EUROPEAN COMMISSION
DG INFORMATION SOCIETY & MEDIA

SEVENTH FRAMEWORK PROGRAMME

THEME 3

'INFORMATION AND COMMUNICATION TECHNOLOGIES'

Collaborative Project – CONTRACT N. FP7-216353

Theoretical background and intermediate local scenarios for services to be provided

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EXECUTIVE SUMMARY

In section 1 a conceptual model is presented that is well suited to understand the relationships between traffic, transport and logistics and the way this relationship has changed over time and under the influence of information technology. The model has been extensively published and used in international work by for example EC, OECD, Euro-CASE and the transatlantic transportation research network STELLA. The model is intended to facilitate the harmonization and common understanding of terminology within SMARTFREIGHT. The text is therefore rather detailed with comparisons of chosen definitions of basic terms with definitions in Dictionary.com.

The model is used in sections 2 and 3 to explain why the traffic management and freight transport communities still have rather limited knowledge and understanding of each other's field and perspective. One example is this: The transport freight community has come a long way after the deregulation wave in the 1980s and is now using a market approach with far reaching adaptation of their services to the needs of each individual customer. In contrast the traffic community is still serving flows of vehicles, where each vehicle is anonymous to the traffic manager.

The conclusion is that communities will have a difficult learning process in order to understand how to best market the added functionalities that are offered by SMARTFREIGHT. We think that this learning is best achieved if a community sets up a specific agency called Freight Transport Service & Control Centre (FTSCC). This centre is given the task of working with a marketing approach at the tactical level. This means that they must also keep records about their customers like any other business undertaking. In particular they need to keep a register

of those vehicles - and their owners - that enjoy the extended functionalities offered. The FTSCC must of course maintain a close contact with the urban traffic control centre (UTCC) that produces most of the services that are tailored by the FTSCC.

As a consequence we find it necessary to split the box "Freight distribution management for city centre", which is part of the overall SMARTFREIGHT concept (Figure 1, page 11 in Technical Annex.doc) in two parts, where one is the FTSCC, being the supplier of SMARTFREIGHT value added services and led by a transport supervisor, and the other the VFDC or Vehicle Fleet Dispatching Centre, being the consumer of these services. A VFDC can in size be anything from a personal computer on a desk in the home of the owner of a small company, who himself drives the single distribution vehicle of the company, to a large office, instrumented to track a whole fleet of vehicles on graphic screens. The VFDC can also be the control centre of a specially founded non-profit company set up – possibly with joint ownership by the community and the transport industry or other private stakeholders- to handle the last mile distribution problem in a city centre through a monopoly type of operation.

In section 5 the extended functionalities of the transport and traffic management systems and the services offered to the driver, as required by the objectives of SMARTFREIGHT, are presented. The way the systems interact in producing these functionalities is illustrated graphically. The functionalities that each test site has accepted to study by means of technical demonstrations, simulation or desktop studies is listed in Table 2 on page 12 and Figure 7 on page 13. A template for describing the activities at all test sites in more detail has been developed and used for data collection. Each site has filled out the details for each of the relevant functionalities using the following headings: *General description of functionalities, Links to other functionalities, Use cases, Stakeholder interests –authorities, Stake holder interests – transport industry, Stakeholder interests – others, Key performance indicators, Test set-up (planned).* These data have been transferred to a joint document that is appended to this report (SMARTFREIGHT WP6 Function descriptions – Draft version).

An analysis has shown that many of the individual functions that are needed to provide the extended functionalities have a composite character. Many of them are also closely related to each other. In order to easier identify the possible combinations, we have found it useful to apply a modular approach and split them up into functional modules. For simplicity, we refer to a functional module as a *function*. All the functions needed to meet a SMARTFREIGHT objective, i.e. realise one of the extended functionalities shown in table 2, are referred to as a *composite function*. Table 4 on page 15 shows a preliminary set of all functions needed to realise all planned functionalities in SMARTFREIGHT. Functions that exhibit generic relations are kept together in groups. It is also indicated whether a function is strategic, tactical or operational.

In section 7 a hypothetical scenario is given. It is intended to show the general character and level of detail for a typical SMARTFREIGHT scenario. It is inspired by activities in Winchester.

1. A general conceptual model

As a background and introduction a general conceptual model will be presented. It is very general and can by principle be able to any system that exhibits dynamics over time and space. The model has proved useful to better understand how concepts such as transport, traffic, logistics and infrastructure relate to each other. It is referred to as the Sjostedt-Ridley model and was inspired by the four stages in standard traffic forecasting models (Euro-CASE, 1996). An early version of the model has been refined and adapted to public transport by Stig Franzén in his doctoral thesis (Franzén, 1999). It should be stressed that the model is conceptual and as such it must not be confused e.g. with a time based simulation model of a physical process.

For the purpose of SMARTFREIGHT the model is here adapted to urban freight. Some key terms that are implicitly defined when describing the model are highlighted in Italic. These definitions are more or less directly quoted from http://dictionary.reference.com.

Human *activities* drive our society, and as human muscle and brain work is increasingly supplemented by automated processes, so do industrial activities. Most of these activities take place at specific facilities. A *facility* is something designed, built and installed to serve a specific function affording a convenience or service. Thus a facility permits the easier performance of an action, course of conduct, etc. Examples of facilities are houses for various uses, sports arenas, manifesting plants etc. In the use of the term here a facility has a fixed location given by its spatial coordinates relative to the infrastructure to which it belongs. *Infrastructure* is defined as the basic, underlying framework or features of a system or organization. It comprises the fundamental facilities and systems serving a country, city, or area, as transportation and communication systems, power grids.

To allow the specialised use of facilities exchange of goods and services between facilities is required. By *goods* is meant articles of trade; raw materials; components; finished products that are produced, transformed, stored, used or consumed at facilities. This exchange is provided by the transportation function. Characteristic of the last decades of development is that while transport volumes in tonnes have increased moderately, transport work has increased considerably more due to the globalization phenomenon. Less noted is that the average value of goods has increased due to proliferation by longer value added chains and an extreme increase in product variants of final products. This has typically hit the large cities where the last mile distribution means more frequent deliveries with smaller vehicles and smaller shipment sizes

The last component used in the general model is tool or movable resource, A *tool* is anything used as a means of accomplishing a task or purpose without being used up in. Economically it is seen as a movable resource involved in the value-adding process that needs to be separately identified. In SMARTFREIGHT a tool is explicitly limited to a vehicle for freight transportation, although a lot of other tools are involved, such as fork lift devices for loading and unloading.

Accordingly, SMARTFREIGHT defines infrastructure as the network of roads and streets, including freight terminals, parking space, loading bays etc. where freight vehicles under certain conditions are allowed to enter. Thus most facilities are themselves not seen as part of the infrastructure, but their location is. The location is the interface of infrastructure and facility. An important aspect is that a facility may have several locations or entrances, such as a freight terminal with several docks, or an industrial building where most parcels are expected to be delivered to the visitors' reception, while larger shipments are routed to a separate loading bay. A significant problem in many cities today is that the only publicly available address of a facility is its postal address, instead of exact coordinates for all entrances. Another well-known problem in cities is the opposite: the facility has in a strict sense no physical interface with the infrastructure for freight vehicles.

The four components facility, infrastructure, goods and vehicles form the conceptual systems model shown in Figure 1. Pairwise they form four subsystems which alternatively can be perceived as processes, technical systems, markets or planning objects depending on purpose, profession and perspective.

The left subsystem is by far the most difficult to name. For the purpose of SMARTFREIGHT we refer to this as business demand.

Business demand by nature is purely transactional and is driven by the laws of supply and demand. A given product X is available or can be produced in certain volumes in facility A. It is needed elsewhere, e.g. by facility B. The objective of the business demand process is on one hand to make sure that X is available at B whenever needed by sourcing it at A or some other facility C, D, E, etc, and on the other hand to make sure that the volumes of X produced by A be can distributed to B or some other facility F; G; H, etc,. The output of the business demand process is a set of orders for shipments of specific volumes of products X, Y, Z, etc. between certain pairs of facilities. In practise this order can vary from a simple booking of space onboard a vehicle similar to an Internet booking of an airline seat to a complex third party logistics contract that covers multiple shipments of similar goods as well as additional storage and administrative services. In the case transport on own account, which is still quite common, a the same planning stages are carried out, but no formal contract is needed.

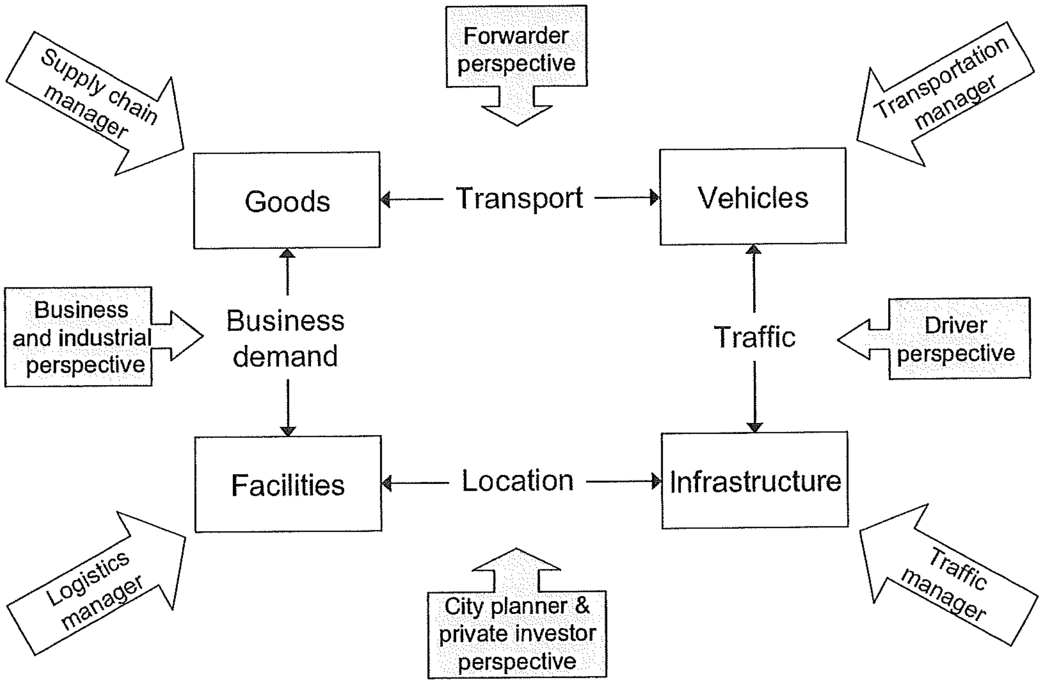


Figure 1. General conceptual model of a system for exchange of goods between facilities. Adapted from (Euro-CASE 1996), p. 74.

All orders for a specific time period can be illustrated in an origin-destination (OD) matrix with all facilities A, B, etc marked on both axis. The orders in one direction (A to B) are found above the empty diagonal, and the orders in the other direction (B to A) under the diagonal. An OD matrix can also be illustrated graphically and is then often referred as a virtual transport network.

The OD matrix represents the demand for transport. *Transport* means to carry, move, or convey something from one place to another. Thus transport focuses the change of address of the goods and is thus transactional by nature. In a narrow sense transport has only three states: the transport has not yet started, it has started but is not yet finished or it is finished. However, since it is logical to include the activity of loading and unloading in the concept of transport as well as the necessary planning, the number of possible states increases. The planning includes finding the right transportation mode and the right transportation company for each shipment, as well as booking space onboard the vehicle and establishing times of pickup and delivery. This was traditionally the role of the forwarder but is now increasingly called transport logistics. In this broader sense transportation overlaps with the business process

Once loading a vehicle has been finished, the vehicle changes its functionality from a transport unit to a traffic unit. From now on the vehicle and its load is a sealed entity. The lorry operator changes his role from someone administering or himself performing loading operations to a professional driver, who with his vehicle enters traffic. The dictionary says that traffic is the movement of vehicles, ships, persons, etc., in an area, along a street, through an air lane, over a water route, etc. but also that traffic is the vehicles, persons, etc., moving in an area, along a street, etc. For the purpose of the model the first definition is chosen, inferring that *traffic* is the interaction of vehicles or other traffic units with each other, with the infrastructure and with the environment (including pedestrians, built environment, natural environment).

Transportation is the sum of transport and traffic. Its ending indicates that it is a professional activity. Thus the dictionary proposes among other alternatives that *transportation* is the act of transporting; the state of being transported, the means of transport or conveyance; the business of conveying people, goods, etc.

The fourth interaction between facilities and infrastructure is of less relevance to SMARTFREIGHT and is not further commented here

Characteristic of the model is that each of the four components possesses a duality; they show different faces in the two directions. It has already been mentioned that a vehicle on one side is designed to possess all the technical functionalities that allow loading/unloading, supporting and safely enclosing the goods, and on the other all the functionalities to allow propelling, braking and steering the vehicle. The dualities of infrastructure and goods are shown in Figure 2.

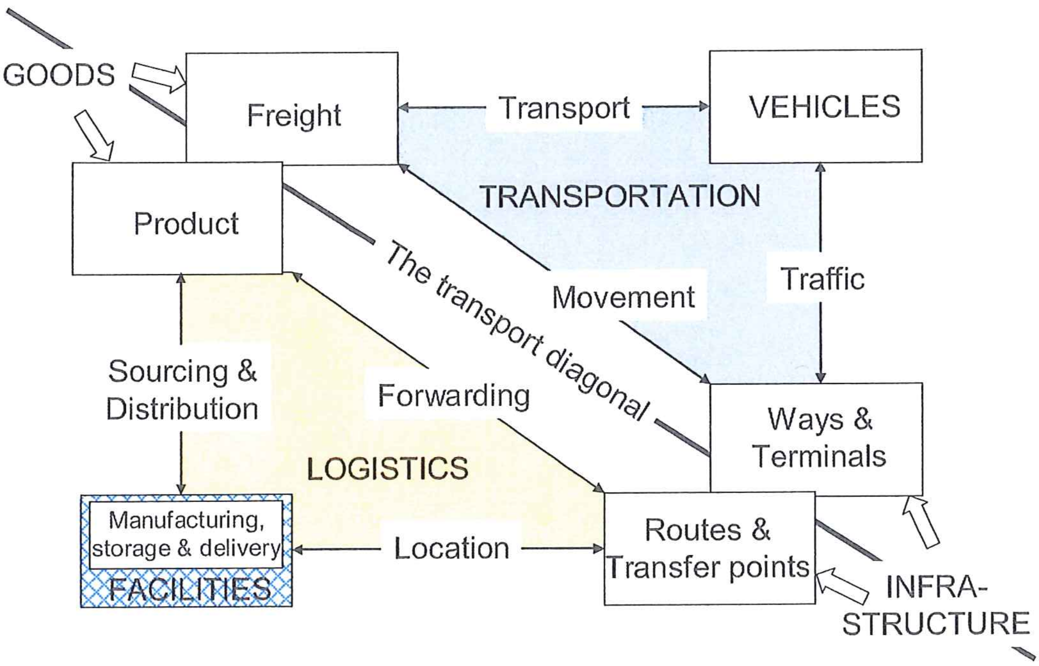


Figure 2. The interface between logistics and transportation and the dualities of goods and infrastructure. Adapted from (Sjöstedt 2005) p. 209

Some products in the logistics system located in A are needed in B and thus demand transport from A to B. Simultaneously some actors in the transportation system offers to transport freight from A to B. When a contract is signed, stipulating that a specific transportation company will carry out the transport, responsibility for the goods temporarily changes, implying that the perspective of the goods also changes from being a shipment of products to being freight. Similarly the infrastructure is perceived as a network of ways and terminals to be used by the vehicles in the transportation system, while it is primarily perceived as a set of locations for pickup and delivery by the logistics system.

The transportation diagonal marked in the figure refers to the different academic background of transportation and logistics, which for a long time has tended to act as a barrier and has slowed down the integration that has now become a hot issue. SMARTFREIGHT is well positioned to stimulate further progress here.

2. The transport diagonal

Today the word logistics is painted as a trade mark on an increasing number of trucks on our highways. It gives the impression that transportation and logistics are almost non-distinguishable. But this is a false picture. It takes a long time to shape professions and disciplines and the roots of transportation and logistics are very different. This is illustrated in In post World War II development scientific efforts in transportation and logistics largely originated in operations analysis as researchers and planners migrated from the military to the civilian sector. But the foci were very different; transportation researchers took primarily an interest in providing infrastructure for the quickly expanding traffic on highway, with emphasis on traffic theory and traffic forecasting methodologies, while logistics researchers concentrated on the administrative routines and technology required to improve the flow of materials through a production facility from its warehouse for purchased materials through its manufacturing operations to its stock-rooms for finished goods. Here, emphasis was on materials handling and production economics External goods transportation was still something that was called upon, ad hoc, when needed.

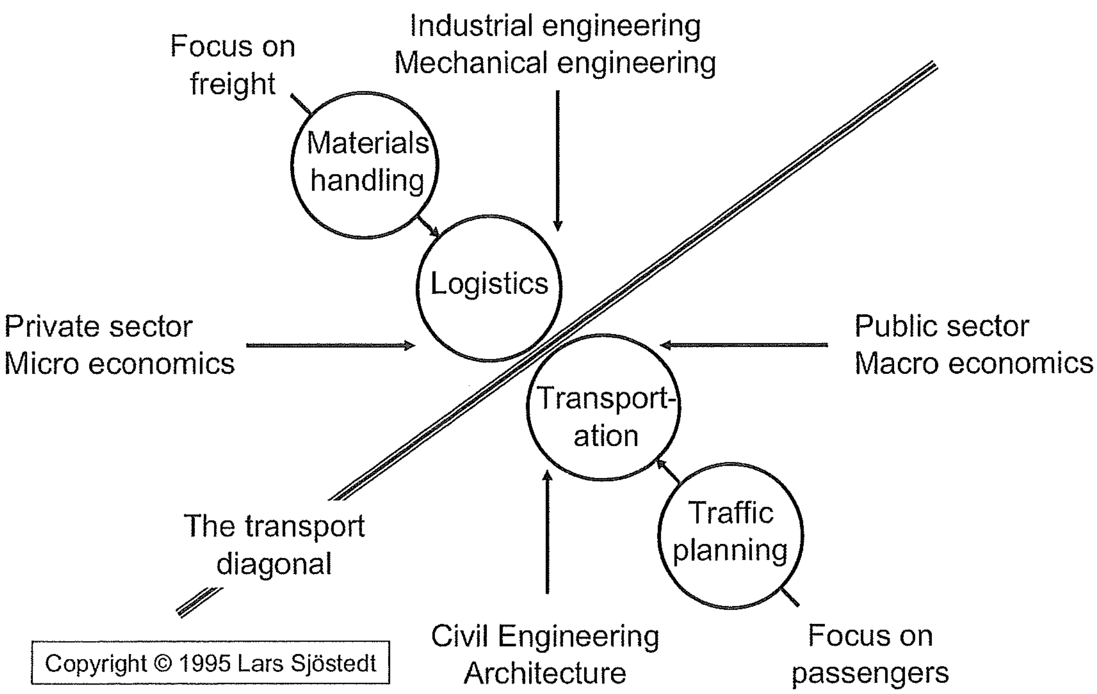


Figure 3. The transport diagonal separating transportation and logistics. Source: (Sjöstedt 2005), p.200

These early developments can still be traced in the structure of our universities. Most academically trained people have their background in at most one of the two sides of the transport diagonal in Figure 3. Courses taught in civil engineering and architecture at technical universities mostly dwell on transport with emphasis on passenger transport and public sector of our society, while courses in mechanical and industrial engineering give priority to logistics and emphasise goods transportation and the private sector of our society. This reflects that logistics and transportation grew out of materials handling and traffic planning, respectively, and thus as academic subjects used to be vastly separated.

In business schools the transport diagonal is less visible, although it could be argued that passenger transportation and the public sector tends to be closer to a macro economy perspective, while logistics and the private sector are closer to a micro economy perspective.

As already mentioned the transport diagonal is now rapidly disappearing as supply chain mangers and traffic planners realise that they share the ultimate goal of the business demand system of facilitating accessibility and mobility without impairing sustainability. This is the end result of a long process over several decades of successive broadening of their interests, respectively. Already in the seventies traffic planners moved from an interest to provide infrastructure capacity, i.e. cater for traffic, to an interest in understanding the needs and providing the means to move from specific origins to specific destinations, i.e. cater for transport. At the time organisations and research bodies in many countries switched from using the word traffic in their names to the word transport or transportation. The next step is reflected by the more recent launching of concepts such as mobility management, which confirms the reorientation of traffic planning from operational issues towards administrative and strategic issues. At the same time interest in goods transportation, which used to be the step child in transportation research, has increased substantially.

Since this broadening of interests is closely related to progress in the use of ICT, the findings are relevant to SMARTFREIGHT

3. Some lessons from the series of OECD studies on global logistics

The main role of traffic planners is to advise public policy makers and to carry out the preparatory work needed to suggest new institutions and regulations in the field of transportation both at the national and community levels. As a supranational organisation OECD early identified the need to increase knowledge in the public sector of their member countries about logistics development, especially as a consequence and facilitator of global trade. As a result two consecutive projects were initiated and finished in the nineties as part of the OECD Road Transport Research Programme (OECD, 1992 and OECD, 1996). A dominant finding was that logistics practises already then were well developed by most large multinational companies and applied in a rather similar fashion in many countries. Thus no significant barriers seem to prevent introduction of advanced logistics by technology transfer to an environment with no or little experience in the field. Another observation is that while logistics practises seem to be rather similar among large companies in a specific industrial sector, they differ a lot among different industrial sectors. The main explanation is the large differences from a logistics point of view in handling, at one end of the spectrum homogeneous raw materials with a value density that counts in dollars per ton, and at the other end of the spectrum high tech specialised customer made components with a value density measured in dollars per microgram. This may also explains that the knowledge level about logistics at the public policy level varies greatly among different nations and among different administrations within the same country.

Thus logistics competence outside universities seemed to be a result of activities of multinational companies, and was almost totally lacking as a domain of public policy. A notable exception was Singapore, the only country that at the time had a national logistics plan. A show case that logistics competence can be developed very fast in the public domain is Taiwan, which in less than ten years has developed a role as a logistics hub for global trade that offers Hong Kong and Singapore serious competition.

The OECD studies noted that few attempts had been made to compare in a rigorous way the different perspectives on goods related transport policy that for historical reasons have developed in Europe, North America and elsewhere. One reason, of course, is that this is not an easy task. As a result of the fast globalisation process in trade and tourism, there is a need for an improved understanding of these differences as a basis for harmonising procedures and elimination of barriers. In addition a new need has arisen: The growing role of logistics in smoothing global trade flows has created a need to provide and harmonise public and industrial logistics policies at all levels i.e. locally as well as nationally and internationally.

These observations prompted OECD to launch a third project with the goal to compare logistics development in the Asian-Pacific, European and North-American regions. The Trilateral Logistics (TRILOG) project (OECD, 2002) started up in 1996 but soon ran into difficulties. These were partly administrative and financial but in the end of methodological character. The main problem was the absence of relevant data. Because few governments had felt the need to establish national logistics policy, there had been no systematic collection of data to support the formulation of such policies. Thus, when the final plenary report (OECD, 2002) was compiled, its focus had shifted to looking at common elements rather than for differences among the regions. This is also reflected by its title: "Transport Logistics: Shared Solutions to Common Challenges"

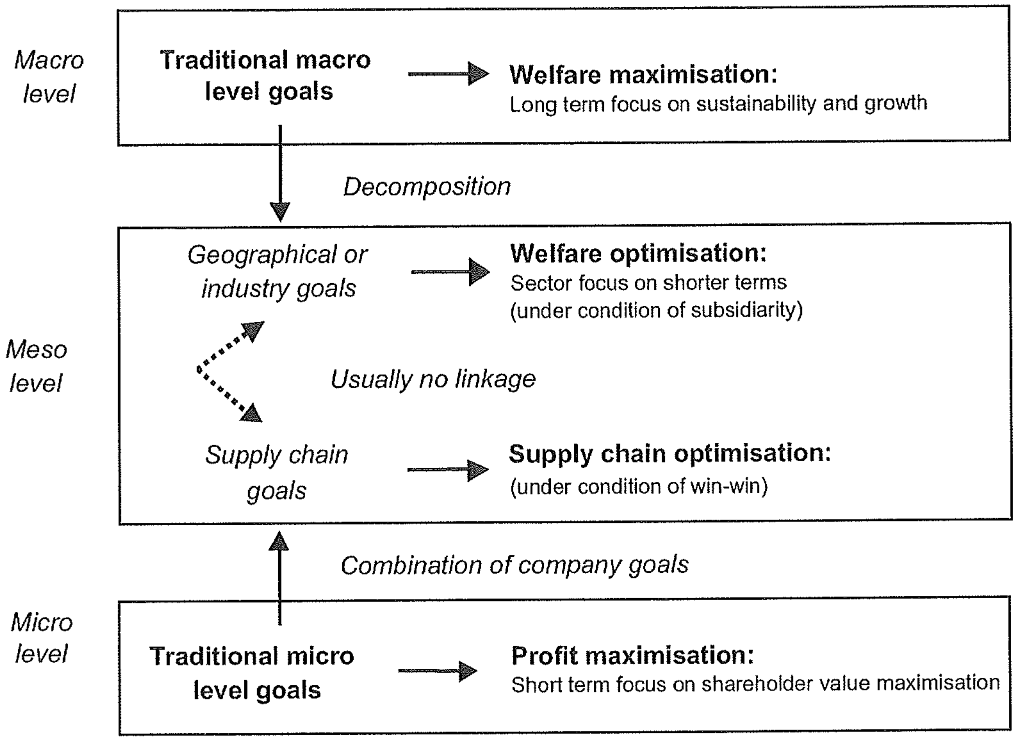


Figure 4. Illustration of the shortcomings in trying to bridge the gap between the macro and micro when measuring the performance of a supply chain. Source: (Demkes et al., 1999), p.6

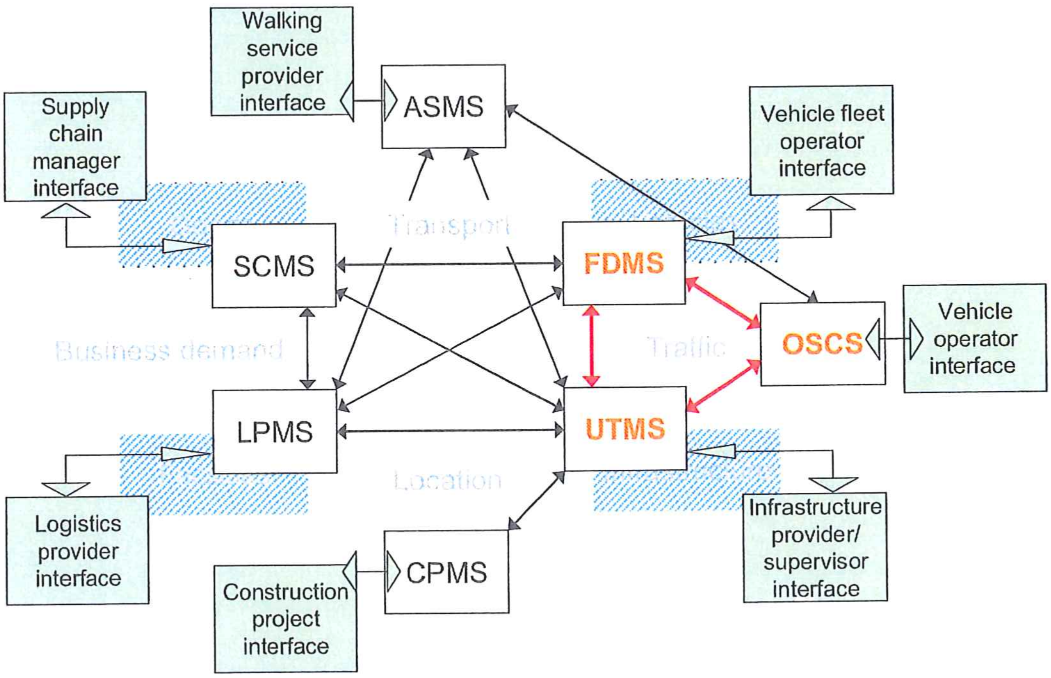
As part of the TRILOG study an attempt was made to find useful indicators of the performance of supply chains. The results were meagre, primarily because of a lack of data. The supply chain seems to fall half way between the traditional macro level on which national statistics in all countries are based, and the traditional micro level on which annual report from individual companies are based. This dilemma is illustrated in Figure 4. Traditionally macro level goals are aimed at maximising welfare while micro level goals reflect the ambition of industry to maximise profits. To a certain extent the indicators formed to measure welfare and profits can be extended to industrial sectors and supply chain, respectively, but there is still a poor understanding of methods and data needs to handle the meso level and establish links between short term welfare optimisation in different industrial sectors and supply chain optimisation under conditions of win-win.

4. Some conclusions for SMARTFREIGHT

Now, what relevance for SMARTFREIGHT has these OECD studies that focus on the national and global perspectives? As already said the findings are in principle equally valid for the community level, but to our knowledge there are no or few studies that have attempted a similar broad approach. There has certainly been a wide-spread interest and initiatives at the local and regional levels for more than 10 years. A large number of projects and demonstrations of a short term nature has been carried out, but there are yet few examples of long term policies and implemented plans of a generic character for city logistics and urban freight. This may to some extent be explained by the existence of the transport diagonal and the fact that also urban freight distribution is an activity at the meso level. But it can also be explained by the sheer complexity of urban freight. Table 1 is an attempt to illustrate this complexity by means of market segmentation.

Table 1. Freight transport in urban areas – a segmentation

- FTL transport with a heavy lorry from the outside of the urban area to a consolidation terminal, harbour, production company, warehouse etc. Typical example: loaded 40' sea container or semitrailer
- Ditto in the opposite direction
- Ditto between two terminals or industrial facilities within the urban area
- Distribution of general cargo with a light truck or van from a consolidation terminal for delivery to a number of addresses, mostly companies
- Ditto collection round in the opposite direction
- Dangerous goods transports from or to industrial facilities from or to the outside of the urban area.
- Distribution of parcels mostly to a number of offices and private homes from a consolidation terminal.
- Ditto in the opposite direction
- Courier transport of parcels directly beween two addresses in the urban area.
- Various types of transports to and from construction sites
- Transport of tools, spare parts and consumables with a pickup or van by all kinds of craftsmen and service producers with walking activities
- Etc.



FDMS=Freight Distribution MS
UTMS=Urban Traffic MS
LPMS= Logistics Provisions MS
OSCS=Operator Support & Control System
ASMS=Ambulant Service MS
SCMS=Supply chain MS
CPMS=Construction Project MS
MS=Management System
Red colour (bold print) indicates the focus of SMARTFREIGHT

Figure 5. A few of many management systems related to urban transport, all supported by their own IT system

As a result we see in the large cities an enormous number of management systems, that all are related to urban freight, where the different transport systems are not at all or very loosely co-ordinated while they all compete for the same street space in the traffic system. This is illustrated in Figure 5, where the different management systems are superimposed on the conceptual model as an indication of their focus and perspective.

The conclusion is that communities will have a difficult learning process in order to understand how to best market the added functionalities that are offered by SMARTFREIGHT. We think that this is best achieved if the communities set up a specific agency called the Freight

Transport Service & Control Centre (FTSCC). This centre will work with a marketing approach at the tactical level, which means they will also keep records about their customers like any other business undertaking. This means they will need to keep a register of those vehicles and their owners that enjoy the extended functionalities offered. The FTSCC of course maintains a close contact with urban traffic control centre (UTCC) that produces most of the services that are tailored by the FTSCC. As a consequence we find it necessary to split the box "Freight distribution management for city centre", which is part of the overall SMARTFREIGHT concept (Figure 1, page 11 in Technical Annex.doc) in two parts, where one is the FTSCC, representing the supplier of SMARTFREIGHT value added services and led by a transport supervisor, and the other the VFDC or Vehicle Feet Dispatching Centre, representing the consumer of these services. A VFDC can in size be anything from a personal computer on a desk in the home of a small company owned by the driver of the single distribution vehicle, which is the main asset of the company, to a large office, instrumented to track a whole fleet of vehicles on graphic screens. The VFDC can also be the control centre of a specially founded non-profit company set up – possibly with joint ownership by a community and the transport industry or other private stakeholders- in order to handle the last mile distribution problem in a city centre through a monopoly type of operation.

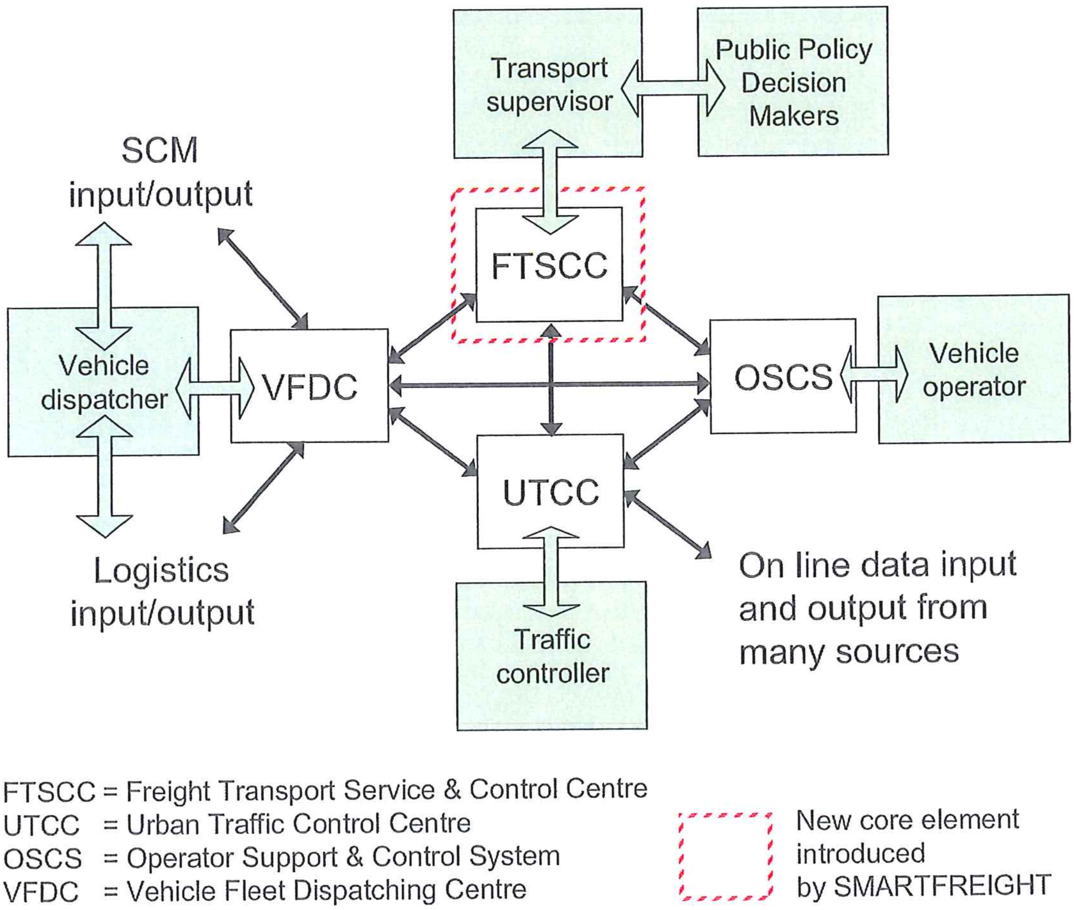


Figure 6. The SMARTFREIGHT core system and its key actors

Now at this stage we want to repeat some of the fundamental principles on which the 'SMARTFREIGHT paradigm' rests:

- The use of road infrastructure is in today's crowded cities not a public good; it is the allocation of specific slots in space and time to specific vehicles, very much the same as an aeroplane needs start and landing slots or a train needs a moving block along the rail, which the Automatic Traffic Control (ATC) system guarantees is not occupied by other vehicles.
- The use of infrastructure is not necessarily free. Priority and price of being allocated a desired slot depends on environmental and other social costs in relation to the benefits.
- A vehicle is no more an anonymous unit in the flow of traffic; its represents an identified customer, whose desired service profile and willingness to pay is known beforehand.
- The city needs a freight transport service centre[1] that handles all planning and administrative contacts with the customers and thus supplements the traffic control centres that are designed and equipped to handle operational traffic issues.
- The customer is in SMARTFREIGHT represented by the vehicle fleet dispatching centre. This could vary in size from a PC on a desk in a private home to a full fledged control centre with capacity to monitor movements of individual vehicles on graphic screens.

Figure 6 shows the resulting modifications of figure 5. The system depicted will be referred to as the SMARTFREIGHT core system. It highlights the four centres involved in planning and executing SMARTFREIGHT functions and the information flows between these centres. For simplicity all information between the customer and the urban freight distribution control centre is assumed to be routed through the customer's vehicle fleet dispatching centre. This section will be expanded in report IR 6-2.

5. Planned activities at the sites

The extended functionalities of the transport and traffic management systems and the services offered to the driver, as specified by the objectives of SMARTFREIGHT, are found in Table 2. The functionalities that each test site has accepted to study by means of technical demonstrations, simulation or desk top studies is also shown

Table 2. Functions explored by site activities

		Dublin	Winchester	Bologna	Trondheim
	Extended traffic management functionality				
A1	Traffic control depending on service level		□	(□)	■
A2	Conditional route assignment, including green areas		■	■	■
A3	Tracking of dangerous goods				■
A4	Incident management support				
A5	Data collection for statistics and planning	■	(■)	■	■
A6	Enforcement				■
A7	Provision of traffic data to freight distribution management systems	■	□	■	■
	Extended freight distribution management functionality				
B1	New data exchange with the traffic management system	■	(□)	(□)	■
B2	Return load coordination		■		
B3	Shared use of vehicle coordination		■		
B4	Planned use of loading/unloading	■	■	■	
B5	Load unit tracking and monitoring				■

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[1] The city may – like Barcelona also decide to provide mandatory service of a third party logistics provider character. This is as such beyond the scope of SMARTFREIGHT, although the use of SMARTFREIGHT functionalities is relevant in such a context.

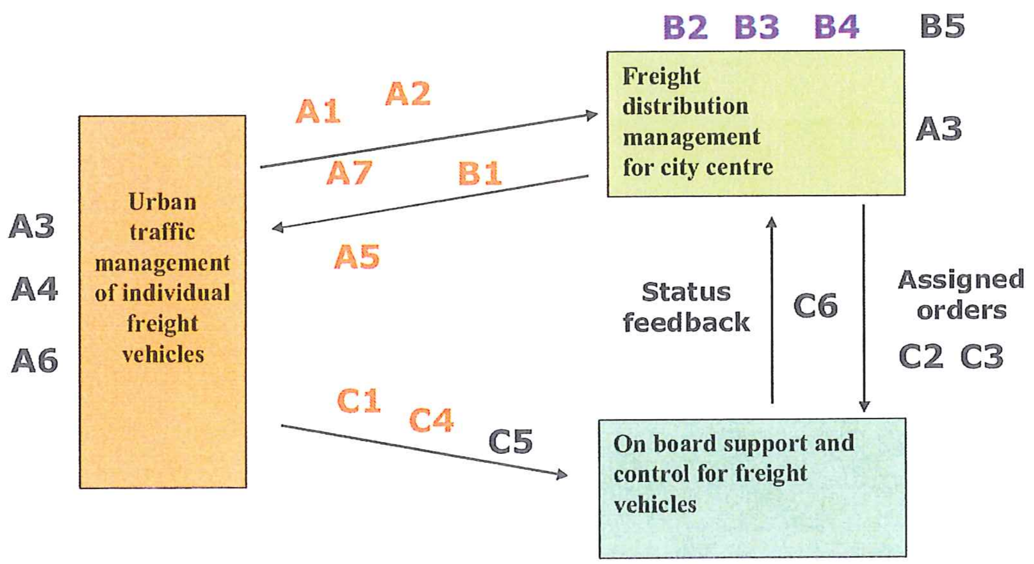
	Onboard support and control functionality				
C1	Routing support				■
C2	Service level	■			■
C3	Transport operation planning support				
C4	Timeslot allocation for loading/unloading	■	□	■	■
C5	Load/unload tracking + status information				■
C6	Efficient communication with distribution centre				■

■ As specified in Annex I Part B in the contract

□ Suggested by the European Reference Group

(■) and (□) Requested by test site to be omitted, either because they are not part of local plans, or because they are not suitable to be studied by simulation techniques, or both.

The way the systems interact in producing these functionalities is illustrated graphically in Figure 7.



Red – simulations Blue – simulation (Winchester only)

Figure 7. Relationship between functionalities

A template for describing the activities at all test sites in more detail has been developed and used for data collection. It uses the following headings: *General description of functionalities, Links to other functionalities, Use cases, Stakeholder interests –authorities, Stake holder interests – transport industry, Stakeholder interests – others, Key performance indicators, Test set-up (planned).* Dublin, Trondheim and Winchester have filled out the template for each of the relevant functionalities. These data have been compiled in a joint document that is appended to this report (Appendix 1. SMARTFREIGHT WP6 Function descriptions – Draft version).

The work on local scenarios in WP 6.2 and preparation of test sites has so far resulted in the documents in Table 3. They are all directly accessible through the E-room by clicking on the desired document.

Table 3. Documents on task 6.1 in the E-room

SMARTFREIGHT Demo Bologna.doc	22 oct 08	09:29	Fabio Cartolano	4358 k
SMARTFREIGHT Demo Dublin_draft.doc	8 nov 08	16:53	John Keyes	11879 k
SMARTFREIGHT Demo Trondheim.doc	21 oct 08	09:44	Eirik Skjetne	3813 k
SMARTFREIGHT Functions Description_Dublin.doc	29 oct 08	17:21	John Keyes	470 k
SMARTFREIGHT Functions Description_Template.doc	23 oct 08	15:17	Solveig Meland	712 k
SMARTFREIGHT Functions Description_Trondheim_081029.doc	29 oct 08	14:36	Solveig Meland	656 k
SMARTFREIGHT Functions Description_Winchester.doc	28 oct 08	18:47	Fraser N. McLeod	552 k
SMARTFREIGHT WP6_20080122.ppt	28 jan 08	11:37	Stig Franzén	226 k
ToC for IR6.1.doc	22 oct 08	13:30	Marit K Natvig	27 k
Trondheim	22 oct 08	10:16	Marit K Natvig	3 items
Workshop in Trondheim October 2008	21 oct 08	09:04	Hans Westerheim	3 items
A1_Trondheim.doc	22 oct 08	12:02	Marit K Natvig	40 k
Functionality.doc	22 oct 08	12:03	Marit K Natvig	222 k
Scenrio.doc	22 oct 08	12:02	Marit K Natvig	26 k
Demo-Trondheim-okt08.ppt	23 oct 08	15:56	Eirik Skjetne	2269 k
MoM-Smartfreight 20081021_22.doc	27 oct 08	12:36	Hans Westerheim	865 k
Netlab_Update_20_Oct_08.ppt	24 oct 08	09:43	Runar Søråsen	1589 k

In addition the following PowerPoint presentations are available:

- Winchester Simulation
- Test site: Winchester, UK
- The Trondheim test site
- Policy pricing and freight distribution. Project Smartfreight: Bologna test site overview

6. Introduction of the concepts composite function and functional modules

An analysis of the SMARTFREIGHT extended functionalities in Table 2 and Figure 7 shows that these are rather heterogeneous. Some are basic to the idea of SMARTFREIGHT, such as allocating service levels in a flexible way to specific non-anonymous freight vehicles in the traffic flow. Some are rather complex, others rather straight forward. Some relate strongly to each other, others are independent. Some relate to the traffic process and are thus strongly dynamic by character; we call those *operational functionalities*. Some relate to the transport process and are thus transactional by nature, such as allocating a specific service level to a loaded freight vehicle; we call those *tactical functionalities*. Finally there are functionalities that more or less explicitly include the business demand process, such as C3 Transport operation planning support; we call those *strategic functionalities*.

It can be argued that strategic functionalities are beyond the scope of SMARTFREIGHT. It is thus not surprising that C3 is neither mentioned in the list of test site activities in the contract, nor in the proposed additions to this list by the European reference group. This attitude might have been relevant, if the scope had been limited to demonstrations of the technical features of the SMARTFEIGHT information technology. But we are also carrying out simulations and desktop studies of SMARTFREIGHT technology in the context of its use in physical transportation. Therefore it is necessary to include the strategic level at least conceptually to the extent that it is possible to specify parameters of use cases.

As a result of this analysis the idea was born to decompose functionalities into *functional modules*. A functional module – from now on for simplicity called *function* - uniquely belongs to one of the categories operational, tactic and strategic functions. A function can be combined in a number of ways with one or other functions to form a *composite function* able to provide a system with a specific desired functionality.

A single function can of course in some situations offer sufficient functionality alone, but usually requires to be split up in strategic, tactical and operational functions. It may be argued that in the context of local applications, some of the strategic and tactical functions have the character of activities that are carried out once and thus are not true functions. Our opinion is that at the generic level these activities should be treated as planning functions that need to be formalised and standardised in the same way as "true" functions. We have therefore kept the concept "function" throughout.

Table 4. Subdivision of the functionalities in Table 2 into modular functions

Func-tional group	Strategic functions – level of policy makers	Tactical functions – level of vehicle dispatcher and transport supervisor	Operational functions – level of traffic controller and vehicle operator
1	1. Define the generic service level concept (**C2**) 2. Implement local practise (**A1**)	3. Establish static service level criteria for specific vehicles classes (static) (**C2**) including one or several classes for dangerous goods (**A3**) 4. Establish a register over vehicles having applied for service level classification 5. Establish dynamic service level criteria for relevant classes in terms of load factor, type of freight, pollution category etc. (**A2**) 6. Establish enforcement rules for all vehicles (**A6**) 7. Provide static routing support when legitimately requested **(A2), (C1)** 8. Prepare agreement about which traffic data should be provided for a specific customer **(A7)**	9. Install equipment for identifying all vehicles and/or communicating with SMARTFREIGHT vehicles at specific locations (**A1**) 10. Give priority to SMART-FREIGHT vehicles at traffic signals where and when appropriate **(A1)** 11. Allow SMARTFREIGHT vehicles to use reserved lanes where and when appropriate **(A1)** 12. Report vehicles that violate service level privileges by being at a detection location at the wrong time **(A6)** 13. Track dangerous goods **(A3)** 14. Provide dynamic routing support when legitimately requested **(A2)**, (**C1**) 15. Provide traffic data to freight distribution management systems **(A7)**
2	1. Define and equip docking sites (**B4**) requiring special permits for use at 2. loading/unloading docks 3. reserved parking space for waiting or e.g. lunch breaks 4. stops on radial roads for approaching vehicles wanting to register for service level allocation	5. Establish rules for access rights and priority between vehicle classes for docks (**B4**) 6. Allocate static time slots at docks (**C4**)	7. Allocate time slots dynamically at docks (**C4**) 8. Track loading/unloading + give status information (**C5**) 9. Supervise use of reserved docks/parking space and report violations (**A6**)

3		1. Develop relevant plan for incident management (**A4**)	Perform incident management (**A4**) and 2. report relevant info to each active vehicle with an active service class; 3. perform dynamic updates of the services offered in **A1**, **A7**, **C1**, **C4**, **C5** and **C6**
4	1. Specify needs of data for statistics & planning (**A5**)	2. Specify system for collecting data for statistics & planning (**A5**)	3. Implement system for collecting data for statistics & planning (**A5**)
5	1. Specify new data to be exchanged with the traffic management system (**B1**)	2. Specify how and when data should be exchanged (**B1**)	3. Verify the functionality of new data exchange by simulation or real tests (**B1**)
6	1. Identify potential of return load coordination (**B2**)	2. Identify companies willing to participate in a test and specify freight and vehicles involved (**B2**)	3. Perform simulation or real test (**B2**), while – if possible – simultaneously testing **A1**, **A7**, **C1**, **C4**, **C5** and/or **C6**
7	1. Identify potential of shared use of vehicle coordination (**B3**)	2. Identify companies willing to participate in a test and specify freight and vehicles involved (**B3**)	3. Perform simulation or real test (**B3**), while – if possible – simultaneously testing **A1**, **A7**, **C1**, **C4**, **C5** and/or **C6**
8		1. Instrument a load unit and a truck with SMARTFREIGHT technology (**B5**)	2. Demonstrate viability of load unit tracking and monitoring by practical test (**B5**)
9	1. Identify potential for use of SMARTFREIGHT for transport operation planning support (**C3**)		
10		1. Identify demands for volumes and speeds needed for efficient communication between FDCC and UTCC (**C6**)	2. Demonstrate the capacity of SMARTFREIGHT technology to meet this demand(**C6**)

Table 4 shows a preliminary subdivision of the functionalities in Table 2 into basic functions. The functions are classified as strategic, tactical or operational along the horizontal axis and as belonging to one of ten functional groups along the vertical axis.

A functional group consists of all functions that are generically related. Two basic functions are generically related when they both support a specific main management issue. Thus functional group 1 addresses the issue of dynamic allocation of road space to moving vehicles, while group 2 addresses allocation of road space to stationary vehicles. These are the two dominating groups. Group 3 concerns incident management and the rest concerns some more specific management issues

Table 5 show which of basic functions in Table 4 that support the original functions listed in Table 2. It should be noted that functions 1.1-1-5 and 1.9 are core functions that may be assumed to be in place in parallel to all other functions, although this neither explicitly mentioned in Table 4 nor in Table 5.

Table 5. Specification of functions relevant to the functional objectives of SMARTFREIGHT

		Strategic functions	Tactical functions	Operational functions
Extended traffic management functionality				
A1	Traffic control depending on service level	1.2	-	1.9-12, (3.3, 6.3, 7.3)
A2	Conditional route assignment, including green areas	-	1.5, 1.7	1.14
A3	Tracking of dangerous goods	-	1.3	1.13
A4	Incident management support	-	3.1	3.2-3
A5	Data collection for statistics and planning	4.1	4.2	4.3
A6	Enforcement	-	(1.6)	1.12
A7	Provision of traffic data to freight distribution management systems	-	1.8	1.15, (3.3, 6.3, 7.3)
Extended freight distribution management functionality				
B1	New data exchange with the traffic management system	5.1	5.2	5.3
B2	Return load coordination	6.1	6.2	6.3
B3	Shared use of vehicle coordination	7.1	7.2	7.3
B4	Planned use of loading/unloading area	2.1	2.5	-
B5	Load unit tracking and monitoring	-	8.1	8.2
Onboard support and control functionality				
C1	Routing support	-	1.7	1.12, (3.3, 6.3, 7.3)
C2	Service level	1.1	1.3	-
C3	Transport operation planning support	-	9.1	-
C4	Timeslot allocation for loading/unloading	-	2.6	2.7, (3.3, 6.3, 7.3)
C5	Load/unload tracking + status information	-	-	2.8, (3.3, 6.3, 7.3)
C6	Efficient communication with distribution centre	-	10.1	10.2, (3.3, 6.3, 7.3)

7. Local scenarios

Task 6.2 in Technical Annex.doc requires every site to develop scenarios with two time horizons (now and near future). The fist constitutes a base line scenario, while the near future scenario addresses situations when certain of those new concepts (and services) have been locally introduced that are technically demonstrated, simulated or evaluated through desk top studies within the project.

A brief description of a scenario was presented by TRG at the ERG meeting in Barcelona. It is reproduced in Figure 8.

An example of a hypothetical building stone in a local scenario is given here. It is inspired by the recent paper by Fraser McLeod and Tom Cherett entitled: Modelling the impacts of shared freight – public transport in urban centres. The description is longer and more detailed than needed when section 7 is completed and codes for standardised basic services can be used.

City X sets up an FTSCC. Its first task is to create a scheme for freight vehicle service level classification, which is also approved of politically.

In the next stage FTSCC participates in introducing a combined bus and freight vehicle reserved lane on one side of a 2+2 lane street in the central business district. The last part of the reserved lane is a bus stop and immediately beyond there is an area serving as a dock for unloading and loading freight vehicles.

Buses and all freight vehicles that have registered with the FTSCC are allowed to use the reserved lane. A condition for registration is that the vehicles are fitted with communication equipment that meets SMARTFREIGHT standards. The unloading/loading dock may only be used by vehicles having a sufficiently high service level and have a booking for this purpose. Bookings can be made for a single visit or on a repetitive basis for a longer period.

Scenario
Use of shared loading bays

Description
The FDMS manager will guide freight and service vehicles into the urban centre. With knowledge of the vehicle size, delivery schedule, cargo handling requirements, the FDMS manager would allot unloading bay space according to these characteristics to best utilize the infrastructure available and minimize disruption to the general traffic flow.

Specific Hypotheses
1. Managed loading bays significantly reduce the impacts of freight vehicles in terms of mean journey/activity times (entry/find bay/unload/exit) compared to the current situation
2. Managed loading bays significantly reduce the instance of traffic violations related to freight vehicles
3. Managed loading bays significantly reduce the journey times of other road users
4. Where managed loading bays are shared space with a public transport system, the system does not a) increase mean waiting times at stops b) negatively impact on bus punctuality schedules (% of buses on time) c)increase general congestion around bus stops

Specific KPI's
- Mean journey-activity times of freight vehicles (entry/find bay/unload/exit) compared to current case
- Mean dwell time of freight vehicles compared to current case
- % of buses 'on time' at stops compared to current case
- Mean number of freight related traffic violations/week compared to current case

Figure 8 A B4 scenario example presented by TRG/Southampton (for Winchester)

The required service class varies with time of day, length of the time window and stop time. The time window is the time between the earliest arrival time and the latest departure time. The stop time is maximum time the vehicle is allowed to stay at the dock. There is also a fourth parameter called buffer time. This is the minimum time between two time windows. It is a system parameter that may also vary with time of day. It serves to stabilise the system at high traffic loads and give any queues that have formed during the stop of the vehicle time to dissolve.

In the first phase static service level classification will be used. In a later phase a fully dynamic classification, which includes e.g. load factor, value of load, volume and/or value of loaded/unloaded freight, will be used.

There are two roadside communications units fulfilling SMARTFREIGHT standards installed. One is in the middle of the reserved lane and has a presence detector attached to it. It serves to report any illegal use of the lane, which requires that all buses that use the lane also have SMARTFREIGHT compatible communication devices. Since most illegal users lack the communication equipment they will remain anonymous, but the police may have there own portable SMARTFREIGHT compatible device to simplify enforcement on site. This roadside device also offers the last possibility to make a booking for the dock. The second device monitors the use of the dock. Illegal use of the dock is regarded as a no stopping violation and reported to the local parking supervisor. Normal use of the dock is reported for statistical purposes.

The critical task for the FTSCC is to set the parameters of the use of the dock in such a way that the negative impact on the local traffic situation is tolerable. To this end precise traffic measurements with separation of vehicle types are carried out. They are used as basis for detailed simulations of different scenarios of total delay, maximum individual delay and other parameters that serve as a measure of the traffic service level offered to anonymous users.

In this scenario the outcome of these studies result in the following decisions of the FTSCC:

- The time window 7:00-7:20 with a stop time of 12 minutes is offered to a.distribution vehicle delivering fresh bread every day Monday-Saturday
- The next bookable time window is 8:00-8:20 with a stop time of 15 minutes
- Etc.

Normal use of the docking service including booking is free. For a vehicle that has a valid booking but either arrives too early, leaves too late or stays too long a service violation fee of 0,50 € per minute is automatically debited. A no show fee of 5 € is also automatically debited.

The scenario just completed is moderately complex. Using the number codes in Table 4 the designation of the composite function that can provide full functionality to the system in phase 1 is (1.1+1.2+1.3+1.4+1.9+1.12+1.15+2.1+2.2+2.5+2.8+2.9). To obtain the number code for phase 2 function 1.5 has to be added to the string of numbers. In Figure 9 the basic functions that are involved are enclosed by frames.

Functional group	Strategic functions – level of policy makers	Tactical functions – level of vehicle dispatcher and transport supervisor	Operational functions – level of traffic controller and vehicle operator
1	1. Define the generic service level concept **(C2)** 2. Implement local practise **(A1)**	3. Establish static service level criteria for specific vehicles classes (static) **(C2)** including one or several classes for dangerous goods **(A3)** 4. Establish a register over vehicles having applied for service level classification 5. Establish dynamic service level criteria for relevant classes in terms of load factor, type of freight etc. **(A2)** 6. Establish enforcement rules for all vehicles **(A6)** 7. Provide static routing support when legitimately requested **(A2)**, **(C1)** 8. Prepare agreement about which traffic data should be provided for a specific customer **(A7)**	9. Install equipment for identifying all vehicles and/or communicating with SMARTFREIGHT vehicles at specific locations **(A1)** 10. Give priority to SMART-FREIGHT vehicles at traffic signals where and when appropriate **(A1)** 11. Allow SMARTFREIGHT vehicles to use reserved lanes where and when appropriate **(A1)** 12. Report vehicles that violate service level privileges by being at a detection location at the wrong time **(A6)** 13. Track dangerous goods **(A3)** 14. Provide dynamic routing support when legitimately requested **(A2)**, **(C1)** 15. Provide traffic data to freight distribution management systems **(A7)**
2	1. Define and equip docking sites **(B4)** requiring special permits for use at 2. loading/unloading docks 3. reserved parking space for waiting or e.g. lunch brakes 4. stops on radial roads for approaching vehicles wanting to register for service level allocation	5. Establish rules for access rights and priority between vehicle classes for docks **(B4)** 6. Allocate static time slots at docks **(C4)**	7. Allocate time slots dynamically at docks **(C4)** 8. Track loading/unloading + give status information **(C5)** 9. Supervise use of reserved docks/parking space and report violations **(A6)**

Figure 9. Illustration showing the basic functions that are employed in the scenario

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APPENDIX 1

Please note that in this document the terms function and functionality are used as synonyms. This conflicts with the main text of this report where these two terms are not identical.

SMARTFREIGHT WP6 Function descriptions
Draft version

The following definitions are used:

Function

- implementation of a set of rules to achieve a specified goal
- unambiguously defined partial behaviour of one or more electronic control units.

System

- a combination of hardware and software enabling one or more functions
- set of elements (at least sensor, controller, and actuator) in relation with each other according to design:
  - An element of a system can be another system at the same time. Then, it is called a subsystem which can be a controlling or controlled system or which can contain hardware, software and manual operations

Use Case

- target condition in which a system is expected to behave according to a specified function

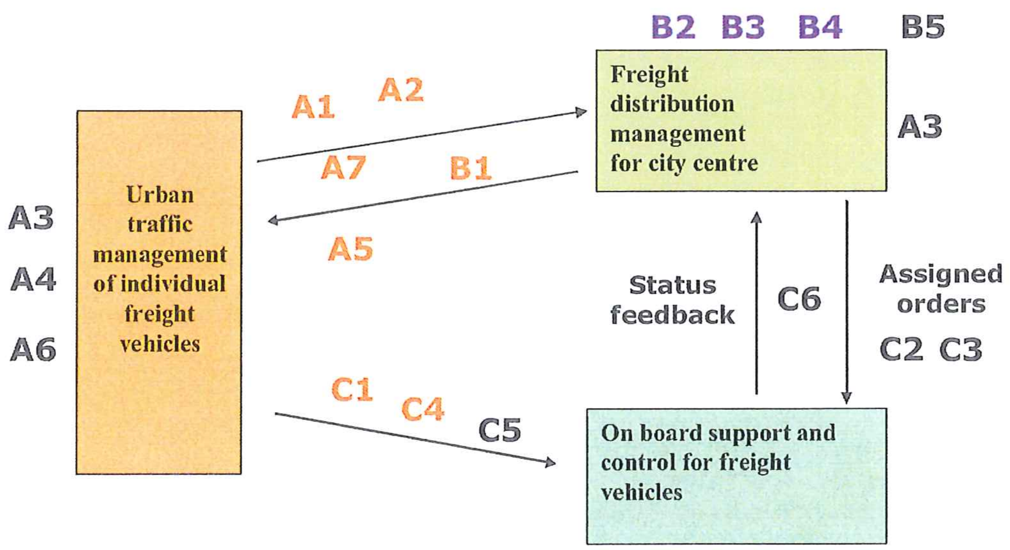
Situation

- a combination of certain characteristics of a use case. Situations can be derived from use cases compiling a reasonable permutation of the use cases characteristics (cp. SMARTFREIGHT Deliverable D2.2, page 49)

Scenario

- a use case in a specific situation

In order to identify the relationships between the functions to be addressed in the SMARTFREIGHT project, the following figure provides the answer:



Red – simulations Blue – simulation (Winchester only)

A table of functions per test site has been produced based on the DoW test and modifications proposed by the ERG

Extended traffic management functionality					
		Dublin	Winchester	Bologna	Trondheim
A1	Traffic control depending on service level		X	X	X
A2	Conditional route assignment, including green areas		X	X	X
A3	Tracking of dangerous goods				X
A4	Incident management support				
A5	Data collection for statistics and planning	X	X	X	X
A6	Enforcement				X
A7	Provision of traffic data to freight distribution management systems	X	X	X	X
Extended freight distribution management functionality					
B1	New data exchange with the traffic management system	X	X	X	X
B2	Return load coordination		X		
B3	Shared use of vehicle coordination		X		
B4	Planned use of loading/unloading area	X	X	X	
B5	Load unit tracking and monitoring				X
Onboard support and control functionality					
C1	Routing support				X
C2	Service level	X			X
C3	Transport operation planning support (same as C1?)				
C4	Timeslot allocation for loading/ unloading	X	X	X	X
C5	Load/unload tracking + status information				X
C6	Efficient communication with distribution centre				X

X: From Technical Annex. X: Suggested by European Reference Group

Function descriptions (draft)

In the following pages, the functions are described in more detail; both the generics and the specifics (by sites) are presented. Mch reference has been made to the SMARTFREIGHT Deliverables D2.1 and D2.2. The descriptions found below are still in a draft format and will be amended following comments from the ERG members as well as SMARTFREIGHT partners (e.g. the entries from the Bologna test site are still to be added).

A1 Traffic control depending on service level
General description of function (all sites): The traditional actions initiated from a traffic control centre are extended by means of the concept "service level" in the criteria used for traffic signal control, VMS messages, access control, incident handling, etc.
Links to other functions (all sites): C1: The traffic management is effectuated by means of routing support C2: A service level must be assigned to the vehicle if service level is to be taken into account
Test site: Trondheim and Winchester
Use cases: **Trondheim** Access to bus/freight lanes through communication with vehicle Access to city areas/zones through communication with vehicle Priority in traffic signals through communication with vehicle Waiting instructions (at holding areas) to vehicle **Winchester** Access to bus/freight lanes Access to city areas/zones
Stakeholder interests - authorities: **Trondheim** Improved traffic flow, improved environment, improved safety **Winchester** Improved traffic flow, reduced congestion, enforcement of parking and loading regulations, improved environment, improved

safety
Stakeholder interests - transport industry: **Trondheim** Reduced travel times, improved reliability **Winchester** Improved reliability: deliveries and collections made on time.
Stakeholder interests - others: **Trondheim** Retailer: Reliable deliveries **Winchester** Retailer: Reliable deliveries.
Key performance indicators: **Trondheim** *Proof of concept* TBA **Winchester** *Efficiency* • Deviation from schedule (i.e. delay) • Distance travelled (by driver and across vehicle fleet) • Time taken to make deliveries/collections, including travel time and unloading time (by driver and across vehicle fleet) *Service provided* • Proportion of on-time deliveries • Proportion of late deliveries *Legal parking and loading* • Proportion of vehicles parking legally • Proportion of vehicles loading/unloading legally
Test set-up (planned): **Trondheim** Technical implementation by means of the CVIS platform. The service level and traffic situation will be taken into account. An on-board computer in vehicle shall be loaded with relevant data about vehicle characteristics and cargo. A communication link shall be demonstrated from the vehicle to the Urban Freight Distribution Centre (UFDC) and forwarded to the UTC. The UFDC and the UTC can be virtual centers simulated by computers. A better setup would be to send real time information to the UTC and use the information to give priority to the vehicle. How simple this implementation is in real life must be discussed with PRA. **Winchester** The Winchester simulation model will be built using AIMSUN. This will include the main entry and exit roads to Winchester city centre and the main roads used within the city centre. Minor roads that are scarcely used and that are unsuitable for freight will be excluded for simplicity. *Access to bus/freight lanes* - the impact of allowing certain groups of freight vehicle to use bus lanes will be assessed in terms of the travel time saved by lorries. The negative impact on buses will also be measured. The assessment will take into account different volumes of buses, freight vehicles and general traffic associated with different times of day. Although Winchester currently doesn't operate any bus lanes within the model area, the city had planned to introduce a bus lane in the city centre. We propose to model this proposed bus lane. *Access to city areas/zones* - the impact of allowing certain groups of freight vehicle to access certain areas of Winchester city, according to service level and to the lorry destinations (i.e. the businesses they are servicing), will be assessed in terms of the time taken to make deliveries/collections and in terms of improvements in legal loading and unloading. It should be noted that some freight vehicles may be disadvantaged, compared to current practice, if they are forced to park further away from the businesses they are servicing. On the other hand, some freight vehicles may gain an advantage if unloading conditions can be improved. One possible option which may be simulated is to allow lorries to make use of bus stops for unloading at times when buses are not expected. This would require detailed knowledge of the approach of buses to bus stops. As bus drivers are often unable to adhere to the timetable, due to traffic conditions, for example, knowledge of the bus timetable would probably be insufficient information, although could be useful in assessing whether there would be any scope for this activity. For example, if buses were frequent then it would be unlikely that any freight unloading at bus stops could be considered.

A2 Conditional route assignment (incl. Green areas, and Access control)
General description of function (all sites): The extension to traditional services (of providing a map of recommended/mandatory routes for specific types of goods, etc.) is made as a dynamic element which can be included. The new options emerge because access to specific areas/lanes, etc. now can be allowed (in certain situations) for vehicles of a specific minimum service level. The route assignments overall are in principle made on the basis on the classification of individual vehicles and on the origin and/or destination of the vehicle.
Links to other functions (all sites): C1, C2, C4, A3
Test site: Trondheim and Winchester
Use cases:

Trondheim Access control of loading/unloading areas Access control of public transport and/or HOV lanes for freight vehicles Access control of environmental zones Priority in traffic signal controlled intersection Route guidance depending on vehicle service level Individual route assignment depending on service level and traffic situation **Winchester** Access to city areas/zones
Stakeholder interests - authorities: **Trondheim** Improved traffic flow, improved environment, improved safety **Winchester** Ensuring that large freight vehicles use appropriate routes to avoid blocking roads and to ensure safety, e.g. routes that are wide enough, avoid sensitive areas (e.g. schools) etc.
Stakeholder interests - transport industry: **Trondheim** Reduced travel times, improved reliability **Winchester** It is also in the interests of the transport industry that lorries use appropriate routes to avoid delays and accidents.
Stakeholder interests - others: **Trondheim** Retailer: Reliable deliveries **Winchester** General public: citizens want to be safe from traffic, particularly freight vehicles.
Key performance indicators: **Trondheim** *Proof of concept* TBA **Winchester:** *Efficiency* • Deviation from schedule (i.e. delay) • Distance travelled within the modelled area (by driver and across vehicle fleet) • Time taken to make deliveries/collections, including travel time and unloading time (by driver and across vehicle fleet) *Service provided* • Proportion of on-time deliveries • Proportion of late deliveries *Legal parking and loading* • Proportion of vehicles parking legally Proportion of vehicles loading/unloading legally
Test set-up (planned): **Trondheim** The on-board computer in vehicle sends request to the UFDC about recommended route. The request includes information about type of vehicle, cargo and agreed time of delivery (if agreed). The UFDC send requested route information to the driver. This information should include information about time when delivery should be done. The UFDC might hold the freight vehicle in a resting place outside city to avoid peak hour traffic if possible. **Winchester** Since Winchester is a small city and has a one-way traffic system, there is rather limited scope for supplying vehicles with alternative routes that are substantially different from one another for any given origin and destination. However, there will be some scope for varying the destinations for freight vehicles according to the service level and the granted access to the different areas of the city centre. It is proposed to model this, as described under function A1.

A3 Tracking of dangerous goods
General description of function (all sites): Existing functions for the tracking of dangerous goods are extended to include functionalities similar to those used in public transport (AVL systems) for a continuous feedback of the vehicle position in real-time in the urban street network.
Links to other functions (all sites): A2, A4, A6, C1, C2
Test site: Trondheim
Use cases: **Trondheim** Tracking all through the city Awareness of DG in tunnels Awareness of DG in zones of the city
Stakeholder interests - authorities:

Trondheim Improved safety and security
Stakeholder interests - transport industry: **Trondheim** Improved safety and security
Stakeholder interests - others: N/A
Key performance indicators: **Trondheim** *Proof of concept* TBA
Test set-up (planned): **Trondheim** The vehicle with dangerous goods must be identified and guided through the urban road network along preferred routes. Identified vehicles with dangerous goods will be tracked through the urban network.

A4 Incident management support
General description of function (all sites): This function is included in traditional traffic control operations and its possible extensions are included in Functions A1, A2, and A3.
Links to other functions (all sites):
Test site: X
Use cases:
Stakeholder interests - authorities:
Stakeholder interests - transport industry:
Stakeholder interests - others:
Key performance indicators:
Test set-up (planned):

A5 Data collection for statistics and planning
General description of function (all sites): The extension here is the availability to a large database where also data related to all types of vehicles moving in the traffic system are stored. As O/D-matrices very often already exist for urban passenger transport, a similar data collection process is created for urban goods transport (or city logistics). The combined use of these two types of data clusters will improve the possibility of calculating travel/journey times and the need for and use of "probe vehicles" as sensors in the traffic system will be extended.
Links to other functions (all sites): A7: It is envisaged that both historic data (EG long term journey time trend) and real time data would be communicated between the UTMS to the FDMS. B1: FDMCs could supply some of the required O/D data for the database (in addition to other means of O/D data collection such as ANPR etc.).
Test site: Dublin and Trondheim
Use cases: **Dublin** Plan a primary, secondary and standby freight network Use data to help calibrate and validate the DTO transportation model Plan location of new depot(s) for large freight operator Plan location of holding area / consolidation centre Use probe vehicles/ANPR etc. to provide real time data, and add this data to the database **Trondheim** Collection of data for calculation of travel times Collection of data about type of cargo Collection of data about routes
Stakeholder interests - authorities: **Dublin** Improved planning capability enabling more efficient use of existing infrastructure and future investment funds. **Trondheim** Better data for public planning purposes, improved traffic flow, improved environment, improved safety
Stakeholder interests - transport industry: **Dublin** Transport industry could use O/D matrices to identify demand corridors / locations and set up business to service this demand more efficiently. **Trondheim** Better data for planning purposes

Stakeholder interests - others: **Dublin** Service industry could use O/D data to help locate service stations, rest stops etc. **Trondheim** Retailer: Reliable deliveries
Key performance indicators: **Dublin** *Note – Dublin is conducting a desktop study and therefore will make qualitative assessments regarding potential performance of scenarios. Quantitative assessments can be made at the other three test sites.* The proposed Dublin test site freight operator survey will help to assess the likely benefits of this function to freight operators. Efficiency benefits would be expected as a result of more planning data being available; *Efficiency* • Number (or weight) of products delivered per litre fuel used • Vehicle fill (also known as load factor) over the various legs of the journey. This may be defined as the ratio of products carried to vehicle capacity in terms of either volume, weight or deck coverage. • Empty running - distance travelled while empty • Deviation from schedule (i.e. delay) • Fuel consumption (litres, km per litre and cost) • Distance travelled (by driver and across vehicle fleet) **Trondheim** *Proof of concept* TBA
Test set-up (planned): **Dublin** The viability of this function for the particular case of Dublin will be tested; Any required additional institutional or technical arrangements for the function to work in Dublin will be outlined The relevance of the function will be checked against the results of the user needs survey The KPIs identified above will be qualitatively assessed **Trondheim** On-board computer in vehicle must send data about vehicle characteristics, cargo, origin, destination and chosen route to the UFDC where the information is stored in a database.

A6 Enforcement
General description of function (all sites): Many new functions will, for their successful implementation, be dependent on the compliance of users to follow existing (or new) regulation, etc. This will be influenced by measures introducing "carrots and sticks". The possibility to check the assigned service level of vehicles, especially in relation to access control and other restrictions, is one example of new functionalities needed for enforcement.
Links to other functions (all sites): A1, A2, A3
Test site: Trondheim
Use cases: **Trondheim** Detection of illegal use of lanes Detection of illegal entry to areas/zones Detection on illegal use of loading bays
Stakeholder interests - authorities: **Trondheim** Improved traffic flow, improved environment, improved safety, acceptance, equity
Stakeholder interests - transport industry: **Trondheim** Reduced travel times, improved reliability, acceptance, equity
Stakeholder interests - others: N/A
Key performance indicators: **Trondheim** *Proof of concept* TBA
Test set-up (planned): **Trondheim** The roadside equipment must monitor the traffic in critical parts of the road network. It could be a freight vehicle overrunning the loading/unloading time slot in a loading bay or a freight vehicle using the PT-lane without permit. Technically the setup could be the same as is being used in tolling stations.

A7 Provision of traffic data to FDMS

General description of function (all sites):
Depending on how advanced the fleet management tools in operation are, different types of traffic data could be provided. This function is more about the opening of a communication channel between the two worlds UTMS and FDMS. In an ideal situation, as is considered here, full information about the traffic systems status is made available for the FMDS decision-making process. This will lead to a better possibility for optimal resource management for the FDMS operators involved.

Links to other functions (all sites):
A1, A2, A3, A4, B1, C1, C3, C4(?)

A5: As well as real time information exchange, it is envisaged that the UTMS would provide long term data to the FDMS in order to facilitate the pre-planning of freight journeys.

Test site: Dublin and Trondheim

Use cases:
Dublin
Provide historic data such as average journey time on each route to FDMS
Provide real time data such as current delays, road works locations, incidents and journey times to FDMS...
Trondheim
Distribution of information about real travel times
Distribution of information about planned events and situations (e.g. road works)
Distribution of information about occurred incidents or emergencies that affects the traffic

Stakeholder interests - authorities:
Dublin
More efficient network utilisation and reduction of the impact of incidents, road works etc. on the network
Trondheim
Improved traffic flow, improved environment, improved safety and security

Stakeholder interests - transport industry:
Dublin
Improved efficiency in planning freight trips as well as better adaptation to real time information.
Trondheim
Reduced travel times, improved reliability

Stakeholder interests - others:
N/A

Key performance indicators:
Dublin
Note – Dublin is conducting a desktop study and therefore will make qualitative assessments regarding potential performance of scenarios. Quantitative assessments can be made at the other three test sites.
The proposed Dublin test site freight operator survey will help to assess the likely benefits of this function to freight operators.
Efficiency
- Number (or weight) of products delivered per litre fuel used
- Time utilisation - time spent on various aspects of the delivery (e.g. loading, driving, parking (including looking for a space), unloading, waiting etc.)
- Deviation from schedule (i.e. delay)
- Fuel consumption (litres, km per litre and cost)
- Distance travelled (by driver and across vehicle fleet)
- Level of hiring sub-contractors to undertake extra workload

Emissions
- CO_2 produced per product delivered

Service provided
- Number of missed deliveries (or collections)
- Proportion of on-time deliveries
- Proportion of late deliveries
- Penalties incurred through failing to provide required service

Trondheim
Proof of concept
TBA

Test set-up (planned):
Dublin
The viability of this function for the particular case of Dublin will be tested
Any required additional institutional or technical arrangements for the function to work in Dublin will be outlined
The relevance of the function will be checked against the results of the user needs survey
The KPIs identified above will be qualitatively assessed
Trondheim
Communication link between UTC and UFDC will be demonstrated.

B1 New data exchange with the UTMS
General description of function (all sites): This function will, in the ideal case, provide the UTMS with access to all existing and planned use of the vehicle fleet, including O/D-matrices for the freight movements, types of vehicles used, disturbances in normal flows of goods and incidents reported from vehicles in the field.
Links to other functions (all sites):: A5: The UTMS would use the data supplied to create a database for statistics and planning A7: The UTMS would provide amalgamated statistics and datasets back to the FDMS to aid journey planning
Test site: Dublin and Trondheim
Use cases:. **Dublin** FDMS collect specific data Transfer data from the FDMS to the UTMS
Stakeholder interests - authorities: **Dublin** Improved knowledge for infrastructure planning New source of real time information **Trondheim** Improved traffic flow, improved environment, improved safety and security
Stakeholder interests - transport industry: **Trondheim** Reduced travel times, improved reliability
Stakeholder interests - others: N/A
Key performance indicators: **Dublin** *Note – Dublin is conducting a desktop study and therefore will make qualitative assessments regarding potential performance of scenarios. Quantitative assessments can be made at the other three test sites.* The proposed Dublin test site freight operator survey will help to assess the likely benefits of this function to freight operators. Efficiency benefits would be expected as a result of more planning data being available; *Efficiency* • Number (or weight) of products delivered per litre fuel used • Vehicle fill (also known as load factor) over the various legs of the journey. This may be defined as the ratio of products carried to vehicle capacity in terms of either volume, weight or deck coverage. • Empty running - distance travelled while empty • Deviation from schedule (i.e. delay) • Fuel consumption (litres, km per litre and cost) • Distance travelled (by driver and across vehicle fleet) **Trondheim** *Proof of concept* TBA
Test set-up (planned): **Dublin:** The viability of this function for the particular case of Dublin will be tested Any required additional institutional or technical arrangements for the function to work in Dublin will be outlined The relevance of the function will be checked against the results of the user needs survey The KPIs identified above will be qualitatively assessed **Trondheim** Communication link between UTC and individual freight vehicles will be demonstrated

B2 Return load co-ordination

General description of function (all sites):
This function implies, in the ideal case, that the position and status of all freight vehicles (from all operators in the city area) are made available to a specific unit, where a co-ordination of return loads is accomplished. Either by using dedicated vehicles for that service or by means of information about position/load factor/home base/etc. of every vehicle, a choice of vehicles for return loads will be made.

Links to other functions (all sites):
B3, B4, C4

Test site: Winchester

Use cases:
Winchester
Back-loading of packaging waste and/or return goods

Stakeholder interests - authorities:
Winchester
Potentially reduced volume of freight traffic

Stakeholder interests - transport industry:
Winchester
Efficiency of operations

Stakeholder interests - others:
N/A

Key performance indicators:
Winchester
Efficiency
- Vehicle fill (also known as load factor) over the various legs of the journey. This may be defined as the ratio of products carried to vehicle capacity in terms of either volume, weight or deck coverage.
- Empty running - distance travelled while empty
- Distance travelled (by driver and across vehicle fleet)
- Reduction in the number of dedicated waste collections

Recycling
- Volume of paper/cardboard collected

Volume of return goods collected

Test set-up (planned):
Winchester
The existing situation, whereby packaging waste and return goods are only back-loaded by some freight operators, will be compared with a managed system where these materials are back-loaded more efficiently. The existing situation on Winchester High Street can be estimated well from a comprehensive survey of the majority of the business managers that was undertaken within another project (Green Logistics). The new, managed system will be devised on an ad hoc basis with the aid of the AIMSUN simulation model.

B3 'Shared use of vehicle' co-ordination

General description of function (all sites):
This function has some similarities with B2, but considers both inward and outward transport services and the possibilities of shared use of vehicles for delivery as well as for return loads.

Links to other functions (all sites):
B2, B4, C4

Test site: Winchester

Use cases:
Winchester
Load consolidation

Stakeholder interests - authorities:
Winchester
Potentially reduced volume of freight traffic in the city centre.
Environmental benefits.

Stakeholder interests - transport industry:
Winchester
Efficiency of operations.

Stakeholder interests - others:

Key performance indicators:
Winchester
Efficiency
- Number (or weight) of products delivered per litre fuel used
- Vehicle fill (also known as load factor) over the various legs of the journey. This may be defined as the ratio of products carried to vehicle capacity in terms of either volume, weight or deck coverage.
- Empty running - distance travelled while empty

- Time utilisation - time spent on various aspects of the delivery (e.g. loading, driving, parking (including looking for a space), unloading, waiting etc.)
- Deviation from schedule (i.e. delay)
- Fuel consumption (litres, km per litre and cost)
- Distance travelled (by driver and across vehicle fleet)

Emissions

CO_2 produced per product delivered

Test set-up (planned):

Winchester

The use case of load consolidation may be evaluated via spreadsheet analysis or via simulation. This could be part of the 'holding area' use case, described under Function B4. Part loads from larger lorries would be consolidated into smaller lorries at the holding area. These smaller lorries would make the deliveries.

B4 Planned use of loading/unloading area

General description of function (all sites):

This new function is related to Function A2, where access control in general is addressed form a UTMS perspective. Depending on the service level assigned and on the time window needed for the delivery, certain load/unload areas/bays are made available on the basis of a schedule. The actual reservation of a time slot can be made, with different levels of guarantee for the UTMS (comparable to travel guarantees applied in public transport operations).

Links to other functions (all sites):

A2: the planned use of loading/unloading areas is linked to access control in general.

A7: The FDMS can use historic traffic data to plan what time slot they will need the loading area for

Test site: Winchester and Dublin

Use cases:

Winchester

Identify available loading/unloading areas (x, y, z, ...)
Booking of time slot in area x
Waiting instructions (at holding areas) to freight vehicles

Dublin

Identify available loading/unloading areas
Booking of time slot in area x
Confirmation of allocated time slot from UTMS to FDMS
Alert FDMS of necessary changes to time slot allocation

Stakeholder interests - authorities:

Winchester

Improved enforcement of loading/unloading and parking restrictions

Dublin

More efficient use of loading bay infrastructure
Less illegal parking of freight vehicles and therefore less delay to other road users

Stakeholder interests - transport industry:

Winchester

Guaranteed access to a loading bay (where available).

Dublin

Improved safety by always parking in loading bays
Compliance with local regulations, reducing fines etc..

Stakeholder interests - others:

N/A

Key performance indicators:

Winchester

Efficiency

- Deviation from schedule (i.e. delay)
- Distance travelled (by driver and across vehicle fleet)
- Time taken to make deliveries/collections, including travel time and unloading time (by driver and across vehicle fleet)

Service provided

- Proportion of on-time deliveries
- Proportion of late deliveries

Legal parking and loading

- Proportion of vehicles parking legally
- Proportion of vehicles loading/unloading legallySpeed of invoicing
- Speed of payment being received

Dublin

Efficiency

- Time utilisation - time spent on various aspects of the delivery (e.g. loading, driving, parking (including looking for a space), unloading, waiting etc.)

- Deviation from schedule (i.e. delay)

Service provided

- Number of missed deliveries (or collections)
- Proportion of on-time deliveries
- Proportion of late deliveries
- Penalties incurred through failing to provide required service

Safety

Number of accidents involving vehicles or drivers and reasons for accidents

Test set-up (planned):

Winchester

In the Winchester simulation model it is proposed to hold vehicles outside the city area until it is known or anticipated that there will be a legal loading area available to them when they arrive at their intended destination. The impact of holding freight vehicles in 'holding areas' on the outskirts of Winchester city centre will be assessed in terms of the time taken to make deliveries/collections, including waiting time at the holding areas and in terms of improvements in legal loading and unloading. The simulation requirements include knowledge of loading area availability and of any bookings that have been made and estimation of travel times from the holding areas to the city centre (variable by time of day). The idea of using bus stops as possible unloading areas could also be included here, as was mentioned under Function A1.

Dublin

The viability of this function for the particular case of Dublin will be tested
Any required additional institutional or technical arrangements for the function to work in Dublin will be outlined
The relevance of the function will be checked against the results of the user needs survey
The KPIs identified above will be qualitatively assessed

B5 Load unit tracking and monitoring

General description of function (all sites):

Based on new and future sensor technologies, a container, a load unit and/or a parcel can be identified when on the move in a similar way as vehicles are today. The term "intelligent goods" is used in ongoing R&D projects to highlight the possibilities now examined to let "individual" load units be equipped with advanced ID tags (advanced RFID) with processing and memory capacities for automatic control of how different load units are loaded and transported most efficiently to meet the demands of delivery time slots in combination with access control based on vehicle service levels, etc.

Links to other functions (all sites):

Test site: Trondheim

Use cases:

Trondheim

Location tracking
Status tracking
Operation tracking (loaded, unloaded, ...)

Stakeholder interests – authorities:

Stakeholder interests - transport industry:

Trondheim

Improved reliability and quality of service

Stakeholder interests - others:

Trondheim

Shop owners: Improved reliability and quality of service

Key performance indicators:

Trondheim

Proof of concept

TBA

Test set-up (planned):

Trondheim

Information about cargo on freight vehicles are by request distributed to UTS and UFDC. This opens for detailed surveillance of vehicles and cargo in the urban road network.. The information also will be available for the UFDC and for operation of goods terminals.

C1 Routing support

General description of function (all sites):

In principle this function is composed of traditional navigation and dynamic route guidance functionalities, where the use of the onboard unit will include highlights related to traffic control actions based on the service level of the vehicle in question.

Links to other functions (all sites):

Test site: Trondheim

Use cases:

Trondheim

Individual route guidance
Information with respect to access to lanes, areas, etc.

Routing information with time slots and waiting instructions
Stakeholder interests - authorities: **Trondheim** Improved traffic flow, improved environment, improved safety
Stakeholder interests - transport industry: **Trondheim** Reduced travel times, improved reliability
Stakeholder interests - others: **Trondheim** Improved reliability
Key performance indicators: **Trondheim** *Proof of concept* • TBA
Test set-up (planned): **Trondheim** Travel time information exchange will be demonstrated by the use of probe vehicles.

C2 Service level
General description of function (all sites): A feedback to the driver about the service level assigned to the vehicle will be designed. Also the possibility of dynamic service level assignments will be included.
Links to other functions (all sites): A1: This function depends on the service level A7, B1
Test site: Dublin and Trondheim
Use cases: **Dublin** UTMS assigns service level and notifies FDMC or driver directly UTMS, FDMC or driver may request and/or confirm dynamic change in service level **Trondheim** Provision of service level information for individual vehicles
Stakeholder interests - authorities: **Dublin** Prioritisation of freight journeys could be facilitated **Trondheim** Improved traffic flow, improved environment, improved safety
Stakeholder interests - transport industry: **Dublin** Improved information flow regarding assigned service level **Trondheim** Improved reliability, acceptance, equity
Stakeholder interests - others: N/A
Key performance indicators: **Dublin** *Efficiency* • Vehicle fill (also known as load factor) over the various legs of the journey. This may be defined as the ratio of products carried to vehicle capacity in terms of either volume, weight or deck coverage. • Empty running - distance travelled while empty **Trondheim** *Proof of concept* TBA
Test set-up (planned): **Dublin** The viability of this function for the particular case of Dublin will be tested Any required additional institutional or technical arrangements for the function to work in Dublin will be outlined The relevance of the function will be checked against the results of the user needs survey The KPIs identified above will be qualitatively assessed **Trondheim** Freight vehicles will be given priority or a certain "service level" according to a set of rules, i.e. EURO class, type of cargo, etc. We will demonstrate how UTC "level of service" is assigned to vehicle and how this is used by UTC to give priority.

C3 Transport operation planning support

General description of function (all sites): This function is FDMS-based. The onboard functionality is related to feedback to the driver about specific issues, which might influence the journey in progress, and might require extraordinary actions from the driver.
Links to other functions (all sites):
Test site: X
Use cases:
Stakeholder interests - authorities:
Stakeholder interests - transport industry:
Stakeholder interests - others:
Key performance indicators:
Test set-up (planned):

C4 Time slot allocation for loading/unloading area
General description of function (all sites): This feedback to the driver is essential for the access control schemes for loading/unloading areas to function in a smooth way. The function must ideally be bi-directional and also include advice on when a request for access is denied or changed. This can be caused by 1) factors in the traffic system itself or 2) by the driver being delayed for whatever reason.
Links to other functions (all sites): A1: The timeslot allocation may be linked to the service level and actions to control traffic on this basis. B4: The function B4 relates to pre-planning of slots. The function C4 extends this to real time on-board support and functionality. A2, A7, B1, B4,
Test site: Winchester, Dublin and Trondheim
Use cases: **Winchester** Booking confirmed in area x Booking denied in area x, Alternative time slot offered in area x Alternative time slot offered in area y **Dublin** Booking confirmed in area x Booking denied in area x, Alternative time slot offered in area x Alternative time slot offered in area y Change of booking requested Change of booking confirmed **Trondheim** Booking information
Stakeholder interests - authorities: **Winchester** Avoidance of unnecessary lorry movements within the city centre. **Dublin** Greater control of limited infrastructure (loading bays), including the ability to change slot allocations quickly. **Trondheim** Improved traffic flow, improved environment, improved safety
Stakeholder interests - transport industry: **Winchester** Lorry drivers and FDMS are better informed about loading bay availability and booking status. **Dublin** Improved data exchange to the freight vehicle and more control of changes in real time **Trondheim** Improved reliability, equity, acceptance
Stakeholder interests - others: **Winchester** Retailers: deliveries made on time **Dublin** Greater certainty of delivery times and loading bay availability for retailers
Key performance indicators: **Winchester** *Efficiency* • Deviation from schedule (i.e. delay) • Distance travelled (by driver and across vehicle fleet) • Time taken to make deliveries/collections, including travel time and unloading time (by driver and across vehicle fleet) *Service provided*

- Proportion of on-time deliveries
- Proportion of late deliveries

Legal parking and loading

- Proportion of vehicles parking legally
- Proportion of vehicles loading/unloading legally

Dublin

Efficiency

- Number (or weight) of products delivered per litre fuel used
- Time utilisation - time spent on various aspects of the delivery (e.g. loading, driving, parking (including looking for a space), unloading, waiting etc.)
- Deviation from schedule (i.e. delay)
- Fuel consumption (litres, km per litre and cost)
- Distance travelled (by driver and across vehicle fleet)
- Level of hiring sub-contractors to undertake extra workload

Emissions

- CO_2 produced per product delivered

Service provided

- Number of missed deliveries (or collections)
- Proportion of on-time deliveries
- Proportion of late deliveries
- Penalties incurred through failing to provide required service

Safety

Number of accidents involving vehicles or drivers and reasons for accidents

Trondheim

Proof of concept

TBA

Test set-up (planned):

Winchester

It is not clear how lorry drivers and FDMS will respond to information received about loading bay availability and booking status. It may be outside the scope of the project to be able to simulate this.

Dublin

The viability of this function for the particular case of Dublin will be tested
Any required additional institutional or technical arrangements for the function to work in Dublin will be outlined
The relevance of the function will be checked against the results of the user needs survey
The KPIs identified above will be qualitatively assessed

Trondheim

One loading/unloading area will be defined as open only for certain vehicles during the test period. This loading/unloading zone will equipped with cameras and sensors tracking freight vehicles stopping.
Booking and status of the loading/unloading zone will be demonstrated.

C5 Load/unload tracking/status information

General description of function (all sites):

This function is related to C4 and highlights the possibility to extend the information flow to the driver with transparency on what the situation at loading/unloading stations look like.

Links to other functions (all sites):

C2, C3, C4, A5, A6, A7

Test site: Trondheim

Use cases:

Trondheim

Vehicle / cargo management
Data collection

Stakeholder interests - authorities:

Trondheim

Improved traffic flow, improved environment, improved safety

Stakeholder interests - transport industry:

Trondheim

Reduced travel times, improved reliability

Stakeholder interests - others:

Trondheim

General public: Reduces safety risk

Key performance indicators:

Trondheim

Proof of concept

- TBA

Test set-up (planned): **Trondheim** One loading/unloading area will be defined as open only for certain vehicles during the test period. This loading/unloading zone will equipped with cameras and sensors tracking freight vehicles stopping. The id of the vehicle will be checked against the booking system. Booking, status and control of the loading/unloading zone will be demonstrated.

C6 Efficient communication with distribution centre
General description of function (all sites): This function is related to the need to establish a two-way communication link between the driver (the vehicle) and the FDMS operators. It is probably not feasible to fully automate the functionalities listed above and exclude the human being from the decision-making loops. Even advanced and high technology equipped complex systems like nuclear power plants will still have human operators on board for supervision and for actions in case of severe incidents or accidents. A similar rationale can be applied in the area of urban transportation for both traffic and transport operations.
Links to other functions (all sites): A4
Test site: Trondheim
Use cases:
Stakeholder interests - authorities: **Trondheim** Improved traffic flow, improved safety
Stakeholder interests - transport industry: **Trondheim** Reduced travel times, improved reliability
Stakeholder interests - others: **Trondheim** Improved service and information
Key performance indicators: **Trondheim** *Proof of concept* • TBA
Test set-up (planned): **Trondheim** CALM and CVIS communication will be established in the test area. This opens for continuous broad band Internet communication in the urban road network for equipped vehicles. This will be demonstrated in the demonstration area.