



Seventh Framework Programme
 Theme 3:
 Information And Communication Technologies

Challenge 6:
 ICT for Safety and Energy Efficiency in Mobility
 Logistics for Life
 ICT-2009.6.1



Deliverable 2.1
D2.1 Knowledge base report
Workpackage WP2
Leading Partner: SINTEF
Security Restriction: PU (Public)
2010-06-22
Version 5.0

Versioning

Version	Description	Author	Date	Comments
0.0	Initial draft	Tor K. Moseng	2010-02-01	Table of content , early definition of ARKTRANS and definitions of initial sections
1.0	Working document for internal discussions	Tor K. Moseng	2010-02-10	Sections defined with some content
2.0	Revised document	Tor K. Moseng	2010-03-19	Figures and more text defined
3.0	Final document for internal review	Tor K. Moseng, Hans Westerheim	2010-04-30	
4.0	Revised document on first peer reviews	Tor K. Moseng, Hans Westerheim	2010-05-18	First review comments has been processed
5.0	Final version	Tor K. Moseng, Hans Westerheim	2010-06-22	Final reviews hav been processed

Contribution

Partner BIBA

Contribution

BIBA has reviewed the work, and given valuable input to the work through conversations by phone and in person. This has specially targeted the taxonomy and how to provide the knowledge base to the users.

Partner Chalmers

Contribution

Early discussions of the initial document, where the taxonomy were the main focus. Have also given comments to the structure of the document, and been actively involved in the taxonomy discussions, which have formed the final version.

Partner Insiel

Contribution

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Partner Intel

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Partner MARLO

Contribution

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Partner SINTEF

Contribution

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Partner TREDIT

Contribution

TREDIT provided knowledge and information about the Euridice project. They validated that the taxonomy can be used for the Euridice project. Have been actively involved in the taxonomy discussions, which have formed the final version.

Deliverable process schedule

No	Process step	Responsible	Date	Involved persons	Notes
1	Deliverable plan Initial planning of process	WP2 Leader	2010-01-22	<ul style="list-style-type: none"> • Hans Westerheim • Tor K. Moseng 	Leader must propose schedule, identify involved contributors and peers.
2	Initial drafting of the Deliverable including structure and first basic content to be sent to the Contributors.	WP2 Leader	2010-02-10	<ul style="list-style-type: none"> • Hans Westerheim • Tor K. Moseng 	Initial drafting.
3	Intermediate version of the Deliverable. Distribute to central Contributors	WP2 Leader, Contributors (especially from WP1)	2010-03-19	<ul style="list-style-type: none"> • Hans Westerheim • Tor K. Moseng • Jannicke Baalsrud Hauge 	Intermediate version of the deliverable.
4	Full concept Leader to approve the document for review	WP2 Leader	2010-04-30	<ul style="list-style-type: none"> • Hans Westerheim • Tor K. Moseng 	Final version of the deliverable.
5	Reviewing	Peers	2010-05-12	<ul style="list-style-type: none"> • Paolo Paganelli • Jannicke Baalsrud Hauge 	Review by internal peers.
	Quality check	Coordinator	2010-05-12		
6	Processing the reviews for the final version	WP2 Leader	2010-06-22	<ul style="list-style-type: none"> • Tor K. Moseng • Hans Westerheim 	Final version
7	Publish on the IC Forum	WP2 Leader	2010-06-22	<ul style="list-style-type: none"> • Tor K. Moseng • Hans Westerheim 	Final stage of process.

Table Of Contents

TABLE OF CONTENTS	4
TABLE OF FIGURES	5
1 EXECUTIVE SUMMARY	6
2 INTRODUCTION	7
3 RELATION TO OTHER WORK PACKAGES	8
4 ARKTRANS	9
4.1 THE ARKTRANS CONTENT	9
4.2 THE ARKTRANS REFERENCE MODEL	10
5 THE L4L TAXONOMY	11
5.1 THE REFERENCE MODEL IN L4L	11
5.2 THE FUNCTIONAL VIEWPOINT IN L4L	12
5.2.1 <i>The Transport Demand functions</i>	12
5.2.2 <i>The Transport Supply</i>	13
5.2.3 <i>The Transportation Network Management functions</i>	14
6 THE KNOWLEDGE BASE	16
6.1 KNOWLEDGE REPRESENTATION IN L4L	16
6.2 KNOWLEDGE BASE PRESENTATION	16
6.2.1 <i>The knowledge base web interface</i>	16
6.2.2 <i>The Content Management System (CMS)</i>	18
6.3 DATABASE MANAGEMENT SYSTEM	18
7 KNOWLEDGE BASE TOOLS	19
7.1 ON-LINE MANUAL	19
7.2 GLOSSARY	19
7.3 SEARCH FUNCTION: THE SMARTFREIGHT EXAMPLE	19
7.4 FREQUENTLY ASKED QUESTIONS (FAQ) FUNCTIONS	20
8 CONCLUSIONS	21
9 FUTURE WORK	22
10 REFERENCES	23
APPENDIX A	24
A.1 MYSQL	24
A.2 ENHANCED ENTITY-RELATIONSHIP (EER) MODEL	24
APPENDIX B	26

Table of Figures

Figure 1: The ARKTRANS content	9
Figure 2: The ARKTRANS reference model	10
Figure 3: L4L relevant domains in the ARKTRANS reference model	11
Figure 4: Example of the relation between the reference model and the functions	12
Figure 5: The L4L relevant functions for the Transport Demand domain.....	13
Figure 6: The L4L relevant functions for the Transport Supply domain.....	13
Figure 7: The L4L relevant functions for the Transportation Network Management domain	14
Figure 8: Knowledge base interface	18
Figure 9: Search function example	20
Figure 10: Hierarchical taxonomy structure	24
Figure 11: Network information structure	25
Figure 12: Transport Demand - in large	27
Figure 13: Transport Supply - in large.....	28
Figure 14: Transportation Network Management - in large	29

1 Executive Summary

The main objective in the Logistics for Life project (L4L) is to provide knowledge of ICT solutions to enable efficient and sustainable freight transport. This knowledge base report describes a knowledge base for efficient and sustainable freight transport by specifying a taxonomy on how to structure collected information for the benefits of the knowledge base users. The collected information will mainly contain results and knowledge from European projects and initiatives, where the collection is mostly done by WP1.

The L4L taxonomy is based on the ARKTRANS framework, which divides the transport sector into different domains. These domains are used as a first classification of the information, while further classification is done through each domain's defined functions. However, only the relevant functions in the context of L4L will be used as classification criterias.

The knowledge base will be an information repository classified by the taxonomy. Another aspect covered by this report is the user interface, which should present the information in an intuitive and easy to follow way. Further, the technology behind the visual aspect is emphasized; the content management system (CMS) and database system is discussed, along with the knowledge base tools. These are tools that will help the users understanding and using the knowledge base are important. The tools focused here are on-line manual, glossary, search function and FAQ.

2 Introduction

One of the main objectives of the Logistics for Life project (L4L) is to collect and describe knowledge¹ of ICT solutions making the freight transport more efficient and sustainable, including more environmental friendly. To be able to overview such knowledge, it is important to have a proper classification system that may relate different knowledge results to each other, as well as make the knowledge easily available for end users. It is also very important that the collection has the basis in non-technical issues to support possible changes in the best possible ways.

The aim of this delivery is to define a taxonomy, which is able to structure obtained results and knowledge from European projects and initiatives collected by WP1, and a knowledge base to contain the structured information. The taxonomy must be intuitive to use for end users searching for ICT solutions to deploy within the freight transport, but also easily updateable for new future results. In L4L, the ARKTRANS framework [1] will be the basis of the taxonomy used. ARKTRANS has pictured the transport sector in a reference model, which consists of different domains. Within each domain, ARKTRANS defines roles and functions needed to fulfil each role's responsibility.

The taxonomy will start out with the different building blocks in logistics and freight transport by means of responsibilities and functions to be performed. Related to these, possible ICT solutions will be identified, and related.

L4L will directly use the ARKTRANS reference model as a starting point for classifying obtained knowledge. However, since the reference model is too coarse grained to classify and find relations and overlaps between the knowledge, a second level is needed. At this level, the functions definitions are used. Section 4 describes the ARKTRANS framework in more detail to be more familiar with the basis of the L4L taxonomy. The L4L taxonomy itself is described in Section 5, which also shows some examples of how identified results will be classified. Section 6 gives some more detail on the knowledge base; how the knowledge will be presented, and structured in a database structure. To make the knowledge base user friendly, several tools are needed. The inclusion of knowledge base tools, such as on-line manual, glossary and FAQ functions, are described in Section 7.

¹ The words knowledge and information are used interchangeably throughout this report.

3 Relation to other work packages

The knowledge base is a part of WP2 in L4L. It receives inputs from other WPs, as well as alignment with technical facilities provided in the project. Below, the relation to each WP is described.

WP1: Survey, Observatory and Synergy

This WP will analyse state-of-the-art technology available and applicable for the freight transport sector. Also, research and development initiatives regarding ICT for freight transport efficiency will be analysed. Here, gaps and synergies can be identified. WP1 will also collect information and requirements from other WPs in the L4L project. All this information gathered and analysed will serve as input to the knowledge base. It is therefore important that the input information is structured according to the L4L taxonomy defined in Section 5.

WP2: Leveraging and catalysing knowledge on freight transport efficiency

The main input to the knowledge base from WP2 is through the special interest groups. There will be a set-up of several different interest groups with themes like wireless technology suitable for freight transport and RFID [2]. Each interest group will be established in the frame of the Intelligent Cargo Forum (IC Forum) [3] and moderated by WP2 partners. The final report from the interest groups will highlight the main contributions to the L4L results, and such to the knowledge base.

WP3: Promotion, Dissemination and Exploitation

The web portal developed in WP3 will use a CMS, which the knowledge base will consider to use. It depends on whether the CMS used by WP3 can suit the knowledge base's requirements to an intuitive, interactive and user-friendly system.

WP4: Forum and Supportive Actions

The knowledge base will interface the IC Forum managed by WP4. The contribution by the IC Forum will be summarized in WP4 and provided as an input to WP1. One of the activities in WP4 is actually to collect requirements from the IC Forum members. The input given to WP1 will further be included in the knowledge base. In addition, the L4L framework will be validated by WP4. This includes both the knowledge base's structure and content.

4 ARKTRANS

This section gives an introduction to the concepts and the content in ARKTRANS. For a more comprehensive and detailed description of ARKTRANS, open the html document containing the version 6.0 of ARKTRANS at the following address: <http://arktrans.no/arktrans/v6/web/>.

ARKTRANS is the Norwegian multimodal framework for ITS. The whole transport sector is addressed, and the specifications are valid for all transport modes (road, sea, rail, and air). ARKTRANS is based on comprehensive studies of the transport sector. Stakeholders, projects and activities representing all transport modes in freight transport have contributed to the establishment. ARKTRANS is used in national and European projects, which address co-modal as well as modal solutions.

ARKTRANS is continuously updated based on results and new knowledge from these projects. The starting point is the version 6.0 of ARKTRANS. Projects that have contributed to this version include, among others, Freightwise [4], MarNIS [5], and SMARTFREIGHT [6]. However, some modifications have been done to the framework based on recent updates from the projects Freightwise and SMARTFREIGHT. These updates are taken into the taxonomy for L4L².

4.1 The ARKTRANS content

ARKTRANS provides a holistic and mode-independent understanding of the transport sector. This has been made possible by using abstractions and different views. This point is illustrated by Figure 1 which shows the content of ARKTRANS, where the content is organised into different abstraction layers and different viewpoints.

What has already been defined in ARKTRANS is contained in the two middle layers: overall concepts and logical aspects. Their viewpoints have been the main focus of ARKTRANS. The technical aspects have not been covered to the same degree as the other viewpoints. The aim is to describe technologies and possible solutions that arrange for interoperability between ITS solutions. It is still under development. The policy aspect is an aspect that has not been looked into in detail in ARKTRANS. It is thus a candidate layer to be enhanced from the added knowledge through L4L.

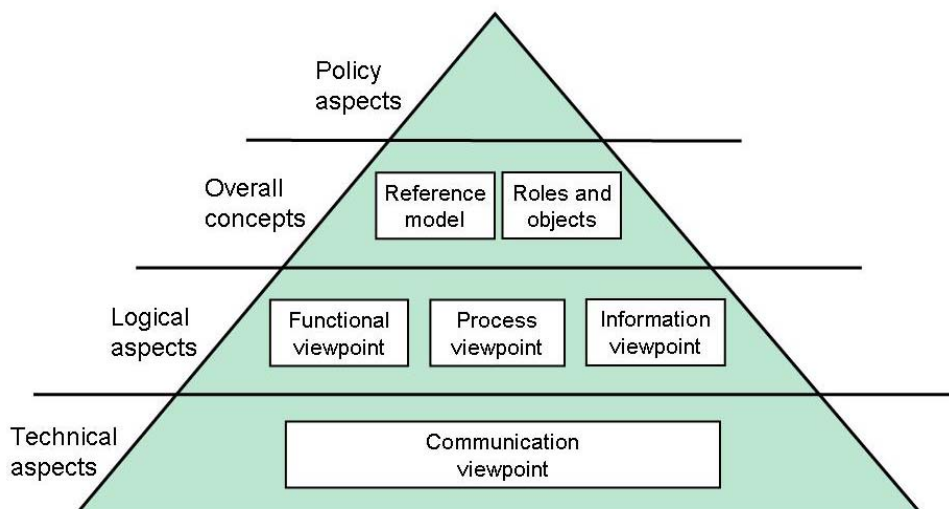


Figure 1: The ARKTRANS content

The ARKTRANS content may be summarized by the two middle abstraction levels: overall conceptual aspects and logical aspects.

² The modifications are mainly concerning the domains Transport Demand and Transport Supply.

- The overall conceptual aspect includes the reference model, which is described in more detail below, and generic roles and object descriptions. Each role represents a unique set of responsibilities, and relates to just one domain of the Reference Model. Remark that a specific stakeholder may take different roles depending on the context and its relation with other stakeholders.
- The logical aspects are the three viewpoints functional, process and information. The functional viewpoint provides a structure and terminology for the logical functions, or activities, of a system. Each of the functions is the responsibility of a role, and therefore also related to only one domain. The process viewpoint identifies the required interactions between the functions (and roles), while the information viewpoint defines the required information objects, their attributes and relations, which are exchanged between the functions. The functional view is described in more detail in Section 5.2, due to its importance in the L4L taxonomy.

4.2 The ARKTRANS reference model

The ARKTRANS reference model pictures and decomposes the transport sector into different domains, each associated with their own roles and responsibilities. Figure 2 shows the different domains: Transportation Network Management, Transport Demand, Transport Supply, and Transport Sector Support. Below, each domain is described in more detail:

- The Transportation Network Management domain arranges for safe, efficient and environmental friendly transport. It includes the management of the physical transportation network infrastructure (e.g. road, railways, fairways and terminal areas), traffic management (of traffic flows and individual transport means), regulation enforcement (e.g. customs), and emergency management.
- The Transport Demand domain represents the transport user, which defines the transport demands, does transport planning, requests the required transport services, and follows up the transport.
- The Transport Supply domain is responsible for providing transport services to the transport user in the Transport Demand domain. This also includes the management and execution of the transport operations (e.g. transport, passenger/goods handling, document handling, etc.), as well as responsibilities related to safe and efficient operation of the transport means (e.g. navigation and adaption to traffic situation).
- The Transport Sector Support domain provides generic services to the other domains, (e.g. different types of information services)

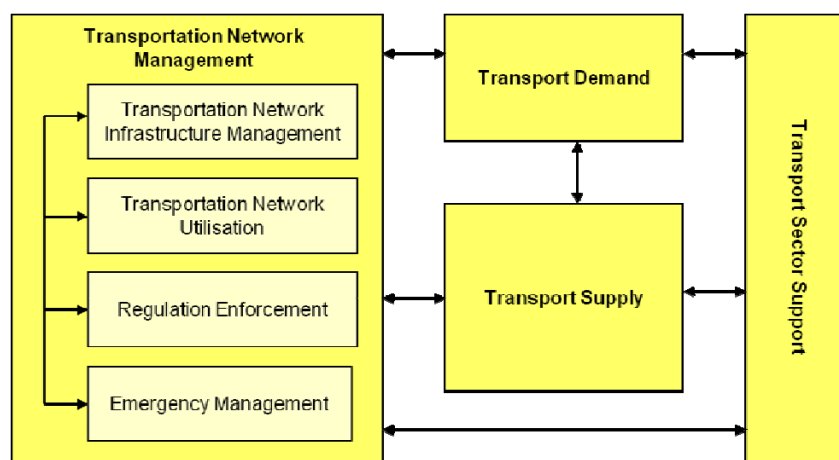


Figure 2: The ARKTRANS reference model

5 The L4L taxonomy

The aim of the L4L taxonomy is to classify results and knowledge that can contribute to more efficient freight transport through the use of ICT. The classification of results and knowledge will be used by different users in the sector, and help to identify and find relations between the knowledge and gaps where knowledge is missing. For this purpose, ARKTRANS is chosen as a basis for the taxonomy. ARKTRANS has divided the transport sector into domains on an overall conceptual basis through its reference model. The domains contain a set of roles and responsibilities, and these roles are responsible for and involved in different activities – or functions. The functions are hierarchically structured by decomposing complex functions into simpler and more comprehensible functions.

This section will review the major building blocks for the L4L taxonomy, namely the reference model and functional viewpoint defined by ARKTRANS. However, not all domains from the ARKTRANS reference model nor functions are relevant in the context of L4L. Partially due to the generic and multimodal perspective of ARKTRANS where both person and goods transport are considered, but also due to the L4L objectives. The reference model in a L4L context is described in 5.1, while the relevant functions that are considered are defined in Section 5.2.

5.1 The reference model in L4L

The reference model will be the first classification criteria in the L4L knowledge base. The classification into the different domains provides a logical division of the transport sector, where examples of roles are transportation authorities, transport service providers and transport users. As mentioned in the introduction to this section, not all domains from ARKTRANS are relevant to the L4L objectives. The L4L objectives are related to increase the freight transport efficiency with ICT, and since ARKTRANS is a holistic and multimodal architecture for both person and goods transport, there will be elements that targets other areas as well. Figure 3 shows the L4L relevant domains in the ARKTRANS reference model (marked light green).

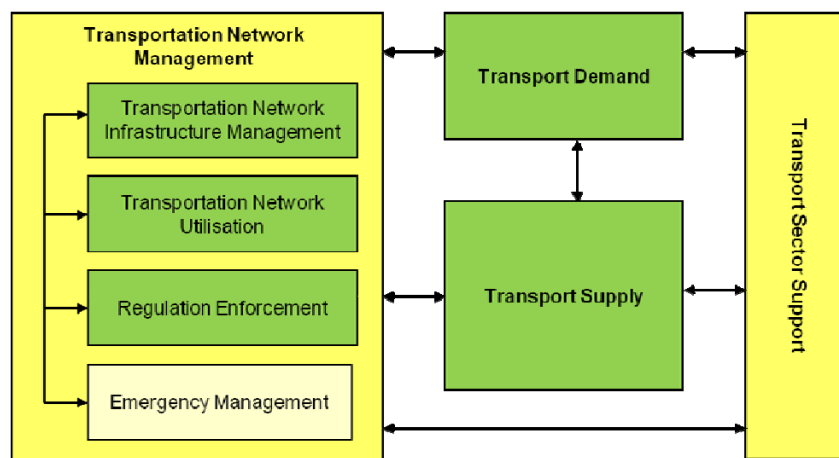


Figure 3: L4L relevant domains in the ARKTRANS reference model

In the Transportation Network Management domain, the subdomain Emergency Management is left out. The reasons for doing this are that ICT will definitely improve the services, but will only help the freight transport in a very in-direct way. Also the Transport Sector Support is left out. This is mainly due to that this domain contains supporting services like banking that is a necessity, but that are not directly involved in the transport sector. The providers of messaging broking services, management of marketing portals and providers of different types of ICT equipment and software are also placed in this sub domain. There might be strong arguments why these stakeholders and the functions they are responsible for should be inside the scope of Logistics for Life. However, none of these functions are

directly related to the planning and execution of transport and logistics services, and hence we have decided to keep them outside the scope in this deliverable.

Results and knowledge will thus be classified into L4L relevant and related domains, however, in many cases the obtained results are not directly covered by only one domain. Most results for a more sustainable sector will involve interactions between actors from different domains, e.g. between transportation authorities (in the Transportation Network Management domain) and transport service providers (in the Transport Supply domain). In those cases where an input (e.g. result from academics, projects or industry) are related to different domains, the input must reflect such information to the users. The coupling with the functions is reflected in the next section.

5.2 The functional viewpoint in L4L

The latter section defined the relevant domains from the ARKTRANS reference model. Within each domain there are a set of functions. This relation is shown in Figure 4 that shows an example of the relation between the Transport Demand domain and its higher level functions.

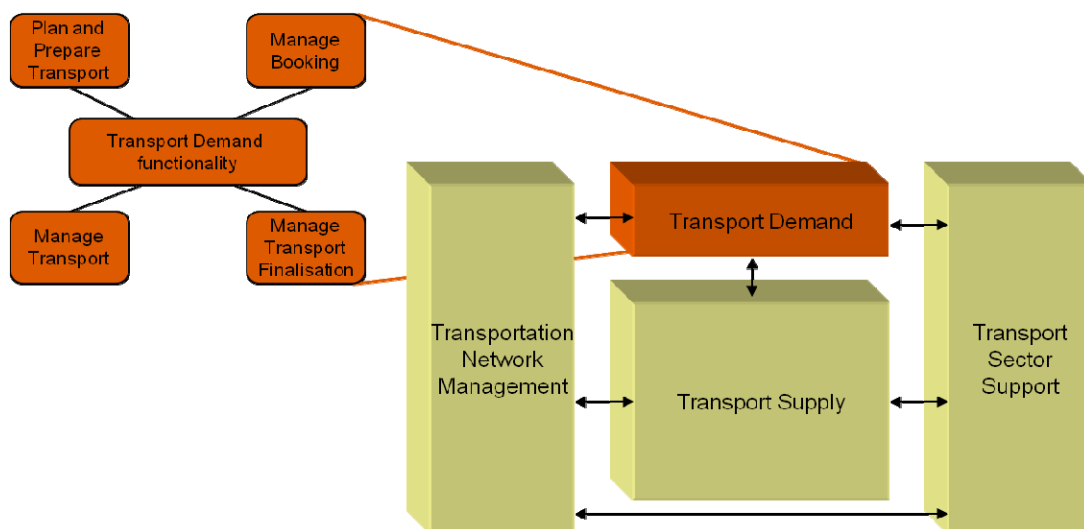


Figure 4: Example of the relation between the reference model and the functions

The functions are defined through compound functions in a hierarchical structure. Figure 4 shows the top function along with its children in the hierarchical tree of more descriptive functions. By taking the functional viewpoint from ARKTRANS as a starting point, there are many functionalities which are not relevant in the context of L4L, as the case was for the domains in ARKTRANS. The same reasoning is done here; ARKTRANS covers all functions necessary for the transport sector, which makes some of them not relevant. The relevant functions must therefore be identified. In the next four sections, only the relevant functions are shown for the relevant domains. Also, to avoid an unnecessary detailing level, some bottom level functions are not displayed. However, in Appendix A, all levels are shown.

It must however be remarked that the complete taxonomy is dynamic regarding the functions. The work in other L4L work packages, especially the analysis and result collection in WP1, might identify gaps in the taxonomy leading to new functions definitions, or to changes/deletions of existing functions towards the final taxonomy in L4L.

5.2.1 The Transport Demand functions

The domain Transport Demand considers roles like Transport User, and Cargo Owner. The responsibilities related to these roles include how to find the best transport alternative, transport planning and the required transport follow up and re-planning. The domain's relevant functions are

shown in Figure 5, while a larger figure with more details is shown in Appendix B. Here, most functions defined in ARKTRANS are relevant in the context of L4L.

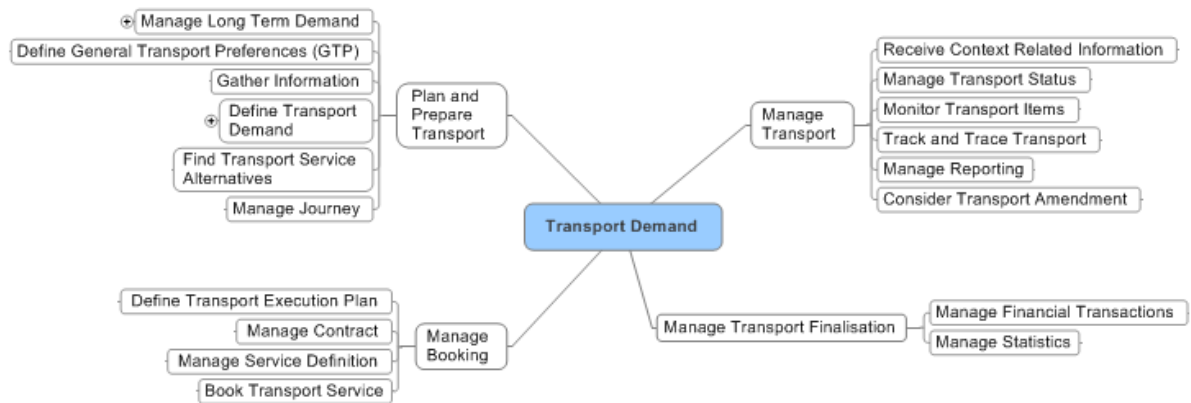


Figure 5: The L4L relevant functions for the Transport Demand domain

5.2.2 The Transport Supply

The domain Transport Supply considers roles like Transport Service Provider, Transport Service Manager, and Transport Operation Worker. The responsibilities related to these roles include the planning, provisioning and execution of transport services to transport users, as well as the condition and qualification of transport resources like transport means and crew. This domain also considers the Driver role, whose responsibility is most related to the integration in the traffic in compliance with laws and regulations and for safety issues related to behaviour and operation of Transport Means. The domain’s relevant functions are shown in Figure 6, while a larger figure with more details is shown in Appendix B.

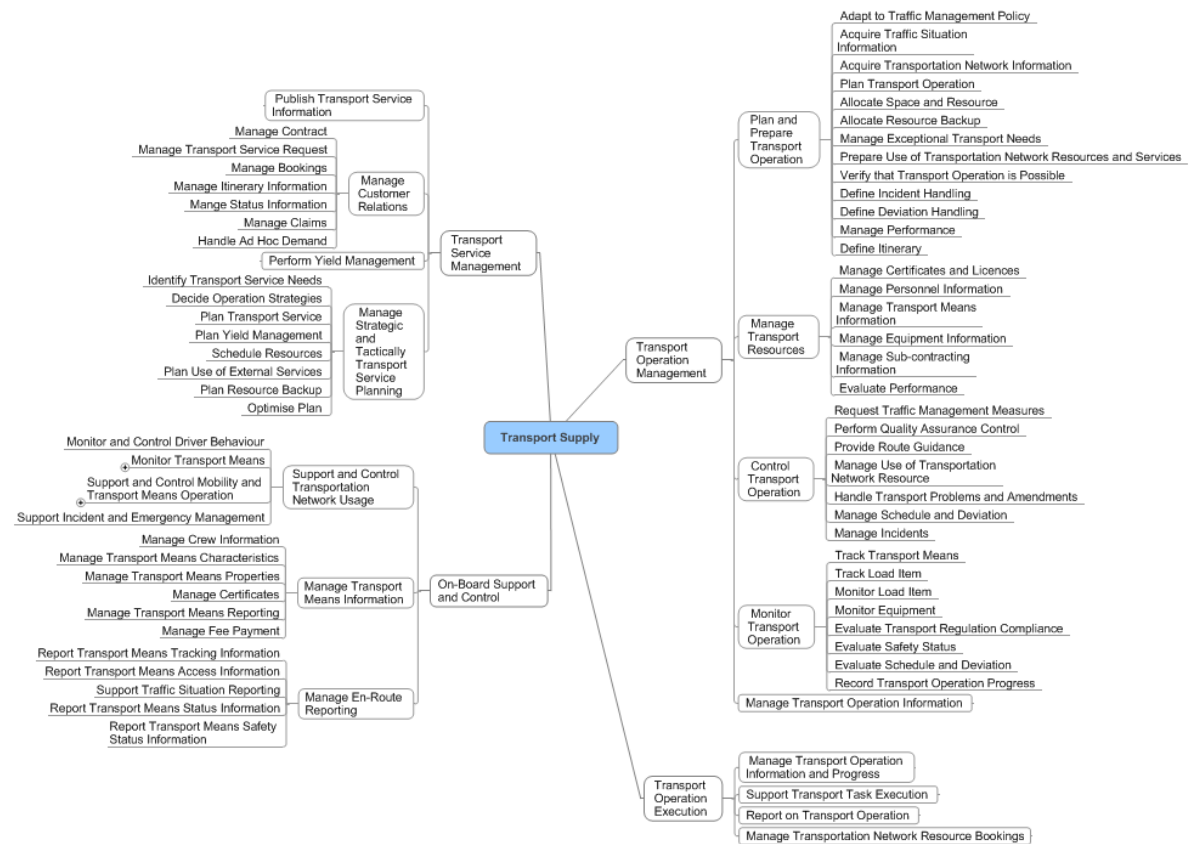


Figure 6: The L4L relevant functions for the Transport Supply domain

Comparing the L4L relevant functions to those defined in ARKTRANS, the most notable difference is the functions related to Manage Transport Business, as well as functions related to strategic and tactical transport service planning.

A notice must be made to the functions related to the On-Board Support and Control area, which was defined as an own domain in the v6.0 of ARKTRANS. However, as already mentioned in the introduction to ARKTRANS, v6.0 has been updated on recent advances in different related projects. Related functions in this subdomain are all relevant for L4L. The reason for this is that all operations require interactions with ICT systems that will enable efficient freight transport. There is currently a lot of research on Cooperative Systems [7], in where the transport means – especially vehicles – use ICT for different purposes where one of them is efficiency as well.

5.2.3 The Transportation Network Management functions

The domain Transportation Network Management (TNM) considers roles like Traffic and Transportation Planner, Traffic Manager, and Transportation Network Operator. Each role has a certain responsibility like the daily operation of the transportation infrastructure and controlling the traffic flow. The responsibilities are further related to the functions. The domain's relevant functions are shown in Figure 7, while a larger figure with more details is shown in Appendix B.

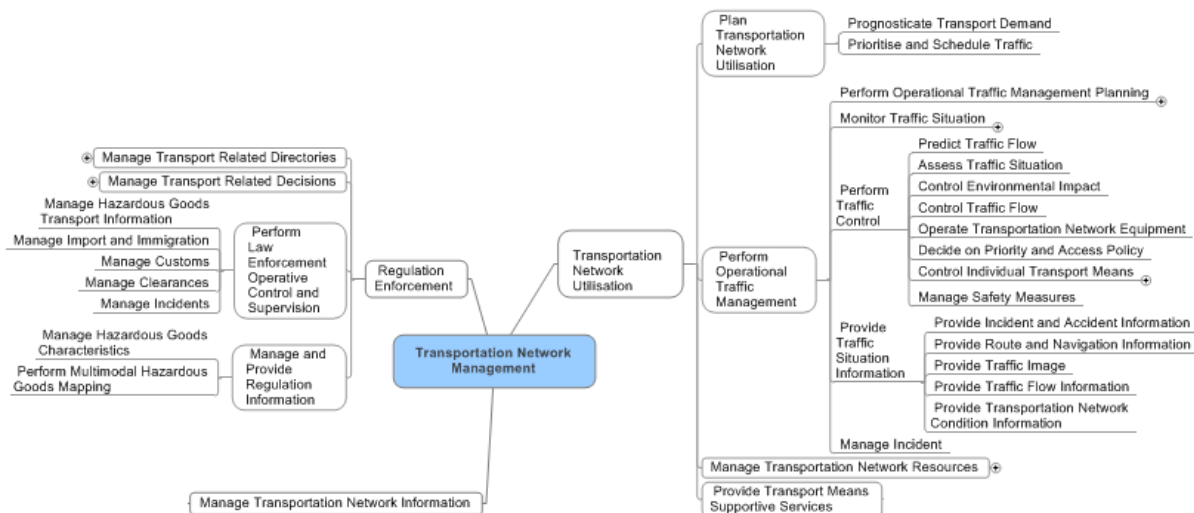


Figure 7: The L4L relevant functions for the Transportation Network Management domain

Parts of the TNM domain are not directly relevant to the scope of L4L. These parts are mainly the three subdomains Emergency Management, Transportation Network Infrastructure Management, and Regulation Enforcement:

Emergency Management

The functions related to Emergency Management are more or less a sidetrack to the L4L objectives. Emergency Management will clearly benefit from good ICT support, but the use of ICT to support Emergency Management is not likely influencing on the efficiency of freight transport, and hence, not within the scope of L4L.

Transportation Network Infrastructure Management

Most of the functions for this part have been omitted since they will not directly influence on freight transport, independent of the level of ICT support. The only exception is the Manage Transportation Network Information. The motivation for keeping this part within the L4L context is that updated information about the transportation network, provided by means of ICT is essential as a basis for the planning and execution of the freight and logistics services.

Regulation Enforcement

Manage Offences is kept outside the scope of L4L. Manage Taxes and Manage Statistics are kept outside L4L. The main reason for keeping these functions outside the scope of L4L is that they do not influence on the freight transport or logistics during planning or execution.

Perform Fare Management is kept outside the scope of L4L since this function deals with passenger transport. Manage Traffic Regulation is done outside the responsibility of the transporters, and they cannot influence on this function.

The Manage Transport Means Directory and Manage Identifiers are kept outside the scope of L4L since these functions are not related to any functions performed by the freight transport and logistics service providers.

6 The knowledge base

The knowledge base is the core of the L4L Framework. The content of the knowledge base is information collected by WP1, as well as validated output from WP2 and WP4. The knowledge is structured on the basis of the taxonomy described in Section 5. In this section, requirements to the collected knowledge are defined for representation and basic operations, along with the Content Management System (CMS) and database technology to be used.

6.1 Knowledge representation in L4L

The knowledge identified in L4L will capture the different stakeholders' perspective and requirements in terms of freight transport efficiency enabled by ICT solutions. The knowledge will be placed in a knowledge base for referencing and use for different stakeholders. The knowledge elements will be related to each other, which will identify duplications and gaps. Critical unaddressed requirements can thus be handled.

In L4L, the input to the knowledge base will mainly come from WP1, with some additions from WP2 and WP4. WP1 will analyse the state-of-the-art technology available, and identify research and development initiatives in the field of ICT solutions for freight transport efficiency. The input of information and best practices will be consolidated in the form of industry requirements and available best practices, and made available in the L4L knowledge base. The Special Interest Groups defined in WP2, and the Intelligent Cargo Forum in WP4 will also contribute with findings and requirements in the L4L knowledge base.

In addition to describing the knowledge itself, each knowledge element will also provide relevant references to e.g. related research projects, documents, and ICT standards. Take the knowledge about the track cargo function as an example; the knowledge will point to references like the research projects Euridice [8] and SMARTFREIGHT, as well as ICT standards like CALM [9] and GNSS [10] (for navigation purposes).

The taxonomy used for classification of information and best practices is based on finding the relevant domain and functions the knowledge belongs to, as described in Section 5. In many cases the information will not map to only one function. Results coming from a research project will most often target one or more domains with consequently several functions. This must be considered when inserting and finding information in the knowledge base. The presentation of the information with related references must therefore be done in a proper and intuitive way. The presentation of the L4L knowledge base is discussed in more detail in Section 6.2.

6.2 Knowledge base presentation

Section 6.1 described how the knowledge is represented in L4L. This section will describe the knowledge base presentation to the viewer; how to display the relation between the knowledge and its relevant references, and how to keep track of the functional hierarchy. Also, requirements for the Content Management System (CMS) used for the knowledge base is described. The CMS should interface with the IC Forum site, managed in WP4. The actual CMS to use will be decided and reported in D2.2.

6.2.1 *The knowledge base web interface*

The web interface towards the knowledge base users must show clear relations between the indexing (the functional hierarchy) and the knowledge showed, and between the knowledge and relevant references. The content displayed on the web interface will include the main parts:

- A functional indexing hierarchy showing the knowledge's place within its domain from the reference model used in the taxonomy
- Knowledge description, which can be at any level of the functionality hierarchy

- Related references
- Supporting knowledge base functions

The knowledge description will include information about the obtained information and user requirements in addition to a glossary needed for this information. The related references will include references sorted by different categories like:

- Related functions within the knowledge base
- Related projects that deals with the knowledge described
- Related documents like core papers and important deliveries from the related projects
- Related ICT standards that can be used to meet the L4L objectives for the knowledge described
- Related products that can be deployed to meet the L4L objectives
- Related events like conferences, workshops and other meeting points for researchers and others in the field

The web interface must be designed and structured in a way that enables the users to intuitively find what they're looking for, and that allows for identification of topics that miss information. However, there is still a need for supporting functions that will be tools to manouvering and helping the users to find knowledge. The functions will be more described in Section 7, but will include:

- Search function for finding relevant knowledge
- An overall glossary covering all knowledge descriptions
- Frequently asked questions (FAQ)
- On-line manual for how to find and insert knowledge as well as understanding the knowledge base itself

As mentioned above, the web interface design must reflect a structure that is intuitive for the users, which means users representing different stakeholders and needs. Figure 8 summarizes the parts that are required for the knowledge base. Notice that Figure 8 only summarizes the parts, and does not necessary represent how the web interface will look. The web interface will further be specified in D2.2.

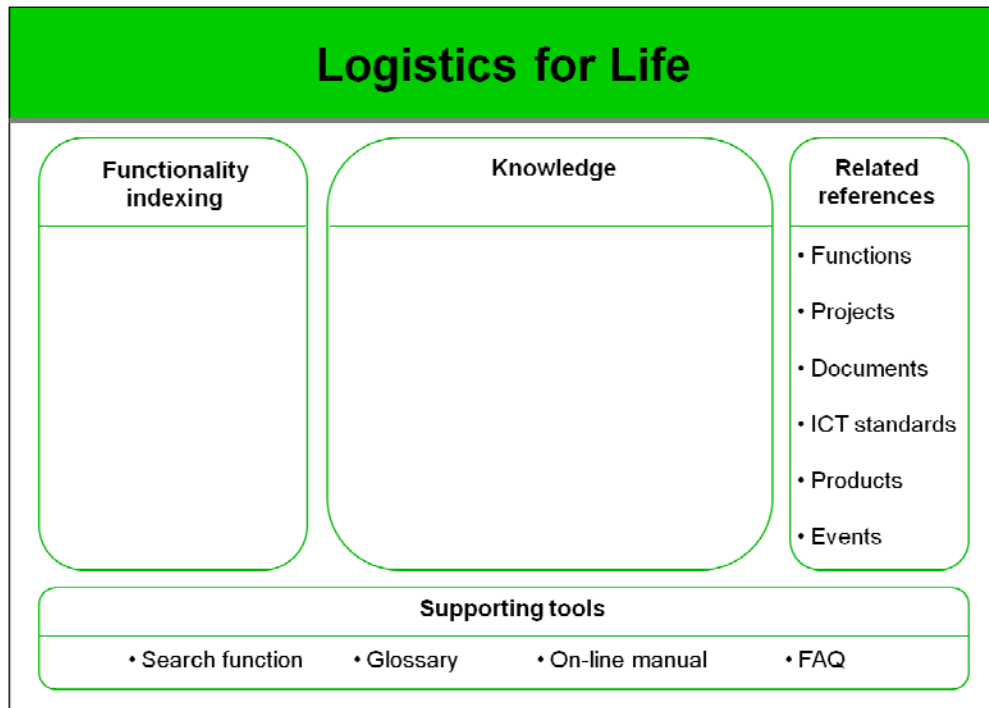


Figure 8: Knowledge base interface

6.2.2 The Content Management System (CMS)

When many users are collaborating on shared data, there is a definite need to control the access (i.e. rights to view or edit) to the data, as well as to ease the retrieval and insert processes. The collection of such work flows is defined as a Content Management System (CMS).

In L4L, both the knowledge base and the web portal will need these kind of processes. Therefore it would be beneficial if both the knowledge base and the web portal could use the same CMS. This would allow the two L4L outputs to be able to use information from each other, and to ensure information integrity in the database. However, it is important that a common CMS does not put restrictions on the knowledge base. If the CMS lacks any of the more important features of the knowledge base, another possibility would be to use a separate management system for the knowledge base, and only link it up to the web portal.

The CMS will interface with the IC Forum, which is the responsibility of WP4. The IC Forum is based on the open source technology PHP [11], which makes it more suitable for interactions with other systems like the knowledge base. PHP is a widely used, general-purpose scripting language. The language is designed for dynamic web pages. It is thus important that the database management system (DBMS) used in the knowledge base works well with PHP. The database technology used will be described in more detail in Section 6.3.

6.3 Database management system

The knowledge base will use a CMS based on open source technology to enable cooperation with other management systems. In addition to the work processes, like inserting and retrieving information, in the CMS, there is a need to include an underlying DBMS. This DBMS will keep a record of the information in the knowledge base, as well as the taxonomy structure. The knowledge stored in the database may be related to different functions situated in different domains. E.g. information about related projects will be linked from different knowledge elements. In this context it seems most suitable to use a relational database management system (RDBMS). A full-featured RDBMS with wide acceptance and use is MySQL [12]. For more details on the RDBMS, please refer to Appendix A.

7 Knowledge base tools

The supporting tools for the knowledge base consists of tools for manouvering and helping users to understand the knowledge base. In the first version of the knowledge base, the tools included, and described here, are on-line manual, glossary, search function and FAQ.

7.1 On-line manual

The on-line manual will be the knowledge base's handbook in how the knowledge base works. It has to give some background information to give an understanding of the knowledge base objectives. Other general information, like how the base is maintained, and by who, must also be included. Except for the background information, the following issues will be covered:

- How to include and edit information: A detailed description with illustrations will provide guidance to how information can be included and edited.
- How to find information: A detailed description with illustrations will provide guidance to how information can be found. Information can be found through several methods, and each should be described.
- How to read and understand the knowledge that is in the knowledge base should be described with an illustration of a typical web interface view.

The on-line manual will be indexed and searchable according to de facto standards for on-line manuals. In addition, it will be evolved and extended throughout the L4L project, and beyond since the knowledge base is something that will last also after the L4L project is ended.

7.2 Glossary

The glossary has the function of any other glossary. Its purpose is to:

- Define and describe transport and ICT related terms that are not well known outside of these areas. This includes terms that other areas also use, but have a specific and different meaning in the transport and ICT business.
- Define and describe typically used abbreviations – terms that mostly are written as abbreviations, e.g. WLAN [13].

As with the on-line manual, the glossary will also be evolved and extended throughout the L4L project.

7.3 Search function: The SMARTFREIGHT example

The search function will basically do as it says. Based on a searchable term, it will check the entire knowledge base looking for the input term. The function will search in the database for information elements, functions, and references (i.e. projects and technologies) – basically, all text in the database. L4L will not implement a new search engine for the knowledge base, but use an already deployed engine to both reduce costs, and to use proven technology.

What is important for the search function is how to display the results of the query. There are many possibilities, including sorting the results from their relevance to the question, according to defined categories. Below, one example of the process is given. The word to search for is “SMARTFREIGHT”. The aim here is to see what knowledge SMARTFREIGHT has provided to the area of ICT for efficient freight transport. Figure 9 shows that the word “SMARTFREIGHT” leads to

different functions it has given input to³. By further looking at one of the listed functions, the registered knowledge, project results, etc. are displayed. This way of displaying results is only an example of many possibilities.

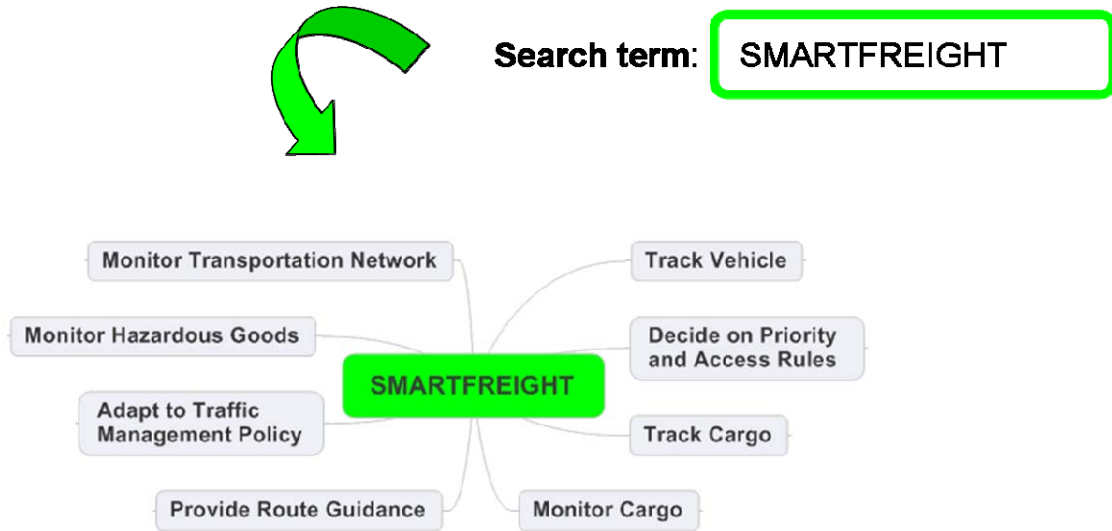


Figure 9: Search function example

7.4 Frequently Asked Questions (FAQ) functions

A list of frequently asked questions (FAQ) will also be included. This is a list with answers to common question as the L4L partnership foresee. But new questions will also be added as there might occur other questions that several actors need answers to. To start with, the following questions need to be included:

- How to use the knowledge base – which of course refers to the on-line manual
- How to receive more information
- Contact information to the responsible stakeholder or group of stakeholders

³ Note, that this example only provides some of the functions covered by the SMARTFREIGHT project for illustration.

8 Conclusions

The main objective with this deliverable is to define the structure of the L4L knowledge base, and the presentation and management of the included knowledge (including the CMS underlying the knowledge base). The knowledge base will include knowledge for more efficient freight logistics through the use of ICT. The structure has been assessed through a taxonomy based on the ARKTRANS framework, while the presentation and content management have been addressed by requirements to the realization of the knowledge base.

The ARKTRANS framework divides the transport sector into different domains where each domain consists of a set of functions that will be the basis of the classification in the L4L taxonomy. ARKTRANS covers all transport modalities and both passengers and goods transport, and includes therefore several functions that are not directly relevant for the scope of L4L. The functions most relevant have in this deliverable been identified for inclusion in the classification scheme. The knowledge collected in L4L, mainly through WP1, will then use the taxonomy defined for classification of collected information.

The basis elements part of the presentation includes a functional indexing hierarchy, knowledge description, related references, and supporting knowledge base tools. The CMS to use will interface the IC Forum, and use a relational DBMS. MySQL is thought as the system to use.

9 Future work

Based on this knowledge base report, the next step is to further specify and develop a first implementation of the knowledge base. A structured knowledge repository along with a graphical user interface showing users the content of the repository will be the first step towards to ultimate goal of a L4L knowledge base and framework.

One important aspect of the presentation of the knowledge base is to re-use already existing products, and not try to re-invent what have already been developed. There will thus be a challenge to identify the product that fulfils the requirements specified in this deliverable.

Another unresolved issue with the presentation of included knowledge is whether the domain and functional views are able to give the users an intuitive feel of the knowledge structure. Can the users identify what they are looking for, is it easy to include new references to the existing knowledge, and is it straight forward to create new input in the knowledge repository? Such questions are currently unresolved, but there will be a higher probability of solving these questions after the initial implementations of the knowledge base.

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Appendix A

This Appendix gives some more details concerning the relational database management system (RDBMS) to use, by giving some details on MySQL and enhanced entity-relationship (EER) models.

A.1 MySQL

A RDBMS is a database management system in which data, and their relationships, are stored in tables. Most popular commercial and open source databases currently in use are based on the relational model. MySQL is a popular RDBMS with wide acceptance due to its ease of use, yet a reliable and high performance database with no functional limitations, and its availability. It is owned by Sun Microsystems[14], a subsidiary of Oracle Corporation [15], and made available under the terms of the GNU General Public License [16]. Among the many high-profile, large scale products MySQL is used in, are Wikipedia [17] and Facebook [18].

Many CMS use MySQL as their underlying DBMS. One popular solution is to couple MySQL with a PHP-based CMS. The combination of PHP and MySQL provides dynamic solutions where content, structure, and other information are stored in MySQL. The combination of PHP and MySQL is also a reason for MySQL's popularity. The use of PHP in the web portal will thus suit the use of MySQL for the knowledge base.

A.2 Enhanced Entity-Relationship (EER) model

As mentioned in the last section, MySQL is a RDBMS. This necessitates that data and their relations are stored in tables. For this reason, an enhanced entity-relationship (EER) model has to be defined. In L4L; both the taxonomy, the knowledge, and related references will be represented as entities in the EER model. The knowledge and references will be integrated with the taxonomy, but to distinguish each structure difference, the taxonomy EER and information EER are described separately below. Remark that the references have the same structure as the information, and will thus be described there.

Taxonomy EER

The taxonomy is a hierarchical structure of domains and functions, where each domain contain some first level functions that have zero or more child functions, see for example Figure 4 that gives the relation mentioned. A hierarchical structure is easy to represent in a relational DBMS. You need one root table that refers to its childs that again refers to there childs. In the context of L4L, you will have one table that includes all domains. The first level functions will further be represented in either a common table or a table for each domain so that all first level functions to one specific domain are collected in single table. Anyway, each element in the table must then be related to its upper level by a reference key in the table. The same procedure is followed when linking the second level functions to their respective first level functions. Consequently we get a hierarchical structure of tables as well. See

Figure 10 that shows this structure.

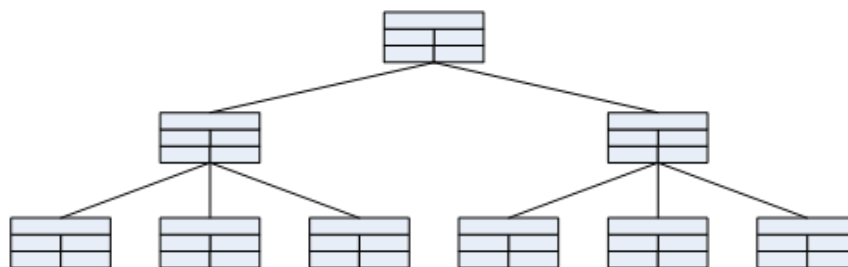


Figure 10: Hierarchical taxonomy structure

The elements needed in for the taxonomy EER are:

- All domains in a table with unique IDs
- All functions that are at the same level (i.e. level i) with unique IDs and a reference to the upper level (i.e. level i-1), which can be either a function or a domain. A different solution, as mentioned in the text, would be to sort all functions at a given level that belongs to the same upper table (has the same parent).

Which solution to go for in the second point above will depend on the current size of the taxonomy, and the solution's scalability if more functions are added – either covering new functions or be the result of a more detailed description (i.e. division of a function).

Information EER

The information that is to be contained in the knowledge base must also reside as elements in tables. If obtained information could relate to only one table, meaning that the information was only relevant to one function, the inclusion of the information would still preserve the hierarchical structure of tables. However, the information can be relevant for different functions, and also other information in the knowledge base. Therefore, the structure is a bit different for the information than the taxonomy. The model will instead be built on a network structure where there really are no parents or childrens. This network structure is shown in

Figure 11.

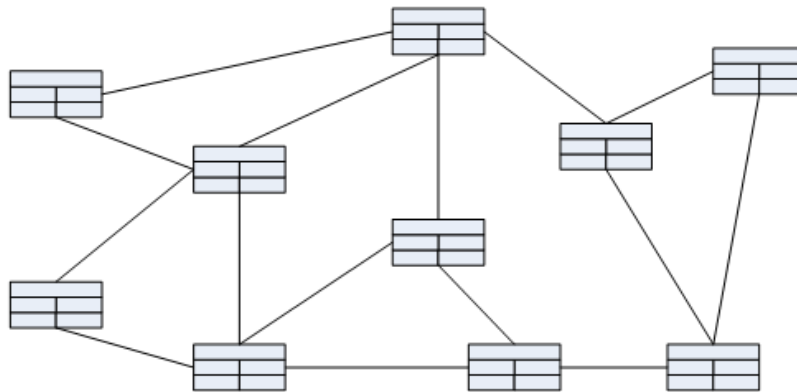


Figure 11: Network information structure

The elements needed in for the information EER are a table for each information element with unique ID, glossary to describe this information element, along with a references to the functions, other information elements, and references it relates to.

As already mentioned, the structure for the references is the same for the relevant references. E.g. the CALM technology will be relevant for other references like research projects, in addition to different information elements as well.

Appendix B

In the sub-section of Section 5.2, the different L4L relevant domains were presented. Each domain was presented with a figure showing their relevant functions. However, due to their many functions the figures became quite small. For better readability they are enlarged in a horizontal orientation here. As in Section 5.2, the different figures show all ARKTRANS functions for each domain, where the not-relevant L4L relevant are colored in light red.

The next pages show the following domains:

- The Transport Demand domain
- The Transport Supply domain
- The Transportation Network Management domain

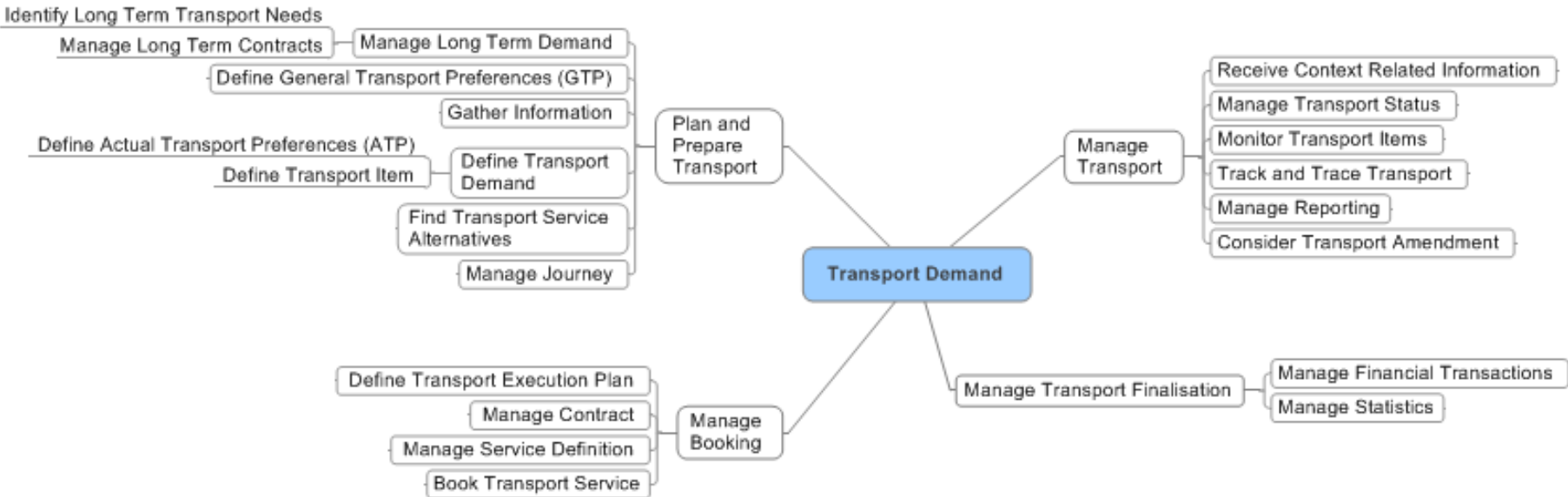


Figure 12: Transport Demand - in large

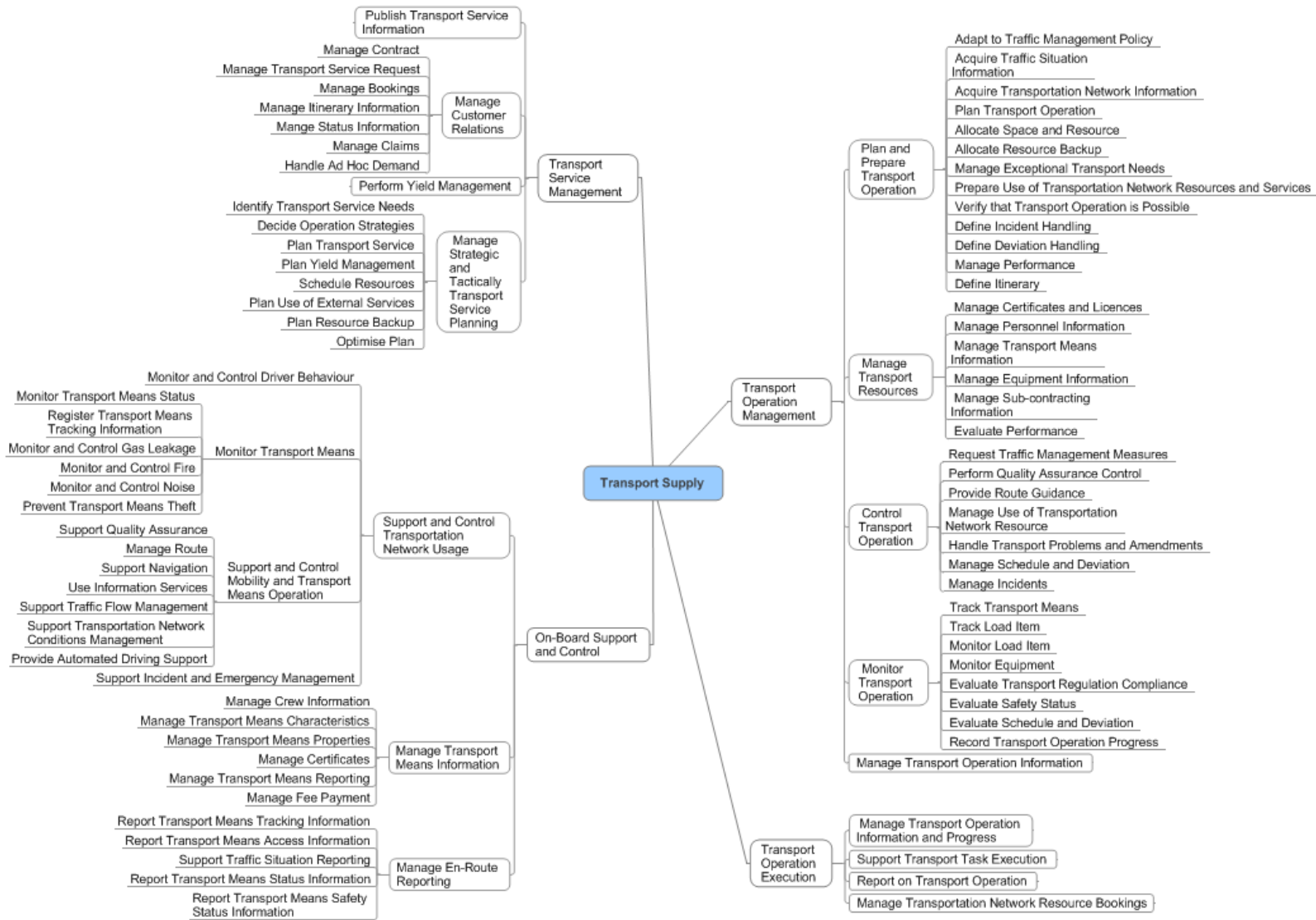


Figure 13: Transport Supply - in large

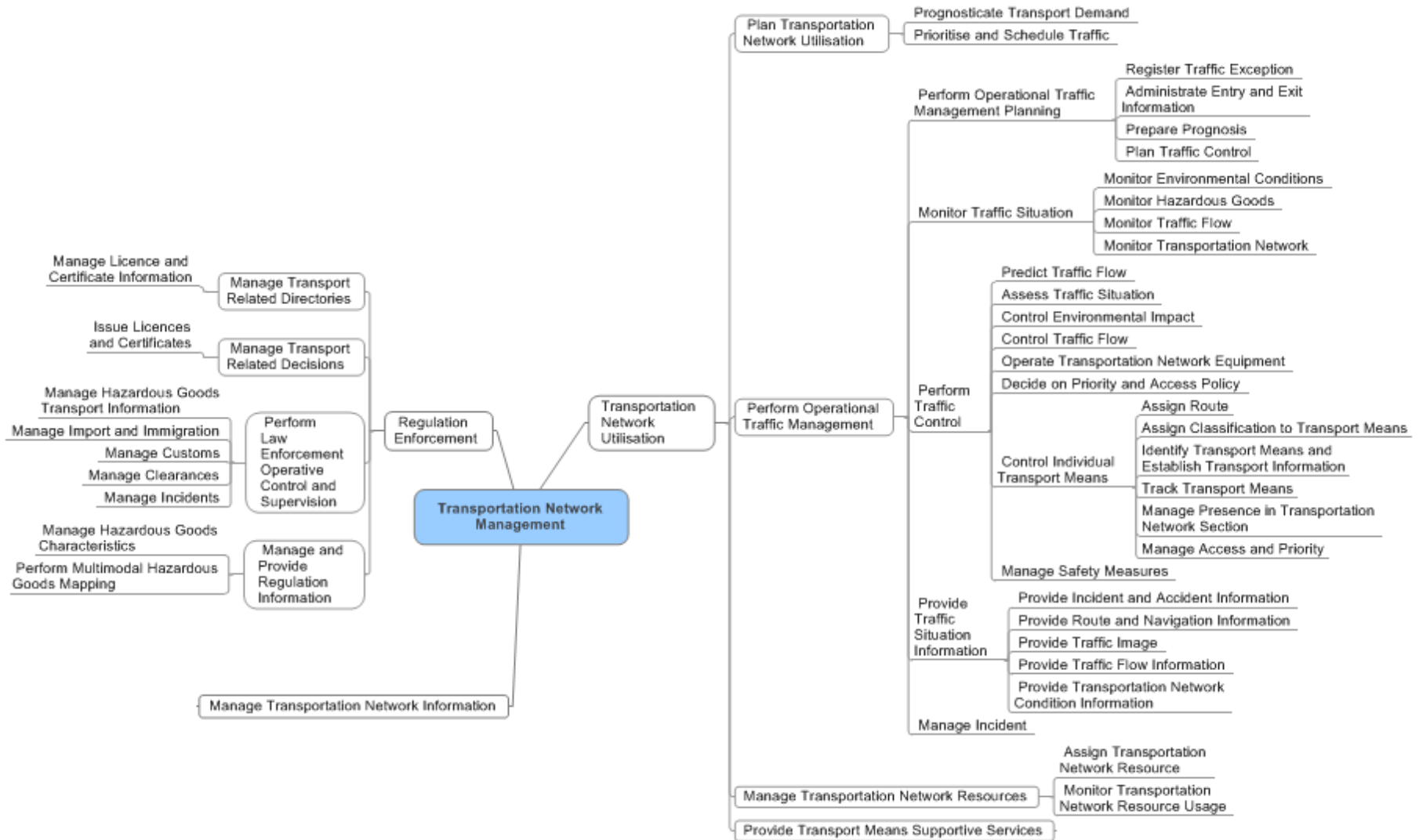


Figure 14: Transportation Network Management - in large