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

Logistics for Life

Logistics Industry Coalition for
Long-term, ICT-based Freight Transport Efficiency.

Deliverable 1.3
D1.3b Impact Analysis & Synergy Report
Work package WP1
Leading Partner: BIBA
Security Restriction: PU
25.09.2011
Version 1.7

Versioning

Version	Description	Author	Date	Comments
0.1	D13_22052010	Jannicke Baalsrud Hauge, Cemile Cabuk	22.5.2010	Table of content, context and guidelines
0.2	D13_071021010	Jannicke Baalsrud Hauge Stina Apel	7.10.2010	Chapter 1, 2 and outline 3
0.3	D13_15102010	Stina Apel	9.10.2010	Survey requirements
0.4	D13_01112010	Henrik Sternberg, Jannicke Baalsrud Hauge	1.11.2010	First draft questionnaire
0.5	D13_10112010	Jannicke Baalsrud Hauge, Adeel Naveed	10.11.2010	Changes in Questionnaire based on feedback from consortium partners collected at the l4l Meeting at 2.Nov.
0.6	D13_26112020	Jannicke Baalsrud Hauge	26.11.2010	Prepared for review
0.7	D13_10012011	Jannicke Baalsrud Hauge	10.01.2011	Update results, changes conclusion
0.8	D13_03032011	George Tsukos, Moritz Quandt	04.03.2011	Review of updated document finished
1.0	Final version			Final review comments has been processed
1.1	D13_12072011	Oscar Kjellberg, Henrik Sternberg	12.07.2011	New version of deliverable where the input and comments from the technical review report have been taken into account. Deliverable thoroughly re-worked.
1.2	D13_19082011	Jannicke Baalsrud Hauge	19.08.2011	Sent out for discussion, Executive summary
1.3	D13_16092011	Tor-Kjetil Moseng, Jannicke Baalsrud Hauge, Nikolai Finder	14.09.2011	Adding chapter 6.1-6.3,
1.4	D13_18092011	Jannicke Baalsrud Hauge	18.09.2011	Updated questionnaire, Adding input from Paola Lupieri, inserted table in annex answering reviewers comments. Sent to internal reviewer
1.5		Paola Lupieri,	19.09.2011	Changes and correction whole document
1.6		Kostas Kalaboukas	23.09.2011	Changes
1.7		Jannicke Baalsrud Hauge	25.09.2011	Changes according to reviewers' advices

Contribution

Almost all partners have contributed with feedback on the first questionnaire, in order to improve it. Hence, this contribution is not listed separately

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Research / work
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Partner BLG

Research / work
Review first version

Partner VTT

Research / work
Contribution the development of questionnaire.

Deliverable process schedule

No	Process step	Responsible	Timing (working days)	Involved persons	Notes
1	Deliverable plan Initial planning of process including: - Identification of individual contributors and peers. - Draft table of contents. - Detailed planning of timeline.	Jannicke Baalsrud Hauge		Stina Apel Henrik Sternberg Hans Westerheim Cemile Cabuk	Leader must propose schedule, identify involved contributors and peers.
2	Structure and guidelines Initial drafting of the Deliverable including structure, guidelines and first basic content to be sent to the Contributors.	Jannicke Baalsrud Hauge		Stina Apel Henrik Sternberg Hans Westerheim Cemile Cabuk	Initial drafting from leader.
3	Leader to organize contributors input and distribute updated version to Contributors, Internal Peers and SP leader	Leader, Contributors		Cemile Cabuk, Adeel Naveed Felix Hunecker Stina Apel Henrik Sternberg Hans Westerheim Tor Kjetil Moseng Wolf Lampe Peter Sonnabend Martin Ollus Paolo Paganelli	Chapter 3, Development of questionnaire and online survey. Feedback on first requirement questionnaire (written and oral comments on the questionnaire)
4	Full concept Leader to consolidate contributors input and result.	Leader		- Jannicke Baalsrud Hauge	
5	Reviewing Quality check	Peers Coordinator		- George Tsukos, Hans Westerheim, Moritz Quandt - Paolo Paganelli -	Review by internal peers including cross reading by external peer.
6	Submission to Commission	Coordinator		- Coordinator	Final stage of process.
7	Restructured content, added content Leader to consolidate contributors input and result.	Leader.		- Jannicke Baalsrud Hauge	

No	Process step	Responsible	Timing (working days)	Involved persons	Notes
8	Leader to organize contributors input and distribute updated version to Contributors, Internal Peers and SP leader	Leader, Contributors		Henrik Sternberg Oscar Hans Westerheim Tor Kjetil Moseng Nikolai Finder Jannicke Baalsrud Hauge Paola Lupieri	Rewriting deliverable according to reviewers advice
9	Reviewing Quality check	Peers Coordinator		- Kostas Kalaboukas - Paola Lupieri - Paolo Paganelli	Review by internal peers including cross reading by external peer.
10	Resubmission to Commission	Coordinator		- Coordinator	Final stage of process.

Table of Contents

TABLE OF FIGURES

Executive Summary

The Deliverable Impact Analysis & Synergy Report aims at highlighting the requirements and issues needed to be addressed within the logistics sector for implementing ICT. Implementing ICT solutions is a key component in making logistics sustainable not only for the environment and society but also economically for the actors within the logistics industry.

The freight transport and logistics sector today is characterized by inefficiencies in several areas (e.g., inefficient use of trucks and other transport resources, inefficient administrative procedures at modal interfaces. ICT solutions can help making logistics more efficient and thus reducing the need for transport, thus reducing the environmental and societal impact of freight transport. Mainly the information flows between different actors will be improved, and this will allow improved planning and resources optimization, reducing e.g. congestion problems in urban areas. Moreover, ICT solutions will produce value for the actors involved in logistics by reducing cost which adds to economical sustainability.

This Deliverable is presented as a desktop study, building the foundation for the development of a questionnaire. This is then used for collecting the relevant requirements from the stakeholders who are:

- Participating in L4L
- Active in the Intelligent Cargo Forum
- Active in any of the projects under observation
- Interested in using ICT for improving the efficiency in freight transport

The requirements from the desktop study are presented on three levels:

- Policy requirements
- Operational requirements
- Technological requirements

The findings on a policy level reflect the need for clarity from policymakers on future strategies and polices, that should be harmonized across Europe since transports are transnational and to fully realize the expected benefits ICT systems should support the exchange of information across borders. Harmonized strategies and policies will increase the trust between actors and enable investments on ICT implementations. The current policies and strategies are also excessively abstract and are mainly considering environmental and social sustainability issues. There is a need for more operational policies that support commercial interests and enable investments and implementation of ICT solutions by logistics business operators.

On an operational level there is a lack of education and awareness of ICT, which results into a cultural resistance against implementing and using technological solutions. There is also currently a lack of appropriate business models to assess the cost of ownership against the value added of ICT solutions that need to be quantified in order to let support public and private investments. Implementation also suffers from a “chicken and egg” dilemma: to gain the aggregated benefits from ICT it needs to be widely spread. Otherwise the early adopters will not be able to reap the aggregated benefits, and there is a need for showing and disseminating the individual benefits for ICT usage that will support the initial spread of ICT.

Technological requirements rise mostly from the necessity of solving the interoperability problems. The use of different systems and software in different supply chains limits the required information exchange that would be needed for more sustainable logistics. Technologies supporting the information exchange exist, but they must be used in compliancy with interoperability standards that are far from being mature and widespread adopted. To support environmental and social sustainability the research and development of ICT systems should focus on freight transport systems that are transferable and adaptable for larger stakeholder groups, since this will reduce the barriers of implementing a solution in a supply chain. Due to the large contribution to emissions, solutions

reducing this contribution esp. within the road transport are of high importance.. To promote the diffusion of ICT systems, these also need to be made more user-friendly.

To complement the desk analysis from research and policy documents, a questionnaire that will be used to gather an empirical requirements analysis is presented. The questions in the questionnaire focus on gathering requirements that organisations have on ICT in order to increase their freight transport sustainability. The questionnaire covers the three dimensions on economic, environmental and social sustainability.

1 Introduction to the Work package 1

Main objective of Logistic for Life Coordinated Action is to provide an overview of all initiatives and projects dealing with ICT for sustainable freight transport and to establish a common research agenda in this field.

1.1 Scope and objective of this work package

Work package (WP) 1 lays the foundation for most of the activities carried out in the project. WP1 will work as catalyser, gathering, analysing and providing information to the other work packages.

All other work packages rely on the community and information-exchange links built and managed in this WP, but WP4 will also give contribution to WP1 via Forum activities. The main goal of this WP is to achieve synergy between the existing regional, national and international research and projects with a particular attention to ICT/IST, DG TREN and DG Research initiatives.

In order to disseminate the information and to ensure a smooth utilisation in the other work packages all partners will participate in the work of WP1. The work is distributed geographically between the partners to stimulate an efficient collection of information and to get contacts to initiatives in different European countries. WP1 collects information and best practices from all these related activities and sources, and consolidates it in the form of observatory reports on industry **requirements** and available **best practices**. Once processed and enriched by WP2, formalized knowledge is returned back as input to the **Roadmap** that constitutes the main result of WP1.

1.2 Scope of the task

This task will explore the commonalities, the key issues and the emerging best practices among the projects related to ICT for an efficient freight transport, with the specific purpose to serve as a knowledge collection tool, gathering input information and requirements for all Logistics for LIFE work packages. It will also collect the requirements on ICT from a sustainability perspective.

1.3 Relation to other work packages

The Logistics for LIFE work plan is designed to support parallel development in different directions, corresponding to the four Coordination work packages (survey, observatory and synergy, catalyzing knowledge, forum and supportive actions, dissemination and exploitation).

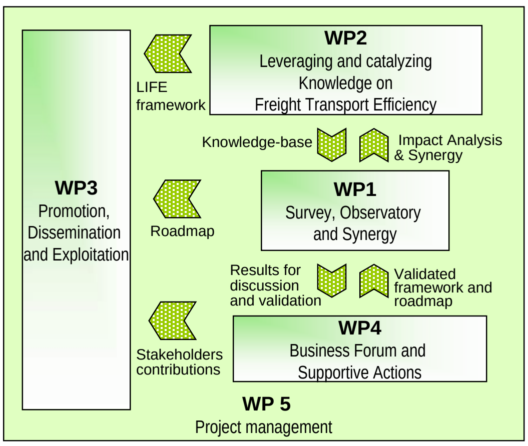


Figure 1: WP overview and dependence

To achieve results in the four areas within the project timeframe, the work packages run in parallel and the dependencies between them are managed by sharing outcomes and interacting on common topics. WP1 will feed the other three work packages with impact analysis and different versions of the roadmap, and will in return get formalized knowledge from WP2 and validated results from WP4.

WP1, WP2 and WP4 will all contribute to promotion and dissemination in WP3 by providing results that can be presented and will contribute to the creation of the network

In particular, the result of the analysis carried out in this task will serve as input to WP2, but will also get its input from WP2, 3 and 4. In order to make it easier to find relevant information for different stakeholders and external audience, feedback on the collected best practices and requirements will be given from WP4 as well as from the special interest groups established in WP2. To take feedback into account, three versions of the Best Practices and Synergies reports (Deliverables D1.2 and D1.3) will be produced to be iteratively revised and enhanced.

1.4 Objectives and structure of deliverable 1.3

The purpose of this Deliverable is to support the collection of requirements from transport logistics stakeholders, on ICT solutions enabling improved sustainability of the sector, aiming at large-scale adoption of such solutions.

The requirements analysis on ICT solutions for freight transportation will be done from three perspectives: environmental, social and economical sustainability. The requirements will further be evaluated at three different levels[1] of abstraction; a policy level, an operational level and a technological requirements level.

1. A policy level is strategic in its nature. What are the requirements that need to be addressed on a country, EU or even on global level? What are the overall questions that politicians, lobbyists and senior leaders in global or Pan-European logistics organizations need to agree on to support implementations of advanced ICT within transport logistics?
2. The operational level is more tactical in its nature. What needs to be done to get ICT solutions working into companies? What process needs to be improved or changed and how will this affect the people working in transport logistics?
3. Technological requirements evaluate what issues need to be addressed and solved on a technological level for implementing ICT solutions and reaping the benefits on both an individual and aggregated system level.

Finally, the deliverable will describe the questionnaire which will be used to collect the requirements within the L4L community[2]. The results from this requirements collection will later be included and taken into consideration in D1.3c. They will provide valuable input for the roadmap activities as well as to the development of the Logistics for LIFE framework in WP2.

1.5 Terms and conventions used in the document

CALM	Communications Air-Interface, Long and Medium Range
CEN	European Committee for Standardization
CO_2	Carbon dioxide
DSRC	Dedicated short-range communications
EE	Energy Efficiency

[1] These three different levels interact and an iterated process continuously changes the reality and gives room for further requirements. E.g. new technological advancements can create new requirements and problems on a policy level that in turn affect operational processes. Or a new EU regulation can change the operational processes and create requirements on a technological level.

[2] This community comprises project partners, organisations involved in projects under observation as well as those stakeholders actively involved in the Intelligent Cargo Forum.

EC	European Commission
ETSI	European Telecommunications Standards Institute
EU	European Union
GDP	Gross Domestic Product
GHG	Greenhouse gas
GNSS	Global Navigation Satellite System
ICT	Information and Communication Technology
IEEE	Institute of Electrical and Electronic Engineers
IRID	Infrared Identification System
ISO	International Organization for Standardization
ITS	Intelligent Transport System
L4L- Logistics for LIFE	Logistics for Life**- Logistics** Industry Coalition **for L**ong-term, **I**CT-based **F**reight Transport **E**fficiency
LDM	Local Dynamic Map
LSP	Logistics Service Provider
LTE	Long Term Evolution
RFID	Radio Frequency Identification
ROI	Return on Investment
RO	Read Only
RW	ReWritable
SLA	Service Level Agreement
SOA	Service oriented architecture
TMCS	Traffic Management & Controlling System
TMS	Transportation Management System
UHF	Ultra High Frequency
UMTS	Universal Mobile Telecommunications System
V2I	Vehicle to Infrastructure
V2V	Vehicle to Vehicle
WORM	Write Once Read Many
WP	Work package
WSDL	Web Services Description Language

2 Why are sustainability issues important for transport logistics?

The transport sector has an enormous environmental impact: oppositely to the trend in many other sectors, the transport industry has increased its CO_2 and GHG emissions since 1990. Transport generated 23.1% of the CO_2 emissions and 19.5% of the GHG emissions in the EU-27 in 2007; of this the road transport is the major contributor standing for over 70% (European Commission, 2010). If Europe is to achieve the targeted 80% reduction in CO_2 emission, compared to the levels of 1990, oil consumption needs to decrease by roughly 70% from today's level (European Commission, 2011a).
Beside the positive impact from travel and movement of goods the impact transport has on society is also massive. Congestion and traffic jams clog urban areas, e.g. in London, Amsterdam, and Brussels drivers are stuck in traffic for more than 50 hours a year (European Commission, 2011a). However, as stated in the 2011 White Paper on Transport (European Commission, 2011c) "curbing mobility is not an option". This means we need to become more efficient and use effective means of transport.
Transports are fundamental for our economy and society (McKinnon, 2006); we depend on transports to deliver the goods we need and to move us where we want to go. Furthermore, the transport industry is an enabler of economic growth and employment within the EU; it alone stands for 4,6% of the European GDP and employs directly more than 10 million people (Eurostat, 2011). It is therefore clear that transports will continue to have an enormous impact on our environment and society.

The logistics industry is growing and globalization will continue to move production out of EU; this means that the EU will become even more dependent on effective and reliable transports to satisfy the needs of its citizens in the future. Projections show that the freight transportation industry will grow by around 80% within 2050 compared to the levels of 2005 (European Commission, 2011c). However strangely, even though around 47% of the transport energy use is for the movement of freight, and this part is growing, the attention freight transport is getting from both the research community and policymakers compared to the movement of people is remarkably low (Gilbert and Perl, 2007).

Within EU road freight is the dominating mode of transport and it is also growing faster than other modes. Between 2000 and 2009 the share in percent of total inland freight ton/km carried out by road freight increased from 73.7 to 77.5 (Eurostat, 2011) and the trend is bound to continue (Gilbert and Perl, 2008). The current amount of traffic already put strain on the road infrastructure and creates problems for society, e.g. congestion and increased pollution, and building more roads into urban areas is not always an option. Therefore greater efficiency is needed for a sustainable future. Adding the fact that road transport haulers still experience empty haulage rates between 40% and 60% (Adra et al., 2004), it is evident that we need to increase efficiency in transport operations. Logistics' practitioners can easily point out several other inefficiencies: poor planning or missing information in the synchronization among different transport modes, or lengthy administration processes.

3 Methodology

In order to investigate the sustainability requirements on ICT for transport logistics, various sources, e.g., books, scientific papers, white papers and research projects were reviewed, with focus on requirements. These sources represent a wide range of areas, e.g. logistics and transportation, ICT, city logistics and information science.

The figure below shows the large number of projects that have addressed one or many aspects of sustainability through the use of ICT:

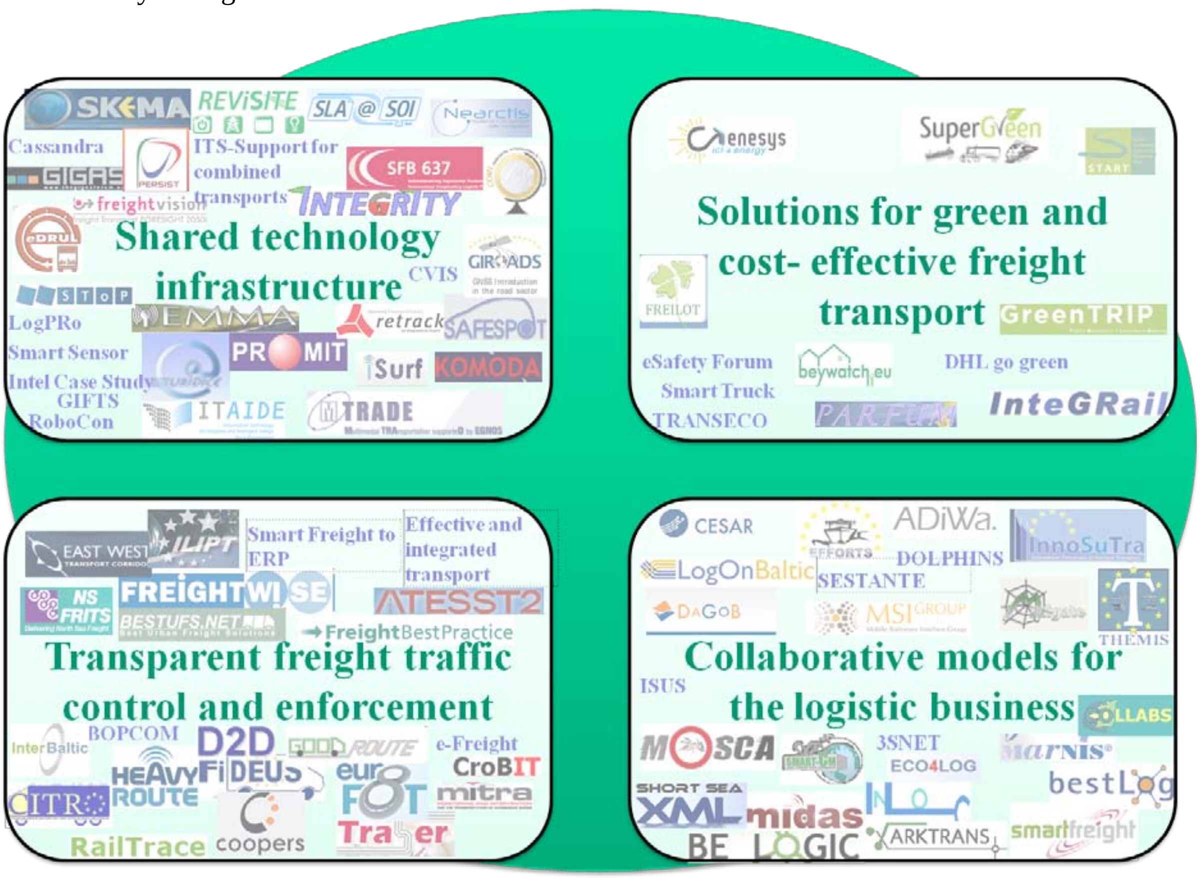


Figure 2: Projects providing different solutions

Most of these projects already deliver some proof of concept, and consequently, their requirements can serve as input for the development of the L4L requirements collection and analysis.

3.1 L4L and sustainability

The L4L project aims at contributing to more sustainable transports with the help of ICT and it works under the assumption that improving operational efficiency is the key for long-term sustainability. In this notion sustainability entails more than just "environmental friendliness" and it tackles the sustainability problems from three different perspectives: environmental, social, and economical. An important underlying assumption to consider is the following:

Environmentally friendly measures that cause firms to go out of business are not sustainable.

Sustainability is a multifaceted issue and the three viewpoints often overlap and influence each other, i.e., what is positively impacting on the environmental sustainability is often positively impacting on social and economical sustainability. It is however important to note that this is not always the case and overlooking one of the perspectives would eventually lead to unrealistic requirements and demands.

3.1.1 Environmental sustainability

Today road transport, the most used modality to transport freight, is carried out almost exclusively with fossil fuels, with 96% of EU transports being dependent on oil and oil products (European

Commission, 2010, Stern, 2007). Even though we are aiming at reducing our fossil fuel dependency it will still in the foreseeing future dominate as fuel for our trucks. ICT contributes to environmental sustainability by making logistics more efficient and thus reducing the amount of transportation needed. ICT can also be used to ease the adoption of intermodal transports that have a weaker impact on the environment (Council of the European Union, 2007). Efficiency improvements will generate less CO_2 emissions, a reduction of fossil fuel consumption, and a reduced environmental impact because of the needed infrastructures (Roso, 2007).

3.1.2 Societal sustainability

Transports also have an impact on communities and the citizens that populate them. Congestion, noise, road safety issues and traffic accidents are some issues that negatively impact social sustainability. ICT will contribute to social sustainability by improving transportation management and using the available infrastructures more efficiently, which will reduce the congestion in urban areas (Huschebeck et al., 2009, Hubbard, 2003). Better control, track and tracing of hazardous goods as well as improved transport management mean that the safety and security of transports can be improved. To the benefit of communities ICT also has a role in creating jobs as well as improving the access to transport services for its citizens.

3.1.3 Economical sustainability

Transports are a vital part of the European economy but the current transport services, in particular road transportation, that serve us are characterized by a high level of inefficiency and there is a big opportunity for improving operation efficiency (Landers et al., 2000, McKinnon and Ge, 2006, Kalantari, 2009). This will both be of benefit in environmental terms for society and contribute to economical sustainability for the logistic firms. ICT will help companies to better serve their customer, save costs and hence to stay competitive. A better information flow will help companies to better balance supply and demand and to reduce the level of empty haulage. Better transportation management systems (TMS) will reduce delays, and ICT technologies can support and increase the adoption of intermodal freight transport services. Intermodal transport will (European Commission, 2011c, Huschebeck et al., 2009) become more important in the future due to environmental demands put on freight transport.

4 Policy requirements for supporting sustainability in logistics with the help of ICT

There is no lack of "Green initiatives" and statements from leaders from both government and industry on the importance of environmental sustainability. Ambitious goals of lowering emissions of pollutants and greenhouse gases (GHG) are put forward on a regular basis. Recently the EC analysis "A Roadmap for moving to a competitive low carbon economy in 2050" (European Commission, 2011b) stated that a reduction of GHG of at least 60% by 2050 compared to the levels of 1990 is required from the transport sector.

If these ambitious goals are to be made a reality policymakers need to support and enable investments in ICT. The EC (European Commission, 2011c) states that "*The EU and Governments need to provide clarity on the future policy frameworks… … for manufacturers and industry so they are able to plan investments*". This means there is a need to develop and implement transport management strategies that are optimized for environmental criteria[3]. This should e.g. include mobile data collection, real-time traffic and travel information, parking management and energy-optimized dynamic transport control.

Strategies and policies should be harmonized across Europe because freight transportation is performed between different companies and across borders, this means that different systems need to communicate and exchange information. To reap all the benefits from ICT a common ICT-infrastructure as well as regulation need to be present, to support integration and information exchange between different actors in a transport network (Huschebeck et al., 2009, Commission of the European Communities, 2006, Stefansson et al., 2007). Currently there is a lack of technical interoperability between technologies and systems, as well as a lack of agreed and consistent policy objectives. This might lead to country specific standards and practices (Commission of the European Communities, 2008) hindering the positive effects on efficiency of ICT in the transport industry. Integration amongst actors also requires high levels of trust; thus actions aimed at supporting information exchanges by increasing the levels of trust between actors will be important. Bachmann (2001) underlines that regulation and clarity from policymakers increases the level of the so called "system trust" which will act as a catalyst and enable a quicker and higher level of trust between actors.

The policy requirements for environmental sustainability also apply to societal sustainability. Optimization of transports according to current traffic flows is also important to minimize delays and congestions. Policymakers need to work with industry to set up a cooperative infrastructure allowing for, e.g., V2V and V2I communication (European Commission, 2011c). For this to be possible standards need to be agreed upon and put into place for the industry to work with (Commission of the European Communities, 2006, European Commission, 2011c).

A general problem affecting all areas of sustainability is obtaining the support of transport logistics senior-level management for investments in new technologies (Commission of the European Communities, 2008, Madden and Weißbrod, 2008). The latest EC White paper on Transport (European Commission, 2011c) also stresses the importance of relying on market based mechanisms for getting the industry to invest in ICT that will make transport more sustainable. This relates back to the awareness and trust issue where policymakers and the research community need to show large pilot projects to give the industry the confidence to invest, which is currently lacking (Commission of the European Communities, 2008). The L4L initiative as a whole is part of this effort to raise the level of knowledge and awareness of the possibilities of ICT within the transport sector.

Lastly the policies put forward by the EC mainly address the problems on an abstract level. A requirement to get ICT implemented within the freight transport industry is to complement these with more operational policies (Behrends, 2009). A further requirement is to identify and address the differences between the macro-economic level and the commercial ones. Mainly the differences come from lack of concern about economical sustainability and merely focusing on environmental and

[3] Optimising for environmental criteria means optimizing for efficiency; environmental, social and economical sustainability usually go hand in hand.

societal sustainability. L4L proposes to incorporate more economical sustainability issues into general policies and to also make them more concrete, creating an urge for the commercial actors to push implementations of ICT solutions into the industry.

5 Operational requirements for supporting sustainability in logistics with the help of ICT

A fundamental result of the ICT and business performance literature is that ICT is not a driver of performance per se (Francalanci and Morabito, 2008) and a significant impact of ICT is achievable when accompanied by organizational change. The responsibility lies on the industry to provide individual and commercial services, based on the digital infrastructure provided. Solving current inefficiencies in ICT solutions requires education, training and behavioural changes in addition to the introduction of new ICT (Hagen, 2011). The end-user, e.g. the consumers, needs to be able to verify and compare sustainability improvements offered by ICT with improvements from other measures. Within organizations there is a resistance to cultural change and the deployment of new working practices enabled by ICT. There is a lack of awareness of what the technologies can do, the potential benefits ICT delivers and how that relates back to the specific user (Commission of the European Communities, 2008). It does not matter how good the supporting technologies are if the end user does not use them. One of the requirements on an operational level is therefore education about ICT for the user.

A report from Huschebeck et al. (2009) shows that one barrier for implementation lies in how we should secure the data transferred within the different ICTs. Technology for encryption is available today, but how to solve this is an operational problem. The report also stresses that job profiles and qualifications for employment will change. Again, a key issue is the acceptance and integration of ICT with the employees, along with the proper education about ICT.

Huschebeck et al. (2009) stresses the importance of defining new business models to offset the costs of these new systems. What value adding services can ICT add to the transport that could increase the profit margin for companies in the forefront of implementing ICTs? There is a need for business cases of different technologies to identify which has the best potential for ROI. An economical operational problem that hinders the use of ICT across Europe is the expensive roaming fees for data traffic when across borders. Freight transports are global by nature and to be able to harvest the benefits from ICT the costs for using it need to be moderate and appropriate to the savings for the individual company.

An obstacle to the wide deployment of ICT is the lack of agreed standards in how to measure freight transport sustainability and this means that decision makers have trouble comparing different options (Commission of the European Communities, 2008). There is a need for an introduction of international standards for measuring and reporting freight transport sustainability and for agreed consistent policy objectives among governments. To further promote environmental sustainability public procurements should lead the way and set an example for selecting the most energy efficient ICT, encouraging others to do the same (Commission of the European Communities, 2008).

Many times significant effects of ICT can only be achieved if several organizations collaborate (Closs et al., 2005, Potter, 2005), thus adding complexity to the system design. Sternberg et al. (2011) have illustrated ICT effects as shown in the figure below:

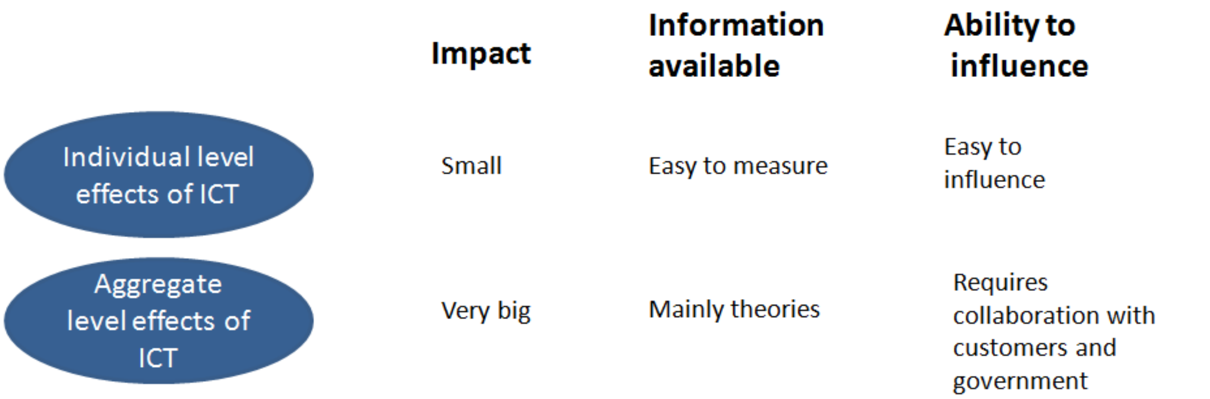


Figure 3: Effects of ICT (Sternberg et al., 2011)

The distinction between the terms *individual level* (i.e., the level of an individual operator and activity) and *aggregate level* (i.e., a system level where improvements become available when all operators or nearly all operators are using technological solutions to support specific operations) (Holland, 1995, Parsons and Wand, 2000) is very useful, since it helps dividing previous knowledge on ICT effects in transportation into two major groups.

Benefits from ICT such as reducing inefficiencies in transport operations through a better information flow on an aggregated level have been advocated by national and international projects and studies (Belella et al., 2009, Euridice, 2011, Huschebeck et al., 2009, Kalantari, 2009, Lumsden and Stefansson, 2007, Schumacher et al., 2009, Stefansson and Lumsden, 2009). However, the benefits on an aggregated system level will not be present until ICT infrastructures and the usage of ICT solutions have widely spread amongst all the actors within a transport system as well as in society (Sternberg et al., 2011). Furthermore, the structure of today's transport systems give little room for improvement and in the short term it is not realistic to change it (McKinnon and Ge, 2006, Kalantari and Sternberg, 2009). Reasons for this are e.g. structural imbalances in good flows, infrastructure constraints, the relative low cost for transports and the fact that the implementation of ICT, such as e.g. RFID, requires investments in equipment both at terminals and in trucks. This leads to an operational problem with adopting ICT into freight transport, the early adopters will not receive the expected benefits until ICT is standard and we have a "*chicken and egg problem*" (Sternberg et al., 2011).

Sternberg et al. (2011) stresses the importance of showing and promoting the benefits on an individual level from implementing ICT. On an operational level, benefits come mainly as a reduction in administrative work through information sharing between consignor and consignees, potentially being the driver for getting transport industry to invest in ICT. Further research along this route can be the future basis for more business-cases where cost and benefits analysis can be done. However, the individual benefits for investing in ICT are related to interoperability issues between different systems, and use of common technical standards.

6 Technical requirements for supporting sustainability in logistics with the help of ICT

Technical barriers arise from interoperability problems, the use of different standards and software in different supply chains. The technologies to create a well-functioning digital infrastructure already exist (Lumsden and Stefansson, 2007). However, to realize its full potential it will require common standards for information exchange, e.g., different technologies, equipment, systems, use of different wireless communication technologies and protocols. The lack of a communication standard limits the information flow, both the physical and the digital one (Huschebeck et al., 2009).

There is an urgent need for more research in the area of optimal technological change and technological diffusion involving multi-disciplinary cooperation between engineers, social scientists and end users in order to detect the true potential and benefits of various forms of ICT driven innovations for a more sustainable society. This will require extensive cross-disciplinary and cross-industry approach for an enhanced holistic view of ICT for logistics sustainability.

For supporting environmental and societal sustainability it is important to increase the rate of development and diffusion of the most energy efficient equipment, components and systems. The market penetration of more efficient systems as well as best practices should be encouraged. However, it is of great importance not to force the technical progress, since this may lead to new and undesirable technological lock-in as newer and still better technologies rapidly emerge. The appropriate ICT systems will also have to be supported with appropriate user-friendly software and education for the users.

6.1 Vehicle-to-vehicle and vehicle-to-infrastructure communication (cooperative systems)

Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication is not a new concept. Pioneering work was carried out in the 1970s, however it is only recently that technical progress and innovations, involving both on-board devices and end-user applications, have raised interest in cooperative systems for the vehicular environment.

In a European context there are several projects that have been focusing on various technological building blocks of cooperative systems: e.g. sensing and positioning technologies, communication, visualization and actuation technologies. Two of the most prominent projects within the basic technological development are CVIS[4] and SAFESPOT[5] - both EC supported in FP6. CVIS has developed an open service architecture with a communication platform based on the emerging ISO-family of CALM standards along with Internet Protocol version 6 (IPv6). The CALM protocol enables continuous connectivity over different wireless bearers, while IPv6 allows globally unique addresses to all connected devices (and possibly cargo transported). SAFESPOT focused on V2V communication with safety applications as primary objective. Included in this work was the development of the Local Dynamic Map (LDM) concept, which enables the vehicle to know its context relative to both static and dynamic objects in roads. Other projects that have contributed to technology for cooperative systems are COOPERS[6] and GeoNet[7]. All these rather technology intensive projects are complemented by several support actions where COMeSafety[8] is the most prominent one by bringing the cooperative community around the table and moderating the development of the European Communications Architecture for Cooperative Systems[9].

[4] Cooperative Vehicle-Infrastructure Systems (CVIS). EC FP6. Online: http://www.cvisproject.org/
[5] Cooperative vehicles and road infrastructure for road safety (SAFESPOT). EC FP6. Online: http://www.safespot-eu.org/
[6] Co-operative systems for road safety (COOPERS). EC FP6. Online: http://www.coopers-ip.eu/
[7] Geographic addressing and routing for vehicular communications (GeoNet). EC FP7. Online: http://www.geonet-project.eu/
[8] Communication for eSafety (COMeSafety). EC FP6 SSA. Online: http://www.comesafety.org
[9] COMeSafety deliverable: COMeSafety_DEL_D31_EuropeanITSCommunicationArchitecture_v2.0.pdf at www.comesafety.org

Being the core of the cooperative aspect of these systems, communication protocols and technologies have been thoroughly investigated and, through standardization in organizations like ETSI and CEN on a European level and ISO and IEEE on an international level, are now becoming mature for deployment. Different wireless technologies are used, ranging from line-of-sight technologies like Infrared, via short ranged and medium ranged technologies like CEN DSRC and WiFi, to long ranged cellular systems like UMTS and LTE. In most V2V and V2I scenarios, the wireless bearer technology is based on the IEEE 802.11 standard with the p-amendment for vehicular environments. Both the CALM M5 and WAVE protocols use this technology. At higher layers both IPv4/v6/NEMO and CALM FAST are used. Which protocols to use will very much depend on the nature of the application, where freight transport sustainability applications do not have the most stringent service requirements.

Taking the basic technology components for cooperative systems in to a transport context, there are three projects that should be mentioned: FREILOT[10], SMARTFREIGHT[11] and eCoMOVE[12]. FREILOT is deploying ITS solutions based on the CVIS approach across different European cities, which will after a pilot phase be valuable input to the evaluation of e.g. the environmental benefits of the technology. SMARTFREIGHT put the CVIS approach in the context of traffic and freight managers by enabling information exchange across domains and responsibility, connecting cargo and vehicles with the back end management centers for real-time information access. The solution was implemented and demonstrated. In eCoMOVE the aim is to develop cooperative services for increased freight transport sustainability – e.g. in areas such as eco-driving, eco-traffic management and eco-fleet management. eCoMOVE is based on both the CVIS and GeoNet approach.

Among the international activities, most notable is the Connected Vehicle Research program[13] for V2V and V2I systems within the U.S. Department of Transportation (DoT), formerly called IntelliDrive. IntelliDrive is focused on advancing connectivity among vehicles and roadway infrastructure in order to significantly improve the safety and mobility of the U.S. transportation system. The program’s future vision is to enable “crash-less” vehicles, where vehicles and infrastructure are connected and cooperating, and access to real-time data on the status of both vehicles and the roadway which may dramatically improve performance like freight transport sustainability.

Along with the technical progress and innovation comes the market aspect, and in this sense it is also recently that the potential benefits of cooperative systems have been identified and targeted. Currently cooperative systems have not reached the market yet and the state-of-the-art consists mainly of EC and nationally supported initiatives and standardisation activities. Hence the requirements in this area are not related to further technical implementations, but concerns mostly how to foster market take-up based on reliable business models, how to make cooperative infrastructure available and how to promote standards adoptions by industry.

6.2 Integration with miscellaneous back office

The ICT landscape changes rapidly, and there is a continuous need for supply chain’s stakeholders to integrate their backend systems, mostly their legacy systems with the other systems used in the supply chain in order to ensure inter-enterprise integration. But, as long as there are several standards in use, as well as a lot of proprietary systems not using any standard, this integration is a challenge and cost intensive. Consequently, inter-operability issues are of great concern when enterprises intend to

[10] Urban freight energy efficiency pilot (FREILOT). EC FP7. Online: http://www.freilot.eu/

[11] Smart freight transport in urban areas (SMARTFREIGHT). EC FP7. Online: http://www.smartfreight.info/

[12] Cooperative mobility systems and services for energy efficiency (eCoMOVE). EC FP7. Online: http://www.ecomove-project.eu/

[13] Connected Vehicle Research program. U.S. Department of Transportation, Research and Innovative Technology Administration (DoT RITA). Online: http://www.its.dot.gov/connected_vehicle/connected_vehicle.htm

integrate their backend systems. Also the research landscape has focused on this topic during the last decade and several approaches and standardization issues have been suggest.
In European level, there is a plethora of FP6 and FP7 projects dealing with various aspects of Interoperability[14]; interoperability as a science and integrated framework (e.g. INTEROP, ATHENA), platforms and tools dealing with document exchange and various aspects of security (GENESIS, ABILITIES, TRUSTCOM, etc.), architectures and tools for interoperability (FUSION, COMMIUS, etc.), community-based interoperability (DBE, etc.) and many other areas that deal with enterprise application connectivity.

New trends in interoperability are driven by the Future Internet paradigm. Interoperability is not just interconnecting applications; it is rather an integrated framework with concepts, tools, architectures and knowledge that help enterprises collaborate better in the context of communities (e.g. non-hierarchical supply chains). Enterprises that will operate in this manner belong to what is called as Future Internet Enterprises (FInES). FInES will not only be concerned with Enterprise Resource Management; they will also monitor Enterprise Innovation Systems, meaning that innovation will come from more close and dynamic collaboration. According to the FInES cluster research Roadmap[15]:

The shift from management-centric to innovation-centric enterprise systems will represent a major discontinuity in current ICT solutions and will pose key research problems. This research will be successful only if, in parallel, Future Internet, and the supporting technologies (from Internet of Things to Software as a Service, from Social Networking to Semantic Knowledge Management) will be consolidated and openly available. In particular, the paradigm of the Cloud Technologies appears able to provide the necessary flexibility and agility that today's enterprise systems are far from exhibiting.

To this end, supporting technologies comes from the domain of Service Oriented Architectures, Semantic web, Service discovery and composition which supports definition, publishing, identification and use of community-based services, interoperable with existing back-end applications.

6.3 Identification technologies

There are different identification technologies available in the market today, esp. optical identification methods like barcodes are widely used, but the role of RFID increases. For freight transport efficiency, esp. automatic collection and reuse of data is of importance.

Barcodes

Barcodes are the most used data capture methods and today barcodes can be found even on item level. They have become smaller and smaller even though they can contain more and more information and are nowadays made two dimensional. Problems with barcodes are that they require line of site, and are sensitive to dirt and are often easily damaged. Systems using barcodes only need static information.

RFID

RFID is the most important identification method looked upon from many companies today. This is because of the great possibilities of this technology. Various RFID systems are used in different environmental conditions and applications. There are different factors regarding RFID that need to be considered and investigated:

[14] For more information on all FP6 and FP7 projects the reader may refer to the Future Internet Enterprise Systems (FiNEs) cluster (http://www.fines-cluster.eu/fines/jm/)
[15] FINES Research Roadmap, June 2010, page 34 (http://www.fines-cluster.eu/fines/jm/Cluster-Publications/Cluster-Publications/View-category.html)

- Frequencies - Low, High, Ultra High and Microwave, all of these with different reading/writing range, data transfer rate, coupling, sensitivity to moisture
- Tags – can be passive, active with battery support, or semi active/passive
- Data storage – RFID tags can be Read Only (RO), ReWritable (RW) or Write Once Read Many (WORM)
- Standards – there are many issues to consider regarding standards. UHF for example, does not have the same frequency across the world.

The RFID system is clearly not a plug and play system, but a very complex system compared to barcodes. It also has its advantages, e.g. barcodes need the line of sight technology whereas with RFID that is not necessary. RFID tags can be read as long as they are within range of a reader. Another RFID advantage is that the tags can be read through different kind of substances such as snow, fog, ice, paint and other environmentally challenging conditions. The barcode label can be ripped off or soiled which will make it impossible to scan, and standard barcodes identify only the manufacturer and product, not the unique item. RFID tags can also be read very fast, in most cases responding in less than 100 milliseconds. Another benefit with RFID tags is that the tag itself can contain a large amount of information. The disadvantages with RFID are the expenses in equipment and implementation, lack of common standardisation, and that some frequencies are very sensitive to metal and fluid.

The problem with reaching a level of smart connectivity concerns the distribution of costs since it is difficult to determine who should pay for a system to better control and track vehicles and goods through the supply chain. Any company that wants to implement a functional RFID system incurs costs for readers, printers, middleware and software. It is also likely that it will need consultancy support, employee training, system tuning and trials, and the internal processes also need to be redefined and developed, which leads to further costs. Smaller organizations do not have the resources needed to implement RFID and accept the risk of adopting a technology not yet diffused which leads to the larger companies that are leading the adaptation process. Due to the lack of long-term experience in using RFID systems in the commercial environment, many companies face difficulties to demonstrate the business case and the ROI, and it is not yet possible to reduce cost by imitating industry best practices.

Important issues from a technological point of view are the lack of interoperability and communication standards, and the different frequency bands available in different countries. Especially when using UHF, where the technology is relatively immature, it is important to be aware of the concerns about the reading accuracy and the system reliability. Another important issue is the vendors' lack of RFID system expertise, especially in the domain of integration with enterprise software already in use, and the way the massive stream of data will be managed. Moreover, companies have to be prepared to share information with their partners.

The table below compares the two identification methods.

Barcode	RFID - Transponder
Not rewriteable	rewriteable
Direct indivisibility needed	No direct indivisibility needed, because of radio transmission
Reading error due to dirtiness and damage	Environment Resistant
Rate of read about0 %	Rate of read about9 %
12-15 sign	Filling until 256 kB
Handscanning mostly needed (But Auto ID is also possible)	Automatic reading

Table 1 draws comparisons between RFID and Barcode (in dependence on Obrist 2009)

In the smart supply chain different companies with different enterprise systems can connect without any human interference, and the synchronization between physical goods flow and information flow in the supply chain is important for operational efficiency[16].

To achieve a smart supply chain, support is needed from advanced technologies that can make the different resources or infrastructures smart. Immediate access to corporate data, anytime and anywhere, is a competitive advantage. Data capture solutions enhance productivity of frontline and back office operations. Wireless and mobile devices, scanners, PDA devices, GPS, and especial management software are the most common technologies that are used. This kind of infrastructures and resources are capable of communicating effectively with their environment[17].

[16] AP4 Intelligent Gods.doc
[17] AP4 Intelligent Gods.doc

7 Inclusion in the L4L Framework

The questionnaire listed below is based on the results in previous chapters. The objective of the questionnaire is to verify the requirements on ICT solutions for sustainable freight transport by all stakeholders being interested in the topics covered by L4L.

7.1 Online Questionnaire for collecting requirements on freight transport sustainability

Purpose

Throughout the last decades, a continuous trend towards networked enterprises operating in a highly dynamic environment can be perceived. Complex and widespread communication often needed in supply chain and production networks are more vulnerable and inflexible since the large number of different entities and their complex interrelations increase the occurrence of possible risk factors.

The last decade has seen a significant amount of effort carried out in order to make the transport and handling of goods more robust and efficient, both so that the quality of the products and services increases and the negative environmental impact decreases.

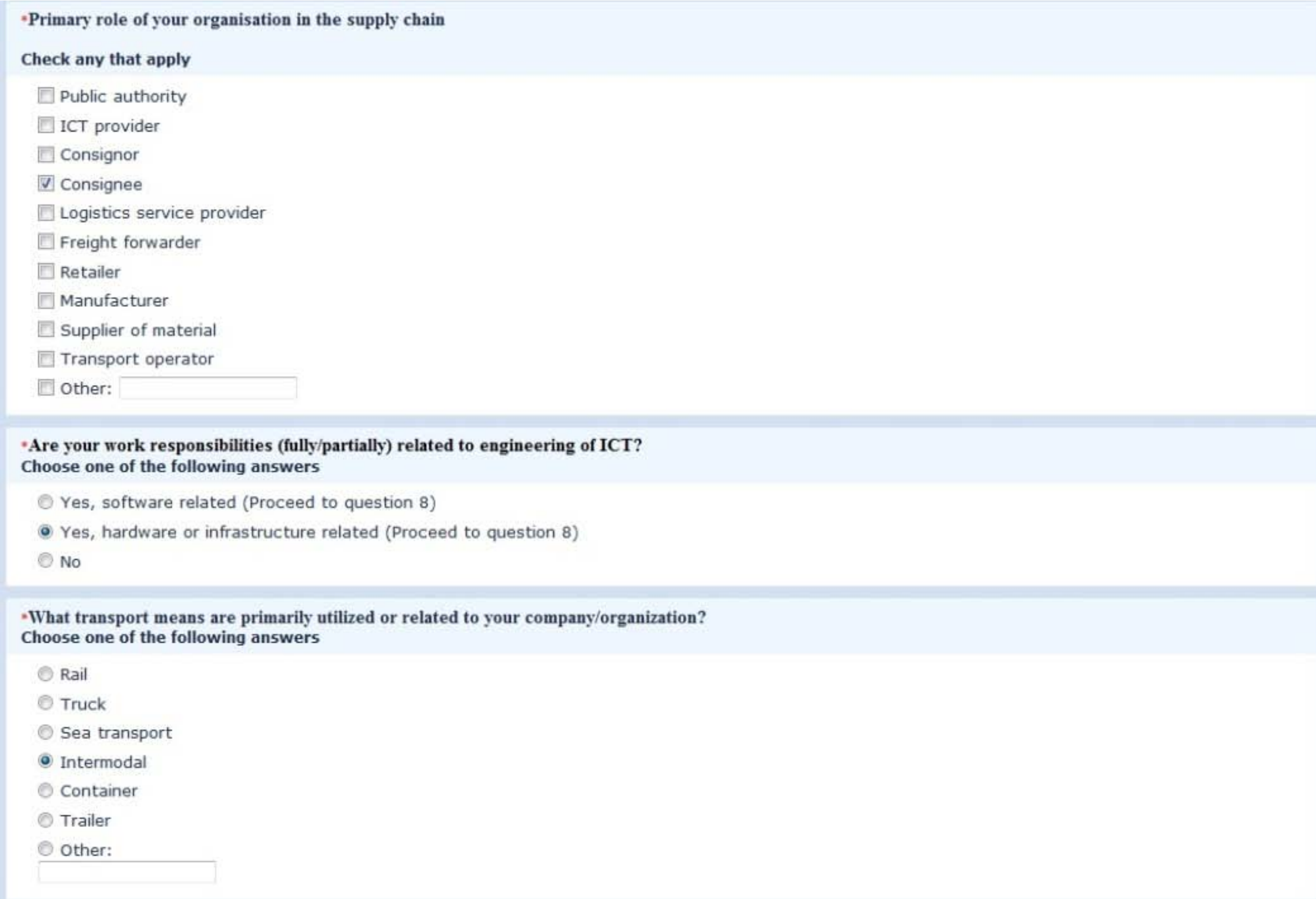
In order to reduce the costs of unexpected events, increasing the traceability of information flow and flows of goods, improving customer service, an effective investment has been done in ICT to provide solutions supporting freight transport. Additionally, a lot of research has been carried out. Up to now only a small number of logistic services prviders and freight carriers has implemented and put into operation ICT solutions, hence, Logistics for LIFE would like to collect the requirements from industry and the logistic sector, in order to compare the requirements for different solutions and to take this into account for the roadmap activities.

Different stakeholders have different ICT related requirements, in order to improve their own role to support sustainability. These requirements also depend on the size of the organization, technical knowledge of stakeholders, method of supply chain. By considering all these factors, an online survey is designed based on “ICT supporting freight transport efficiency”. The requirements different stakeholders’ organisations have on ICT solutions to support sustainability depend on the role of the stakeholder, the size, the technical know-how as well as on the supply chain. Thus, this questionnaire collects information on the stakeholders as well as the related requirements.

Structure of the Questionnaire

The questionnaire is structured in sections:

Section A: Administrative information on type of organisation, transport means, infrastructure etc. Questions here can be like the ones shown in Figure 4


*Primary role of your organisation in the supply chain

Check any that apply

- [ ] Public authority
- [ ] ICT provider
- [ ] Consignor
- [x] Consignee
- [ ] Logistics service provider
- [ ] Freight forwarder
- [ ] Retailer
- [ ] Manufacturer
- [ ] Supplier of material
- [ ] Transport operator
- [ ] Other:

*Are your work responsibilities (fully/partially) related to engineering of ICT?
Choose one of the following answers

- ( ) Yes, software related (Proceed to question 8)
- (•) Yes, hardware or infrastructure related (Proceed to question 8)
- ( ) No

*What transport means are primarily utilized or related to your company/organization?
Choose one of the following answers

- ( ) Rail
- ( ) Truck
- ( ) Sea transport
- (•) Intermodal
- ( ) Container
- ( ) Trailer
- ( ) Other:

Figure 4: Questions regarding users' and organization's profile, section A

Section B: Position of ICT within the company, function to be supported in the supply chain, barriers for ICT implementation. Examples of such questions, which are on a strategic level, are given in the below Template Questionnaire. The idea of such questions is that if they are combined with administrative data and if the data basis is large enough, this can contribute to a better understanding of under which circumstances a company will invest in ICT.

Section C: More detailed questions on functionalities and technologies
These questions are developed in order to get feedback on the functionalities the different stakeholders would find relevant and important for implementing ICT. This section also delivers information on the relation between ICT and the sustainability dimensions (economic, environmental and social).

7.2 Template Questionnaire

This section shows the whole questionnaire. The access to the online survey is through the L4L site.

7.2.1 SECTION A

1	Your position
	• ICT-research and development • Consultant • Executive/manager • Logistics expert • User of ICT application for freight transport • Other, please comment

2	Company/organization size
	• Self-employed (1-2 Employee/s) • Small-sized company (3-15 Employees) • Medium-sized company (16-99 Employees) • Large company (+100 Employees) Other, please comment
4	Primary role of your organisation (Multiple selection OK)
	• Public authority • ICT provider/consultancy • Consignor • Consignee • Logistics service provider • Freight forwarder • Retailer • Manufacturer (non-food) • Manufacturer of food • Supplier of material • Transport operator • Research and education
5	Are your work responsibilities (fully/partially) related to engineering of ICT?
	• Yes, software related (Proceed to question 8) • Yes, hardware or infrastructure related (Proceed to question 8) • No
6	• Are actual logistics operations parts of your primary work responsibilities? If no, proceed to question 8.
	• Yes • No
7	• How would you characterize your organization: (Multiple selection OK)
	Logistics service provider: ☐ Transport purchase: ☐ Transport operator: ☐ Infrastructure operators: ☐ Authorities/Organizations: ☐ Other:
8	What transport means are primarily utilized or related to your company/organization?
	• Rail transportation • Road transportation (Trucking) • Sea transportation
9	Select the type of Transport/logistics operator most fitting to your organization?
	• Haulier (Motor carrier) • Ferry operator • Container operator • Trailer operator • Rail operator • Intermodal operator • Other:
10	If applicable, what type of authorities/organizations do you represent?

	• Rescue service • Customs • Traffic authority • Other:
11	Are you active in the Intelligent Cargo Forum?
	• Yes • No
12	Are you involved in L4L or EURIDICE?
	• Yes • No
13	(only if partner of L4L): Please insert your name and affiliation:

7.2.2 SECTION B

Please indicate the position of ICT support for freight transport sustainability in your organisation. Logistic for Life looks at how different ICT solution may support different aspect of freight transport efficiency.

1. Do you have a department in your organization responsible for ICT?

No	☐	☐	Yes

2. How do you consider the approach of your organization to new technologies?
   - Early adopter – you are willing to use the very latest new technologies, taking the risk of unprofitability or uncertainty
   - First follower – you could take the risk of deploying new technologies relatively early if they are promising
   - Slow adopter – you are cautious and will deploy new technologies only when the market is mature and the benefits are clear
   - Forced adopter – you will deploy new technologies only if your customers, legislative regulation, etc. oblige you to

3. From your perception – what is the priority level of technologies supporting freight transport sustainability in your organization?

Sustainability indicator	Not rel.	low	Medium	high	Do not know
Economic- quality	☐	☐	☐	☐	☐
Economic- efficiency	☐	☐	☐	☐	☐
Economic- responsiveness	☐	☐	☐	☐	☐
Social- health and safety (like reduction of accidents)	☐	☐	☐	☐	☐
Social- benefits for employee	☐	☐	☐	☐	☐
Social –noise, congestion etc	☐	☐	☐	☐	☐
Environmental- emissions	☐	☐	☐	☐	☐
Environmental-natural resources utilisation	☐	☐	☐	☐	☐

Environmental-waste and recycling	☐	☐	☐	☐	☐

4. If you consider implementing state-of-the-art ICT boosting logistics efficiency during the next five years , do you plan to
    - Put into operation
    - Pilot or test scenario
    - Do not intend to implement

5. Which function should the new technology support? (rank 1 to 5; 1 less significant)

Automated administrative information flow through the supply chain	☐	☐	☐	☐	☐
Information on cargo status (incl. temperature, humidity control)	☐	☐	☐	☐	☐
Information on delays, rescheduling, traffic information, re-routing	☐	☐	☐	☐	☐
Active fuel management (eco-driving)	☐	☐	☐	☐	☐

6. In your opinion, what are the major barriers to the adoption of ICT for efficient transport sustainability? (rank 1 to 5; 1 less significant)

Lack of knowledge of the practical applications	☐	☐	☐	☐	☐
Difficult to calculate the Return On Investment	☐	☐	☐	☐	☐
Difficult to measure the direct impact of the solution/technology on the level of noise and congestion	☐	☐	☐	☐	☐
Lack of proof on the security and safety level throughout the supply chain	☐	☐	☐	☐	☐
Difficult to assess the impact on health and safety issues	☐	☐	☐	☐	☐
Direct impact on fuel consumption unclear	☐	☐	☐	☐	☐
Contribution to reduction of emissions too difficult to calculate and show	☐	☐	☐	☐	☐
Unwillingness to redefine new processes and/or train employees	☐	☐	☐	☐	☐
Technical reliability considerations	☐	☐	☐	☐	☐
Lack of familiarity with the technology	☐	☐	☐	☐	☐

Lack of standards	☐	☐	☐	☐	☐
Sparse availability of hardware and software vendors	☐	☐	☐	☐	☐
Cost of system integration	☐	☐	☐	☐	☐
Worries about compatibility of hardware supplied by different vendors	☐	☐	☐	☐	☐
Key customers and suppliers will not be interested paying more for the increased service	☐	☐	☐	☐	☐
Difficult to show the positive effect of such solution for the employees	☐	☐	☐	☐	☐

7. Please indicate the relevance of the following suggestion for your investment decision. You may rank several at the same level

	Not relevant				Very relevant	Comments
Costs	☐	☐	☐	☐	☐	
Feasibility demonstration prototype	☐	☐	☐	☐	☐	
Return on investment case	☐	☐	☐	☐	☐	
Message architecture	☐	☐	☐	☐	☐	
Innovative new services	☐	☐	☐	☐	☐	
Reduction of noise	☐	☐	☐	☐	☐	
Reduction of emission	☐	☐	☐	☐	☐	
Job security	☐	☐	☐	☐	☐	
Improved working conditions	☐	☐	☐	☐	☐	
Increased safety for employees	☐	☐	☐	☐	☐	
Security level improvement	☐	☐	☐	☐	☐	
Reduction of time	☐	☐	☐	☐	☐	
Level of quality of products and services	☐	☐	☐	☐	☐	
Responsiveness	☐	☐	☐	☐	☐	
Reduction of accidents	☐	☐	☐	☐	☐	
Reduction of waste	☐	☐	☐	☐	☐	

8. Which of the listed factors pushing for ICT implementation would you consider most relevant for your organization? (rank 1 to 5; 1 less relevance)

	1	2	3	4	5	

Freight transport sustainability	☐	☐	☐	☐	☐	
Competitive advantage	☐	☐	☐	☐	☐	
Public opinion	☐	☐	☐	☐	☐	
Legislative change	☐	☐	☐	☐	☐	

7.2.3 SECTION C

This section deals with specific functionalities and technologies.

1. Traffic management and control

Please indicate on the scale, whether you think the information mentioned below should be considered as very relevant for improving the freight transport sustainability.

	Not true				**true**	**Do not know**
Collecting real-time information about traffic and environment conditions, incidents	**1**	**2**	**3**	**4**	**5**	
Improved traffic flow through infrastructure measures like traffic light synchronization, variable message signs, and dynamic route guidance (RTTI); demand management, and access control	☐	☐	☐	☐	☐	☐
Navigation and guidance	☐	☐	☐	☐	☐	☐
Automated facility access control	☐	☐	☐	☐	☐	☐
Freight and fleet management	☐	☐	☐	☐	☐	☐
Higher penetration of in-vehicle safety devices to avoid accidents and related congestion	☐	☐	☐	☐	☐	☐
Smoother driving using safety systems such as adaptive cruise control (ACC), stop-and-go assistance, vehicle-to-X communication (e.g. interactive traffic control, local danger warning)	☐	☐	☐	☐	☐	☐
Traffic Management & Controlling Systems (TMCS)	☐	☐	☐	☐	☐	☐
Geofencing	☐	☐	☐	☐	☐	☐
Intelligent road pricing system	☐	☐	☐	☐	☐	☐
Intelligent Cargo	☐	☐	☐	☐	☐	☐
Freight distribution optimization	☐	☐	☐	☐	☐	☐
Urban traffic management system	☐	☐	☐	☐	☐	☐

2. Eco-Driving Support

Please indicate on the scale, whether you think the information mentioned below should be considered as very relevant for improving the freight transport sustainability

	Not rel				**Fully rel**	**Do not know**
Help travellers find the most eco-friendly route & transport mode choice	☐	☐	☐	☐	☐	☐

Support drivers to acquire and adopt eco-driving techniques	☐	☐	☐	☐	☐	☐
Traffic Management & Controlling Systems (TMCS)	☐	☐	☐	☐	☐	☐
Geofencing	☐	☐	☐	☐	☐	☐
Intelligent road pricing system	☐	☐	☐	☐	☐	☐
Intelligent Cargo	☐	☐	☐	☐	☐	☐
Freight distribution optimization	☐	☐	☐	☐	☐	☐
Urban traffic management system	☐	☐	☐	☐	☐	☐

3. Technology to be used

Please indicate on the scale, whether you think the implementation of the technologies standards and concepts mentioned below will have an impact on freight transport sustainability or not.

	Not rel			**Very rel**	**Do not know**
Barcodes	☐	☐	☐	☐	☐
Smart cards	☐	☐	☐	☐	☐
Voice recognition	☐	☐	☐	☐	☐
RFID	☐	☐	☐	☐	☐
IRID	☐	☐	☐	☐	☐
GNSS positioning	☐	☐	☐	☐	☐
SOA	☐	☐	☐	☐	☐
The level of interoperability	☐	☐	☐	☐	☐
The use of common standards (like eb XML, ...)	☐	☐	☐	☐	☐
Web services available	☐	☐	☐	☐	☐

4. Other

The questionnaire above only considers some specific aspects. If you feel that it is vital, too, please fill in the table below. Indicate if it is a must (+++++) or just relevant (0).

description	**Level of relevance**					**Comments**
	0				+++++	
	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	

8 CONCLUSIONS AND FURTHER STEPS

The new questionnaire will collect answers in the period Oct.2011 to- March2012, as soon as it is approved by the Commission. The analysis of these results will be used both for WP4 as well as serve as input to the roadmap. The results of the survey will also be used in order to understand exactly where the challenges are by the implementation of ICT supporting freight transport efficiency and sustainability

In a second step, part of D1.3c, it will be analysed how available solutions and their contribution to freight transport sustainability can contribute to fulfil the requirements set by the outcome of this survey.

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10 Annex

This section gives examples of used information systems and also of available ICT. It is not a complete overview. A complete overview of the technologies will be found in D2.2b

10.1 Examples of IS and applications using ICT for supporting logistics operations

Example of applications and IS using ICT for supporting logistics operations		
Name	**Description**	**How does it help to support sustainability?**
Traffic Management & Controlling Systems (TMCS)	TMCS aim to collect real-time information and to control the traffic and have the ability to prioritize certain traffic. Examples of these systems are traffic signal controlling systems that prioritize certain traffic and motorway controlling systems	Improved traffic flow through infrastructure measures like traffic light synchronization, variable message signs, and dynamic route guidance (RTTI); demand management, and access control
Information systems	Systems that provide information in several contexts such as individual and collective travel planning, parking and road-based information. E.g. may provide real-time information about available parking spots in the city and information about the direction to reach these. Another example is systems that can provide information on estimated driving time for a certain distance and speed of the traffic flow using Variable Message Signs (VMS) or information available through the Internet, GSM and radio. The system can also inform the road users about accidents and other traffic disturbances and provide directions of other alternative routes.	These systems increase the amount of information given to the drivers and planners about different conditions affecting the route. This means that they can take better decisions about where to go and this will reduce the amount of traffic.
Geofencing	A geofence is a defined geographical area with virtual boundaries on an electronic map, with the purpose to alarm if one of its boundaries is crossed. Geofencing has several deployment areas, e.g. Safe tunnels etc.	Security can be increased and it can reduce the risks of hijacking and theft. Information exchange, i.e. a geofence can be triggered when a vehicle enters the area close to its destination company. Route planning, i.e. dangerous goods when geofencing can verify that the vehicle stays on route. If a deviation occurs an alarm will be triggered.
Intelligent road pricing system	Automatic or Intelligent road pricing systems are based on GPS technology and a small computer, “On Board Unit (OBU)”, which is installed in the vehicle. Via GPS, the OBU can determine if the vehicle travels on a tax road and if so, it measures the travelled distance and based on that it calculates the toll tax which is sent with mobile communication from the OBU to a computer center. Based on the data from the OBU the computer center generates a monthly invoice which is sent to the user. For those vehicles not equipped with an OBU, there is a possibility to pay manually at payment terminals located along the motorways.	It improves traffic flow and reduces congestion in urban areas where tollbooths will severely stop up traffic and create long ques.
Smart Logistics Systems - SLS	SLS enables transparency throughout the supply chain and gives flexibility, security and efficiency in transport and logistics processes and can be divided into "Smart Goods", "Smart Vehicles" and "Smart infrastructure" Smart goods studies how RFID technology can benefit of identification, planning, steering and tracing of goods. Smart vehicles studies how the transport vehicles can be connected to the goods in the vehicles and to the infrastructure (roads, harbours, tunnels etc.). The goal is to be able to dynamically steer the goods efficiently from supplier to receiver. Smart infrastructure studies different technologies how infrastructure can be connected with Intelligent Transportation Systems (ITS) in order to provide information to different actors in the supply chain and services based on this information in order to increase the transparency in the supply chain.	Increased flexibility, efficiency and security are all parameters that affect sustainability.

Freight Distribution Management (FDMS)	Cities have very different requirements of control and therefore most different need for freight data. The control may be performed by using specification of access regulations or ban place on certain types of vehicles. By using a Freight Distribution Management system, different kinds of information on freight distribution activities could help local authorities, such as driver reporting when an/a accident/breakdown occurs or freight statistics for planning purposes. If a more active control of freight vehicles would take place, real-time tracking data could be useful. Before systems as these are implemented, different aspects need to be solved as for example, having good public-private coordination and clear roles for the different stakeholders it will address. Moreover, data privacy issues and the set-up and maintenance costs could be an important barrier. However, the concept will have to be proven, e.g. actual contribution to circulation time, before local authorities and operators decide to become active in such a system.	The main advantages of such system would be the monitoring of the number of freight vehicles entering the city and the time they stay which would help to solve congestion issues, follow-up of dangerous goods vehicles and enforcement support.
Urban Traffic Management Systems (UTMS)	Freight operators could also benefit from Urban Traffic Management data that includes static information, i.e. journey times, road works or pre-booking access, and dynamic information, i.e. real-time traffic data or alternative routing during accidents. This kind of systems needs to be able to filter out unwanted information, and the data needs to be accurate and timely.	Improves planning and improves efficiency in operations and use of infrastructure.

10.2 Technologies that can be used with ICT to support logistics operations

The lowest layer of information carrier should be of a kind that supports the information system with relevant information. The main issue is whether it should be automated information collection or not. Automated collection is generally preferred since human error is minimized. RFID has grown in importance and is generally thought to increase in importance within supply chains and is thus more thoroughly described in chapter 6.3.

Examples technologies for supporting Auto ID		
Type	**Pros**	**Cons**
Barcodes	Cheap Standards applied	Line of sight needed Sensitivity to dirt and damage
Smart cards		Short distance
Voice recognition		Sensitive
OCR – Optical Character Recognition		
RFID – Radio Frequency Identification	Memory Rewritable information Better automation possible Multiple reading	Different frequencies in different countries Standards Certain frequencies sensitive to metal and fluids.
IRID – Infrared Identification		Unknown technology

Several of the functions are based on some kind of position, and this requires that GPS receivers are becoming commodity in vehicle. The EU has also launched a project called GALILEO which is also a positioning system upon which European nations can rely independent from the US GPS system or the Russian GLONASS. The reason for building GALILEO is to reduce the dependence for commercial traffic on the GPS system that is fundamentally a military system that could be turned off.

There are several mediums for information transmission and they are becoming faster and cheaper, enabling large amount of data being redistributed, e.g. our current telecom and data networks 3G and GPRS. The technical development of transports systems means moving technology from the physical infrastructure into the vehicles and making them the new sensors for collecting and providing information. The embedded equipment and existing technologies can still be used for collecting and distributing information. However, to provide more accurate and updated information in real-time, the digital infrastructure in combination with the services based on it must be expanded.

11 Annex II- Answers to Reviewers' recommendation

Main comments from the reviewers from last review:

Reviewers' Comments	**ACTION DONE**	**Section in this deliverable**
# 6,p4 double information	The WP leaders of esp. WP1, 2, 4 have exchange detailed information in where to put different information in the different deliverables in order to avoid double information. I.e the results of the survey will only be presented in D1.3c and online, and not in the deliverables belonging to WP4 and vice versa	Chapter 7
The deliverable should be re-written- bothe English and writing style	Deliverable restructured and re-written. Focus turned away from only energy efficiency to include all three sustainability dimension.	Chapter 4-6
Online Questionnaire	Re-design of questionnaire in order to fulfill this.	Chapter 7
More solid content chapter 3	The old chapter 3 is divided into three new chapters. Chapter 6 as well as Annex 1 deals with the technical part	Chapter 6 and annex 1
Consortium could not state if the respondents are partner in EURIDICE or L4L	We specifically ask for L4L/Euridice involvement	Chapter 7
Both 1.3 and 1.4 addresses the results.	Only D1.3c addresses the results	
Executive summary should address goal, approach and main result	A new executive summary has been written according to the advices	
List of abbreviation in alphabetic order	done	Section 1.5