffic management				
9	Cost management	Collecting the event information necessary for charging customers for logistics services, creating an invoice database and making performance-based efficiency analyses.			The tasks associated with actually compiling and sending an invoice and with monitoring invoicing are the responsibility of the financial administration process.

The Delivery process outlines the operations involved in the physical transport of goods within the Shipment-Transport-Transshipment-Receipt chain. By combining the Transport and Transshipment processes in different ways, these subprocesses can used to create processes to describe any kind of supply chain. In the architecture application area diagram, this is illustrated using the supply chain Shipment-Transport-Transshipment-Transport-Receipt. Process map descriptions of the Delivery subprocesses are outlined in the next table (Table 4.2).

Table 4.2. Process map of Delivery subprocesses.

ID	Name	Description	Starting point	End point	Notes
1.1	Shipment	Preparing goods for transport and releasing them to the transport operator.		The delivery lot (goods) and the responsibility for them are given to the transport operator.	The process may entail loading procedures at the loading site and by the means of transport.
1.2	Transport	Transporting goods by a means of transport from the departure point to the destination.	The goods and responsibility for them have been accepted at the departure point.	The goods and responsibility for them have been released at the destination.	The process may entail the loading of goods/shipments at the departure point and their unloading at the destination.
1.3	Transshipment	The handling of a shipment/goods between two transport legs. The shipment is unloaded from a vehicle and loaded onto another for the next leg. Transshipment may include other activities associated with the handling of a shipment and goods, such as storage, terminal handling or other value added services	The goods and responsibility for them have been accepted.	The goods and responsibility for them have been released.	The process may entail the unloading of incoming shipments and the loading of outgoing shipments at the loading site and by the means of transport.
1.4	Receipt	Receiving a shipment, checking and unloading the parcels, checking the goods and their condition, and preparing the goods for the next stage of the consignee's production process.	The goods and responsibility for them have been accepted.	The goods and data are ready for use in the next stage of the production process.	The process may entail the unloading of goods/the shipment from the means of transport.

The subprocess interfaces have been defined so that the interfaces are also the points where responsibility for the transported goods changes hands.

The Planning and Tracking and Tracing processes describe the processes of both the logistics service provider (transport operator or terminal operator) and the operator responsible for the whole supply chain. The Management and Delivery processes are very closely connected, and both use the same process component division. The Management process is, however, supplemented with the process component Supply Chain Management. The process maps of these subprocesses are below.

Table 4.3. Process map of Planning subprocesses.

ID	Name	Description	Starting point	End point	Notes
2.1	Supply chain planning	Planning and putting together supply chains, signing contracts with logistics service providers, and producing services (routes, timetables). Planning of services and operations for use by logistics service providers, planning the use of resources.			
2.2	Transport planning	Planning the execution of a transport order: receiving transport orders, drawing up a transport plan, booking the necessary transport resources from logistics service providers.			

Table 4.4. Process map of Management subprocesses.

ID	Name	Description	Starting point	End point	Notes
3.1	Shipment operations management	Managing consigner production.			The description does not include the management of transport means, personnel and other resources.
3.2	Transport operations management	Managing transport means and personnel, and managing transports.			
3.3	Transshipment operations management	Managing transshipment resources, managing transshipment operations.			
3.4	Reception operations management	Managing consignee production.			The description does not include the management of transport means, personnel and other resources.
3.5	Supply chain operations management	Managing the entire supply chain on the basis of the transport plan.			

Table 4.5. Process map of Tracking and Tracing subprocesses.

ID	Name	Description	Starting point	End point	Notes
4.1	Supply chain tracking and tracing	Shipment tracking and tracing within the supply chain. Tracking data is primarily collected on individual shipments / parcels / goods.			
4.2	Logistics operator tracking and tracing	Collecting and recording tracking data, and distributing it to users. Carrying out tracking and tracing on request through logistics service providers within the supply chain. The users of tracking data provided by logistics service providers include at least the supply chain service provider, who is provided with tracking data as per the tracking request.			

Transport authority operations include the operations of the infrastructure manager, enforcement operators and licencing authorities. It should be noted that some of the transport authority operations have been modelled as parts of other processes (e.g. the management of licenses and declarations). Transport authority operations have only been modelled as second level subprocesses.

Table 4.6. Process map of Transport authority operations subprocesses.

ID	Name	Description	Starting point	End point	Notes
5.1	Maintenance of infrastructure information	Maintaining information on the transport infrastructure and individual transport facilities.			
5.2	Capacity booking	Booking transport infrastructure capacity, planning the use of transport infrastructure.			
5.3	Traffic monitoring	Collecting traffic tracking information.			Tracking data can be collected on vehicles through transport operators' tracking systems. Tracking data can also be collected using separate, fixed systems connected to the transport infrastructure.
5.4	Traffic control and enforcement	Planning and carrying out traffic control operations, monitoring traffic violations, deciding on the consequences and carrying them out.			
5.5	Transport control and enforcement	Monitoring transports and violations, deciding on the consequences and carrying them out.			

The Delivery, Management and Tracking and Tracing processes (Figure 4.2) are essential for the description of the objectives set in the architecture and for the objectives themselves. The management of the Shipment and Receipt processes takes place in the Consigner and Consignee Production Planning processes, so these too are very significant. The Planning process is less significant, but still significant or highly significant. The Planning process becomes less significant the farther we move from the planning of operations.

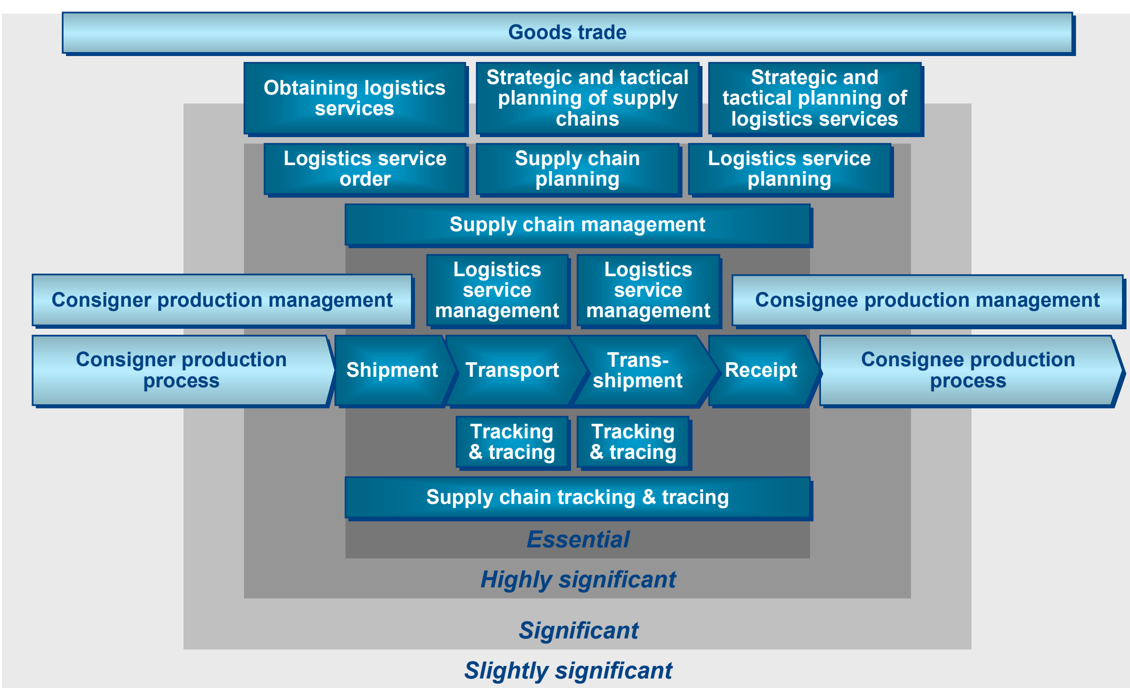


Figure 4.2. The significance of processes for the architectural objectives.

4.2 Main process data flows

The main process data flows are outlined in the next figure (Figure 4.3). The figure shows the data flows divided into groups according to their contents. The data flows have been divided into

- data flows containing goods order and transport agreement information. Most of these data flows originate outside the freight transport process area.
- data flows containing transport order information.
- data flows containing consignment note and load list information. The consignment note and load list here refer to their information content in an extensive sense[9].
- data flows containing management information. Management information mostly consists of the internal data flows of processes/actors.
- data flows containing tracking data.
- other (unclassified) data flows.

The processes have been divided slightly differently in the figure than in the architecture application area diagram (Figure 4.1). In the Planning process, Supply Chain Planning and Transport Planning have both been divided into actor-specific parts:

- In the logistics service provider level, 2.1 is named Service Planning.
- In the logistics actor level (includes consigners, consignees and service providers), 2.2 is named Transport Leg Planning.

The material and data flows have been divided between two processes: the material flow travels within the Delivery process from one actor to the next, while a corresponding data flow (consignment note / load list) travels from actor to actor within the Management process.

Adjacent actors within the process make a management contract, i.e. exchange management information to ensure the controlled release and acceptance of the material flow among the actors. At its simplest this can be seen when a driver asks a forklift driver to move a pallet to the left side of a trailer and the forklift driver waves back as a sign of approval.

The overall process is outlined in detail in Appendix 3.

---

[9] Logistics Chain EDI Project - Increasing the Efficiency of Trade Data Exchange

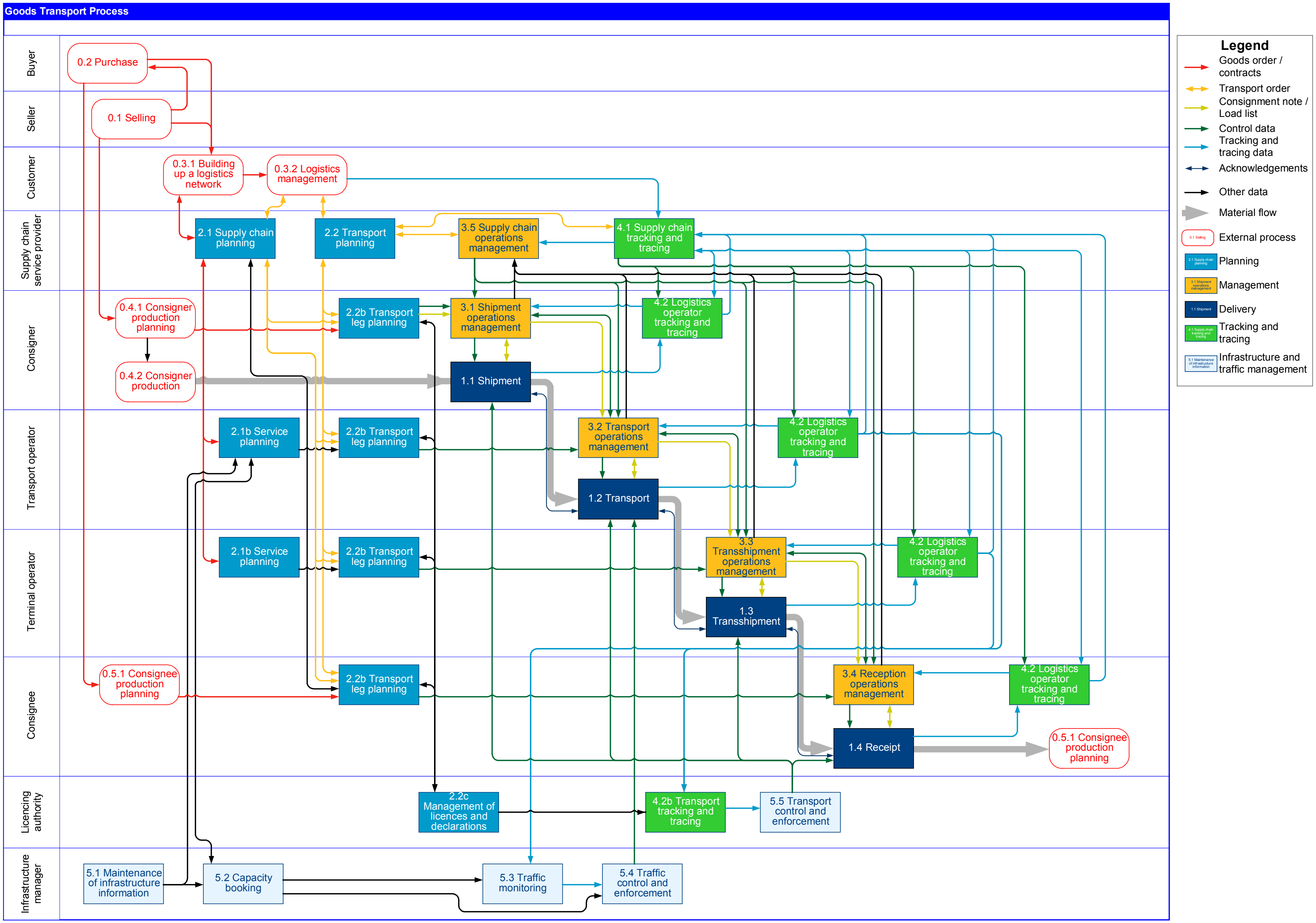


Figure 4.3. Freight transport upper-level process diagram; process components and data flows.

4.3 Roles and actors

A number of roles that may be filled by real-world actors have been identified in the freight transport processes. The roles are described in the table below (Table 4.7).

Table 4.7. Role descriptions.

Name	Description	Notes
Customer	Consigner, consignee or other party whose logistics chain the delivery is part of. A customer can make an order for transportation. A transport can also be ordered by another party, but the transport demand depends on the customer production planning and management process, and the transport order can be seen to be based on the customer's logistics planning process.	The role of the customer and the roles of the consigner and consignee have been separated, so that the same process model can be used to represent the fulfilment of the transport requirements of both push and pull logistics chains.
Transport operator	The transport operator is responsible for providing the transport service.	
Means of transport	The means of transport is a vehicle used to transport goods, i.e. a car, train, ship or plane.	
Enforcement operator	Carries out traffic enforcement operations. Can also carry out traffic control operations.	Often set by transport mode. Can be an authority or route/infrastructure manager or other service provider.
Track & trace service provider for logistics services	The logistics services' track & trace service provider is responsible for collecting, recording and managing tracking data on an individual logistics service.	
Logistics service provider	The logistics service provider is responsible for providing either a logistic transport or terminal service. Thus, the logistics service provider is either the Transport operator or the Terminal operator.	
Licencing authority	Receives transport declarations and issues licences. The licencing authority can also carry out transport control and enforcement operations.	An infrastructure manager can be a licencing authority.
Consigner		
Track & trace service provider	The track & trace service provider provides tracking and tracing services, receives, records and stores tracking information and distributes it to the parties that are authorised to receive such data. The track & trace service provider can supply either logistics services or a supply chain with information.	
Tracking data user	The tracking data user is an actor involved in goods transport who is able, willing and allowed to receive and utilise tracking data from a delivery lot transport. The consigner and consignee are typical tracking data users. Other actors within the goods trade process may also be interested in tracking data. Authorities and infrastructure managers who enforce transports and transport routes can also be tracking data users.	
Tracking unit	A tracking unit is a vehicle, transport unit, parcel or individual goods item that collects tracking data. A tracking unit can record tracking data in a local data storage.	Fixed tracking data collection equipment are tracking system input terminals, not tracking units as defined here.
Track & trace service provider for supply chain	The supply chain track & trace service provider is responsible for collecting, storing and managing tracking data throughout the supply chain.	
Supply chain service provider	The supply chain service provider is responsible for the entire supply chain, i.e. for a transport from its departure point to its destination.	
Consignee		
Terminal operator	The terminal operator is responsible for the provision of transshipment logistics services.	
Infrastructure manager	The infrastructure manager is in charge of the maintenance, use and enforcement of the transport infrastructure, e.g. roads, railroads and waterways. The infrastructure manager also issues transport licences for licenced transports. The responsibilities of the infrastructure manager can be divided among several actors, e.g. enforcement operations can be carried out by a different actor from the one responsible for all other route network maintenance tasks.	

The roles are somewhat abstract concepts. It should be remembered that in many cases a physical actor and a role defined in a process description do not correspond directly to one another. An actor can have many roles within a process, or the same role can be carried out by several actors. An example is the tracking data user, who can be e.g. a goods consigner, goods consignee, other trade participant or authority.

4.4 Detailed descriptions of subprocesses

The process descriptions are divided by sub-area. Figure 4.4 illustrates the sub-areas as parts of the overall process.

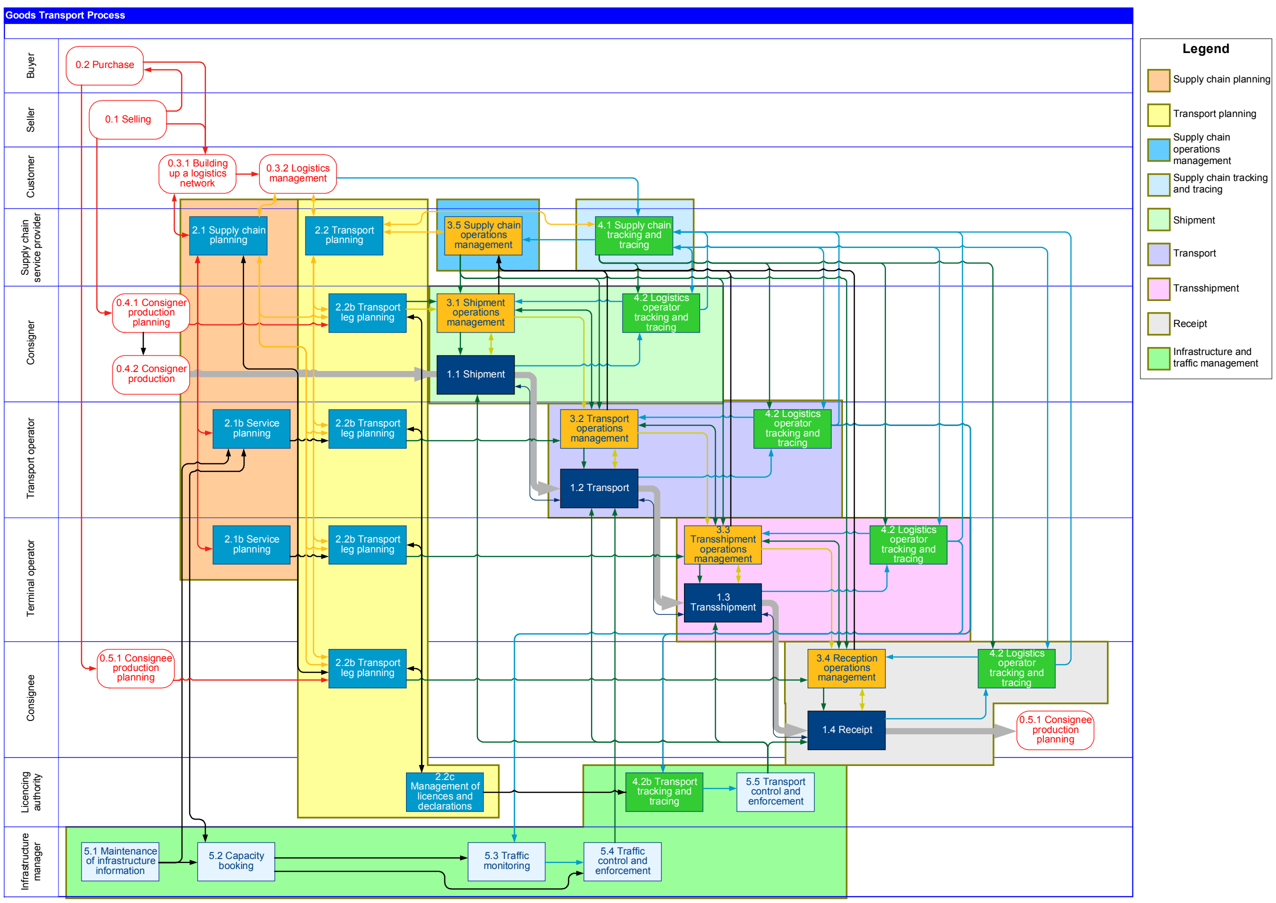


Figure 4.4. Process description sub-areas.

The process descriptions are structured slightly differently for an actual transport process: for each part of the Delivery process (Shipment, Transport, Transshipment and Receipt), the description also gives those parts of the Management and Tracking and Tracing processes that are connected with the subprocess. This structure is based on the facts that there are a great many data flows between these process components and that most of the process components are the responsibility of one and the same actor.

4.4.1 Supply chain planning

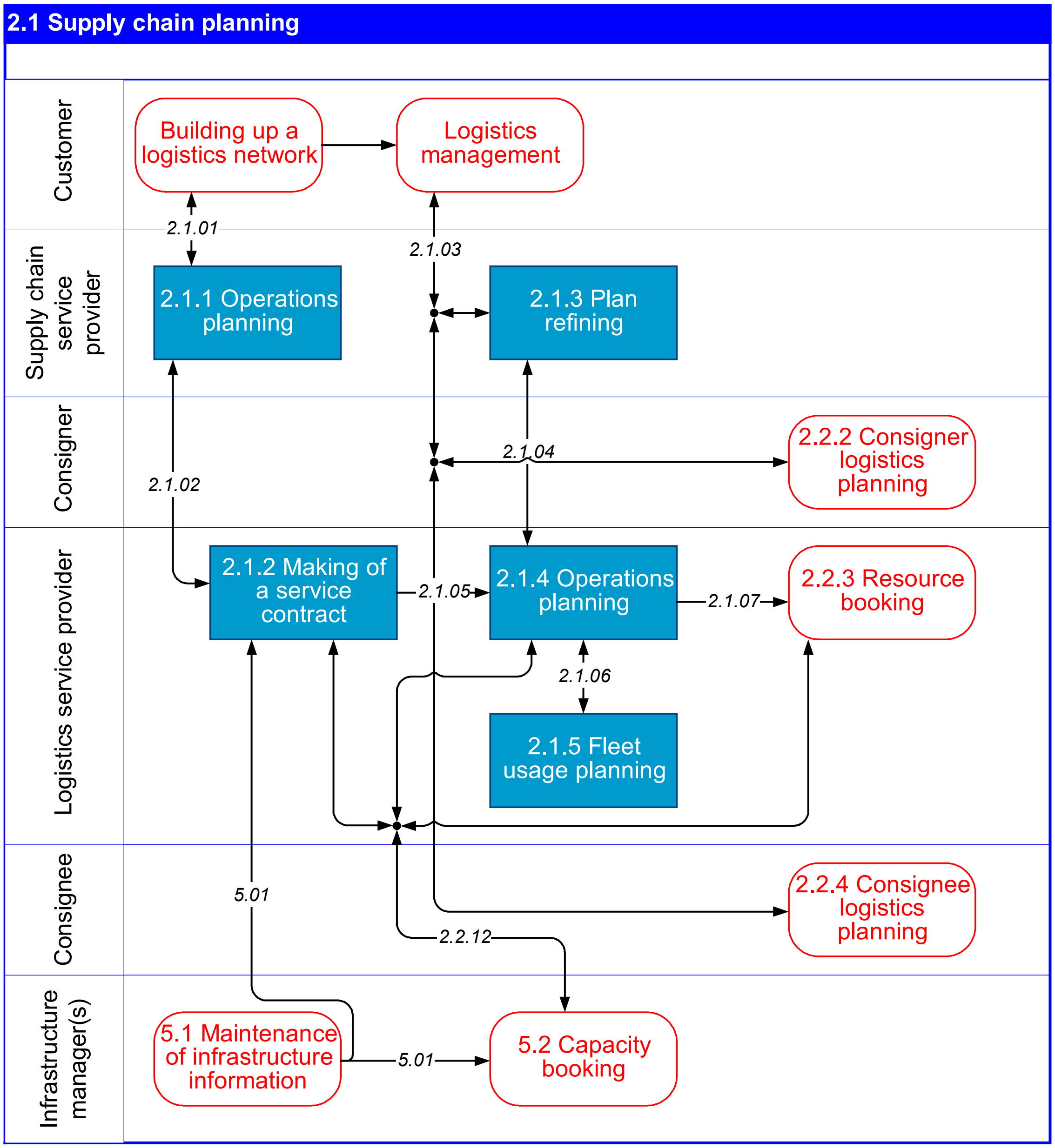


Figure 4.5. Process components and data flows of the Supply Chain Planning process.

The process includes the actor with the role of Supply Chain Service Provider and all the actors with the role of Logistics Service Provider. The main products of the process are the contracts between the customer and supply chain service provider and between the supply chain service provider and other service providers. Plans concerning transports and their realisation are other main products. Advance information on transport orders and plans is relayed to the actors in both the consigner and consignee roles.

The actors in charge of the infrastructure mostly receive transport-related capacity booking data flows.

The process components are outlined in the following table.

Table 4.8. Descriptions of process components in process 2.1 Supply Chain Planning.

ID	Name	Description	Starting point	End point	Notes
2.1.1	Operations planning	Signing contracts with logistics service providers, signing contracts with customers, producing services.			The services provided may include e.g. routes, transport modes and schedules.
2.1.2	Making of a service contract	Signing contracts with the owner of the supply chain. Planning the use of resources. Producing services for logistics service providers and adjusting these to suit the needs of the supply chain service provider.			
2.1.3	Plan refining	Receiving a preorder (preliminary transport order). Drawing up a preliminary transport plan, relaying the preorder to the logistics service providers, the consigner and the consignee.			
2.1.4	Operations planning	Planning of transport or transshipment according to the preorder. The goal is to optimise transport and transshipment operations.			
2.1.5	Fleet usage planning	Planning the fleet usage of logistics service providers.			The goal is the management of the fleet (and other necessary resources), and the optimisation of costs and e.g. environmental impacts.

4.4.2 Transport planning

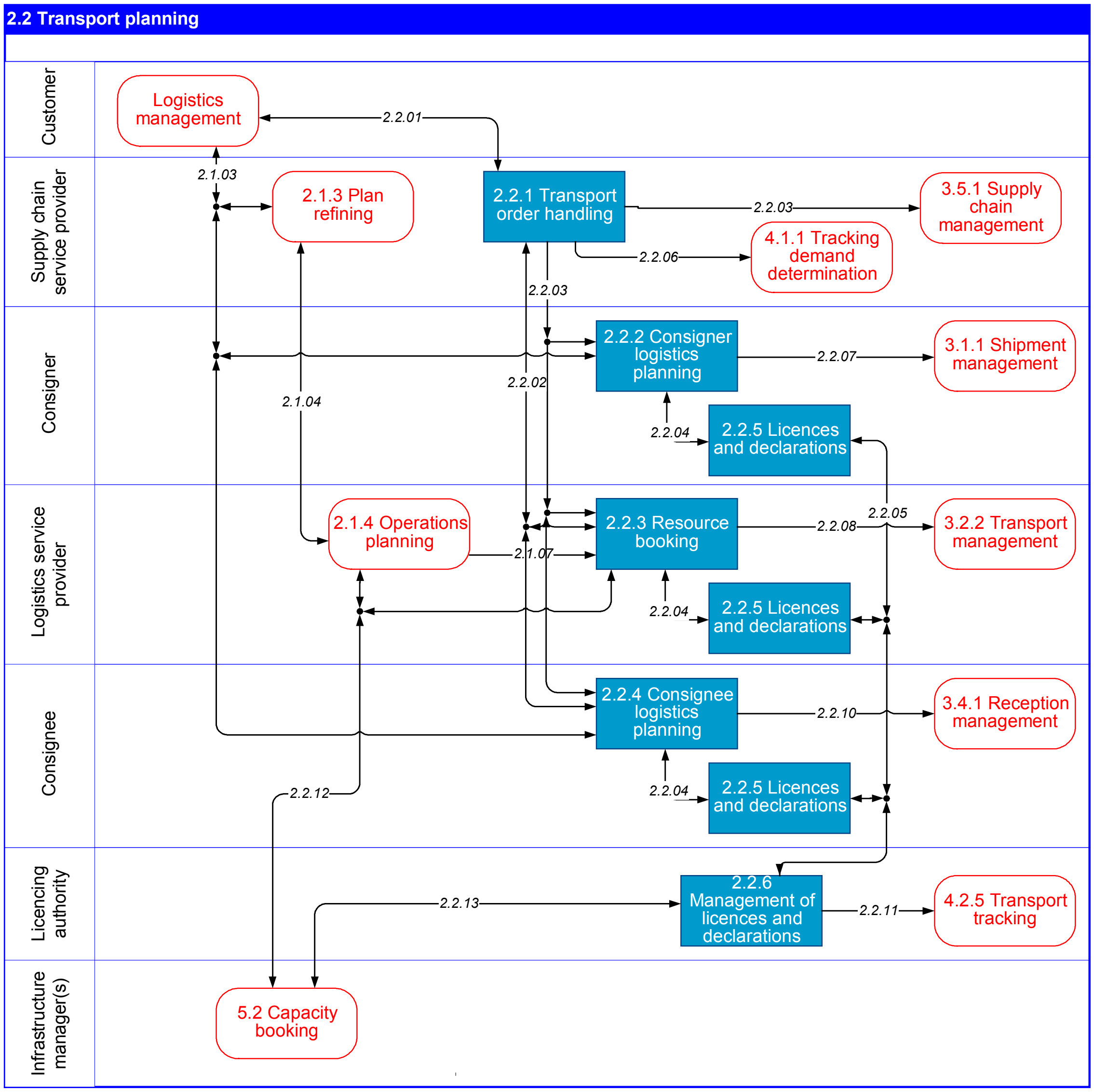


Figure 4.6. Process components and data flows in process 2.2 Transport Planning.

Table 4.9. Descriptions of process components in process 2.2 Transport Planning.

ID	Name	Description	Starting point	End point	Notes
2.2.1	Transport order handling	Receiving a transport order, drawing up a transport plan, booking supply chain resources from transport and terminal operators, and relaying the transport plan to all parties in the supply chain.			
2.2.2	Consigner logistics planning	Planning consigner production.			
2.2.3	Resource booking	Receiving a transport order for a leg, and booking resources for providing logistics services. Giving an order confirmation to the supply chain service provider.			
2.2.4	Consignee logistics planning	Planning consignee production.			
2.2.5	Licences and declarations	Processing and managing the licences and declarations needed to provide a logistics service.			
2.2.6	Management of licences and declarations	Receiving and processing licences and declarations. Managing licences and declarations. Maintaining licence registers.			

4.4.3 Supply chain management

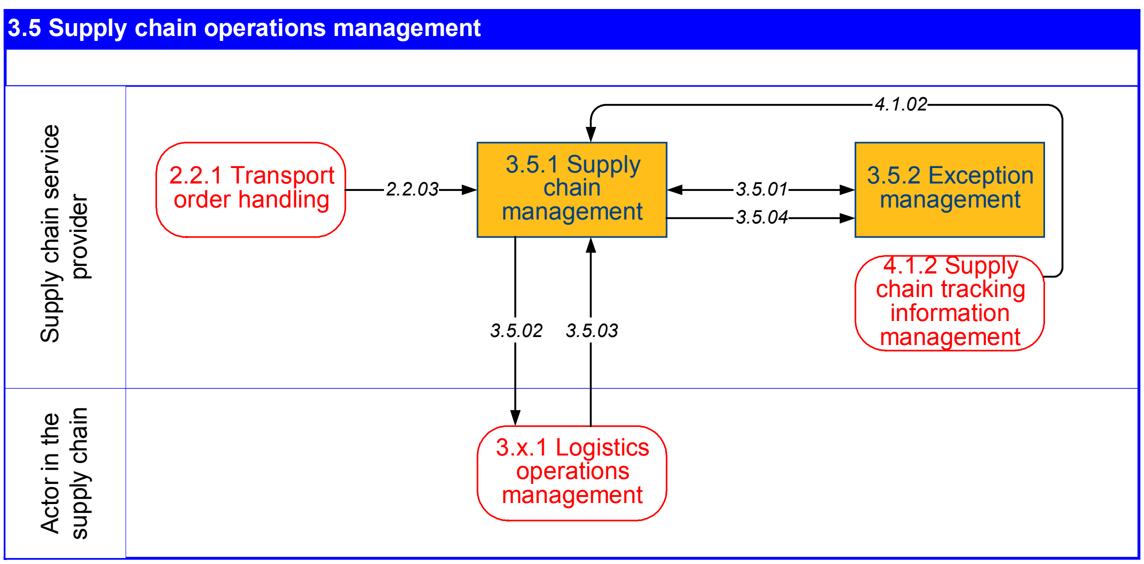


Figure 4.7. Process components and data flows in process 3.5 Supply Chain Management.

Table 4.10. Descriptions of process components in process 3.5 Supply Chain Management.

ID	Name	Description	Starting point	End point	Notes
3.5.1	Supply chain management	Relaying the transport plan to the other actors within the supply chain. Receiving information on the carrying out of transports from other actors within the supply chain. Observing exceptions and relaying the information to Exception management.		The goods have reached the consignee at the destination and have been accepted by the consignee.	
3.5.2	Exception management	Receiving incident and exception data, analysing exceptions, updating the transport plan.	Information on exceptions.	The updated transport plan has been relayed to Supply chain management.	Exception management is an internal process of the supply chain service provider. It only communicates with Supply chain management.

This process is the sole responsibility of the actor with the role of supply chain service provider. It is connected to the operations management processes of all the supply chain actors. It is connected in the same way with shipment, transport, transshipment and receipt management: the logistics chain actor receives the transport plan and the supply chain service provider receives the realisation data.

4.4.4 Supply chain tracking and tracing

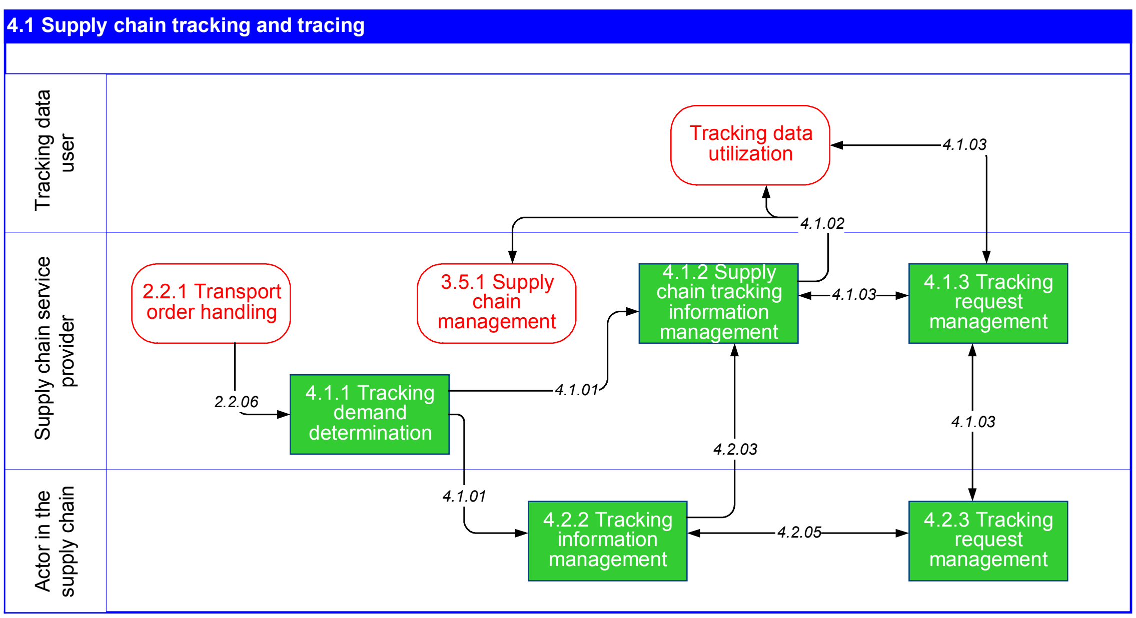


Figure 4.8. Process components and data flows in process 4.1 Supply Chain Tracking and Tracing.

Table 4.11. Descriptions of process components in process 4.1 Supply Chain Tracking and Tracing.

ID	Name	Description	Starting point	End point	Notes
4.1.1	Tracking demand determination	Determining the demand for tracking and the level of tracking needed on the basis of the transport order (and other contracts). Creating a tracking ID. Making tracking requests to supply chain service providers.			The demand for tracking is affected e.g. by the value of the goods, the length of the transport and the type of goods being transported, e.g. hazardous goods transports and special transports.
4.1.2	Supply chain tracking information management	Managing tracking data within the supply chain: Receiving information from within the supply chain. Collecting and combining the information. Recording the information. Distributing tracking data to users. Deleting tracking data.			
4.1.3	Tracking request management	Receiving and handling tracking requests, and responding to tracking requests. The tracking request is first handled within the supply chain. If the necessary information is not available, the tracking request is relayed to logistics service providers.			

4.4.5 Shipment

This chapter outlines process 1.1 Shipment. The shipment-related parts of processes 3.1 Shipment management and 4.2 Logistics Service Tracking and Tracing are also described.

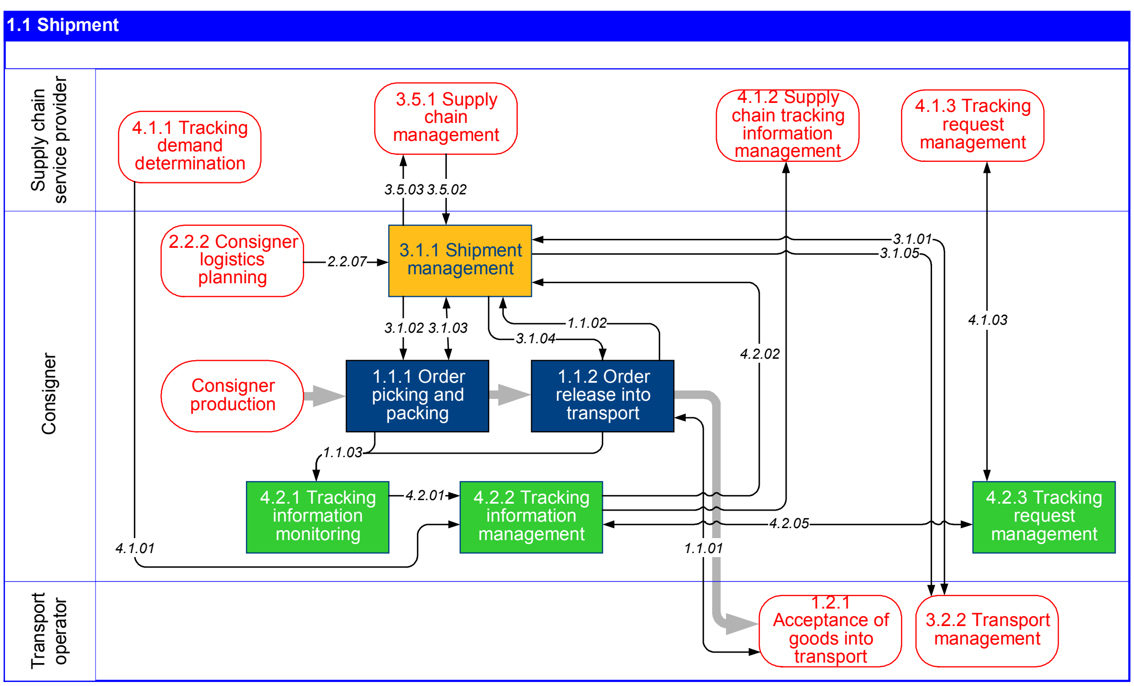


Figure 4.9. Process components and data flows in process 1.1 Shipment.

Table 4.12. Descriptions of process components in process 1.1 Shipment.

ID	Name	Description	Starting point	End point	Notes
1.1.1	Order picking and packing	Collecting goods at the shipment point, prepping for transport, packaging and putting together parcels. Together, parcels form a delivery lot. Parcels can also be combined and consolidated.		Parcels exist and have been compiled into a delivery lot.	
1.1.2	Order release into transport	All tasks involving the loading of parcels that the actor is responsible for. The transfer of goods and responsibility to the next actor within the supply chain. The identification of the next actor and getting the proof of delivery from them.	The delivery lot exists. The parcels exist.	The next actor within the supply chain has accepted the goods and responsibility for them.	The same as process component 1.3.3, Order release.
3.1.1	Shipment management	Managing consigner operations. Managing packing and consigning, aligning the consigner's parts of the loading plan and shipment plan.			
4.2.1	Tracking information monitoring	Monitoring and collecting tracking information within the process. Tracking information may include - content information (transport means / transport unit / parcel / goods hierarchy) - condition information - location information The monitoring of tracking information can be carried out automatically with fixed or mobile equipment, or manually by personnel.			
4.2.2	Tracking information monitoring	Receiving information on the tracking demand. Collecting, recording and distributing tracking data. Deleting tracking data.			
4.2.3	Tracking request management	Receiving tracking requests, collecting tracking data, and responding to tracking requests. Tracking requests are handled within logistics services. If the necessary information is not available there, tracking requests can be relayed to be handled on the level of individual tracking units (transport means / transport units).			

The data flows are outlined in the tables separately for the Shipment and Shipment Management processes and the Tracking and Tracing process.

4.4.6 Transport

This chapter outlines process 1.2 Transport. The transport-related parts of processes 3.2 Transport Management and 4.2 Logistics Service Tracking and Tracing are also described.

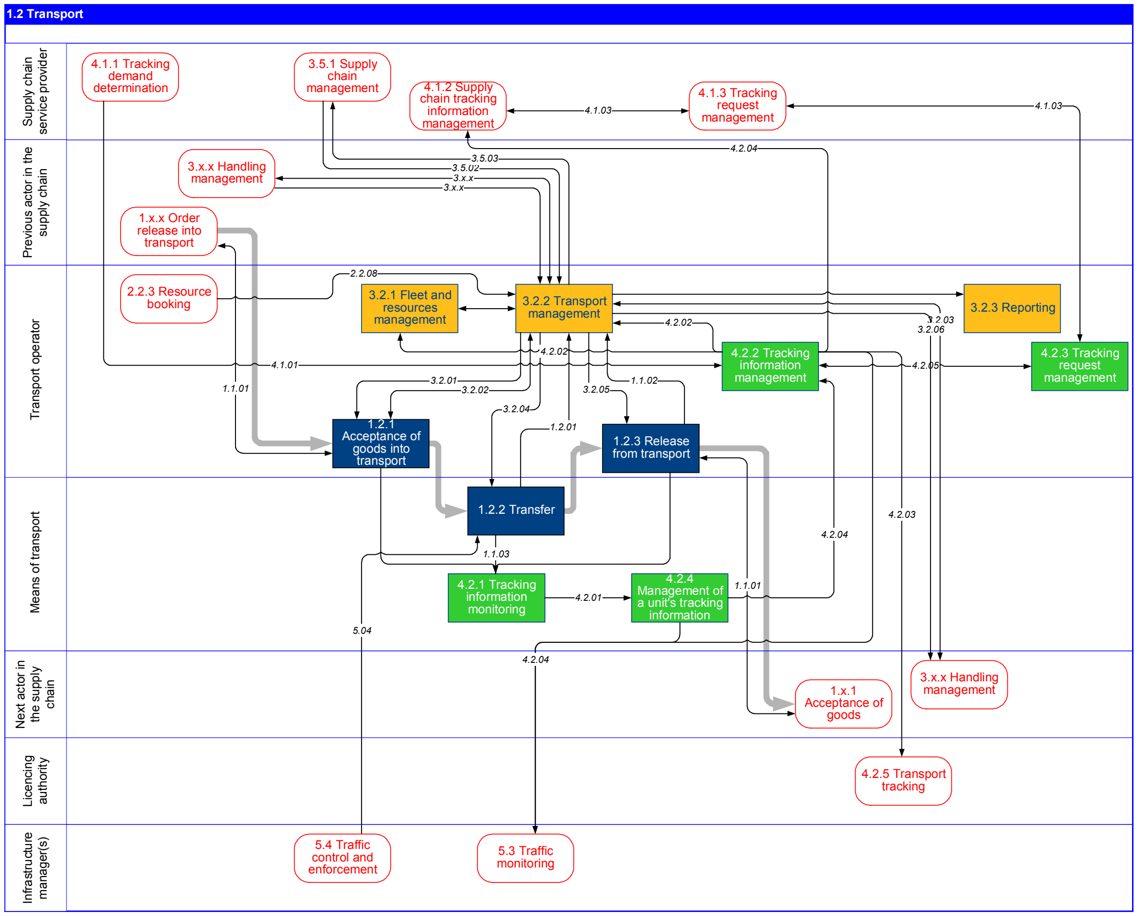


Figure 4.10. Process components and data flows in processes 1.2 Transport and 3.2 Transport Management.

Table 4.13. Descriptions of process components in process 1.2 Transport.

ID	Name	Description	Starting point	End point	Notes
1.2.1	Acceptance of goods into transport	All tasks involving the loading of parcels that the transport operator is responsible for. The receipt of goods and responsibility, signing the proof of delivery. Forming delivery lot shipments, and making a record of the means of transport and the content of the transport units.	Acceptance of goods at the departure point.	The means of transport is ready to depart, all shipments have been loaded.	
1.2.2	Transfer	The transfer of the means of transport (and the shipments/parcels/goods being transported in it) from the departure point to the destination, the management of events and exceptions during transport, informing other parties of these events and exceptions, and giving an ETA for the transport.			The relationship between the means of transport and the transport units may change during the transfer: one part of a car-and-trailer combination is switched, or train carriages are transferred and coupled onto another train during a trip.
1.2.3	Release from transport	All tasks involving the unloading of cargo that the transport operator is responsible for. The release of goods and responsibility, and receipt of the proof of delivery.		The release of goods and responsibilities at the destination.	
3.2.1	Fleet and resources management	Managing transport means (and personnel and other necessary resources). The focus is on managing the means of transport and optimising their use.			Approximately / exactly the same as process component 3.3.1.
3.2.2	Transport management	Managing a single transport leg. Managing loading and unloading. Aligning the consignment plan and loading plan. Receiving exception and event data, and managing incidents and other exceptions.			
3.2.3	Reporting	Reporting the use of resources and the number of successful transports and exceptions.			
4.2.1	Tracking information monitoring	Monitoring and collecting tracking information within the process. Tracking information may include - content information (transport means / transport unit / parcel / goods hierarchy) - condition information - location information The monitoring of tracking information can be carried out automatically with fixed or mobile equipment, or manually by personnel.			

4.4.7 Transshipment

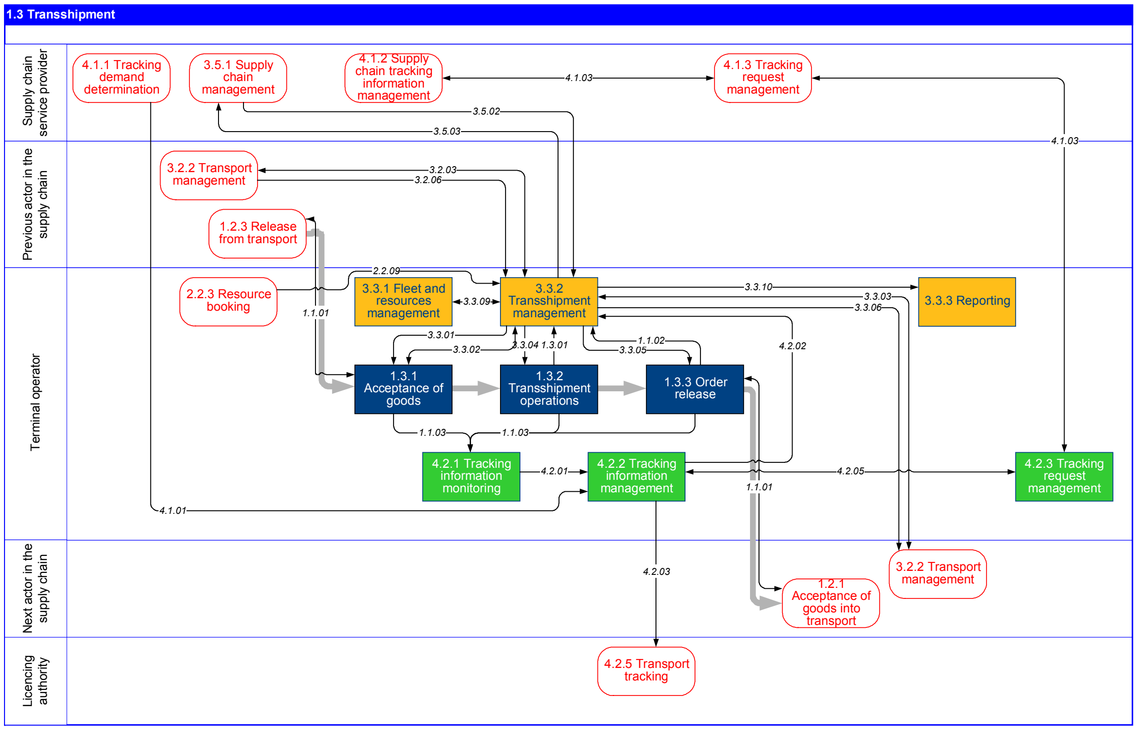


Figure 4.11. Process components and data flows in processes 1.3 Transshipment and 3.3 Transshipment Management.

The terminal operator mainly communicates with the actors directly before and after it in the process. The actor and process before it are usually the Transport operator and the Transport process. The process can also be Shipment. The actor and process after it are also usually the Transport operator and Transport process. The process can also be Receipt.

The Transshipment process can be viewed as terminal operations. It should be remembered that this analogy is not totally correct, as a terminal operator's process can also contain parts of the Shipment and Receipt processes when modelling real-world processes. For instance, a ”customer service terminal” (post office) at the sending end mainly possesses characteristics of the Shipment process, while the receiving end (pick-up point) mainly possesses characteristics of the Receipt process.

Table 4.14. Descriptions of process components in processes 1.3 Transshipment and 3.3 Transshipment Management.

ID	Name	Description	Starting point	End point	Notes
1.3.1	Acceptance of goods	All tasks involving the unloading of parcels from the vehicle / transport unit that are the responsibility of the actor. The checking of parcels, the acceptance of the shipment and possible transport reclamations. The acceptance of goods and responsibility, and signing the proof of delivery.			The same as process component 1.4.1, Acceptance of goods.
1.3.2	Transshipment operations	The handling of goods and parcels within the transshipment process. At the minimum, transshipment operations consist of the moving and preparation of shipment parcels for loading. Transshipment operations can also include terminal handling (cross-docking), storage or other value added services.			If the transshipment includes terminal handling, storage operations or other value added services, the supply chain often ends with the transshipment, and a new supply chain begins.
1.3.3	Order release	All tasks involving the unloading of parcels that are the responsibility of the actor. The release of goods and responsibility to the next actor within the supply chain. Identifying the next actor and receiving the proof of delivery.			The same as process component 1.1.2, Order release into transport.
3.3.1	Fleet and resources management	Managing the means of transport (and personnel and other necessary resources). The focus is on managing the means of transport and optimising their use.			Approximately / exactly the same as process component 3.1.1.
3.3.2	Transshipment management	Managing a single transport during transshipment. Managing the acceptance and release of transports. Aligning the transshipment plan and unloading plan. Receiving exception and event data, and managing incidents and other exceptions.			
3.3.3	Reporting	Reporting the use of resources and the events and exceptions that take place during transshipment.			

4.4.8 Receipt

This chapter outlines process 1.1 Receipt. The receipt-related parts of processes 3.4 Reception Operations Management and 4.2 Logistics Service Tracking and Tracing are also described.

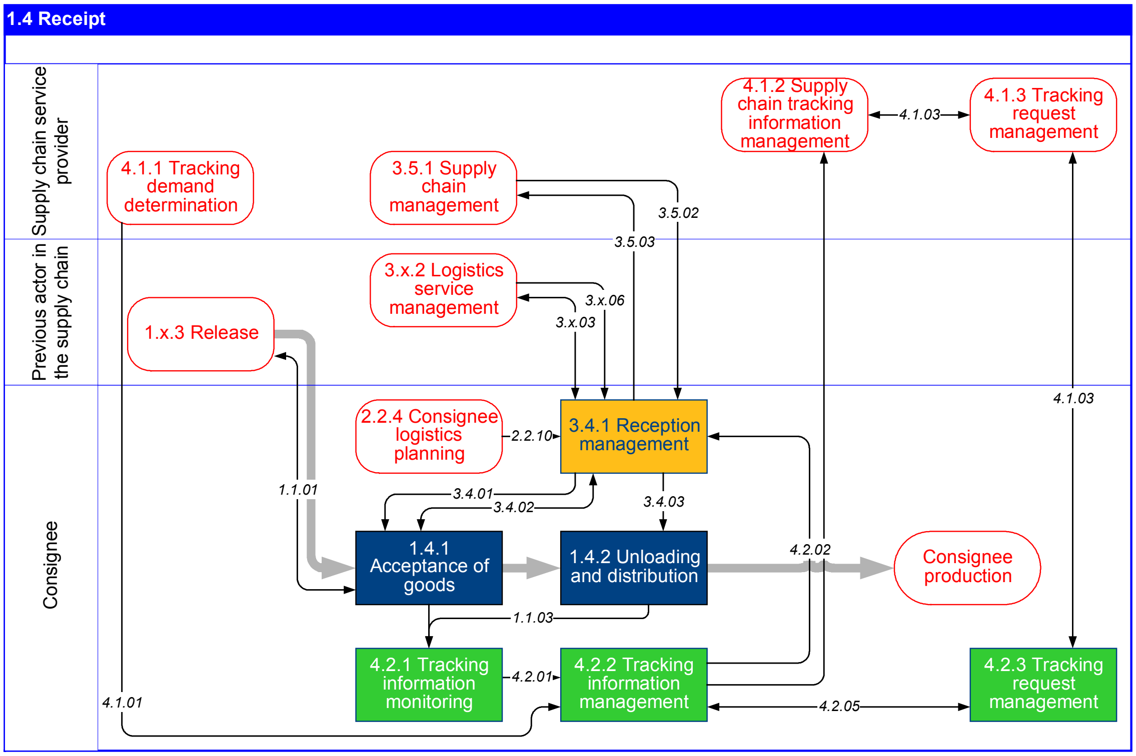


Figure 4.12. Process components and data flows in processes 1.4 Receipt and 3.4 Reception management.

The consignee's part of the delivery process and management process mainly communicates with the corresponding processes of the actor right before it in the supply chain. The supply chain service provider's processes mainly provide information on the transport plan and receive realisation information.

Table 4.15. Descriptions of process components in processes 1.4 Receipt and 3.4 Reception Management.

ID	Name	Description	Starting point	End point	Notes
1.4.1	Acceptance of goods	All tasks involving the unloading of parcels from the vehicle / transport unit that are the responsibility of the actor. The checking of parcels, the acceptance of the shipment and possible transport reclamations. The acceptance of goods and responsibility, and signing of the proof of delivery.			The same as process component 1.3.1, Acceptance of goods.
1.4.2	Unloading and distribution	Unloading goods from parcels. Checking the goods and accepting the delivery lot. Making possible goods reclamations. Transferring goods to the consignee for use in the production process.			
3.4.1	Reception management	Managing the acceptance of transports. Managing unloading and distribution operations. Aligning the transshipment plan and unloading plan. Receiving exception and event data, and managing incidents and other exceptions.			
4.2.1	Tracking information monitoring	Monitoring and collecting tracking information within the process. Tracking information may include - content information (transport means / transport unit / parcel / goods hierarchy) - condition information - location information The monitoring of tracking information can be carried out automatically with fixed or mobile equipment, or manually by personnel.			
4.2.2	Tracking information monitoring	Receiving information on the tracking demand. Collecting, recording and distributing tracking data. Deleting tracking data.			
4.2.3	Tracking request management	Receiving tracking requests, collecting tracking data, and responding to tracking requests. Tracking requests are handled within logistics services. If the necessary information is not available there, tracking requests can be relayed to be handled on the level of individual tracking units (transport means / transport units).			

The checking of the accuracy of the goods order and delivery (delivery lot) is not part of the Receipt process, but of the Consignee Production Planning and Management process.

4.4.9 Transport authority operations

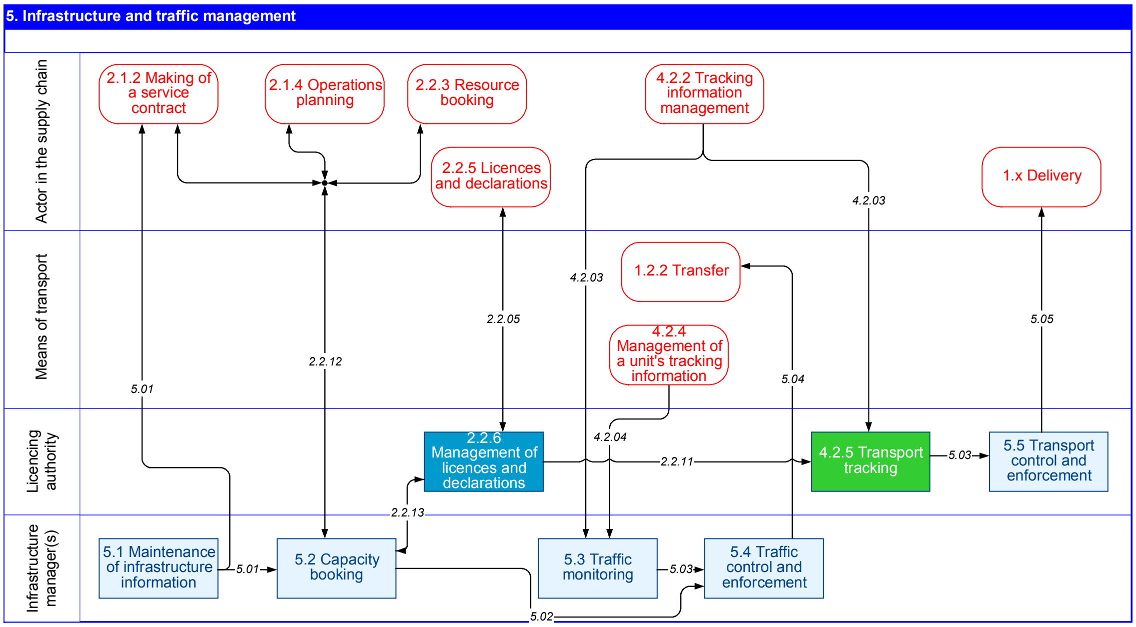


Figure 4.13. Proccess components and data flows in process 5 Transport Authority Operations.

Table 4.16. Descriptions of process components in process 5 Transport Authority Operations.

ID	Name	Description	Starting point	End point	Notes
5.1	Maintenance of infrastructure information	Maintaining information on the transport infrastructure and individual transport facilities.			
5.2	Capacity booking	Booking transport infrastructure capacity, planning the use of transport infrastructure.			
5.3	Traffic monitoring	Collecting traffic tracking information.			Tracking data can be collected on vehicles through transport operators' tracking systems. Tracking data can also be collected using separate, fixed systems connected to the transport infrastructure.
5.4	Traffic control and enforcement	Planning and carrying out traffic control operations, monitoring traffic violations, deciding on the consequences and carrying them out.			
5.5	Transport control and enforcement	Monitoring transports and violations, deciding on the consequences and carrying them out.			

4.5 Conclusions

It is essential to the functioning of the freight transport process that an extensive consignment note travels from actor to actor with the delivery. Relaying just the goods order information from the consigner to the consignee is not sufficient, since more detailed information on the transported goods is usually needed along the supply chain. Different transport modes have different information requirements.

The consigner is responsible for the accuracy of the information. Most of the information flowing through the process originates in the Shipment process.

The Tracking and Tracing process clearly takes place on two levels. The logistics actor level focuses on fleet use monitoring. If fleet tracking data (especially location data) is collected and the contents (parcels and goods) of the vehicle are known, parcel, goods and shipment tracking data is easy to obtain (at least in principle).

The supply chain owner level focuses on the tracking of shipments, parcels and goods. Most of the time when transport plans are available to customers, they are only interested in incident and exception data.

The tracking demands of infrastructure managers are fulfilled by (mainly vehicle) tracking data provided by logistics actors. Sometimes infrastructure managers do need quite detailed information on the goods being transported. Licensing authorities and enforcement operators on the other hand need shipment tracking data, as some of their enforcement operations focus on shipments.

5 LOGICAL ARCHITECTURE

This chapter outlines the logical architecture. It contains descriptions of the information objects and the information services derived from these as well as descriptions of the information system services.

The logical architecture describes a framework that fulfills the requirements defined and modelled in the conceptual architecture. The aim of the logical architecture is to enable ideas described on a conceptual level (in the processes) in the architecture to be defined as separate entities to be realised through the use of different information systems. Technological solutions are not evaluated, but the functional and information contents of an overall solution are described.

5.1 Information architecture

The information architecture describes and models the information processed in the freight transport processes. The model outlines the essential information.

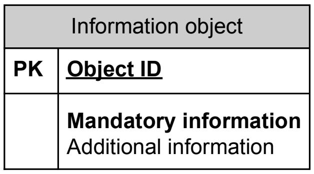
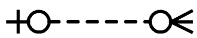
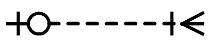
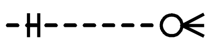
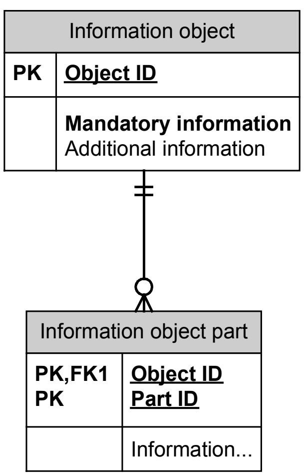
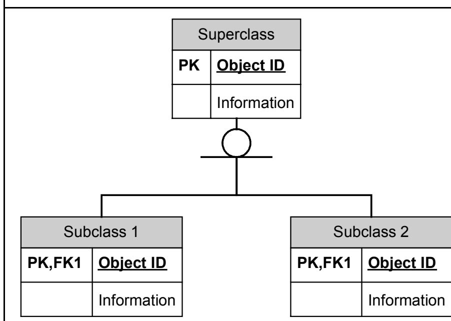
5.1.1 Information model

The information model is outlined using an entity-relationship diagram. The diagram illustrates the data sets (information objects) and the permanent relationships between them. A permanent relationship is a relationship between two objects that exists no matter what data set instance is being examined. Explanations for the symbols used in the diagram are listed in the table on the opposite page (Table 5.1).

The description has been normalised. This means that all many-to-many relationships between data sets have been broken down into parts. For example, a shipment can contain several parcels or one parcel can be part of several shipments during its life span. Normalisation introduces the data set Parcels in a shipment, which connects a shipment with the parcels belonging to it.

The freight transport architecture information model is shown in its entirety in the next figure (Figure 5.1). The data sets are described in the later figures and tables that outline different sections of the model.

Table 5.1. Explanations for the symbols used in the information model.

Diagram element	Description
	Information object (object class): Information object can have an ID that uniquely identifies instances of information object (PK, primary key).
	Relation between information objects (object classes): The dashed line describes a relation between two independent information objects. Instances of both classes can exist independently. The left side object instance can have a relationship with zero or more instances of the right side object. The right side object can have a relationship with zero or one instances of the left side object.
	Relationship between information objects: Left side information object instances can have relationships with one or more instances of the right side object
	Relationship between information objects: The right side information object instance has a relationship with one and only one of the left side information object instances.
	Continuous line describes a dependency between information object instances: The instances of a dependent information object (the lower one) can only exist if an instance of the other (the upper) information object exists.
	Information object subclasses The instances of an information object can be divided into several subclasses. These subclasses have some common attributes (described in the superclass) and some subclass-specific attributes (described in each subclass). The subclass instances can be exclusive or non-exclusive.

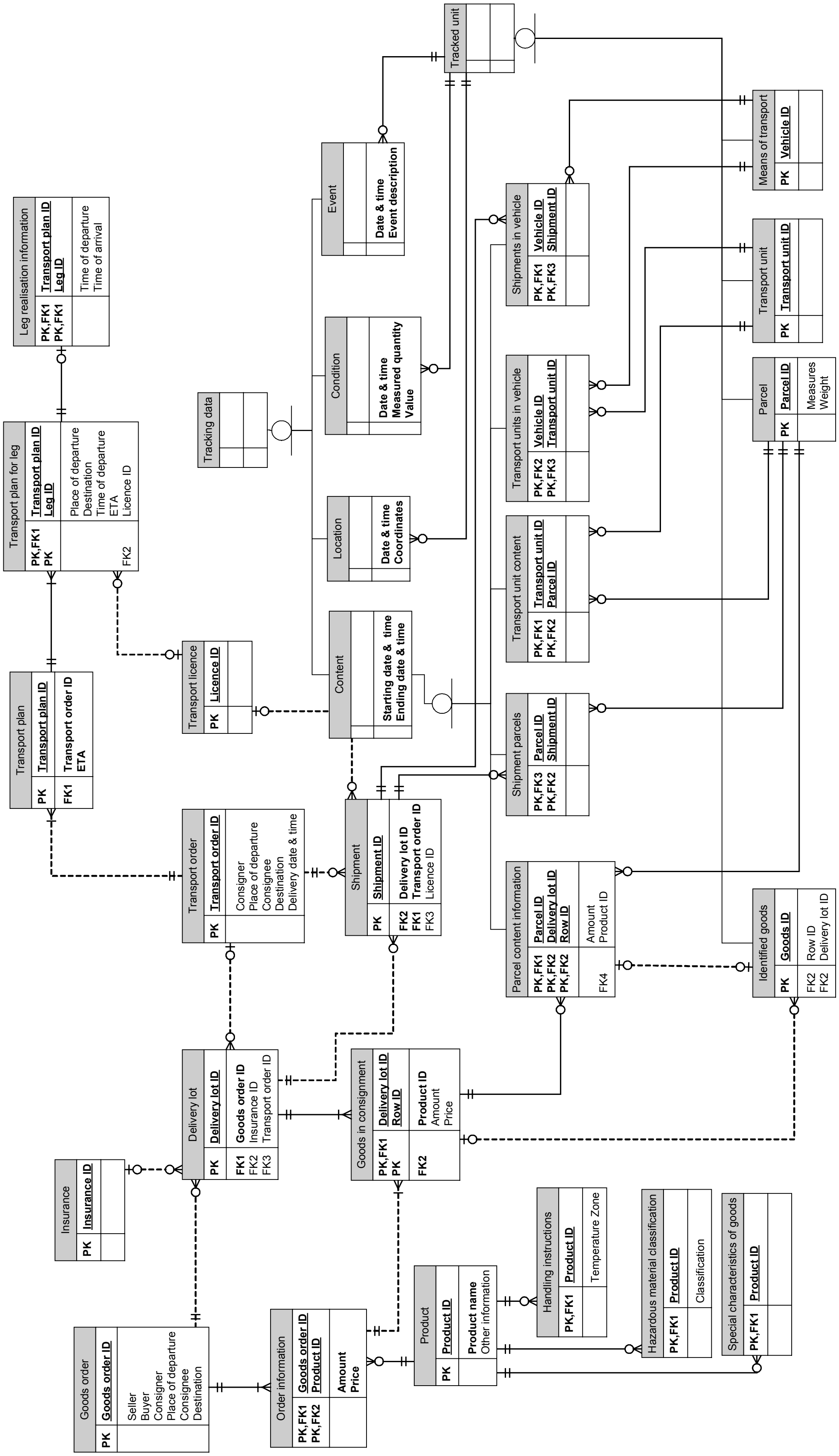


Figure 5.1. Freight transport information model.

A goods order is the ordering of one or more types of goods or products (order rows). The goods or products may come with additional information, such as handling instructions, hazardous goods classifications or other special properties.

The goods order is shipped in one or more delivery lots. If the delivery lot is not yet put together, the goods order will of course not include any delivery lots. Each type of goods in a delivery lot corresponds to no more than one type of goods (order row) in the goods order. The goods on one order row can be delivered as one or more delivery lot goods sets (rows). The goods in a delivery lot can also consist of a group of identified goods.

One transport order can order transports for several delivery lots. A transport order can contain one or more shipments. A transport order can exist even before a delivery lot and shipment have been compiled (hence the circles on these lines).

The data sets contained by the previous diagram are outlined in the following tables.

Table 5.2. Data set descriptions.

Name	Description
Goods order information	General information on a goods order: seller, buyer, consigner and consignee details, terms of delivery and other information on the trading of goods that does not concern goods or products.
Order information	Details on the goods included in a goods order and their amounts and prices.
Delivery lot information	General information on a delivery lot.
Goods in consignment	The goods contained in a delivery lot. Information on the goods and their amounts and prices.
Insurance	Insurance details for a delivery lot.
Goods	Goods are the object of transport/logistics services. They can be - identified goods or products / items, such as a piece of antique furniture or a product with a unit ID - non-identified goods (products / items), such as a carton of milk - bulk goods, such as liquids, which cannot be itemised or counted as individual units or pieces but can be counted and measured in terms of quantity.
Handling Instructions	Instructions on how to handle the goods.
Hazardous material classification	Hazardous material classifications for goods / products.
Special characteristics of goods	Special characteristics of goods / products. These may affect the transport.
Identified goods	Goods contained by a delivery lot that have a unit ID.
Transport order	General information on a transport order: consigner, departure point, consignee, destination, delivery time.

Table 5.3. Data set descriptions.

Name	Description
Transport plan	General information about a transport plan.
Transport plan for leg	The plans for one leg of a transport, including timetables.
Leg realisation information	Information on the carrying out of a transport on a leg.
Shipment information	General information about a shipment.
Transport licence	Details on the transport licence for one leg of a transport.

Table 5.4. Data set descriptions.

Name	Description
Content information	General information on content: time frame (starting time and end time)
Parcel content information	Information on the goods contained in a parcel. The goods can be identified or not.
Consolidated parcel	Content information on parcels that have been combined to form new parcels.
Shipment parcels	The parcels contained in a shipment.
Transport unit content	The parcels contained in a transport unit.
Transport units in vehicle	The transport units contained in a vehicle.
Shipments in vehicle	The shipments being transported in a vehicle.
Tracking data	Content, location, condition and event information.
Condition	Information on the condition of a vehicle, transport unit, parcel or goods lot at a specific time. Always includes information on the measured quantity and its value.
Location	Information on the location of a vehicle, transport unit, parcel or other identified physical device/instrument. Includes information on the timing and location of the device/instrument within a given set of reference coordinates.
Event	Information on an event that took place during transport. The event may be expected, and can be inferred on the basis of other tracking information. The event may also be unexpected, and have an effect on the transport.
Tracked unit	A tracked unit has tracking data collected on it. The concept of a tracked unit is used to make descriptions of tracking information handling more uniform. Possible tracked units include: - vehicles - transport units - parcels - identified goods What is essential about a tracked unit is that the associated tracking information can be collected (automatically), and the tracked unit can be recognised and identified in information systems. A tracked unit can also function as a monitoring system and record tracking information locally. It can transmit tracking information to those who need it.
Transport unit	A package, device or space transported by a vehicle. Transport units include e.g. parcels and train carriages. The transport unit for bulk goods and liquids can be an entire vehicle or part of it, e.g. the tanks on the tractor and trailer of a full trailer combination.
Means of transport	A car, train, plane, ship or other means of transporting goods. A means of transport is used to haul transport units.

A transport order includes one or more transport plans, consisting of the plans for each transport leg. A transport consists of at least one leg. Each leg has its own ETA, as does the transport plan as a whole.

The transport licence concerns one or more transport leg plans. It can also concern more than one shipment.

A transport plan can include leg realisation data, if the shipment has already travelled that leg. The leg realisation data always concerns exactly one transport plan leg.

The tracking and content data sets use a number of main and subclasses to clarify and unify the model. Tracking information consists of the data sets Content, Location, Condition and Event. The Location data set itself contains the data sets Parcel Content Information, Shipment Parcels, Consolidated Parcels, Transport Unit Content, Transport Units in a Vehicle and Shipments in a Vehicle.

Condition, Location and Event information can be collected on instances of the category Transport unit. This includes Vehicles, Transport Units, Parcels and Identified Goods, as information can only be collected on objects with a physical instance.

A shipment is an abstract data set, so the above information cannot be collected on it. Shipment tracking data can only be obtained by using the Content Information to determine which of the tracking units belong to which shipment. The content information needed can be obtained from the data sets Shipments in a Vehicle and Shipment Parcels.

5.1.2 Real-world concepts and information model

The information model uses real-world concepts, but in much more specific meanings than usual. The following table outlines the concepts and their meanings here. The concept definitions are mostly those used in the Logistics Chain EDI Project study.

Table 5.5. Descriptions of real-world concepts.

Nimi	Kuvaus	Lähde	Synonyymeja
Tavaratilaus	Myyjän ja ostajan välinen tavaran toimittamista koskeva tilaus. Tavaratilaus sisältää osapuolten tiedot ja tiedot tilatuista tavaroista, määristä ja hinnoista. Tavaratilauksen tavarat toimitetaan vastaanottajalle yhdessä tai useammassa toimituserässä. Toimituserät määrittelee joku osapuolista, usein tavaran toimittaja.	Logistics Chain EDI Project. Ministry of Transport and Communications, 1998.	
Toimituserä	Yhdestä tai useammasta tavarasta [ja niiden tilauskohtaisista määristä] muodostettu erä, joka muodostaa yhden toimituksen. Toimituserä lähtee yhdellä kertaa lähettäjältä yhtenä tai useampana lähetyksenä. Toimituserä voi eri kuljetusetapeilla koostua erilaisista lähetyksistä ts. se voidaan kuljetuksesta toiseen vaihdettaessa koostaa eri tavalla. Toimituserä sisältää tavaratilauksen osapuolten tiedot ja tiedot toimitettavista tavaroista, määristä ja hinnoista. Toimituserä voi lisäksi sisältää tiedot vakuutuksista.	Kaj E. Karrus: Logistiikka (muokattu)	
Kuljetustilaus	Kuljetuksen (tai muun logistiikkapalvelun) tilaus. Tekijänä on yleensä joku tavarakaupan osapuolista. Logistiikkapalvelutilaus koskee yhtä tai useampaa toimituserää.		
Kuljetussuunnitelma	Kuljetustilaukseen liittyvä suunnitelma tavaran kuljettamisesta etappi- ja aikataulutietoineen.		
Lähetys	Yhdessä kuljetusvälineessä yhdellä kertaa kuljetettava joukko kolleja. Lähetys voidaan kuljettaa eri kuljetusyksiköissä. Lähetys on olemassa yhden kuljetuksen ajan. Toimituksen koostuessa useasta peräkkäisestä kuljetuksesta lähetys voi muuttua siirrettäessä tavarat (välikäsittelyssä) kuljetuksesta toiseen. Samassa lähetyksessä voidaan kuljettaa useiden toimituserien (ja siten useiden tavaratilausten) tavaroita.		
Sisältö	Tunnistetun, yksilöidyn kohteen sisältö tietyllä aikavälillä (alkuaika ja loppuaika). Tavaran toimituksen aikana on pystyttävä kuvaamaan tavaran pakkauksen hierarkia (tavara - kolli - kuljetusyksikkö - kuljetusväline) samoin kuin tähän läheisesti liittyvät toimituksen aikana mahdollisesti 'elävät' suhteet toimituserä - lähetys - kolli - tavara. Sisältö kuvaa näistä hierarkioista aina yhden hierarkiatason kerrallaan. Minimissään se sisältää tiedot siitä, - minkä kohdeluokan kohteita kohde sisältää ja - sisältyvien kohteiden yksilöintitiedot sekä - alku- ja päättymisajankohdan. Sisältö voi koostua mm. seuraavanlaisista tiedoista: - kuljetusvälineen kuljetusyksiköt - kuljetusyksikön sisältämät kollit - kollin sisältämät tavarat - kollin sisältämät kollit - lähetyksen sisältämät kollit - kuljetusvälineen sisältämät lähetykset Sisältö-käsitteen avulla on mahdollista yhdistää seurattavaan asiaan (seurantayksikköön) sijaintitieto.		
Lähetysluettelo	Lähetyksen tiedot. Laajasti ymmärrettynä.	Logistics Chain EDI Project. Ministry of Transport and Communications, 1998.	
Kuormanerittely	Lähetyksen tiedot, kollien sijainti kuljetusyksiköissä.	Logistics Chain EDI Project. Ministry of Transport and Communications, 1998.	

In the information model, one real-world concept covers the information contained by several data sets. The following table (Table 5.6) shows how the real-world concepts and data sets correspond to one another in the information model. This is further illustrated in the following two figures (Figure 5.2 and Figure 5.3).

Table 5.6. How the real-world concepts and data sets correspond to one another.

Concept	Information objects
Goods order	Goods order Order information Product Identified goods
Delivery lot	Delivery lot Goods in consignment Product Identified goods
Transport order	Transport order Tranport plan Transport plan for a leg Product handling instructions Hazardous material classification Special characteristics of goods
Shipment	Shipment Shipment parcels Parcel
Consignment note	Transport order Delivery lot Goods in consignment Identified goods Product Product handling instructions Hazardous material classification Special characteristics of goods Shipment Content Parcel content information Parcel Shipment parcels
Load list (in addition to information contained in the consignment note)	Transport unit Transport unit content

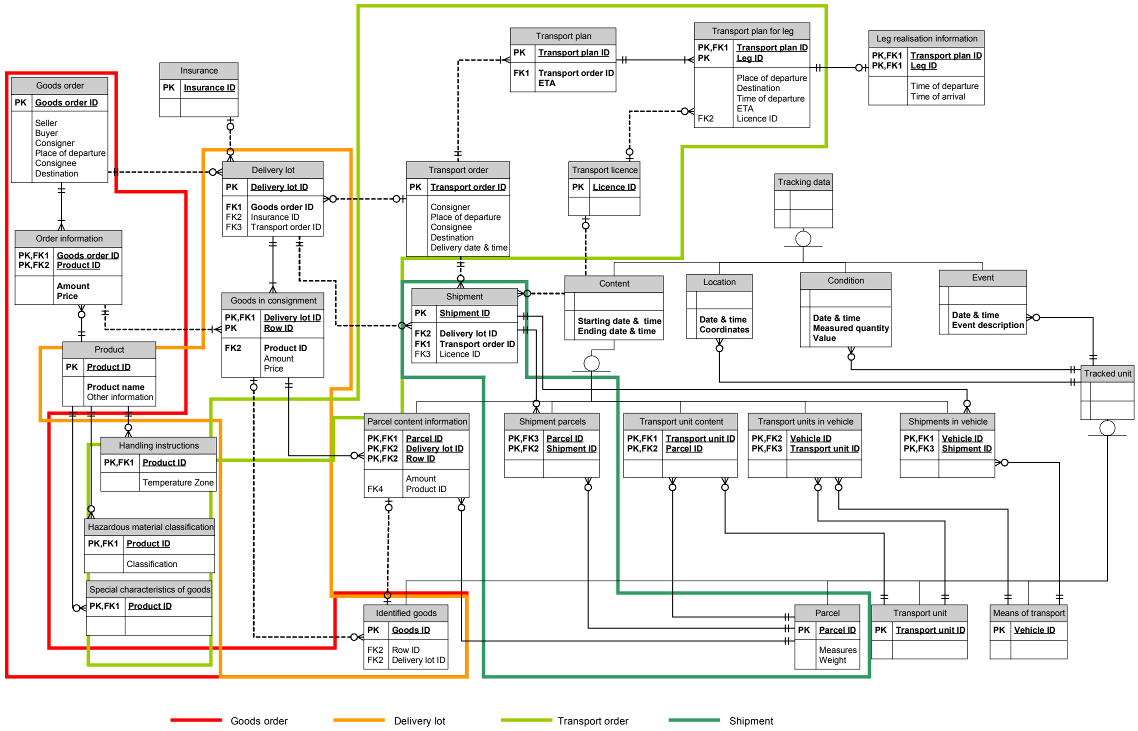


Figure 5.2. Goods order, delivery lot, transport order and shipment data sets.

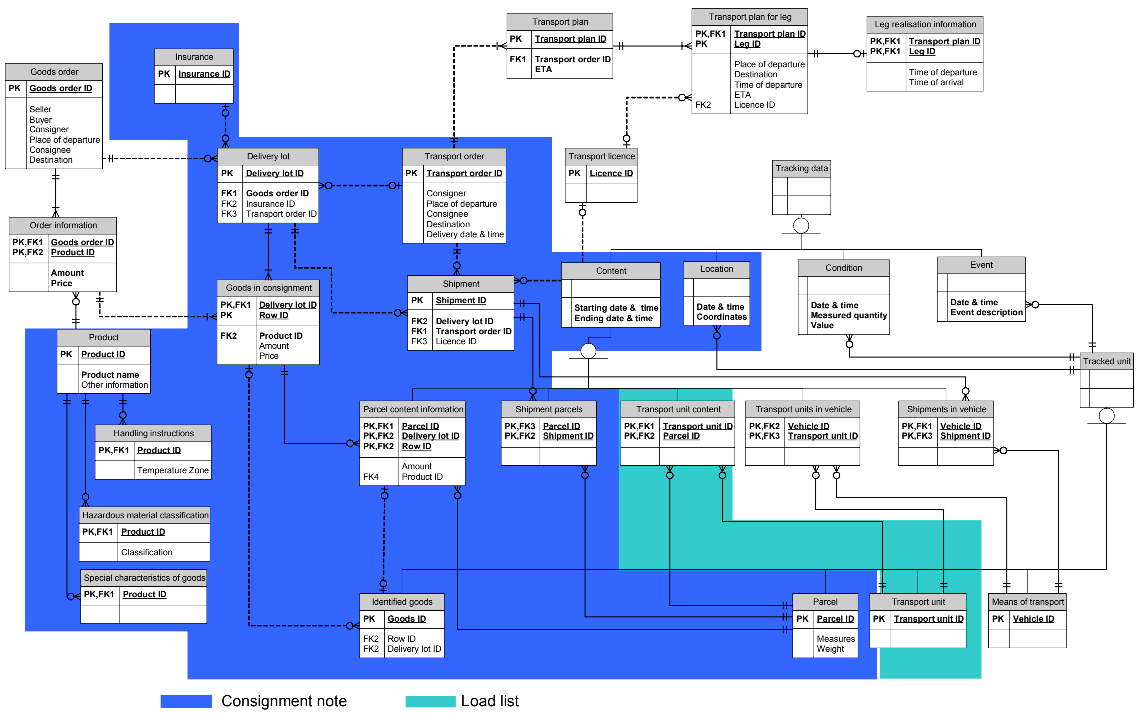


Figure 5.3. Consignment note and load list data sets.

5.1.3 The nature of the tracking data

Tracking data consists of all the collected content, location, condition and event information. The design of the information model is such that the content information helps minimise the need for collecting location, condition and event information.

Content information need only be collected at specific locations where the contents may change ie. the content information is discrete in nature. It should be noted that content information should be collected on all types of tracking unit: the means of transport, transport units and parcels. This is the only way to ensure that individual (vehicle or transport unit) location, event or condition data can be connected to specific shipments, parcels or goods items.

Location and condition information can be discrete (information only collected at certain points along the route) or continuous (data collection rate is significantly higher than for discrete information). Continuously collected data should be recorded locally as part of the vehicle or transport unit's Tracking Data Management Service.

It is possible to keep track of the transport timetable and ETA if both content and location information is collected at either discrete or continuous fashion (Figure 5.4).

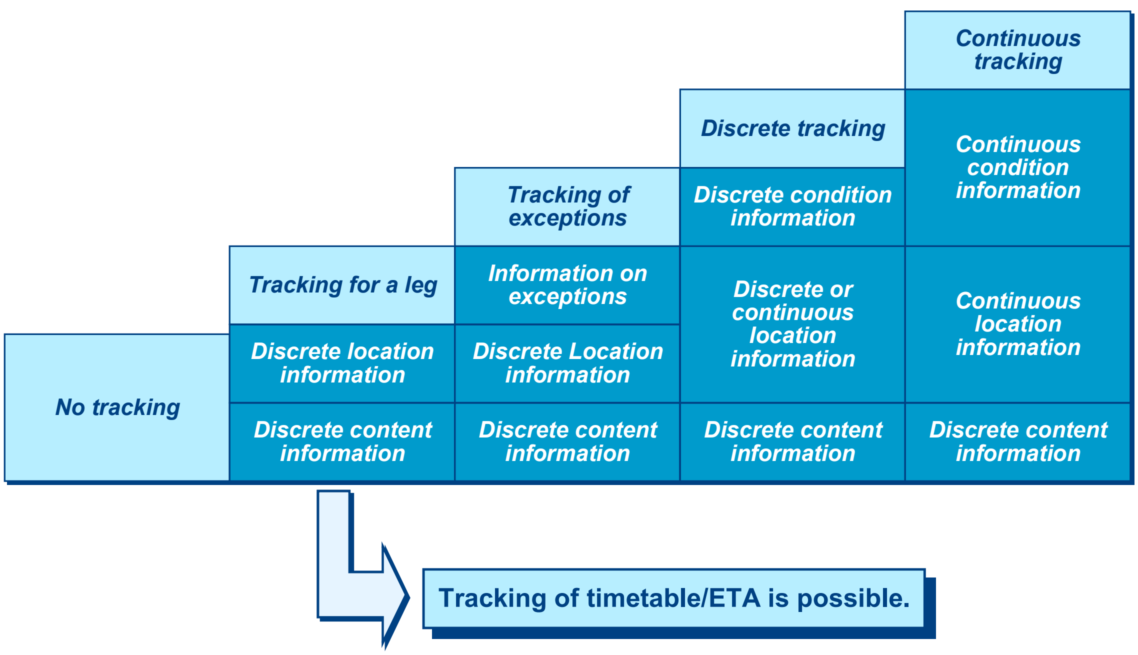


Figure 5.4. Tracking requirements at different levels.

The tracking hierarchy can be described as follows:

- (Local) processing of vehicle tracking data
- Processing of tracking data for the logistics service provider
- Processing of tracking data for the supply chain service provider
- Processing of tracking data for the tracking data user (e.g. customer)

It is sensible to try and reduce the amount of tracking data relayed from one actor to the next when moving downwards in the hierarchy from the location of the vehicle to nearer to the customer. One might think it would be sufficient to only relay incident and exception data to the supply chain service provider, since the higher levels of the hierarchy are aware of the transport plan or at least the ETA. But this is usually not true. Discrete location data or event data (not data on exceptions, but on normal expected events, such as the end of a leg) should at least be relayed to supply chain service providers so that the information relayed down to tracking data users will be accurate, rather than just prediction.

It should also be noted that exceptions on the logistics service provider level do not necessarily affect the timetable set for the supply chain as a whole. The actor with the role of logistics service provider may not know this; it may only know the transport plan for its share of the transport.

5.1.4 Information consists of predictions and facts

The importance of operations planning increases when the aim is to increase operating efficiency. This planning – especially when carried out by actors – mostly consists of the optimisation of the use of resources, which calls for the availability of sufficiently detailed advance information on future transport needs. If advance transport order information is available, the necessary plans and process management data can be produced in advance.

The following figure (Figure 5.5) illlustrates which data sets may include advance information. The shade of the colour represents the likelihood that a data set contains advance information. The darker areas are those that are more likely to quickly provide advance information, while the lighter areas will take more and more time to produce predictions.

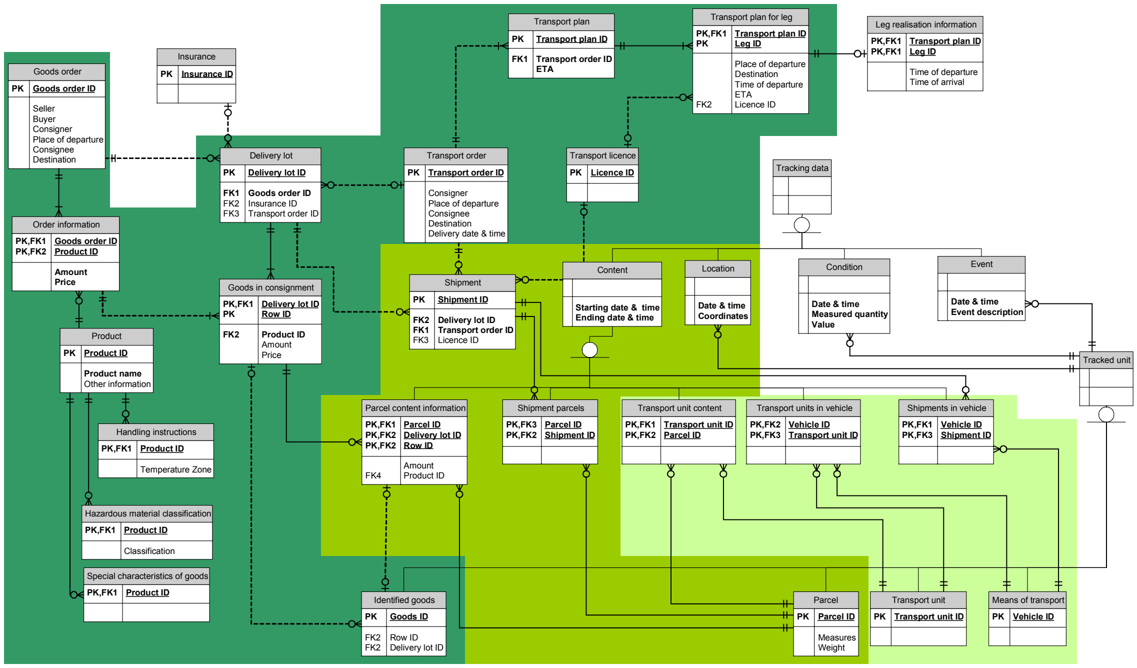


Figure 5.5. Data sets containing advance information. The darkness of the colour represents the likelihood that a data set includes advance information.

5.1.5 Process components and information model

The use of data sets in the freight transport process is outlined in the CRUD-table[10], which lists the data sets and the way they are used within each process. The CRUD-table is shown in Appendix 4.

5.1.6 Data flow data sets

The data sets contained by the data flows between process components are listed in a table in Appendix 5.

The table includes the data sets, the data flows that contain (often internal process) management data and information on which data flows may contain advance information/predictions and which ones may contain known facts.

5.1.7 Information confidentiality

There are several levels of information confidentiality. The confidentiality levels of the data sets are shown in the following figure (Figure 5.6). Each shaded area represents a different confidentiality level, but does not signify as such which actors and roles have the right to use the information contained within it.

[10] CRUD is short for Create, Read, Update, Delete. It describes the table's information content: each cell in a cross-referencing table tells whether a process component creates instances in the data sets, uses information from the existing instances, or updates or deletes the information.

The most confidential information for transport process actors is the goods order information and the prices of the transported goods. This information is located in the red area.

The next level of confidential information is the information on the delivery lot and the goods being delivered. This information is represented by the pale red area.

The yellow area represents the next level of confidentiality, consisting of transport order, transport plan, shipment, parcel and tracking information.

The turquoise area represent the data sets at the lowest level of information confidentiality.

The data sets on the white background are available to the general public.

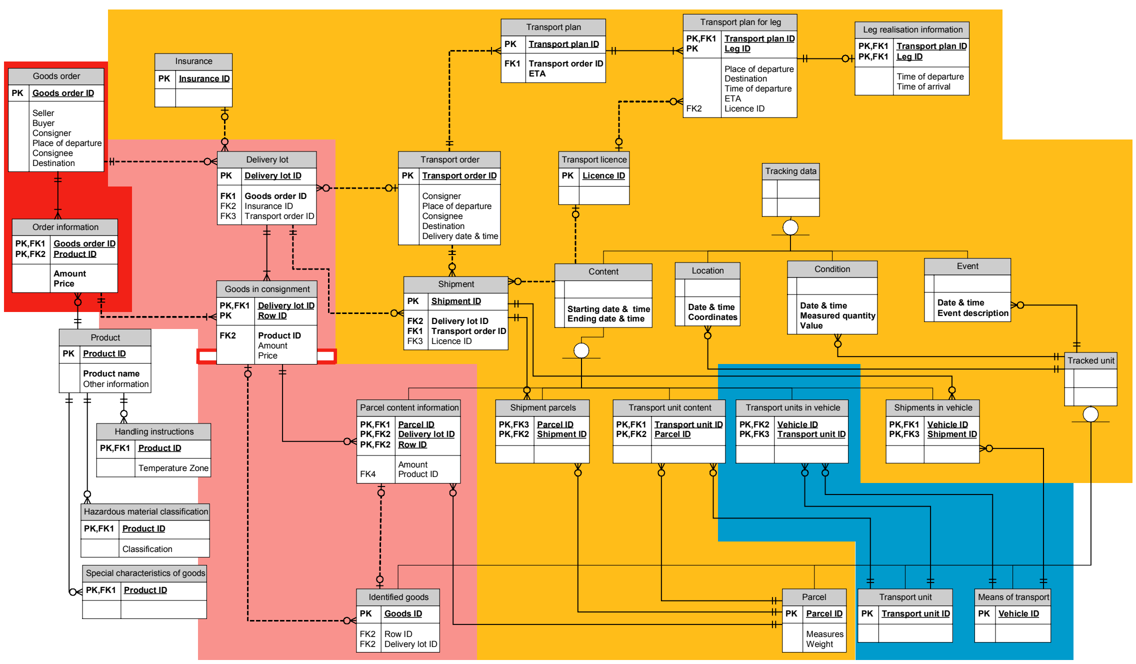


Figure 5.6. Levels of data set and information confidentiality. Note that the colours only signify different levels of confidentiality, not who has the right to use the information.

5.2 Information system services

5.2.1 Integration view of information system services (distribution map)

The information system function distribution maps outline the information system functions that support the components of the function processes. The map is based on the process component and information system service cross-reference matrices outlined in greater detail in Chapter 6.1.3.

The upper part of the map shows the connections with information system functions supporting other processes, i.e. the public connection services. The map shows the information system services that are directly connected with the transport process on a blue background.

Cf. Appendix 7 – Information system service distribution map.

5.2.2 Definitions of information system services

The following tables outline the functionality of each information system service.

Table 5.7. Connection services (TelemArk)

Data system service	Description
EnvDataMgmt	Maintenance of information on the condition of the route network.
MapServ	Management of digital maps.
TrafficData	Management of up-to-date traffic situation data.
RoadMaintTasks	Management of up-to-date information on road transport network maintenance operations.
RiskTrLicenseMgmt	Transport licence register service organised according to operator and vehicle type.
RiskTrTracking	Risk transport tracking system. Offers risk transport identification and tracking services and data transfer services.
VehRegisterServ	Official vehicle register services offered by the authorities. Vehicle register data, transport classifications etc.

Table 5.8. TARKKI information system services 1/3

IS Service	Description
TimetableMgmt	The service manages timetables for different logistics services.
GoodsAcceptanceMgmt	The service implements procedures for handling information related to the acceptance of goods. Combines shipment data and exception data. Handles condition information for goods. Delivers exception data to ExceptionMgmt and ReclamationMgmt. Production planning and management for receipt of goods.
TransportPlanMgmt	The transport plan management service gathers information about products offered by logistics service providers and builds the supply chain for the transport. It creates orders for logistics services.
VehiclePositioning	Positioning service for vehicles. Combines positioning data from the vehicle with digital map information.
VehicleMonitoring	A service for the monitoring and identification of vehicles.
VehicleIdentification	The service provides vehicle identification services. This service can be situated for instance in a wireless device in the vehicle.
HandlingInstructionsMgmt	The service manages handling instructions for goods.
WirelessChannel	The wireless channel transfers data produced by wireless devices.
WirelessDevice	A wireless device in the vehicle. Can send out vehicle positioning data.
LoadingMgmt	Management of loading data. Manages vehicle loading plans.
VAServicesMgmt	The service manages data about value-added services of goods. Keeps track of goods and services applied to them. Controls and manages the production of value-added services.
LogisticsOperatorMgmt	Manages a pool of logistics operators. Handles contacts with the operators. Supply chain break-up between the operators and information delivery to operators.
GoodsReleaseMgmt	Management of goods release data.
LicenceMgmt	The service manages licences for transport operations. The licences can be for the operator or for a single transport.

Table 5.9. TARKKI information system services 2/3

IS Service	Description
ShipmentMgmt	Management of shipments.
PartyIdentityMgmt	The service implements the identification of parties involved in the transport event.
ExceptionMgmt	Management of exception data, assessment of the effects of the exceptions.
ExceptionReceipt	Receipt of exception data. Combining exception data with transport data.
UnloadingMgmt	Management and planning of unloading activities.
RouteMgmt	Management of routes and route information. Route information contains data about logistics services offered for a leg and other data relevant for planning.
ReclamationMgmt	Management of reclamations. The service receives information from GoodsAcceptanceMgmt to create reclamations.
ResourceMgmt	The service manages data about resources needed in the production of logistics services. The resources include vehicles, personnel, locations etc.
TrackingTargetCreation	The service handles tracking requests. Receives control data required for tracking and creates a tracking object.
TrackingDataMgmt	Receipt, handling and delivery of tracking data.
TrackingDataMonitoring	In-vehicle tracking data monitoring, data collection and delivery.
ContractMgmt	Management of contracts for logistics services.
ParcelHierarchyMgmt	A general purpose service for the management contents. Handles contents of parcels, shipments and vehicles so that transported goods can be identified at each instance.
OrderMgmt	The service manages transport orders.
OrderReceipt	Receipt of transport orders and advance orders.

Table 5.10. TARKKI information system services 3/3

IS Service	Description
SupplyChainMgmt	Management of the supply chain including planning of the whole supply chain, legs, operators, time tables. This service is responsible for adjusting the transport plan during the transport if exception events disrupt the plan.
ProductionMgmt	Management of production.
ProductMgmt	Management of product data.
ProductIdentification	The product identification service produces product id's. This can be e.g. a RFID or a bar code in the product.
ProductListMgmt	Management of product lists.
WarehouseMgmt	Management of warehousing data. Handling of shipment positioning and environmental data during storage, management of activities in the warehouse.
ResponsibilityMgmt	Verification of the transfer of responsibility over the shipment between two parties. Identifies the parties and registers the transfer of responsibility.
TransshipmentMgmt	Management of transshipment data. Handling of shipment positional and environmental data during transshipment, management transshipment activities.

5.2.3 Information system services used by the processes

An information system service is an information technology application that carries out some of the functionality of the architecture. Information system services are usually responsible for recording and processing specific types of information.

The following cross-reference matrix shows which information system services are used/required by each process component. For the sake of clarity, the information system services are divided into the tables by process.

Table 5.11. Transport process

		External IS services							IS Services																																				
#	Process component	EnvDataMgmt	MapServ	TrafficData	RoadMaintTasks	RiskTrLicenseMgmt	RiskTrTracking	VehRegisterServ	TimetableMgmt	GoodsAcceptanceMgmt	TransportPlanMgmt	VehiclePositioning	VehicleMonitoring	VehicleIdentification	HandlingInstructionsMgmt	WirelessChannel	WirelessDevice	LoadingMgmt	VAServicesMgmt	LogisticsOperatorMgmt	GoodsReleaseMgmt	LicenseMgmt	ShipmentMgmt	PartyIdentityMgmt	ExceptionMgmt	ExceptionReceipt	UnloadingMgmt	RouteMgmt	ReclamationMgmt	ResourceMgmt	TrackingTargetCreation	TrackingDataMgmt	TrackingDataMonitoring	ContractMgmt	ParcelHierarchyMgmt	OrderMgmt	OrderReceipt	SupplyChainMgmt	ProductionMgmt	ProductMgmt	ProductIdentification	ProductListMgmt	WarehouseMgmt	ResponsibilityMgmt	TransshipmentMgmt
0.3	Purchase of logistics services																			x																		x							
9	Cost management																			x																									
1	Delivery																																							x	x	x			
1.1	Shipment																																												
1.1.1	Order picking and packing																						x												x										
1.1.2	Order release into transport																							x																			x		
1.2	Transport																				x																								
1.2.1	Acceptance of goods into transport																	x					x																					x	
1.2.2	Transfer			x								x	x	x																			x												
1.2.3	Release from transport																				x						x																	x	
1.3	Transshipment									x																																	x		
1.3.1	Acceptance of goods									x															x				x															x	
1.3.2	Transshipment operations																																		x								x		
1.3.2.1	Terminal handling																																x		x										x
1.3.2.2	Storage																																										x		
1.3.2.3	Value added services																		x																										
1.3.3	Order release																				x			x																				x	
1.4	Receipt									x															x																				
1.4.1	Acceptance of goods									x															x				x															x	
1.4.2	Unloading and distribution									x															x				x															x	

Table 5.12. Planning process

		External IS services							IS Services																																				
#	Process component	EnvDataMgmt	MapServ	TrafficData	RoadMaintTasks	RiskTrLicenseMgmt	RiskTrTracking	VehRegisterServ	TimetableMgmt	GoodsAcceptanceMgmt	TransportPlanMgmt	VehiclePositioning	VehicleMonitoring	VehicleIdentification	HandlingInstructionsMgmt	WirelessChannel	WirelessDevice	LoadingMgmt	VAServicesMgmt	LogisticsOperatorMgmt	GoodsReleaseMgmt	LicenseMgmt	ShipmentMgmt	PartyIdentityMgmt	ExceptionMgmt	ExceptionReceipt	UnloadingMgmt	RouteMgmt	ReclamationMgmt	ResourceMgmt	TrackingTargetCreation	TrackingDataMgmt	TrackingDataMonitoring	ContractMgmt	ParcelHierarchyMgmt	OrderMgmt	OrderReceipt	SupplyChainMgmt	ProductionMgmt	ProductMgmt	ProductIdentification	ProductListMgmt	WarehouseMgmt	ResponsibilityMgmt	TransshipmentMgmt
2	Planning																			x																		x							
2.1	Supply chain planning								x																			x						x				x							
2.1.1	Operations planning								x																			x						x											
2.1.2	Making of a service contract																													x				x											
2.1.3	Plan refining										x																									x	x								
2.1.4	Operations planning										x																																		
2.1.5	Fleet usage planning																													x															
2.2	Transport planning	x									x																			x						x	x								
2.2.1	Transport order handling	x	x		x						x																			x						x	x								
2.2.2	Consigner logistics planning	x	x		x																																		x						
2.2.3	Resource booking																													x						x	x								
2.2.4	Consignee logistics planning																													x									x						
2.2.5	Licences and declarations							x														x																							
2.2.6	Management of licences and declarations					x		x														x																							

Table 5.13. Management process

		External IS services							IS Services																																				
#	Process component	EnvDataMgmt	MapServ	TrafficData	RoadMaintTasks	RiskTrLicenseMgmt	RiskTrTracking	VehRegisterServ	TimetableMgmt	GoodsAcceptanceMgmt	TransportPlanMgmt	VehiclePositioning	VehicleMonitoring	VehicleIdentification	HandlingInstructionsMgmt	WirelessChannel	WirelessDevice	LoadingMgmt	VAServicesMgmt	LogisticsOperatorMgmt	GoodsReleaseMgmt	LicenseMgmt	ShipmentMgmt	PartyIdentityMgmt	ExceptionMgmt	ExceptionReceipt	UnloadingMgmt	RouteMgmt	ReclamationMgmt	ResourceMgmt	TrackingTargetCreation	TrackingDataMgmt	TrackingDataMonitoring	ContractMgmt	ParcelHierarchyMgmt	OrderMgmt	OrderReceipt	SupplyChainMgmt	ProductionMgmt	ProductMgmt	ProductIdentification	ProductListMgmt	WarehouseMgmt	ResponsibilityMgmt	TransshipmentMgmt
3	Management																								x	x												x							
3.1	Shipment operations management																																						x						
3.1.1	Shipment management																						x																						
3.2	Transport operations management																													x						x									
3.2.1	Fleet and resources management																													x															
3.2.2	Transport management																	x					x			x	x																		
3.2.3	Reporting																													x															
3.3	Transshipment operations management																													x															x
3.3.1	Fleet and resources management																													x															
3.3.2	Transshipment management									x															x																			x	x
3.3.3	Reporting																													x															
3.4	Reception operations management																																						x						
3.4.1	Reception management									x					x										x		x																		
3.5	Supply chain operations management																																					x							
3.5.1	Supply chain management										x																													x	x	x			

Table 5.14. Tracking and Tracing process and Infrastructure and Transport Management process

#	Process component	External IS services							IS Services																																						
		EnvDataMgmt	MapServ	TrafficData	RoadMaintTasks	RiskTrLicenseMgmt	RiskTrTracking	VehRegisterServ	TimetableMgmt	GoodsAcceptanceMgmt	TransportPlanMgmt	VehiclePositioning	VehicleMonitoring	VehicleIdentification	HandlingInstructionsMgmt	WirelessChannel	WirelessDevice	LoadingMgmt	VAServicesMgmt	LogisticsOperatorMgmt	GoodsReleaseMgmt	LicenseMgmt	ShipmentMgmt	PartyIdentityMgmt	ExceptionMgmt	ExceptionReceipt	UnloadingMgmt	RouteMgmt	ReclamationMgmt	ResourceMgmt	TrackingTargetCreation	TrackingDataMgmt	TrackingDataMonitoring	ContractMgmt	ParcelHierarchyMgmt	OrderMgmt	OrderReceipt	SupplyChainMgmt	ProductionMgmt	ProductMgmt	ProductIdentification	ProductListMgmt	WarehouseMgmt	ResponsibilityMgmt	TransshipmentMgmt
3.5.2	Exception management																									x																			
4	Tracking and tracing																							x								x													
4.1	Supply chain tracking and tracing																															x						x							
4.1.1	Tracking demand determination																														x														
4.1.2	Supply chain tracking information management																															x													
4.1.3	Tracking request management																														x														
4.2	Logistics operator tracking and tracing																																x												
4.2.1	Tracking information monitoring											x	x	x		x	x																x												
4.2.1.1	Content information monitoring											x	x	x		x	x																x												
4.2.1.2	Condition information monitoring											x	x	x		x	x																x												
4.2.1.3	Location monitoring											x	x	x		x	x																x												
4.2.2	Tracking information monitoring																															x													
4.2.3	Tracking request management																														x	x													
4.2.4	Management of a unit's tracking information																																x												
4.2.5	Transport tracking						x					x	x	x		x	x																												
5.1	Maintenance of infrastructure information	x	x	x	x																																								
5.2	Capacity booking			x																																									
5.3	Traffic monitoring			x		x																																							
5.4	Traffic control and enforcement			x		x																																							

5.3 Information services

The information services (data storages) are the central data storages where the information created in and connected with the function processes is recorded during the process throughput time. The information services may be located either in the operators' information systems or in centralised registers available to all parties.

5.3.1 Definitions of information services

The following table defines the central architecture data storages.

Table 5.15. Architecture data storages

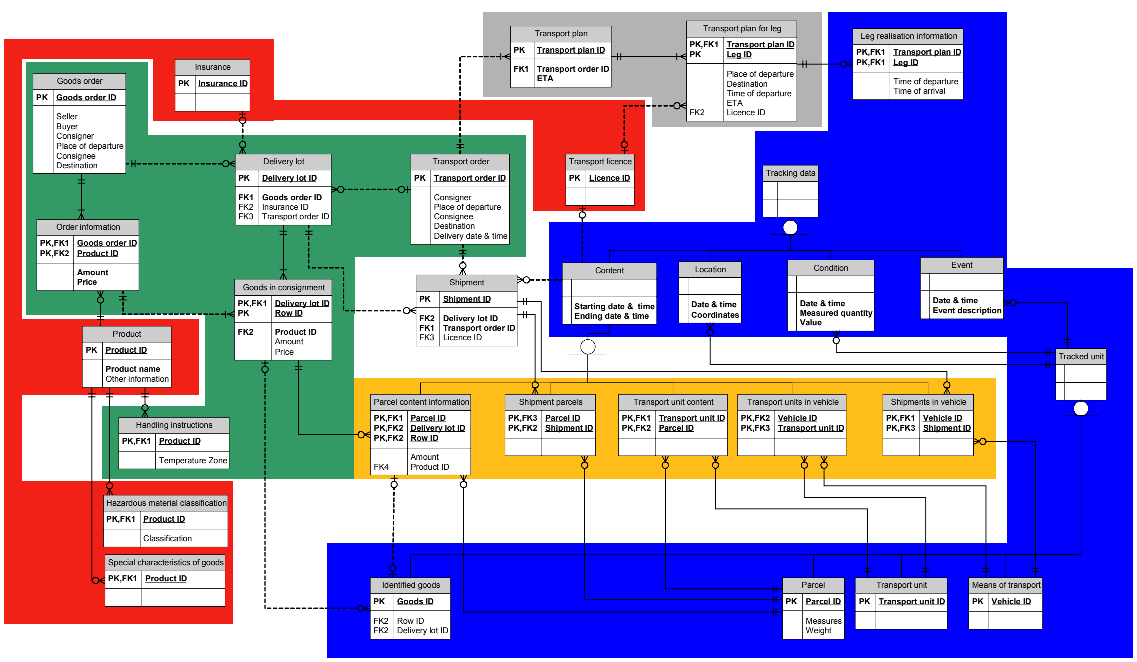
#	Data storage	Description
1	Supply chain register	Part of production management system. Contains information about (planned or realised) supply chains.
2	Supply chain party data	Contains data about logistics service providers connected to planned supply chains.
3	Route data	Supply chain routes. The data can come from public or operator-specific systems.
4	Position data	Digital map information for positioning activities.
5	Exception data	Incidents and exceptions during the transport.
6	Vehicle register	Vehicle register is modal and it can also be operator-specific.
7	Logistics service provider register	Contains information about the logistics service providers and the products they are offering.
8	Resource database	Resources of a logistics service provider including personnel and vehicle data etc.
9	Contract rergister	Contract data for contracts between service providers in the logistics chain. This is operator-specific or supply chain -specific.
10	Order register	The order register is operator-specific.
11	Product / goods register	Product register.
12	Licence register	Public licence registers as well as operator-specific licence reigisters. The operator must have licence data consistent with the data in the public registers.
13	Insurance register	Insurance data for each shipment.
14	Hierarchy register	The hierarchy register contains information about the shipment's hierarchy of products, parcels, transport units, vehicles and delivery lots.
15	Tracking object register	A register of tracking objects.
16	Tracking database	A database of tracking data for each tracking object.
17	Tracking history database	A history database of tracking data.

5.3.2 Over-all view / primary information model of information services

The main data storages in the architecture contain various kinds of information produced in the function processes. The primary information model outlines which types of information are primarily situated in which data storage. The cross-reference matrix in Figure 6.10 illustrates the logical relationships between the data sets and data storages that are outlined in the primary information model.

Table 5.16. Relationships between the data sets and data storages

#	Information objects	Hierarchy register	Supply chain register	Supply chain party data	Route data	Position data	Exception data	Vehicle register	Logistics service provider register	Resource database	Contract register	Order register	Product / goods register	License register	Insurance register	Tracking object register	Tracking database	Tracking history database
		Data storages																
1	Goods order			x					x		x	x	x					
2	Order information											x	x			x	x	
3	Delivery lot	x										x	x					
4	Goods in consignment	x										x	x					
5	Insurance											x			x			
6	Goods	x											x					
7	Handling Instructions										x	x	x					
8	Hazardous material classification							x	x					x				
9	Special characteristics of goods												x					
10	Identified goods												x			x	x	x
11	Transport order			x								x						
12	Transport plan		x	x	x													
13	Transport plan for leg		x	x	x													
14	Leg realisation information					x	x										x	x
15	Shipment	x	x		x													
16	Transport licence													x				
17	Content	x											x					
18	Parcel content information	x								x								
19	Consolidated parcel	x																
20	Shipment parcels	x																
21	Transport unit content	x																
22	Transport units in vehicle	x																
23	Shipments in vehicle	x																
24	Tracking data						x									x	x	x
25	Condition						x									x	x	x
26	Location						x									x	x	x
27	Event					x	x										x	x
28	Tracked unit					x				x								
29	Transport unit					x				x								
30	Means of transport					x				x								
31	Parcel					x				x								



Information stored mainly in product and order registers.

Information mainly in external registers (e.g. authorities public registers)

Event information mainly in tracking registers

Content information stored mainly for track & trace.

Information related to transport planning stored at supply chain level.

Figure 5.17. Data storage primary information model

As in the process component and data set cross-reference matrix (Chapter 7.1 and Appendix 4), most of the information is created within the delivery process. The data storages that contain the associated data sets are also located in a number of organisations. But if the data storages are separate (e.g. registers of individual operators), the information system services managing them should be connected through carefully planned, standardised message-based communication. Standardised integration at the supply chain level, where much of the information should be available, is also essential.

6 DEVELOPMENT PLAN

6.1 Shortcomings and development needs of processes

6.1.1 In general

The shortcomings and development needs of the processes were listed during the interviews and workshops that took place during the project. The aim was to map out what things were missing or needed to be developed further to reach the targets set in the architecture. A special workshop was also set up to supplement, categorise and prioritise by significance and difficulty of implementation the items on the list. This was necessary for the drawing up of the actual development plan. The list of shortcomings and development needs is shown in its entirety in Appendix 8.

The mapping out phase utilised a working method used in the TelemArk project: the following checklist (Table 6.1) was used to ensure that the issue was examined from all angles.

The checklist was also used during the workshop to divide the shortcomings and development needs into groups. The main groups were defined as follows:

Processes and connections: issues concerning the development of missing or deficient processes or connections between these, paying special attention to standardised interfaces.

Administration or organisation: the shortcomings and development needs that can only be solved through actor co-operation and commitment to jointly agreed-upon operating methods and practices.

Economy and markets: the problems that cannot be solved by individual actors, but are solved according to the needs and practices of a larger group.

Legislation: the shortcomings and development needs that may create the need to alter public sector regulations, guidelines or legislation.

Technology is quite a limited group: the shortcomings and development needs that call for the development of new techniques or new technology.

Table 6.1. Checklist for assessing the shortcomings, possibilities and requirements of the processes.[11]

Processes and connections

- Missing or deficient processes or connections
- International connections and integration
- Standardised data exchange interfaces or process standards

Administration or organisation

- Distribution of tasks and responsibilities
- Policies and responsibilities of parties
- Decisions on the form of the relayed information
- Duties associated with public services
- Distribution of responsibilities between the public and private sectors
- Updating and maintenance
- Organisation of the implementation phase
- Practices and agreements
- Co-operation with the authorities
- Implementation in phases
- Commitment

Economy and markets

- Commercial possibilities
- Outsourcing and tendering
- Funding
- Payments
- The budget
- Market development
- Compensations for use of data vs. compensations for relaying of data

Legislation

- Accuracy of information
- Product liability
- Minimum requirements of services
- Protection of privacy
- Copyright and business secrets
- Control of service content

Technology

- Keeping up with technological developments
- Availability and stage of development of technology
- Dependence on other systems
- Risks of technical solutions

[11] MinTC B1/2000. The National Transport Telematics System Architecture. Summary.

6.1.2 Main shortcomings and development needs

A total of 64 shortcomings and development needs were examined during the workshop. After prioritisation, the most important ones for all the processes were found to be (Table 6.2):

Table 6.2. Main shortcomings and development needs of the current system in comparison with the targets set in the freight transport telematics architecture.

Process	**Shortcoming or development need**	**Significance (on a scale of 0-5)**	**Difficulty of implementation**	
			Hard	Easy
Tracking and tracing	Development of automatic identification.	■■■■■	■■■■	
Delivery	Compatibility of international chains with the architecture.	■■■■		■■■■
Management	Information technology connections between actors (technology and message formats, i.e. standardisation).	■■■■	■■■■	
Delivery	Availability of shipment packing and handling data for different actors (temperature, hazardous goods transports…).	■■■		■■■■
Delivery	Connections between processes (between roles).	■■■		■■■■
Concerning all processes	Reducing the number of transferred documents.	■■■	■■■	■
Delivery	Standardised ”messages” between different kinds of supply chains.	■■■	■■■■	
Concerning all processes	Development of operating methods to ensure correct and relevant data is distributed to all actors within the network who need it.	■■■	■■■■	

The difficulty of implementation was only assessed for those development needs that were deemed important. The difficulty of implementation of some other shortcomings and development needs was also assessed when the actual development programmes were being formulated. These assessments used the following criteria (Figure 6.1).

	Hard to implement	Easy to implement
Duration	Will take at least a year.	Will take no more than 6-12 months.
Politics	"Major" political decision-making required.	At most, "minor" political decision-making required.
Conflicts of interest	Major conflicts of interest between different parties must be resolved.	No major conflicts of interest exist.
Operating practices	Established operating practices will have to change drastically.	No great change in established operating practices required.
Organisations	Established organisation/actor structures have to be altered drastically.	No great change in organisation/actor structures required.
Technology	Technological innovations required.	No new technology needs to be developed.
Transport modes	Multimodal agreements required.	No multimodal agreements required.
Harmonisation	National or international standards must be created.	No national or international standards have to be created.

Figure 6.1. Criteria used to assess the difficulty of implementation.

The shortcomings and development needs are analysed in more detail in the next couple of chapters under the following groups: those concerning all processes, delivery, planning, management and tracking and tracing. Only the issues that were deemed significant (32 out of the total of 64) are included.

6.1.3 Concerning all processes

The largest group of significant shortcomings was those concerning all processes in the telematics architecture. Most of these concern organisational issues, but the other problem groups (technology, processes, markets and legislation) were also represented. These significant issues are listed in the following table (Table 6.3):

Table 6.3. Main shortcomings and development needs that concern all of the processes.

Shortcoming/development need	Organisation	Technology	Processes	Markets	Legislation	Significance	Difficulty of implementation	
							Hard	Easy
1. Reducing the number of transferred documents.			■		□	■■■	■■■	■
2. Development of operating methods to ensure correct & relevant data is distributed to all actors within the network who need it.	■		□			■■■	■■■■	
3. Automatisation of transport authority procedures (licences and declarations).		■			□	■■		■■■■
4. Electronic, paper-free data transfer and data processing.		■	□			■■	■■■	■
5. Definition of responsibilities (e.g. data distribution).	■				□	■■	■■■	■
6. Responsibilities and managing the interfaces where they change hands (delivery terms).			■		□	■■	■■■■	
7. Development of data security.	■					■■	■■■■	
8. Increasing collaboration between actors.				■		■		■■■■
9. Handbook on electronic business activities in the transport sector.	■					■		■■■■
10. Combining overlapping operations.			■			■	■	■■■
11. Formulation of uniform indicators (costs, efficiency, quality).	■					■	■	■■■
12. Data transfer problems. Standards exist, but have not been widely introduced.				■		■	■■■	■
13. Mapping out the risks and compatibility of technical solutions.				■		■	■■■■	
14. Heterogeneity of logistics terminology.	■					■	■■■■	
15. Product data bank (product and package data) for use in logistics.	■						■■■■	

1. Reducing the number of transferred documents. The aim is to harmonise the documents used by different actors for the same purposes and, if possible, make the processing and relaying of more of them electronic.
2. Development of operating methods to ensure correct and relevant data is distributed to all actors within the network who need it. With increasing transparency, correct and up-to-date information is always available to those who need it. The actors themselves can define what information they need, so they need not receive information irrelevant to their operations. This idea was deemed difficult to implement, as it calls for big changes in established operating practices.
3. Automatisation of transport authority procedures (licences and declarations). The aim is to increase the use of electronic data transfer in the processing of licences and declarations, and make processing quicker, the documents more uniform and changes more rapid.
4. Electronic, paper-free data transfer and data processing. The aim is to make data transfer quicker and reduce the risk of errors in manual functions. The implementation of this idea may partly call for legislative change: e.g. if the bill of lading is made electronic, the transport operator has to be able to present the enforcement authorities with an electronic document instead of a paper one.
5. Definition of responsibilities (e.g. data distribution). Agreeing on simple ground rules with other actors in the supply chain to cut down on overlapping operations, to improve data security and to ensure the availability of up-to-date information.
6. Responsibilities and managing the interfaces where they change hands (delivery terms). Includes the checking of the correctness of the releaser and consignee of the transported goods, and the development of the operating methods and technology involved. Also calls for the identification of the critical points, i.e. interfaces where the responsibilities of one actor end and the responsibilities of the next begin.
7. Development of data security. Data security is improved e.g. through inter-actor data connections and the prevention of wireless data that may travel with the goods and transport units from falling into the wrong hands.
8. Increasing collaboration between actors. Includes activities on a number of levels: agreements on common operating methods, different forms of business collaboration, and the development and obtaining of operating methods, systems and hardware as economically and unproblematically as possible.
9. Handbook on electronic business activities in the transport sector. It will contain the main operating methods used in electronic freight transport business transactions.
10. Combining overlapping operations. Cutting down on the redundant work being done by different actors e.g. by agreeing on marking shipments with jointly agreed-upon IDs that all parties in the supply chain can utilise.

11. Formulation of uniform indicators (costs, efficiency, quality). Measuring critical attributes for the supply chain so that the results of different parties are comparable. The aim is to improve the functioning of the entire supply chain by identifying the functions and actors that require the most improvement.
12. Data transfer problems. Standards exist, but have not been widely introduced. Agreements should be reached on the use of standardised or best practice -type forms of data transfer within the supply chain. In the future, increasing data transfer compatibility especially in extensive supply chains calls for the active monitoring of standard initiatives and, if possible, affecting their contents.
13. Mapping out the risks and compatibility of technical solutions. The aim is to invest in technology that is compatible with the systems and hardware used by other actors, and that enables the use of technologies of different generations with as little reconfiguration needed as possible.
14. Heterogeneity of logistics terminology. A permanent group chaired by an expert/professor should be set up to harmonise the terminology. The group should actively develop the terminology and release progress reports on their achievements.
15. Product data bank (product and package data) for use in logistics. The product data used should be agreed upon for each field, and the data should be recorded in a common register. One example of this is the EAN code.

6.1.4 Delivery

The delivery process is a central part of freight transport, where the transported goods are moving from the consigner to the final consignee and are handled during different operations. If the architectural targets are reached, the function process will receive and send data from and to other processes fluently. The most significant shortcomings and development needs of the delivery process are outlined next (Table 6.4):

Table 6.4. Main shortcomings and development needs of the development process.

Shortcoming/development need	Organisation	Technology	Processes	Markets	Legislation	Significance	Difficulty of implementation	
							Hard	Easy
1. Compatibility of international chains with the architecture.			■			■■■■		■■■■
2. Availability of shipment packing & handling data for different actors (temperature, hazardous goods).			■			■■■		■■■■
3. Connections between processes (between roles).			■			■■■		■■■■
4. Standardised "messages" between different kinds of supply chains.		□	■			■■■	■■■■	
5. Alignment of the content and time levels of the fleet and freight data so that they can be combined in the necessary functions.			■			■■	■■■■	
6. Standardisation of vehicle telematics.		■	□	□		■	■■■■	
7. Up-to-date data on and details of incidents in transport, and loading and unloading sites.			■		□	■	■■	■■
8. Harmonisation of consigner and consignee IDs (pick-up and delivery address identifiers, customer address list).	□			■			■■■	■

1. Compatibility of international chains with the architecture. Due to the global nature of logistics, an architecture based just on national requirements and requests does not serve actors or encourage architecture utilisation. (Both national and international architectures were examined during this study.) Collaboration in international architectural development should be continued to ensure architecture compatibility.

2. Availability of shipment packing and handling data for different actors (e.g. instructions on temperatures during transport and the handling of hazardous goods transports). The availability and use of correct and up-to-date instructions reduces the risk of damage to the shipment throughout the supply chain.

3. Connections between processes (between roles). The aim is to increase inter-actor visibility within the supply chain. This is connected with a number of other issues concerning e.g. data connections, standardised messages, etc.

4. Standardised ”messages” between different kinds of supply chains. By reducing the number of different message forms in use, operating methods can be harmonised and fluent data transfer can be ensured.
5. Alignment of the content and time levels of the fleet and freight data so that they can be combined in the necessary functions. The special characteristics of each transport mode are mapped out in detail in mode-specific architectures. For example, road transports are outlined in the European KAREN architecture.
6. Standardisation of vehicle telematics. The development and application of compatible technologies e.g. in data transfer.
7. Up-to-date data on and details of incidents in transport, and loading and unloading sites. The availability of real-time, up-to-date information on the status of the transport network and supply network nodes in transport management helps transports stay on schedule and cuts down on unnecessary waiting times.
8. Harmonisation of consigner and consignee IDs (pick-up and delivery address identifiers, customer address list). Different actors within the supply chain currently use different IDs for the same customers. Use of a common, up-to-date ID data bank e.g. cuts down on the need to tag or label shipments.

6.1.5 Planning

Questions about this process were not deemed very important during the workshops, which can be considered a slight surprise. After all, the planning process is essential for a successful delivery. On the other hand, the planning process may be closer to the set objectives and thus needs less work than the other processes. The examined issues were:

- It is necessary to develop an established chain planning method that corresponds to the architecture
- Extensive shipment information supplied by the consigner/orderer (what, when, where to, where from)
- Extensive information supplied by logistics service companies (schedules, resources…)
- Information technology connections between actors (technology and message formats, i.e. standardisation)

6.1.6 Management

The significance of management in the successful realisation of a delivery and especially in exception management calls for efficient data transfer and good connections between all actors within the supply chain. The identified shortcomings and development needs mostly involved the aforementioned issues and the availability of up-to-date planning information (Table 6.5).

Table 6.5. Main shortcomings and development needs of the management process.

Shortcoming/development need	Organisation	Technology	Processes	Markets	Legislation	Significance	Difficulty of implementation	
							Hard	Easy
1. Information technology connections between actors (technology and message formats, i.e. standardisation).		□	□	■		■■■■	■■■■	
2. Relaying and updating of ETA data (automatisation).			■			■■		■■■■
3. Drawing up a new plan and relaying it to the actors involved (e.g. consigner, consignee and orderer).			■			■■	■	■■■
4. Extensive tracking data.	□	□	■			■■	■■■■	

1. Information technology connections between actors (technology and message formats, i.e. standardisation). The aim is to use uniform connections and unambiguous wording to develop error-free data transfer systems. The issue is significant, but also difficult to implement, since it calls for extensive collaboration between all actors within the supply chain.

2. Relaying and updating of ETA information (automatisation). The availability of accurate and precise advance information increases the efficiency of logistics service management and enables the amending of the original plans. This calls for the real-time relaying of realisation data e.g. on all departed vehicles. Implementation was not considered difficult.

3. Drawing up a new plan and relaying it to the actors involved (e.g. the consigner, consignee and orderer). To ensure the seamless collaboration of actors within the supply chain, the actors in the coming stages should have access to the same updated plan. New operating methods should also be deployed so that all the actors that receive updated planning data can also use it in managing their operations.

4. Extensive tracking data. Tracking can take place at certain points along the supply chain (terminals, critical points) or in real time, depending on the technology used,

the object being tracked and the utilisation of tracking data. The relaying of up-to-date tracking data to the supply chain and logistics service providers enables the timely identification of exceptions and the initiation of actions to deal with them.

6.1.7 Tracking and tracing

Track and trace systems that cover entire supply chains do not yet exist in practice. There are also no providers of large-scale track and trace services. So describing this process is the most difficult, since e.g. rapid advances in technology can make currently unknown services possible in the near future. On the other hand, actors in this process and especially the future service providers play an essential role in the utilisation of the freight transport telematics architecture. The most significant shortcomings and development needs of the tracking and tracing process are outlined below (Table 6.).

Table 6.6. The main shortcomings and development needs in tracking and tracing.

Shortcoming/development need	Organisation	Technology	Processes	Markets	Legislation	Significance	Difficulty of implementation	
							Hard	Easy
1. Development of automatic identification.		■				■■■■■	■■■■	
2. Compatibility of parcel IDs (e.g. the same technology, uniform bar codes and even the existence of labels).	■	□				■■	■■■■	
3. Planning, development and updating of information registers (customer codes / postal codes / address lists).	■				□	■■	■■■■	
4. Hierarchy: minimisation of tracking events.	□	□	■			■■		■■■■
5. Compatibility and usability of interface codes.			■			■	■■■■	
6. Definition of the need for tracking data in operations management and services.	■					■	■	■■■
7. Combination of logistics and transport data.			■			■	■■	■■

1. Development of automatic identification. This development need was deemed the most significant of all the examined statements, but also one of the most difficult to implement. It reduces the need for manual identification or handling for identification (e.g. turning the goods so that the labels are facing a specific way on the conveyor). The deployment of technology that makes automatic identification possible

must not alter or hinder actual operations and should be compatible, within standards, with products from different manufacturers, with no need for closed systems.

2. Compatibility of parcel IDs (e.g. the same technology, uniform bar codes and even the existence of labels). The use of IDs jointly agreed upon by all parties in the supply chain decreases the use of parcel tagging and labelling during various stages of the chain and aids the development of identification systems.
3. Planning, development and updating of information registers (customer codes / postal codes / address lists). The aim is to deploy common, centralised registers where updated customer and address data is available. The owner of each address is responsible for updating the data.
4. Hierarchy: minimisation of tracking events. The aim is to always track the highest possible level and, if necessary, obtain lower-level data from background databases (e.g. product package, parcel, container, truck, ship).
5. Compatibility and usability of interface codes. Standardisation should be continued, and international recommendations should be considered.
6. Definition of the need for tracking data in operations management and services. The significant tracking data for each actor should be defined on both the supply chain and actor level.
7. Combination of logistics and transport data. Freight transport tracking data is time, location and condition data for a vehicle, transport unit or goods (e.g. the temperature of a transport unit in a certain location at a certain time). As supply chains become more and more streamlined, this information may not be sufficient for efficient management, but has to be supplemented with up-to-date or advance data on the status of the transport network (e.g. road weather, accidents, congestion).

6.2 Development programmes

6.2.1 Formulating the development programmes

The shortcomings and development needs of individual processes were combined during the workshops to form development programmes, i.e. actions used to reach some of the objectives set in the architecture. The aim was to combine all the issues associated with the main development needs that should be developed or solved within the same development programme. Often this means that a common vision should be set and that all parties should be committed to it. All of the other statements were also scoured to find the ones that form prerequisites, i.e. that must be realised before the development programme can be kicked off. The suitable responsible parties and other parties that participate in setting up and carrying out of development programmes were also sought.

Three development areas clearly stood out:

1. Information infrastructure
2. Identification
3. Processes.

6.2.2 Information infrastructure development

The development of the information infrastructure is an essential prerequisite for the development and deployment of operating methods and systems that correspond to the architecture. The development targets include the construction of data banks and registers, agreements on common operating methods and practices and, significantly, the development of data security.

Naming a responsible party for this development programme was found to be difficult. ITS Finland was named as a possible responsible party for the moment, but the responsibilities and deployment of the organisation in question have not been clearly defined. Other parties who could implement the development programme include trade and industry branch organisations and their members, and the major actors for each transport mode. One of these could also be the responsible party. The involvement of a couple of global companies and government actors is also necessary. The structure of the development programme is outlined in the figure on the next page (Figure 6.2).

Development programme:

Information infrastructure

Responsible party: **ITS Finland**

Development targets	Participants	Connections to other programmes

42 Planning and development of information registers.
8 Product data bank (product & package data) for use in logistics.
43 Product code & shipment ID registers.
41 Compatibility of parcel Ids (e.g. the same technology, uniform bar codes or even the existence of labels).
46 Hierarchy: the minimization of tracking events.
61 Heterogeneity of logistics terminology.
16 Harmonisation of consigner & consignee Ids (unique pick-up & delivery address, customer addresses).
12 Improvement of data security.
	• Trade & industry branch organisations
	• Major logistics actors (all transport modes)
	• large companies
	  • Nokia
	• Administration
	  • Customs
	  • The Finnish Vehicle Administration
		• Connection with the national transport telematics development (e.g. DigiRoad)
		• Existing (sector-specific) information infrastructure.
		• Architectural compatibility of international companies & chains.
		• Use of existing sector-specific codes & registers..
		
		Prerequisites

Figure 6.2. Information infrastructure development programme.

The development of the information infrastructure includes projects that belong to both the Ministry of Transport and Communications and the Ministry of Trade and Industry. The development programme is also clearly connected with other transport telematics development projects (e.g. DigiRoad).

6.2.3 Identification development

Identification development aims for the successful identification of vehicles, transport units, shipments and goods at different points along the supply chain, focusing especially on solutions that enable the automatic identification of objects. In addition to supply chain actors, the programme involves the actual system implementers, i.e. hardware manufacturers, system integrators and software companies. Public authorities are also an essential part of the programme. The responsible party will presumably be a business actor, whose own business or its active development promotes the deployment of automatic identification systems.

The realisation of the objectives of the development programme calls for changes in operating methods and practices, especially in the deployment of electronic data transfer systems and the harmonisation of IDs and message formats. The structure of the identification development programme is outlined in the following figure (Figure 6.3).

Development programme :

Identification

Responsible party: **Business actor**

Development targets	*Participants*	*Connections*

49 Development of automatic identification.
50 Updating of Ids (e.g. time stamps).
20 Standardisation & harmonisation of vehicle telematics.
23 Architectural compatibility of international companies & chains.
57 Connections with production management systems.
13 Definition of responsibilities (e.g. data distribution).
29 Interfaces between actor's information systems (technology & message formats, standardisation).
11 Mobile applications.
12 Improvement of data security.
14 Mapping out the risks & compatibility of technology solutions.
	• Hardware manufacturers
	• Logistics service providers
	• Systems integrators
	• Software vendors
	• Administration
	  • Customs
	  • Police, rescue services
	  • CAA Finland
		• Declarations (customs, hazardous goods transports)
		• Combining logistics & traffic data.
		• Electronic identification of persons.
		
		Prerequisites
		• Electronic, paper-free data transfer & data processing.
		• Hierarchy: minimisation of tracking events.
		• Standardisation of IDs.
		• Interfaces between actor's information systems (technology & message formats, standardisation).

Figure 6.3. Identification development programme.

Identification development also takes place in other fields besides transport. The development of e.g. the electronic identification of people should be monitored, since solutions in this field may be applicable to freight transport, e.g. the identification of the parties within the supply chain. Traffic data collection and information services for passenger transport should also be utilised in the field of logistics by increasing collaboration with passenger transport information service providers.

6.2.4 Process development

The issues concerning process development were divided into three groups by subject:

- Operational efficiency
- Operations
- Incident management

The natural choice for the responsible party is an active actor in the field with an essential role within the supply chain. Representatives of the other roles in the supply chain also participate, so the development programme is very diverse (it includes e.g. the VIPRO project, upgrading the forest industry export delivery process). The company representatives should include representatives of small and medium-sized firms to ensure that the needs and limited resources of these companies are taken into consideration. Industry branch organisations are also potential participants and thus provide a good way for their members to voice their ideas and concerns. The track and trace systems are represented by track and trace service providers and infrastructure managers.

Development programme :

Processes

Responsible party: **Business actor**

Development targets	*Participants*	*Connections*
Operational efficiency 1 Reducing the number of transferred documents. 2 Combining overlapping operations. 40 Sufficient transparency. Operations 25 Alignment of the content & time levels of the fleet & freight data so that they can be combined in the where needed. 31 Up-to-date supply chain plan available to actors in electronic form. 39 Delivery & updating of ETA information (automatisation). Incident management 21 Up-to-date data of incidents in routes and transportation loading & unloading sites. 52 Combining logistics & traffic data. 32 Extensive tracking data. 33 Speedy identification of incidents. 34 Updating & delivery to actors of transport plan.	• Parties in the supply chain • Branch organisations • Tracking service providers	• Declarations (customs, hazardous goods transports), automatisation of transport authority operations. • Architectural compatibility of international companies & chains. • Development of operating methods to ensure the delivery of correct & relevant data to all actors who need it. *Prerequisites* • Electronic, paper-free data transfer & data processing. • Interfaces between actor's information systems (technology & message formats, standardisation). • Increasing collaboration between actors.

Figure 6.4 Process development programme.

The aim is to increase the operational efficiency in order to rationalise the operations of individual actors in a way that increases the efficiency of the entire supply chain. This can be reached e.g. by cutting down on redundant operations and by increasing transparency, i.e. by improving information availability. Operational efficiency also involves the development of management operations and the availability of the required up-to-date information. Responsibilities and the management of the interfaces where they change hands include authentication of the releaser and accepter of the transported goods and the development of the associated operating methods and technology. This also calls for the definition of the critical points, i.e. interfaces where the responsibilities of one actor end and the responsibilities of the next begin. The results (e.g. costs, efficiency, quality) can be compared and the most urgent development needs can be targeted when uniform indicators have been introduced.

Operations are mostly practical activities, involving the physical movement and handling of goods. Error-free operations call for the availability of an up-to-date plan and its supplementation e.g. with ETA information. The needs of the different parties, i.e. the supply chain and actors involved in freight and fleet management, should also be noted.

Incident management is the utilisation of impulses caused by the tracking data in supply chain and logistics service management, in which actual realised information is compared with the original planning data. The speedy identification of incidents on the basis of extensive tracking data is essential for the timely deployment of measures to fix the problems. This includes distributing a new plan to the next actors within the chain. The freight transport tracking data (time, location and condition data on a vehicle, transport unit or goods) may not be sufficient for the efficient management of incidents, and may need to be supplemented with up-to-date or advance data on the status of the transport network (e.g. road weather, accidents, congestion). More efficient incident management calls for the development of operating practices, increasing collaboration between actors and the construction of automated tracking systems.

7 UPDATING AND DEVELOPING THE ARCHITECTURE

The time horizon for reaching the objectives set in the architecture is 5-10 years in the future. During that time, different parts of the architecture will change in varying cycles.

There should be a set party responsible for assessing the need for updating the architecture. This task is suitable for parties who use the architecture to develop their fields of activity. One possible model is an architecture work group steered by the Ministry of Transport and Communications that would annually assess the need to update the architecture. The architecture could be updated either by the work group itself or by outside consultants. The work group would include representatives of all the main developers of freight transport telematics. Another possible solution is an architecture work group based around the FITS programme.

7.1 Changes in the operational environment

Changes in the operational environment affect the processes in the architecture. This change in the conceptual architecture will in turn usually affect the logical architecture, so the need for change in the logical architecture also needs to be checked. The changes in the conceptual architecture can involve:

- The architectural requirements
- The coverage of the architecture (new services will be covered)
- Changes caused by changes in the actors
- Changes caused by changes in the function processes

7.1.1 Changes in architectural requirements and objectives

The architectural requirements (Figure 2.2 Objectives of the freight transport telematics architecture) may call for changes in the function processes or the order of importance of different parts of the process. These changes in turn will result in the need to checking of the logical architecture, or at least the information system functions and the data flows between them.

7.1.2 Changes in architectural limits

The limitation of which telematics services belong to the architecture affects the processes. New services will have to be produced by changing an existing process or by defining a completely new one. The effects of the changes can be seen in the data flows and the information system functions and components.

7.1.3 Changes associated with the actors

The architectural structure aims not to directly reflect changes in the roles of real-world actors. The function processes identify the most common types of actors, focusing on entities consisting of logically-connected systems. Actors can usually be broken down into one or more architectural roles. The roles and their responsibilities may have to be altered e.g. if a new role is being created in the architecture through legislation.

7.1.4 Changes in function processes

Changes in the function processes will directly affect the data flows and the information system functions and components in the logical architecture. Function processes may change as new telematics services or actor roles are created. The function processes themselves may also be optimised later as more experience and information is gained.

7.2 Changes in technology

The logical architecture outlines how the architectural requirements modelled in the conceptual architecture are fulfilled. All changes in the conceptual architecture will naturally result in an assessment of whether the logical architecture needs to be updated. The logical architecture can also be directly affected by:

- significant technological improvements
- new standards

7.2.1 Technological improvements

Information technology innovations that radically affect the way a problem is solved may also call for changes in the logical architecture, though ordinary changes in technological performance usually do not. Technological changes that may affect the architecture include e.g. :

- increasing use of rapid wireless data transfer
- increasing use of portable intelligent terminal devices
- new types of user interfaces (speech, virtual environments)

Changes in the actual freight transport technology are also reflected in the transport telematics architecture. New types of vehicles, the increasing use of information technology in vehicles and new fuels and power sources are examples of changes in transport technology that may affect the architecture.

The above changes mostly affect the logical architecture's information system components in the form of new communication interfaces and ways to diversify functionality.

Technological changes may also be reflected in the conceptual architecture's function processes, since they enable new types of services to be created.

7.2.2 New standards

Finland as a market area is strongly integrated into the Western European markets. Therefore, a market area the size of Finland cannot use significantly different standards, but must correspond to those set in the larger market areas. The road transport telematics standards drawn up by technical committees under CEN278 must be taken into consideration in public procurements.

The TARKKI architecture must correspond to the international *de facto* and *de jure* standards. The changes demanded by these standards usually concern the data flows and information content of the logical architecture. Equipment standards may also affect the distribution model of the logical architecture's information system components.

7.3 Introduction and marketing of the architecture

7.3.1 Information services

A long-term marketing plan should be introduced to make as many people as possible aware of the potential and benefits of the freight transport telematics architecture to ensure its implementation. In accordance with the example set by TelemArk, the marketing could include the organisation of a seminar, magazine articles and seminar papers.

Interface descriptions of data flows that correspond to the architecture within implemented telematics systems are requested for the Transport Data Exchange Library Platform (www.kalkati.net), where they can be accessed by all actors when necessary. This promotes the formation of an open and standardised information exchange environment in Finland.

The information and practical experiences gained on general information technology architecture projects also increase awareness about the architecture. These include

- the forest industry project PaperIXI, covering documentation management and logistics. Project participants include parts and system providers, production line and hardware suppliers, consultants, users (forest industry), and service and maintenance companies.
- the electronics industry project RosettaNet, involving the development of open business processes and standards. These help connect the ordering, manufacturing, product development and storage monitoring chains with one another.

7.3.2 Training

Training helps increase the knowledge of the implementers of the architecture and helps them apply this knowledge to fit the needs of their organisations. Training could be provided e.g. during significant telematics projects at transport operator pilot sites or in companies.

As in the TelemArk project, the suggested training forum is an implementation workshop (the Help Desk action), where the structure and contents of the architecture are outlined for the participants, as are its benefits and uses, its application, and possible advice and recommendations. The organisers also receive feedback and can list discovered shortcomings and development needs to help further develop the architecture. The objectives and structure of the Ministry of Transport and Communications' Transport data exchange platform "Kalkati.net" are also discussed.

7.3.3 International architecture connections

International architecture connections, e.g. the harmonisation of the national architecture and the European KAREN architecture, are also important. In the long run, this will ensure that the freight transport telematics architecture corresponds to the EU KAREN architecture. Guidelines on the joint use of these two architectures should be drawn up in the near future.

In accordance with the European framework architecture KAREN and the U.S. National ITS Architecture, the aim of the national architecture is to collect all telematics functions in one system architecture. This means that the existing freight and passenger transport architectures should be united, as should any other potential architectures.

7.3.4 Steering

Steering consists of all steps taken to increase the use of the architecture in research and product development and through system and hardware investments. For example, the Ministry of Transport and Communication and other investors can introduce the practice of taking the architecture into consideration during the planning and realisation of new public projects.

7.3.5 Further stages in architectural development shown in the prestudy

The applicability and usability of the architecture will be increased through follow-up actions that will complement the actual architecture. The freight transport telematics architecture feasibility study already listed a number of these actions.

Recommendations data bank

The aim is to increase Finnish actors' awareness of the main international standards, frameworks and existing architectures and their development by compiling an up-to-date recommendations data bank. The breadth of the subject and the rapid pace of development are the main challenges for the development and management of the data bank. First, the main monitoring targets and content providers should be determined. Then, the data bank itself can be compiled with the help of the content providers.

Road transport management system interface architecture

The aim is to draw up a road transport management system interface architecture, which consists of the transport fleet and its manager, as well as the necessary connections with other transport modes, the consignee and especially the consigner. The architecture should also fulfill the legal information requirements (e.g. information on temperature-controlled products).

Air cargo interface

The aim is to draw up an architecture description for the interfaces between consigners, shipping agents, airline companies and consignees. The architecture includes definitions of the main terms and descriptions of the basic processes.

PortNet Plus

The aim of this project is to expand PortNet and develop its interfaces to make the service part of the operating systems of Customs, ports and other members of the PortNet cooperative. The objective is that officials at all Finnish ports and border stops should use uniform operating practices.

Tracking message

The aim of this project is to design and deploy a common tracking message simple enough for use in automatic identification devices and mobile devices. The contents of electronic short messages (part messages) should be based on an internationally agreed-upon message structure and list of information contents.

Infrastructure status reports

The aim is to define applicable solutions and architectures for relaying transport infrastructure (road network, railway network, ports and terminals) situation and incident information and especially exception information and instructions. The required information and its presentation and transfer methods are defined in the architecture.

Sources

Airaksinen J., Hohti M., Pitkänen O., Simojoki S., Tervo-Pellikka R., Bäckström J., Ylisiurunen K. 2003. Legislative, Commercial and Organizatory Framework of ITS Services. FITS Publications 13/2003, Ministry of Transport and Communications. 70 p. (Liikennetelemaattisten tuotteiden ja palvelujen pelisäännöt.)

ARKTRANS, http://www.informatics.sintef.no/projects/arktrans/arktransweb/

Aspelin E. 2001. Case Academica – Final Report on the ebXML Pilot Project. Finnish Information Society Development Centre. 74 p. (Case Academica – ebXML-pilottiprojektin loppuraportti.)

Aspelin E. 2002. Development of the IP applications as a part of the Port@Net system. FITS Publications 2/2002, MinTC. 57 p. (IP-järjestelmän kehittäminen osaksi Port@Net-kokonaisuutta.)

EAN International, http://www.ean-int.org

Electronic Data Transfer for Efficient and Speedy Logistics Chain Operations. Brochure. Finnish Information Society Development Centre. (Sähköisellä tiedonsiirrolla tehoa ja vauhtia logistiikkaketjuun.)

European Communities. 2000. KAREN – European ITS framework architecture. CD-ROM.

Finnterms 2001: Standard Domestic Trade Definitions. Pohjola Oy. (Kotimaankaupan toimituslausekkeet.)

Haapanen M., Valta E. 1990. Logistiikka. Ekondata Oy. 205 p. (Logistics)

Hedin J., Sundberg J., Eriksson O. 2002. Plan för utveckling av systemarkitektur för ITS i Sverige. Delrapport A4. Hybris Konsult AB. 21 p.

Incoterms 2000: Critical Points in International Transports. Pohjola Oy. (Kriittiset pisteet kansainvälisissä kuljetuksissa.)

Kanerva K., Purola J. 2001. Logistics Study 2001. Publications of the Ministry of Transport and Communications 52/2001, MinTC. 190 p. (Logistiikkaselvitys 2001.)

Karrus K.E. 2001. Logistiikka. WSOY. 319 p. (Logistics.)

Leviäkangas P., Lähesmaa J., Lehtonen M., Oinas J., Ristola T., Appel K., Mäkinen P., Ruoti K. 2000. The Finnish National System Architecture for Transport Telematics.

Summary. Publications of the Ministry of Transport and Communications B 1/2000, MinTC. 22 p. (Liikennetelematiikan kansallinen järjestelmäarkkitehtuuri. Tiivistelmä.)

Lähesmaa J., Lehtonen M., Oinas J., Ristola T., Appel K., Mäkinen P. 2000. The Finnish National System Architecture for Transport Telematics. The Development Plan. Publications of the Ministry of Transport and Communications B 2/2000, MinTC. 52 p. (Liikennetelematiikan kansallinen järjestelmäarkkitehtuuri. Kehittämissuunnitelma.)

Maunuksela-Malinen P., Salo J. 1999. Common Access Reference - Delivery Management in International Trade. TEDIM publications. 34 p. (Yhtenäisviite kansainvälisen kaupan toimitusvalvonnassa.)

MinTC 1998. Logistics Chain EDI Project - Increasing the Efficiency of Trade Data Exchange. Publications of the Ministry of Transport and Communications 37/1998, MinTC. 88 p. (Logistiikkaputken EDI.)

Odette International, http://www.odette.org

Pajunen-Muhonen H., Hyppönen R., Lähesmaa J., Löfgren P., Rautiainen P. 2002. Freight telematics architecture. Feasibility study. FITS Publications 10/2002, MinTC. 61 p. (Tavaraliikenteen telematiikka-arkkitehtuuri, esiselvitys.)

PapiNet, http://www.papinet.org

Rinta-Keturi I., Auvinen S. 2002. AirportNet. Functional definition. FITS Publications 11/2002, MinTC. 33 p. (AirportNet, Toiminnallinen määrittely.)

RosettaNet, http://www.rosettanet.org

SAP INFO 3/2002. Journal for customers and interest groups.

SCOR model terminology in Finnish, http://www.logy.fi/scor.shtml

Terminology in Finnish, http://www.fi.danzas.com/hyodyllistatietoa/alansanastoa.html

The National ITS Architecture version 4.0. CD-ROM. Department of Transportation, USA.

Transport data exchange library, http://www.kalkati.net

UN/CEFACT. 2001. Facilitation Measures related to International Trade Procedures, Recommendation 18. ECE/TRADE/271. 13 p.

Corporate and expert interviews

Henric Bladh	Danzas Oy
Jukka Holm	Danzas Oy
Vesa Jormakka	Danzas Oy
Eija Aspelin	Finnlines Oy
Pertti Kohi	Inex Partners Oy
Ilkka Tirkkonen	Kiitolinja Oy
Tom Kullström	Kiitolinja Oy
Vesa Salminen	Technology Industries of Finland
Heidi Niemimuukko	Finnish Rail Administration
Ahti Turkia	Steveco Oy
Kauko Saarela	Stora Enso Oyj
Jari Salo	Finnish Information Society Development Centre
Virpi Kantola	National Board of Customs
Olli Tuomisto	National Board of Customs
Sirkka-Leena Holmberg	VR Cargo

People who took part in the workshops

Process validation workshop 9.12.2002

Hilska, Lassi	Ministry of Transport and Communications
Vänskä, Helena	Ministry of Transport and Communications
Boman, Juha	TNT Suomi
Turkia, Ahti	Steveco
Bladh, Henric	Danzas
Tilli, Markku	AIM Finland
Viitanen, Sami	SAP Suomi
Salo, Jari	Finnish Information Society Development Centre
Vaarama, Hannu	Viking Line Marketing
Niemimuukko, Heidi	Finnish Rail Administration

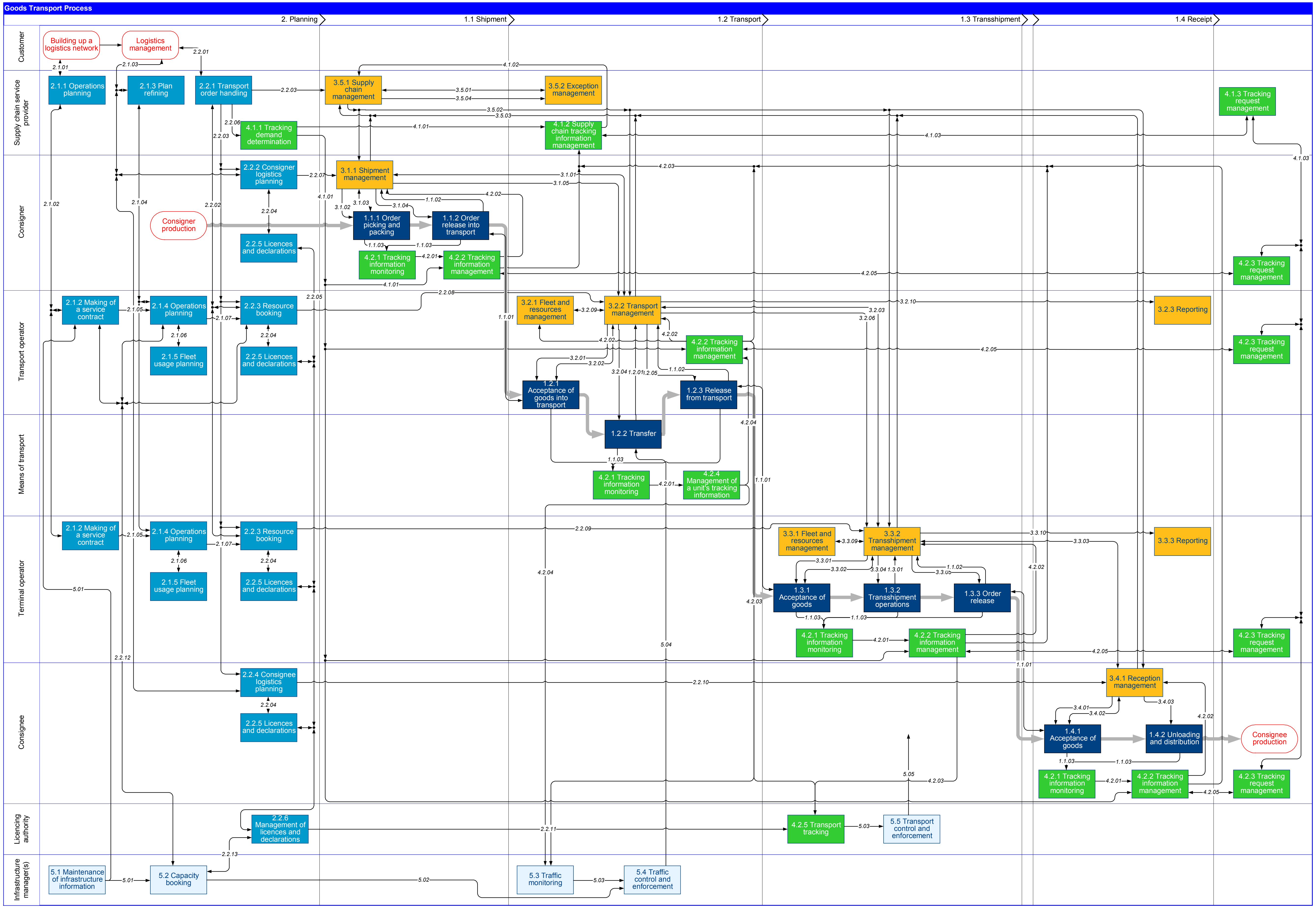
Process validation workshop 3.1.2003

Hilska, Lassi	Ministry of Transport and Communications
Vänskä, Helena	Ministry of Transport and Communications
Tirkkonen, Ilkka	Kiitolinja
Turkia, Ahti	Steveco
Bladh, Henric	Danzas
Tilli, Markku	AIM Finland
Rautiainen, Pekka	EP-Logistics Oy
Vaarama, Hannu	Viking Line Marketing
Holmberg, Sirkka-Leena	VR Cargo

Prioritisation of shortcomings and development needs -workshop 14.1.2003

Vänskä, Helena	Ministry of Transport and Communications
Melasniemi, Mikko	Confederation of Finnish Industry and Employers
Salo, Jari	Finnish Information Society Development Centre
Vaarama, Hannu	Viking Line Marketing

Overall process description



Data flow descriptions

ID	Direction	Name	Description	Notes
1.1.01	I	Proof of release	Releaser ID and information on release.	
1.1.01	O	Proof of delivery, POD	Consignee ID and information on the acceptance of the transport.	
1.1.02		Order release information	Information on the release and acceptance of the transport, and the transfer of responsibility.	Consignee signs off.
1.1.03		Tracking data	Tracking data collected during all stages of the supply chain.	The tracking data can include content, condition and location information. The desired information is defined while making the tracking order.
1.2.01		Transport realisation information	Information on the carrying out and events of a transport.	
1.3.01		Transshipment realisation information	Information on the carrying out of and events during transshipment.	
2.1.01	I	Transport agreement	Information on a long-term agreement between a customer and supply chain service provider.	For instance annual contracts.
2.1.01	O	Transport agreement	Information on a long-term agreement between a customer and supply chain service provider.	For instance annual contracts.
2.1.02	I	Service agreement	Information on a long-term service agreement between a supply chain service provider and logistics service provider.	For instance annual contracts.
2.1.02	O	Service agreement	Information on a long-term service agreement between a supply chain service provider and logistics service provider.	For instance annual contracts.
2.1.03	I	Advance order	On the basis of the production plan, the customer provides advance information on the transport order to the supply chain service provider, consigner and consignee.	Also known as a preorder. The preliminary information can be given e.g. during any significant refining of the production plan. The transport order contains information on the necessary transport and possible other services (e.g. transit storage).
2.1.03	O	Advance order	Information on the transport plan is sent to the customer.	In accordance with the advance order, the transport plan contains information on the transport and possible other services (e.g. transit storage).

ID	Direction	Name	Description	Notes
2.1.04	I	Advance order for transport and transshipment services	The supply chain service provider gives the transport and terminal operators their own advance information on the transport order.	The transport order contains information on the necessary transports and other services (e.g. transit storage services). Advance orders for transport and other services can be adjusted upon receiving updated advance orders from the customer.
2.1.04	O	Advance order for transport and transshipment services	Logistics service providers transmit information on the transport or service plan for a transport leg to the supply chain service provider.	
2.1.05		Agreement information	The necessary information is gathered on the agreements for use in the more precise planning of operations.	
2.1.06	I	Fleet and service plan	Information on transport and service planning.	Operations planning provides fleet usage planning with information on the fleet usage requirements of transports and services.
2.1.06	O	Fleet usage plan	Information on fleet usage planning.	Fleet usage planning provides operations planning with information on the available fleet.
2.1.07		Preliminary transport or service plan for transport leg	Preliminary information on the transport order and the transport or service plans for a transport leg, for use in booking resources in advance.	
2.2.01	I	Transport order	The information contained by a transport order.	The transport order contains e.g. the following information: consigner and departure point, consignee and destination, delivery time, goods information and special transport requirements, e.g. hazardous goods transports, transport condition requirements etc.
2.2.01	O	Transport order confirmation	The transport order information and transport plan.	
2.2.02	I	Transport order for a leg	Transport order information for the transport and terminal operators.	The transport order contains information on the necessary transports and other services (e.g. transit storage services).
2.2.02	O	Transport order confirmation for a leg	Transport order information and the transport plan for a leg.	The transport order contains information on the necessary transports and other services (e.g. transit storage services).

ID	Direction	Name	Description	Notes
2.2.03		Transport plan	Planning information for supply chain management.	The transport plan can be transmitted as a whole or in sections for reasons of information security.
2.2.04	I	Transport order information	Transport order information for use in the licencing and declaration processes.	
2.2.04	O	Transport licence	Information on a transport licence issued by an authority.	
2.2.05	I	Transport licence application/declaration	Information on a transport licence application or transport declaration handed in to an authority as required.	
2.2.05	O	Transport licence	Information on a transport licence issued by an authority.	
2.2.06		Tracking specifications	Transport order and other contract information used to determine the level and amount of tracking required.	The tracking service can include content, condition and location information.
2.2.07		Shipment plan	Shipment planning information used to carry out the picking, packing and release of goods.	
2.2.08		Transport plan	Transport planning information used to carry out the loading, transport and unloading of goods.	
2.2.09		Transshipment plan	Transshipment planning information used to carry out the acceptance, transshipment and release of goods.	
2.2.10		Receipt plan	Receipt planning information used to carry out the acceptance, unloading and distribution of goods.	
2.2.11		Licence information	Licence information for the authorities.	Carries out transport tracking, e.g. during hazardous goods transports.
2.2.12	I	Capacity booking	A request to obtain transport infrastructure capacity for use.	The request can concern either repeated/cyclical (regular scheduled traffic) or one-time needs for infrastructure capacity.
2.2.12	O	Capacity booking confirmation		

ID	Direction	Name	Description	Notes
2.2.13	I	Licence information	Declaration on the issuing of a required licence to the infrastructure manager.	
2.2.13	O	Capacity booking confirmation	Declaration made to a licencing authority about the booking of infrastructure capacity for a transport that requires a licence.	
3.1.01	I	Shipment management information	The shipment management information and preliminary consignment note are sent to the transport operator prior to transport to help align the loading and shipment plans.	
3.1.01	O	Loading management information	The loading management information is sent to the previous actor within the supply chain prior to transport to help align the loading and shipment plans.	
3.1.02		Picking and packing instructions	Instructions for the picking and packing of goods.	
3.1.03	I	Consignment note	The consignment note contains e.g. consigner and consignee information, parcels (measurements, weights), parcel contents, goods and their prices, and insurance information.	
3.1.03	O	Updated consignment note	The updated consignment note.	Parcels can be combined or packed in a different way than the consignment note details, and the goods may be deficient. These details are updated in the consignment note.
3.1.04		Loading instructions	Loading instructions for use in releasing a shipment into transport.	
3.1.05		Consignment note	Consignment note for the transport operator.	The term Consignment note here refers to an extensive shipment data set. It does not refer to the information content of the consignment note (usually on paper) being used. The content is more alike the one presented in the study ???.
3.2.01		Receipt instructions	Instructions for the acceptance and loading of goods.	

ID	Direction	Name	Description	Notes
3.2.02	I	Consignment note	Consignment note for use in verifying the accuracy of the shipment.	The term Consignment note here refers to an extensive shipment data set. It does not refer to the information content of the consignment note (usually on paper) being used. The content is more alike the one presented in the study Logistics Chain EDI Project.
3.2.02	O	Loading list	Verified consignment note supplemented with information from the loading list.	
3.2.03	I	Unloading management information	Management information for unloading goods.	Sent to the next actor within the supply chain before the transport arrives in order to help align the unloading plans.
3.2.03	O	Transshipment management information	Receipt information is sent to the previous actor within the supply chain before the transport arrives at the transshipment terminal in order to align the unloading plans.	For instance the time frame for the terminal.
3.2.04		Transport instructions	Management information for transport.	More precise information e.g. on the time frame for the terminal.
3.2.05		Unloading instructions	Management information for unloading of goods.	
3.2.06		Loading list	The consignment note supplemented with information from the loading list is sent to the consignee for the transport leg, i.e. the next actor within the supply chain.	
3.2.07	I	Fleet management information	Management information on the means of transport and other resources, for use in transport management.	
3.2.07	O	Transport management information	Management information on shipments, necessary for the management of transport means and resources.	
3.2.08		Realisation information	Information for reports on the carrying out of transports.	
3.2.09	I	Transport management information	Information on the use of transport means and resources for use in transport management.	
3.2.09	O	Fleet management information	Information on the management of transports for use in fleet and resource management.	

ID	Direction	Name	Description	Notes
3.2.10		Reporting data	The information needed for reporting.	
3.3.01		Receipt and unloading instructions	Management information for receipt of goods.	
3.3.02	I	Loading list	Consignment note with loading list to verify the accuracy of the shipment.	
3.3.02	O	Information on the acceptance of goods	Verified consignment note and shipment acceptance data.	
3.3.03	I	Order release instructions	Information on the release of the shipment is sent to the next actor within the supply chain to assist the acceptance of the shipment.	
3.3.03	O	Instructions for the acceptance of goods	Information on the acceptance of the shipment is sent to the previous actor within the supply chain to assist the release of the shipment.	
3.3.04		Transshipment instructions	Instructions for agreed transshipment operations.	
3.3.05		Order release instructions	Instructions for releasing orders.	
3.3.06		Consignment note	Consignment note for the next actor within the supply chain.	The term Consignment note here refers to an extensive shipment data set. It does not refer to the information content of the consignment note (usually on paper) being used. The content is more alike the one presented in the study Logistics Chain EDI Project.
3.3.07	I	Fleet management information	Management information on the fleet and resources for use in transshipment management.	
3.3.07	O	Transshipment management information	Management information on shipments in the terminal required for fleet and resource management.	
3.3.08		Realisation information	Information for reports on the carrying out of transshipment.	
3.3.09	I	Transshipment operations management information	Information on transshipment resource management for use in the management of transshipment operations.	
3.3.09	O	Transshipment resource management information	Information on transshipment operations management for use in the management of transshipment resources.	
3.3.10		Reporting data	The information needed for reporting.	

ID	Direction	Name	Description	Notes
3.4.01		Receipt and unloading instructions	Instructions for receipt of goods.	
3.4.02	I	Consignment note	Consignment note for verifying the accuracy of the shipment.	
3.4.02	O	Receipt information	Verified consignment note and shipment acceptance data.	
3.4.03		Handling instructions	Instructions on the handling of goods during the unloading and distribution phase of the Receipt process.	
3.5.01	I	Transport plan	Transport plan for use in Exception management in case of possible replanning of the transport.	
3.5.01	O	Transport plan	Updated transport plan.	
3.5.02		Transport plan	Updated transport plan.	
3.5.03		Realisation information	Information on the carrying out of the various stages of the transport.	
3.5.04		Exception information	Exception information for use in Exception management during the replanning of the transport.	
4.1.01		Tracking request	Information on a tracked shipment / transport order used to help actors within the supply chain identify and recognise the shipment.	The tracking specifications include the tracking ID in use, the quality/type/nature of tracking taking place, and the sites/actors the tracking data is transmitted to.
4.1.02		Tracking data	Tracking data on the management of tracking data within the supply chain for use in supply chain management.	
4.1.02.01		Content information	Observed content information for use in local vehicle tracking data management.	
4.1.02.02		Condition information	Observed condition information for use in local vehicle tracking data management.	
4.1.02.03		Location information	Observed location information for use in local vehicle tracking data management.	

ID	Direction	Name	Description	Notes
4.1.03	I	Tracing request	Tracing request sent to tracking data management.	
4.1.03	O	Tracing data	Response to a tracing request.	
4.2.01		Tracking data	Tracking data for use in an actor's tracking data management.	The tracking data contains content, condition and location information.
4.2.02		Tracking data	Tracking data for use in an actor's own management process.	
4.2.03		Tracking data	Tracking data used in supply chain tracking data management and in tracking by the authorities.	
4.2.04		Tracking data	Tracking data transmitted from a tracking unit and local tracking data management to an actor's tracking data management system.	The tracking unit can be e.g. a means of transport.
4.2.05	I	Tracing request	Tracing request sent to tracking data management.	
4.2.05	O	Tracing data	Response to a tracing request.	
5.01		Transport infrastructure information	Information on the topology and characteristics of the transport infrastructure.	
5.02		Infrastructure capacity bookings	Information on the booked infrastructure and transport capacity.	
5.03		Tracking data		
5.04		Traffic control information	Traffic control data for means of transport.	
5.05		Transport control information	Transport control data for actors within the supply chain.	

Data sets used by the process components

#	Process component	Goods order	Order information	Delivery lot	Goods in consignment	Insurance	Goods	Handling Instructions	Hazardous material classification	Special characteristics of	Identified goods	Transport order	Transport plan	Transport plan for leg	Leg realisation information	Shipment	Transport licence	Content	Parcel content information	Consolidated parcel	Shipment parcels	Transport unit content	Transport units in vehicle	Shipments in vehicle	Tracking data	Condition	Location	Event	Tracked unit	Transport unit	Means of transport	Parcel
0	Trade																															
0.1	Selling	RU	RU				R				R																					
0.2	Purchase	CRU	CRUD				R				R																					
0.3	Purchase of logistics services	R	R																													
0.3.1	Building up a logistics network																															
0.3.2	Logistics management	R	R	R	R	R	R	R	R	R		C																				
0.4.1	Consigner production planning	R	R	C	C	R	R	R																								
0.4.2	Consigner production	R	R	R	R		R	R			C																					
0.5.1	Consignee production planning	R	R	R	R		R	R																								
0.5.2	Consignee production	R	R	R	R		R	R																								
1	Delivery																															
1.1	Shipment																															
1.1.1	Order picking and packing			RU	RU		R	R	R	R	R	R	R	R				C	C	C					C	C	C	C				C
1.1.2	Order release into transport							R	R	R		R	R	R	C	R		R			R				C	C	C	C				R
1.2	Transport																															
1.2.1	Acceptance of goods into transport							R	R	R		R	R	R	C	C		C			C	C	R	C	C	C	C	C		R	R	R
1.2.2	Transfer							R	R	R		R	R	R				CRU					CRU		C	C	C	C		R	R	
1.2.3	Release from transport							R	R	R		R	R	R	C			RU				RU		RU	C	C	C	C		R	R	R
1.3	Transshipment																															
1.3.1	Acceptance of goods							R	R	R		R	R	R	C										C	C	C	C				
1.3.2	Transshipment operations							R	R	R		R	R	R		R		C		C	RU				C	C	C	C				R
1.3.2.1	Terminal handling																															
1.3.2.2	Storage																															
1.3.2.3	Value added services																															
1.3.3	Order release							R	R	R		R	R	R	C	R					R				C	C	C	C				
1.4	Receipt																															
1.4.1	Acceptance of goods							R	R	R					C	R		R			R				C	C	C	C				R
1.4.2	Unloading and distribution			R	R		R	R	R	R	R							R	R						C	C	C	C				R
2	Planning																															
2.1	Supply chain planning																															
2.1.1	Operations planning																															
2.1.2	Making of a service contract																															
2.1.3	Plan refining												C																			
2.1.4	Operations planning													C																		
2.1.5	Fleet usage planning													R																R	R	
2.2	Transport planning																															
2.2.1	Transport order handling											RU	CRU	R																		
2.2.2	Consigner logistics planning												R	R			R															
2.2.3	Resource booking												R	CRU			R													C	C	
2.2.4	Consignee logistics planning												R	R			R															
2.2.5	Licences and declarations												R	R			C															
2.2.6	Management of licences and declarations																RU															
3	Management																															
3.1	Shipment operations management																															
3.1.1	Shipment management			R	R			R	R	R	R		R	R											R	R	R	R				
3.2	Transport operations management																															
3.2.1	Fleet and resources management												R	R	R							R	R		R		R	R		R	R	
3.2.2	Transport management							R	R	R			R	R	R										R	R	R	R		R	R	
3.2.3	Reporting																															
3.3	Transshipment operations management																															
3.3.1	Fleet and resources management												R	R	R							R	R		R		R	R		R	R	
3.3.2	Transshipment management							R	R	R			R	R	R										R	R	R	R		R	R	
3.3.3	Reporting																															
3.4	Reception operations management																															
3.4.1	Reception management			R	R			R	R	R	R		R	R	R							R	R		R	R	R	R				
3.5	Supply chain operations management																															
3.5.1	Supply chain management												R	R	R	R																
3.5.2	Exception management											R	RU	RU	R	R																
4	Tracking and tracing																															
4.1	Supply chain tracking and tracing																															
4.1.1	Tracking demand determination																															
4.1.2	Supply chain tracking information management																															
4.1.3	Tracking request management																															
4.2	Logistics operator tracking and tracing																															
4.2.1	Tracking information monitoring																															
4.2.1.1	Content information monitoring																															
4.2.1.2	Condition information monitoring																															
4.2.1.3	Location monitoring																															
4.2.2	Tracking information monitoring																															
4.2.3	Tracking request management																															
4.2.4	Management of a unit's tracking information																															
4.2.5	Transport tracking																															
5	Infrastructure and traffic management																															
5.1	Maintenance of infrastructure information																															
5.2	Capacity booking											R	R	R	R		R															
5.3	Traffic monitoring											R	R	R	R		R								R		R	R		R	R	
5.4	Traffic control and enforcement																								R		R	R		R	R	
9	Cost management																															

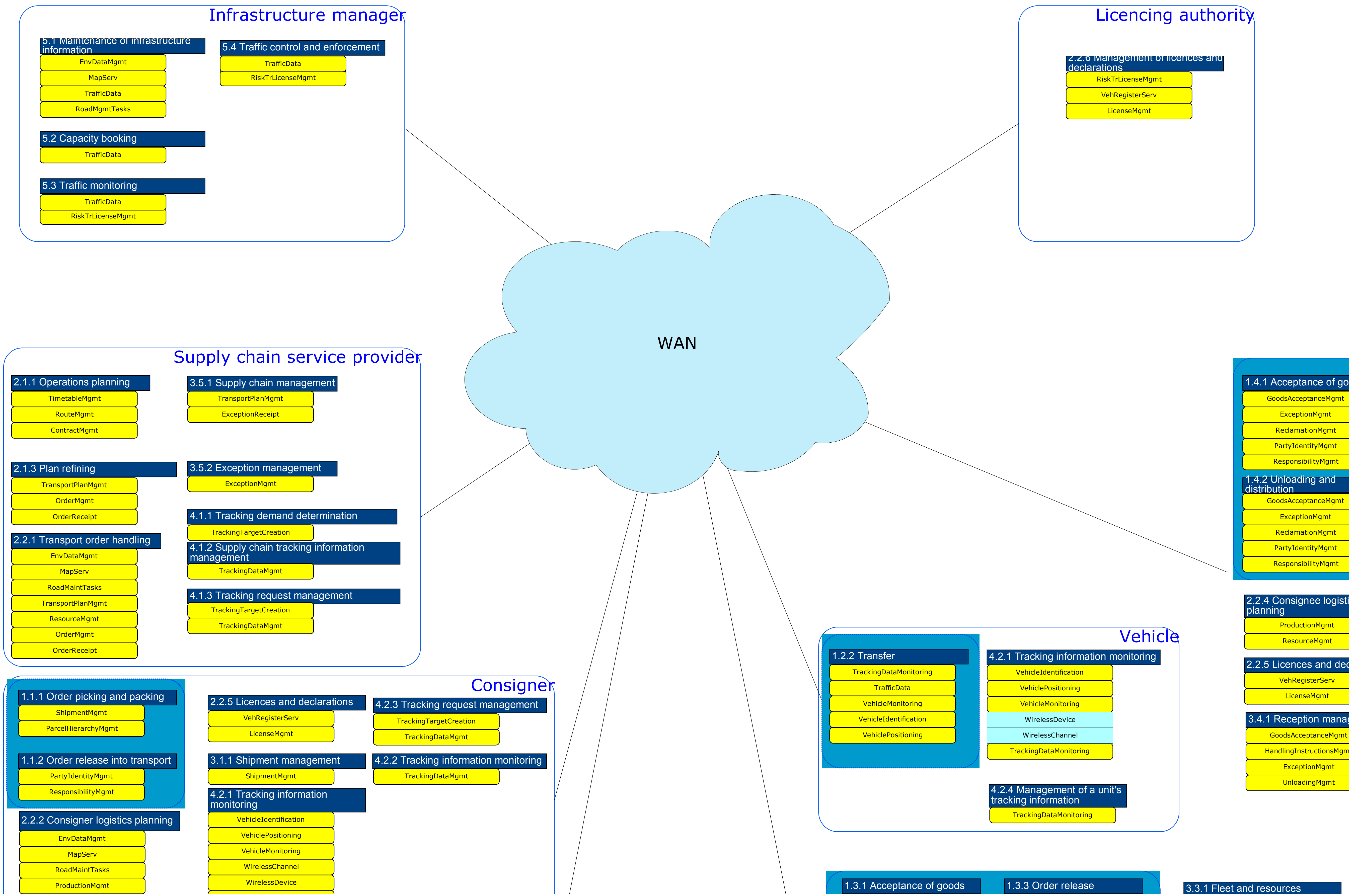
Data sets of the process data flows

#	Direction	Dataflow	Control data	Forecast / Advance data	Realization / fact	Goods order	Order information	Delivery lot	Goods in consignment	Insurance	Goods	Handling Instructions	Hazardous material classification	Special characteristics of goods	Identified goods	Transport order	Transport plan	Transport plan for leg	Leg realisation information	Shipment	Transport licence	Content	Parcel content information	Consolidated parcel	Shipment parcels	Transport unit content	Transport units in vehicle	Shipments in vehicle	Tracking data	Condition	Location	Event	Tracked unit	Transport unit	Means of transport	Parcel
1.1.01	I	Proof of release			x																											x				
1.1.01	O	Proof of release			x																											x				
1.1.02		Order release information			x																											x				
1.1.03		Tracking data			x										x							x	x	x	x	x	x	x	x	x	x		x	x	x	x
1.2.01		Transport realisation information			x												o	o	x													x				
1.3.01		Transshipment realisation information			x												o	o	x													x				
2.1.01	I	Transport agreement		x	x																															
2.1.01	O	Transport agreement		x	x																															
2.1.02	I	Service agreement		x	x																															
2.1.02	O	Service agreement		x	x																															
2.1.03	I	Advance order		x				o	o	o	o	x	x	x		x							o													x
2.1.03	O	Advance order		x				o	o	o	o	x	x	x		x	x	x			x		o													x
2.1.04	I	Advance order for transport and transshipment services		x				o	o	o	o	x	x	x		o	x	x			x		o													x
2.1.04	O	Advance order for transport and transshipment services		x				o	o	o	o	x	x	x		o	x	x			x		o													x
2.1.05		Agreement information		x	x																															
2.1.06	I	Fleet and service plan	x	x	x																													x	x	
2.1.06	O	Fleet and service plan	x	x	x																													x	x	
2.1.07		Preliminary transport or service plan for transport leg		x													x	x																		
2.2.01	I	Transport order			x			o	o	o	o	x	x	x		x							o													x
2.2.01	O	Transport order			x			o	o	o	o	x	x	x		x	x	x			x		o													x
2.2.02	I	Transport order for a leg			x			o	o	o	o	x	x	x		o	o	x			x		o													x
2.2.02	O	Transport order for a leg			x			o	o	o	o	x	x	x		o	x	x			x		o													x
2.2.03		Transport plan	x	x	x												x	x																		
2.2.04	I	Transport order information		x	x			o	o	o	o	x	x	x		o	x	x					o													x
2.2.04	O	Transport order information		x	x			o	o	o	o	x	x	x		o	x	x			x		o													x
2.2.05	I	Transport licence application/declaration		x	x			o	o	o	o	x	x	x		o	x	x			x		o													x
2.2.05	O	Transport licence application/declaration		x	x			o	o	o	o	x	x	x		o	x	x			x		o													x
2.2.06		Tracking specifications		x	x			o	o	o	o	x	x	x		o	x	x			x		o													x
2.2.07		Shipment plan	x	x	x												o	o																		
2.2.08		Transport plan	x	x	x												o	o																		
2.2.09		Transshipment plan	x	x	x												o	o																		
2.2.10		Receipt plan	x	x	x												o	o																		
2.2.11		Licence information			x																x															
2.2.12	I	Capacity booking		x	x																															
2.2.12	O	Capacity booking		x	x																															
2.2.13	I	Licence information			x																x															
2.2.13	O	Licence information			x																															

#	Direction	Dataflow	Control data	Forecast / Advance data	Realization / fact	Goods order	Order information	Delivery lot	Goods in consignment	Insurance	Goods	Handling Instructions	Hazardous material classification	Special characteristics of goods	Identified goods	Transport order	Transport plan	Transport plan for leg	Leg realisation information	Shipment	Transport licence	Content	Parcel content information	Consolidated parcel	Shipment parcels	Transport unit content	Transport units in vehicle	Shipments in vehicle	Tracking data	Condition	Location	Event	Tracked unit	Transport unit	Means of transport	Parcel
3.1.01	I	Shipment management information	x	x	x							o	o	o																						
3.1.01	O	Shipment management information	x	x	x							o	o	o																						
3.1.02		Picking and packing instructions	x	x	x							o	o	o																						
3.1.03	I	Consignment note		x				x	x	x	x	x	x	x	x	x				x		x	x	x	x											x
3.1.03	O	Consignment note			x			x	x	x	x	x	x	x	x	x				x		x	x	x	x											x
3.1.04		Loading instructions	x	x	x							o	o	o																						
3.1.05		Consignment note			x			x	x	x	x	x	x	x	x	x				x		x	x	x	x											x
3.2.01		Receipt instructions	x	x	x							o	o	o																						
3.2.02	I	Consignment note			x			x	x	x	x	x	x	x	x	x				x		x	x	x	x											x
3.2.02	O	Consignment note			x			x	x	x	x	x	x	x	x	x				x		x	x	x	x	x								x		x
3.2.03	I	Unloading management information	x	x	x							o	o	o																						
3.2.03	O	Unloading management information	x	x	x							o	o	o																						
3.2.04		Transport instructions	x	x	x							o	o	o				x																		
3.2.05		Unloading instructions	x	x	x							o	o	o																						
3.2.06		Loading list			x			x	x	x	x	x	x	x	x	x				x		x	x	x	x	x								x		x
3.2.07	I	Fleet management information	x	x	x																															
3.2.07	O	Fleet management information	x	x	x																															
3.2.08		Realisation information			x																															
3.3.01		Receipt and unloading instructions	x	x	x							o	o	o																						
3.3.02	I	Loading list			x			x	x	x	x	x	x	x	x	x				x		x	x	x	x	x								x		x
3.3.02	O	Loading list			x																															
3.3.03	I	Order release instructions	x	x	x							o	o	o																						
3.3.03	O	Order release instructions	x	x	x							o	o	o																						
3.3.04		Transshipment instructions	x	x	x							o	o	o				x																		
3.3.05		Order release instructions	x	x	x							o	o	o																						
3.3.06		Consignment note			x			x	x	x	x	x	x	x	x	x				x		x	x	x	x											x
3.3.07	I	Fleet management information	x	x	x																															
3.3.07	O	Fleet management information	x	x	x																															
3.3.08		Realisation information			x																															
3.4.01		Receipt and unloading instructions	x	x	x							o	o	o																						
3.4.02	I	Consignment note			x			x	x	x	x	x	x	x	x	x				x		x	x	x	x											x
3.4.02	O	Consignment note			x																															
3.4.03		Handling instructions	x	x	x							o	o	o																						
3.5.01	I	Transport plan			x												x	x	x																	
3.5.01	O	Transport plan			x												x	x																		
3.5.02		Transport plan	x	x	x												x	x																		
3.5.03		Realisation information			x												x	x	x										x	x	x	x				
3.5.04		Exception information			x												x	x	x										x	x	x	x				

#	Direction	Dataflow	Control data	Forecast / Advance data	Realization / fact	Goods order	Order information	Delivery lot	Goods in consignment	Insurance	Goods	Handling Instructions	Hazardous material classification	Special characteristics of goods	Identified goods	Transport order	Transport plan	Transport plan for leg	Leg realisation information	Shipment	Transport licence	Content	Parcel content information	Consolidated parcel	Shipment parcels	Transport unit content	Transport units in vehicle	Shipments in vehicle	Tracking data	Condition	Location	Event	Tracked unit	Transport unit	Means of transport	Parcel
4.1.01		Tracking request	x	x	x																															
4.1.02		Tracking data			x																	x							x	x	x	x				
4.1.02.1		4.1.02.1			x																															
4.1.02.2		4.1.02.2			x																															
4.1.02.3		4.1.02.3			x																															
4.1.03	I	Tracing request			x										x					x																x
4.1.03	O	Tracing request			x										x					x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
4.2.01		Tracking data			x																	x	x	x	x	x	x	x	x	x	x	x				
4.2.02		Tracking data			x																	x	x	x	x	x	x	x	x	x	x	x				
4.2.03		Tracking data			x																	x	x	x	x	x	x	x	x	x	x	x				
4.2.04		Tracking data			x																	x					x		x	x	x	x				
4.2.05	I	Tracing request			x										x					x																x
4.2.05	O	Tracing request			x										x					x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
5.01		Transport infrastructure information			x																															
5.02		Infrastructure capacity bookings	x		x																															
5.03		Tracking data			x																	x					x		x	x	x	x		x	x	
5.04		Traffic control information	x		x																															

Information system service distribution map



Issues examined during the Prioritisation of shortcomings and development needs -workshop on 14.1.2003

Concerning all processes

1. Reducing the number of transferred documents
2. Combining overlapping operations
3. Electronic, paper-free data transfer and data processing
4. Automatisation of transport authority procedures (licences and declarations)
5. Responsibilities and managing the interfaces where they change hands (delivery terms)
6. Data transfer problems. Standards exist, but have not been widely introduced.
7. Increasing collaboration between actors
8. Product data bank (product and package data) for use in logistics
9. Development of operating methods to ensure correct and relevant data is distributed to all actors within the network who need it
10. Formulation of uniform indicators (costs, efficiency, quality)
11. Mobile applications
12. Development of data security
13. Definition of responsibilities (e.g. data distribution)
14. Mapping out the risks and compatibility of technical solutions

Delivery

1. Sufficient shipment data (names, addresses…)
2. Harmonisation of consigner and consignee IDs (pick-up and delivery address identifiers, customer address list)
3. Availability of shipment packing and handling data for different actors (temperature, hazardous goods transports…)
4. Lack, availability and accuracy of clear schedules throughout the chain, and for each role (causes hurry/hassle)
5. Information technology connections between actors (technology and message formats, i.e. standardisation)
6. Standardisation of vehicle telematics
7. Up-to-date data on & details of incidents in transport, and loading & unloading sites
8. Connections between processes (between roles)
9. Compatibility of international chains with the architecture
10. Standardised ”messages” between different kinds of supply chains
11. Alignment of the content and time levels of the fleet and freight data so that they can be combined in the necessary functions

Planning

1. It is necessary to develop an established chain planning method that corresponds to the architecture
2. Extensive shipment information supplied by the consigner/orderer (what, when, where to, where from)
3. Extensive information supplied by logistics service companies (schedules, resources…)
4. Information technology connections between actors (technology and message formats, i.e. standardisation)

Management

1. Information technology connections between actors (technology and message formats, i.e. standardisation)
2. Up-to-date supply chain plan available to actors in electronic form
3. Extensive tracking data
4. Speedy identification of incidents
5. Drawing up a new plan and relaying it to the actors involved (e.g. the consigner, consignee and orderer)
6. Single desk -type centralised management
7. Up-to-date information on resources and their use
8. Capacity management
9. Consignee identification (who the shipment is released to within the chain)
10. Relaying and updating of ETA information (automatisation)

Tracking and tracing

1. Sufficient transparency
2. Compatibility of parcel IDs (e.g. the same technology, uniform bar codes and even the existence of labels)
3. Planning, development and updating of information registers (customer codes / postal codes / address lists)
4. Product code and shipment ID registers
5. Compatibility and usability of interface codes
6. Lack of a track and trace service provider
7. Hierarchy: minimisation of tracking events
8. ”Standardisation” of tracking order contents
9. Ownership, recording and management (tracing) of tracking data
10. Development of automatic identification
11. Updating of IDs (e.g. time stamps)
12. Definition of the need for tracking data in operations management and services
13. Combination of logistics and transport data
14. Cost-effective system
15. Allocation of costs

Statements added during the workshop

1. Agreements (has the target been reached?)
2. Handbook on electronic business activities in the transport sector
3. Connections with production management systems
4. Responsibility of companies and public administration for the architecture (ITS Finland)
5. Connection with the development of national transport telematics (e.g. Digiroad)
6. Extent of data connections (actors, mobile connections, regional coverage)
7. Heterogeneity of logistics terminology
8. Common vehicle tracking system
9. Automatic problem identification on the basis of a vehicle’s velocity, acceleration and positioning

FITS Publications
Previously published reports in the series

1/2002 Traffic-safety regulation of in-vehicle information and communication systems. 69 p. ISBN 951-723-760-X (Ajoneuvoissa käytettävien tieto- ja viestintäjärjestel-mien sääntely turvallisuuden kannalta.)

2/2002 Development of the IP applications as a part of the Port@Net system. 55 p. ISBN 951-723-761-8 (IP-järjestelmän kehittäminen osaksi Port@Net-kokonaisuutta.)

3/2002 Liikennetelematiikkahankkeiden arviointiohjeet. 85 p. ISBN 951-723-762-6

4/2002 Guidelines for the evaluation of ITS projects. 87 p. ISBN 951-723-763-4

5/2002 Automatic camera enforcement. Feasibility study. 61 p. ISBN 951-723-764-2 (Liikenteen automaattinen kameravalvonta. Esiselvitys.)

6/2002 Traffic information in congestion management. 143 p. ISBN 951-723-765-0 (Tiedottaminen ruuhkatilanteiden hallinnassa.)

7/2002 Assessment of impacts and socio-economical profitability of real-time passenger information system (ELMI). 111 p. ISBN 951-723-767-7 (Reaaliaikaisen matkustajainformaatiojärjestelmän (ELMI) vaikutusten ja yhteiskuntataloudel-lisen kannattavuuden arviointi.

8/2002 Incident management feasibility study. 36 p. ISBN 951-723-768-5 (Toimintakuvaus häiriönhallinnan tilanteesta.)

9/2002 Technical solutions for automated enforcement. Survey of application areas in Finland. 59 p. ISBN 951-723-769-3 (Automaattivalvonnan tekniset ratkaisut. Selvitys soveltamismahdollisuuksista Suomessa.)

10/2002 Freight Telematics Architecture. Feasibility Study. 77 p. ISBN 951-723-770-7 (Tavaraliikenteen telematiikka-arkkitehtuuri. Esiselvitys.)

11/2002 AirportNet. Functional definition. 33 p. ISBN 951-723-771-5 (AirportNet. Toiminnallinen määrittely.)

12/2002 Mobile phone based parking payments. 69 p. ISBN 951-723-772-3 (Matkapuhelinpohjaiset pysäköinnin maksupalvelut.)

13/2003 Legislative, Commercial and Organizatory Framework of ITS Services. 77 p. ISBN 951-723-774-X (Liikennetelemaattisten tuotteiden ja palvelujen pelisäännöt.)

14/2003 Feasibility study of the digital radio and the digital television in passenger transport telematics. 43 p. ISBN 951-723-775-8 (Digitaalisen radio- ja televisioverkon hyödyntäminen henkilöliikenteen telematiikassa. Esiselvitys.)

15/2003 PortNet Impact Evaluation. 81 p. ISBN 951-723-776-6 (PortNetin vaikuttavuuden arviointi.)

16/2003 ITS Finland preliminary study. 49 p. ISBN 951-723-777-4 (ITS Finland esiselvitys.)

17/2003 DARC services in Intelligent Transport Systems (ITS). Feasibility study. 65 p. ISBN 951-723-778-2 (DARC-palvelu liikennetelematiikassa. Esiselvitys.)

18/2003 Development of public transport incident management. 37 p. ISBN 951-723-799-0 (Joukkoliikenteen häiriönhallinnan kehittäminen.)

19/2003 Intelligent transport services. User needs and transport policy goals. 111 p. ISBN 951-723-880-0 (Telemaattisten palveluiden tarpeellisuus. Käyttäjien mielipiteet ja liikennepoliittiset tavoitteet.)

20/2003 Transport telematics architecture. Final report. 124 p. ISBN 951-723-881-9 (Tavaraliikenteen telematiikka-arkkitehtuuri. Loppuraportti.)

Additional information

Programme web site
www.vtt.fi/rte/projects/fits

Ministry web site
www.mintc.fi

Chairman of Programme Steering Committee
Director ***Matti Roine***
the Ministry of Transport and Communications
P.O.Box 31, 00023 VALTIONEUVOSTO
telephone +358 9 160 28577
fax +358 9 160 28592
e-mail matti.roine@mintc.fi

Programme Co-ordinator
Research professor ***Risto Kulmala***
VTT Building and Transport
P.O.Box 1800, 02044 VTT
telephone +358 9 456 4990
fax +358 9 464 850
e-mail risto.kulmala@vtt.fi or fits@vtt.fi

Mainostoimisto Sinervo&Co.