Novelog Project

D4.1

Integrated inventory of urban freight policies and measures, typologies and impacts

UFT measures, interventions and typologies

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 636626

Deliverable No.		**D4.1**	
Workpackage No.	**WP4**	Workpackage Title	**Toolkit of policies and measures for urban freight and service trips**
Task No.	**T4.1, T4.2 and T4.3**		
Date of preparation of this version:		**12/09/2016**	
Authors:		**Paulus Aditjandra (PA), Tom Zunder (TZ), Dewan Islam (DI), Clare Woroniuk (CW), Ann Zunder (AZ) (UNEW) and Alexander Stathacopoulos (AS) (CERTH)**	
Status (F: final; D: draft; RD: revised draft):		**F**	
File Name:		**NOVELOG-D4.1-v12.docx**	
Version:		**0.12**	
Task start date and duration		**01/09/2015 – 31/08/2016**	

Revision History

Version No.	Date	Details
1	27/07/2016	1st draft version PA
2	10/8/2016	2nd sub edited version AEZ
3	11/08/2016	3rd edited version THZ
4	15/05/2016	4th edited version THZ
5	*17/08/2016*	*5th edited internal reviewed by DI and CW*
6	*25/08/2016*	*6th edited version PA*
7	*27/08/2016*	*7th edited version PA*
8	*28/08/2016*	*8th version THZ*
9	*30/08/2016*	*9th version PA and DI*
10	*31/08/2016*	*10th version PA*
11	*8/9/16*	*11th version THZ with inputs from AS*
12	*30/9/16*	*12th version PA revision in response to reviewers' comments; direct comments to reviewers are enclosed in separate files*

Reviewers List

Name	Company	Date	Signature
Jaume Roca Guitart	CENIT	21/9/16	
Giacomo Lozzi	Polis	26/9/16	

Executive Summary

NOVELOG project aims to innovate by progressing beyond state-of-the-art in urban freight and city logistics within a triple helix of (1) evaluation framework development, data collection and empirical analyses; (2) specific demonstrators and case studies; and (3) guidelines for Europe-wide take up of the best policies and solutions.

This Deliverable (D) 4.1 is part of the Work Package (WP) 4 with the objective to enable determination of optimum policies and measures, based on the city typologies and objectives, link them to tailored business models of city logistics solutions and test and validate them on selected representative city cases.

In D4.1, integrated inventory of policies and measures, city typologies and impacts, containing the interrelations among the four components, based on knowledge stipulated by the NOVELOG partners is delivered. A comprehensive review of city logistics projects and specific city logistics cases were reported. Over 250 city logistics cases from 60 (mainly) EU funded city logistics (and related) projects were drawn to be analysed against a number of typologies.

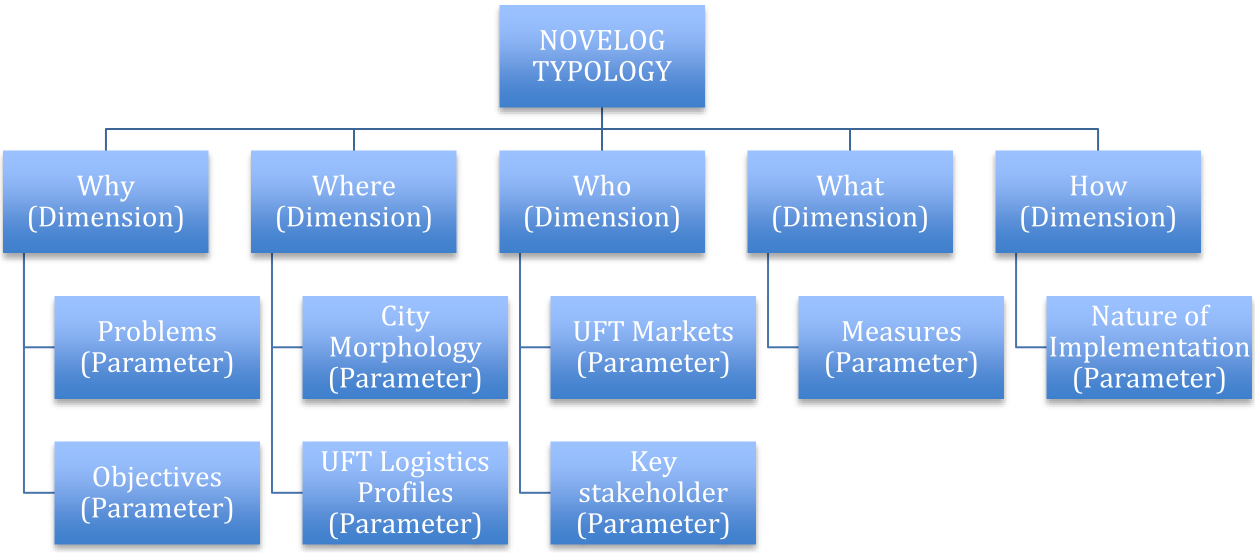
Review of typologies including land use, type of transport policies/measures, urban freight transport (UFT) markets and traffic flows, and city logistics problem/objectives were carried out to characterise the city logistics cases and reported in Section 3. It is clear that previous work in this field has developed typologies, composed of parameters with attributes, to suit certain target stakeholder audiences. NOVELOG WP4 develops a city logistics poly parametric typology that is useable by all significant UFT stakeholders, and as such we have built the novel city typology using a mixture of parameters from previous work, combined with impact parameters from WP3, and novel parameters with attributes, developed from analysis of the past data and the expert analysis of city logistics experts.

The NOVELOG **poly-parametric City Logistics Typology and Toolkit dimensional structure** that shall be used for UFT intervention choice by cities are essentially built from a common core. The dimensional structure therefore follows the same core pattern as the typology detailed below. Note that in each case the attributes for each parameter are either inherited from previous state of the art work, or have been extrapolated from the desktop research and the conclusions of the experts in WP4. At this stage these are a coherent set, but we recognise that future work may reveal or suggest variant attributes, where they do not duplicate or reduce the clarity of the typology.

1) NOVELOG TYPOLOGY
    i) Why (Dimension)
        (a) Problems* (Parameter)
            (i) Attributes
        (b) Objectives* (Parameter)

(i) Attributes
ii) Where (Dimension)
    (a) City Morphology (adopted from HESSE) (Parameter)
        (i) Attributes
    (b) UFT Logistics Profiles (adopted from TURBLOG) (Parameter)
        (i) Attributes
iii) Who (Dimension)
    (a) UFT Markets (adopted from CIVITAS WIKI) (Parameter)
        (i) Attributes
    (b) Key stakeholders* (Parameter)
        (i) Attributes
iv) What (Dimension)
    (a) Measures* (Parameter)
        (i) Attributes
            1. Sub clustering
v) How (Dimension)
    (a) Nature of Implementation (definitions adopted from C-LIEGE) (Parameter)
        (i) Attributes

Figure 1: Novelog Typology



Determination of the relative success or failure of city logistics interventions/measures were measured using the sustainability impact indicators (economic, environment and social) and the level of implementation (of city logistics case). This is reported and detailed in Section 4, and then preliminary analysis is provided in Section 5. While this is not a straightforward statistical answer due to limitation of pre-existing data, a prototype to estimate the model is delivered in Section 6 to support the development of the toolkit in Task 4.4 and Deliverable D4.2.

Contents

LIST OF FIGURES

LIST OF TABLES

1 Introduction

1.1 Objectives of this Document

The NOVELOG project aims to enable the knowledge and understanding of freight distribution and service trips, by providing guidance for implementing effective and sustainable policies and measures, and to formulate detailed business plans of Urban Freight Transport (UFT) measures.

NOVELOG project is developing four tools, addressing essential issues related to urban logistics:

1. Understanding cities (“where” and “for whom”)
2. Toolkit (“what”)
3. Evaluation (“why”)
4. Guidance (“how”)

Within the scope of NOVELOG project, the Work Package 4 (WP4) concerns the second of the NOVELOG tools noted above: the ‘toolkit’. The objective of WP4 is fourfold:

(1) To develop a pool of city logistics measures/interventions (analysed through section 2 and delivered in APPENDIX B) ;
(2) To develop clear city logistics typologies (delivered in section 3);
(3) To identify impacts from those measures/interventions; and (delivered in APPENDIX B, designed in section 4 and analysed in section 5 with model prototype description described in section 6)
(4) To develop the ‘NOVELOG Toolkit’, matching a combination of measures/interventions with the typologies, to be delivered as an open access platform licensed under Creative Commons (briefed in section 7 and to be delivered in D4.2)

WP4 aims to enable determination of optimum policies and measures, based on the city typologies and objectives, link them to tailored business models of city logistics solutions and test and validate them on selected representative city cases. There are four tasks within WP4:

- Task 4.1 (T4.1): Identification of a pool of measures and interventions in UFT;
- Task 4.2 (T4.2): Development of a clear city typology;
- Task 4.3 (T4.3): Identification and quantification of impacts of the measures and interventions.
- Task 4.4 (T4.4): Development of the NOVELOG toolkit

To develop the toolkit, the present deliverable (D4.1) reports on the work conducted in task 1-3. D4.1 forms *part* of the WP4: Toolkit of policies and measures for urban freight and service trips.

1.2 Context and structure of the deliverable

One of the major problems connected with selecting solutions to be implemented in the future, is choosing - from among many available options - those that meet the needs of a given city and that are compatible with the agreed goals. Browsing the whole catalogue (or several catalogues) of good practices, and making a thorough analysis of each option, requires a great deal time and is, in practice, difficult and challenging. This is particularly true in a situation where options are analysed during working meetings with stakeholders. Practical experience shows that it is not advisable to expect stakeholders to intensively analyse numerous examples. More often than not, they want to concentrate on several pre-selected, clearly presented options, which they can analyse thoroughly in the context of expected results. It is therefore worthwhile making a pre-selection, which will also make it possible to eliminate the proposals which surely diverge from their demands and are not compliant with the agreed goals. In the making a pre-selection of solutions, in accordance with which we start with the planned results, go through the impacts generated by individual classes of solutions, and finally indicate the ones that most fully meet the stakeholders' expectations. The methodology for this research comprises the following stages:

- specifying the relation between the goals and the areas of impact;
- determining impact indicators for all areas of impact;
- setting hierarchy of impact areas as per (calculated) indicators;
- identifying selection of the solutions according to their impact on the individual areas;
- selecting the solutions, characterised by the highest impact areas emerging from the analysis.

The deliverable is structured as follows: An executive summary is given at the very beginning of the deliverable to describe abstract of the report delivered. Section 1: Introduction details the purpose and Structure of this deliverable with a link between objectives and sections. Section 2 evaluates past city logistics projects dealing with UFT policy measures (interventions). Section 3 defines city typologies for city logistics. Section 4 reports the Data Collection Methodology. Section 5 summarises initial analysis of the pool of UFT interventions. Section 6 describes the prototyping of T4.3 models to establish the interrelationship between UFT interventions, impacts typologies and it success and failure. Section 7 describes the vision of the NOVELOG toolkit to be delivered in D4.2. This deliverable is the result of the research and innovation carried out in Tasks T4.1-T4.3. The detailed functional specification and implementation of the toolkit follows in Task 4.4.

2 Policies/measures used in city logistics projects

This section aims to review policies/measures used in EU funded city logistics projects, all of these projects have been experienced first-hand by NOVELOG partners as participants, and they have expert knowledge of them. We have deployed that expert knowledge in WP4. The focus of review is on the policies/measures and cities that have been used as case studies in each project. The number of projects included in the review is not limited, in order to draw as many city logistics cases as possible. Both completed and on-going projects are included in the exercise.

The EU funded projects reviewed (please see section 4 for complete list) have a variety of different purposes. Those dealing with city logistics fall primarily into three groups. First, those where a coordination support action (CSA) facilitated networking; sharing knowledge among the project's key stakeholders through workshops and meetings that drew city logistics best & good practices from EU cities. The second group are those projects, usually research and innovation actions (RIA) that facilitated research on a much more traditional basis, where data from a specific case study were used to answer a research hypothesis alongside practical intervention and innovations in policy and practice locally and with implications at a pan European level. Third, are EU funded projects include regional development framework type of projects which embedded specifically to a particular geographical region of Europe, for instance: the Mediterranean, the Alps, etc.

Despite their different approaches, these projects delivered a number of best practices, pilots/trials, and case studies in city logistics, wherein **city freight transport policy**, **city logistics solutions** and **business models** were able to be identified.

This section attempts to compile all three of these elements into a better understanding of one single new dimension: **city typology**.

2.1 IDIOMA (1999-2001)

The EU-FP4 funded **Innovative Distribution with Intermodal Freight Operation (IDIOMA)**[1] project was one of the early EU funded projects aiming to demonstrate the possibilities to improve the distribution of goods within metropolitan areas, and between intermodal transport terminal/freight centres and metropolitan areas. The rationale behind IDIOMA was to consider a growth forecast in vehicle kilometres of 40%, in EU urban areas and cities, between 1995 and 2030. This obliged the thinking about alternative transport concepts and policies which would work towards reducing the pressure on the cities' infrastructure and inhabitants (movement). The (then) new concept of a co-operation scheme of coordinated distribution between several forwarders, as well as the development of concepts integrating modes of transport other than road, were tested. The negative

[1] *http://www.transport-research.info/project/innovative-distribution-intermodal-freight-operation-metropolitan-areas*

impacts from freight transport were highlighted and the importance of sustainability of urban areas and the quality of life were being heralded to be in line with the current strategic planning of EU cities.

The IDIOMA project demonstrated (intermodal) city logistics solutions in 5 cities/regions: Nürnberg (Germany); Öresund, Malmo (Sweden to Denmark); Paris - Ile de France (France); the Randstat region - Amsterdam, Rotterdam, The Hague, Utrecht (The Netherlands); and Zurich (Switzerland). While the idea was aimed at addressing city logistics, the implementation of IDIOMA demonstrations was much closer to intermodal solutions, linked to intermodal design and innovation. Some of the IDIOMA concepts can be seen in Table 2.

Table 2: IDIOMA project concepts in demonstration

Measures/interventions	Cities
Regional or local bundling of UFT, using common carriers or co-operative distribution concepts (e.g. UCC)	Nürnberg,
New loading units in urban (intermodal) transport (Combibox-System for intermodal logistics)	Zurich,
Improving operational and commercial information exchange in intermodal transport by means of innovative	Ile de France
Innovative transhipment systems in intermodal transport (e.g. Multi-temperature zone for food logistics)	Öresund, Malmo
Web-based network optimisation system	The Randstad region
Use of alternative fuels and energy sources in urban freight vehicles (e.g. biogas fuelled van)	Linkoping
Combined passenger and freight transport concepts	Linkoping

The conclusion of the IDIOMA project was that all the alternative approaches to urban goods transport had positive impacts on environmental performance; however, most were not commercially viable, due to the extra running costs involved. Consequently, a public private partnership initiative was promoted, to bridge the gap.

2.2 BESTUFS (2000-2008)

The BESTUFS project objective was to identify, describe and disseminate the best practices, success criteria, and bottlenecks, of UFT solutions. BESTUFS[2] was supported through two consecutive EU funding mechanisms of the RIA (formerly known as Research and Technological Development – RTD)

[2] http://www.bestufs.net/index.html

Framework Programme (FP). BESTUFS 1 was funded under FP 5, between 2000 and 2004, and BESTUFS 2 under FP 6, from 2004-2008. The method of BESTUFS was a coordination and support action, to allow collaboration and knowledge-sharing on an open European network, between urban freight experts, user groups/associations, relevant EU directorates, and representatives of national, regional and local transport administrations and transport operators.

2.2.1 BESTUFS 1

BESTUFS 1 coordinated a series of roundtables, workshops and conferences that generated city questionnaires, policy and research recommendations, best practice handbooks, and clustering reports. Within BESTUFS I, four Best Practice Handbooks were derived, that described 7 measures/interventions:

1. Statistical data, data acquisition and data analysis regarding UFT;
2. City access, parking regulations and access time regulations and enforcement support;
3. E-commerce and urban freight distribution (home shopping);
4. Road pricing and UFT;
5. Urban freight platforms;
6. Public Private Partnership (PPP) in UFT; and
7. Intelligent Transport Systems (ITS).

The formulation of the seven measures/interventions was driven by experiences and suggestions from thematically focussed workshops that examined aspects of urban freight related to:

1. Methodology;
2. Planning and policy;
3. Transport concepts and management;
4. Co-operation and organisation;
5. Transport technology;
6. Supporting technology and infrastructure; and
7. Legal issues

BESTUFS 1 concluded that the most innovative urban areas implementing City Logistics Solutions tend to be large cities, or country capitals. These large conurbations have the resources to access support for innovative transport solutions, participate in city networks, and exchange knowledge and experiences with one another. By contrast, small and medium sized urban areas are more disadvantaged in these respects and often take actions that are comparatively limited in scope, when viewed from a European perspective. BESTUFS 2 aimed to address this gap.

2.2.2 BESTUFS 2

BESTUFS 2[3] aimed to broaden the BESTUFS 1 network to include medium sized urban areas in Europe, including those in the new Member States. The BESTUFS City Logistics Solutions Good Practice guide was extended by translating it into 17 languages. A series of city logistics seminars was disseminated, in national languages, with the aim to establish a knowledge bridge for the exchange of relevant information and experience between the EU and national level. Seminars (again in the local language) were held across the world, to present Best Urban Freight Solutions; to gather information about the national/local situation; to create a national/local network in parallel to the BESTUFS network; and to pay special attention to small and medium sized cities.

Extended policy and research recommendations were concluded, including:

1. Urban Consolidation Centres;
2. Last Mile Solutions;
3. Urban freight in small and medium sized cities;
4. Urban waste logistics;
5. Port cities and innovative urban freight solutions; and
6. Managing UFT by companies and local authorities

Some of these were documented in the Best Practice Handbooks:

7. Waste transport logistics in urban areas;
8. Experiments and incentives for environment-friendly vehicles;
9. Control and Enforcement in UFT; and
10. City access Restriction Schemes

[3] *http://www.transport-research.info/project/best-urban-freight-solutions-ii*

Table ***3*** demonstrates the collection of measures gathered from BESTUFS 1 and 2, showing enforcement type (strategic/tactical/operational), business models, and example of cities reported on.

Table 3: BESTUFS promoted policies/measures (extracted from Allen et al., 2007)

Transport Policy / Measures	City Logistics Solutions	Business Models	Example of cities
PART I: Goods vehicles access			
Efficient usage of infrastructure	Strategic	City authorities driven	General
Signing	Tactical	City auth.	General
Lorry routes	Strategic	National government	Regional/national level applicability
Urban freight information and maps	Tactical	City authorities' control	London
On-street loading bays	Tactical	City auth.	Aalborg
Nearby delivery area (ELP)	Tactical	City auth.	Bordeaux
Urban consolidation centres	Strategic	City auth./ businesses	German cities (Deutche Post AG)
Vehicle weight and size	Tactical	National Govt.	London
Time regulations	Operational	City auth.	French cities (pop.>100k)
Imposing and enforcing access and loading	Operational	City auth.	Barcelona
Environmental zones/emission standard regulations	Strategic	City auth.	Rome, London, Madrid, Paris, Copenhagen, Milan, Norway (urban areas)
Night deliveries (w/ PIEK programme as in NL)	Operational	City auth./ businesses	Barcelona, Dublin, Dutch towns
Lorry lanes	Tactical	City auth.	Paris 'Lincoln' delivery bays
Road charging systems	Tactical	City auth.	London, Oslo, Trondheim, Bergen
Technology in urban freight (UTMC4)	Strategic	Industry/Businesses/City auth.	Berlin, London, Paris

[4] *Urban Traffic Management and Control*

Transport Policy / Measures	City Logistics Solutions	Business Models	Example of cities
Environmentally-friendly vehicles (w/ a combination of incentives and restriction	**Tactical**	**Industry/Businesses/City auth.**	**Germany, France and the Netherlands**
Enforcement regulation	**Strategic**	**City auth.**	**General**
Joint working between public and private sectors	**Strategic**	**City/Businesses**	**UK cities, Paris**
PART II: Last mile solutions			
Defining last mile solutions	**Strategic**	**Home shopping/ deliveries**	**General**
The supply chain	**Strategic**	**Physical distribution**	**General**
Getting the goods to the customers	**Strategic**	**Un/Attended deliveries**	**General**
Technology and telematics in last mile logistics	**Strategic**	**Optimisation of deliveries**	**General**
Guidance on last mile solutions	**Strategic**	**Distribution channel; transport operations; delivery point; information**	
PART III: Urban consolidation centres (UCCs)			
Area UCCs serving town (Broadmead)		**Voluntary**	**Bristol, UK**
Area UCC serving town: Parcel delivery micro UCC (La Petite Reine)		**Voluntary**	**Paris, France**
UCCs on single sites with one landlord: Airport UCC (Heathrow)		**Initially voluntary then compulsory**	**London, UK**
Special project UCCs: Construction consolidation centre (Hammarby)		**Compulsory**	**Stockholm, Sweden**

2.3 CITYFREIGHT (2002-2004)

The EU-FP5 funded CITYFREIGHT[5] project aimed to address inter- and intra-urban freight distribution, collection and reverse (recycling and returning of broken items) flows in urban areas. The agenda was to contribute to the implementation of European 'City of Tomorrow and Cultural Heritage', within

[5] *http://www.transport-research.info/project/inter-and-intra-urban-freight-distribution-networks*

the Energy, Environment and Sustainable Development Programme. CITYFREIGHT's main objectives were to carry out a comparative analysis of urban freight effects for different cities and situations across Europe and to evaluate their socio-economic and environmental impacts, in an urban context, with a common assessment methodology. CITYFREIGHT focused on 23 initiatives in 14 cities, across 7 European countries.

The derived objectives of CITYFREIGHT were:

- to identify and analyse innovative and promising logistics schemes, as well as urban policies that could accompany implementation in order to promote sustainable development;
- to set up a list of criteria and a common assessment method for evaluating those logistics schemes and the related accompanying policies (legal framework, land use planning, road traffic regulation, pricing);
- to analyse their technical and economic efficiency;
- to design one or more implementation scenarios of these schemes and related accompanying policies;
- to assess and optimise the scenarios according to the criteria of a sustainable development of a city;
- to present guidelines for implementing integrated strategies that could be recommended as 'Best Practice';
- to disseminate and exploit the Best Practice Guidelines through collaboration with the local authorities for the design of concrete implementation plans of integrated strategies in each of the case study cities.

Table 4: CITYFREIGHT city logistics cases

Measures	Cities
Urban distribution and storage centre with electric vehicle	**Brussels**
Retail delivery station	**Brussels**
Rail transport to the European centre for fruit and vegetables	**Brussels**
Promoting rail solutions for freight transport to and from Brussels	**Brussels**
Cargo tram-train	**Brussels**
Shopping and e-commerce facilities at commuter rail stations	**Brussels**
Underground service tunnel (as part of underground parking facilities)	**Helsinki**
Logistics centre between the harbour and the airport	**Helsinki**
Municipal Logistics Centre	**Tampere**

Measures	Cities
The Risö Land Transport Centre (logistics terminal)	Vaasa
Goods delivery in urban centre by using electric car	La Rochelle
Chronocity (electric vehicle delivery in urban areas)	Strasbourg
Urban logistics (multi-service freight platform feasibility study)	Strasbourg
Proximity delivery areas (Espace de Livraison de Proximite – ELS: dedicated delivery points)	Bordeaux
Urban road pricing for freight (via time windows for loading/unloading; restriction on night deliveries)	Milan
Urban distribution and sorting waste centre with electric vehicles (defining strategic intermodal centre/UCC location)	Genova
Suburban eco-logistics hub with cooperation agreements between the Municipality and the freight operators	Vicenza
Cooperation agreements on distribution and waste collection (FQP)	The Hague
A collective contract for waste collection (PPP)	The Hague
Consolidation from the demand side (root towards binnenstadservice)	The Hague
Urban distribution centre supported with electric vehicles	Malaga
Data collection initiative	Valladolid
Construction consolidation: Titherban development	Preston

CITYFREIGHT had developed a number of typologies to map urban freight distribution initiatives. The aim was to offer a synoptic overview of the range of solutions available to decision makers as well as to serve as a selection support tool for those looking for relevant sources of inspiration in their search for concrete solutions to such problems. The typologies are organised into the criteria of four dimensions:

- The 'socio, economic and environmental impact':
  - emissions;
  - noise;
  - infrastructure damage;
  - safety;
  - economical; and
  - logistical (transport efficiency).

- The nature of 'approaches / solutions':
    - technical solutions;
    - organisational solutions;
    - operational solutions; and
    - regulatory solutions.

- The nature of the 'policy':
    - urban planning and design;
    - new infrastructure;
    - modal-shift to cleaner mode (of transport);
    - traffic segregation (spatial, vertical, and temporal);
    - load consolidation;
    - consumer logistics initiative;
    - coordination actions and cooperation agreements; and
    - clean road vehicles

- The 'key stakeholders impact'
    - public;
    - local authorities/government;
    - receivers;
    - shippers; and
    - transport providers/operators.

In developing a decision support tool, CITYFREIGHT drew up a list of considerations for cities adopting city logistics measures:

- The solution chosen for a certain problem related to urban freight distribution influences, and therefore should take into account, the interrelationships that exist between actors, the urban context and the distribution model;
- There are no best practice solutions for problems related to urban freight; however there are recommendations for a best practice project and process approach (best practice cannot be defined for UFT without looking at the entire transport chain, considering spatial constraints);
- Best practice guides should not be viewed as a selection of the most successful initiatives in Europe, but as an organised list of initiatives used to lay out the foundations of a general best practice project and process approach.

2.4 SMARTFREIGHT (2008-2011)

The EU-FP7 funded **Smart Freight Transport in Urban Areas** (SMARTFREIGHT[6]) aimed to make UFT more efficient, environmentally friendly, and safe, through addressing challenges related to traffic management, freight distribution management and a better coordination between the two. The SMARTFREIGHT objectives were to:

- develop new traffic management measures towards individual freight vehicles through open ICT services, on-board equipment and integrated wireless communication infrastructure;
- improve the interoperability between traffic management and freight distribution systems; and
- coordinate all freight distribution operations within a city by means of open ICT services, on-board equipment, wireless communication infrastructure and CALM MAIL[7] implementation in on-board and on-cargo units, for all freight.

There were 4 test sites: Trondheim (Norway), Winchester (UK), Bologna (Italy), and Dublin (Ireland).

2.5 SUGAR (2008-2012)

The SUGAR project focussed on addressing the problem of inefficient and ineffective management of urban freight distribution through promotion of the exchange, discussion and transfer of policy experience, knowledge and good practices among advanced and less-experienced sites. The project was co-funded with the EU-INTERREG IVC programme (not the EU-FP programme). The partnership network brought together 12 sites in 9 different countries: Italy (Emilia-Romagna Region); UK (London); France (Paris); Spain (Barcelona, Palma de Mallorca); Greece (Region of Crete); Bulgaria (Vratsa); Slovenia (Celje); Poland (Poznan); and the Czech Republic (Prague).

The main achievement of the SUGAR project (as reported in the published Handbook[8] (SUGAR, 2011)) was the identification of improvements to public policies and actions in city logistics within the project sites. This improvement included the development of Freight Plans, Mobility Master Plans, new techniques for city logistics data collection, policy action on Low Emission Zones, and urban planning for city logistics, as well as the set up and tuning of administrative regulations for access to urban areas.

SUGAR defined best practice cases (for city logistics) as:

- cases that are initiated or supported by a public administration;

---

[6] *http://www.smartfreight.info/*
[7] *Communication Access for Land Mobiles (ISO Standard) Media Adapted Interface Layer*
[8] *https://halshs.archives-ouvertes.fr/halshs-01069813/file/handbook_sugar_1.pdf*

- cases that are currently operating or have been operating for a long enough time to draw relevant conclusions (best practice are NOT drawing table projects or very recent experiments);
- cases that have a sustainable business model (whether public/private or both) and depend upon financial sources that are time-limited; and
- cases that have an (evaluated) impact.

On top of the above definition to capture best practice cases, the SUGAR project also defined 7 categories of cases, based on 'actions' typology (field action of application):

- Administrative actions;
- Urban planning;
- Governance;
- Infrastructure;
- ITS & technical;
- Modelling;
- Supply chain; and
- Information.

44 urban freight cases (19 were based on SUGAR partners' cities, while 25 were not) were reported in the final SUGAR handbook, analysed by objectives type (please see the list below), target groups (private, public, or PPP), territorial level (local, regional, metropolitan, or national), and policy promoting bodies (city, or national). The objectives typology is six fold:

- Efficient infrastructure use;
- Emission and pollution reduction;
- Improving supply chain;
- Improving city attractiveness;
- Decreasing congestion;
- Reducing interference between freight and passenger flows.

Table 5 shows the list of transport policies / measures that arose from SUGAR cases.

Table 5 SUGAR project's existing transport policy measures (extracted from SUGAR, 2011)

Transport Policy / Measures	Cities implementing the measures
Administrative measures	
Access regulations based on delivery time window	**Paris, London, RER, Athens, Celje, Crete, Palma, Poznan, Vratsa**
Access regulations based on emission standards	**Paris London, RER, Poznan**

Transport Policy / Measures	Cities implementing the measures
Access regulations based on loading/unloading time	Paris, London, Athens, Crete, Palma
On-street loading bays	Paris, Athens, Palma
Off-street loading bays	Paris
Urban Consolidation Centre (UCC)	RER
Lorry routes	RER, Athens, Crete, Palma, Usti, Vratsa
Signing	Paris, RER, Athens, Crete, Palma, Usti
Lorry Lanes	Paris
Tax reductions and advantages for environmental fuels and filters technology	RER
Incentives for Environmentally Friendly Vehicle (EFV) buying	RER
Pedestrian areas	Paris, Athens, Celje, Crete, Palma, Poznan, Vratsa
Harmonisation of regulations	Paris, RER
Fuel stations for EVF	RER
Night deliveries regulations and enforcing	Athens, Celje, Poznan
Noise regulation	Athens, Crete, Palma, Usti
Road charging systems	Poznan
Parking pricing	Athens, Celje, Poznan, Vratsa
City logistics monitoring	RER
Public bodies training	RER
Urban planning measures	
On street loading bays	RER, Athens, Crete, Palma
Integrative transport plan for passenger and goods traffic	Paris, RER, Poznan
UCC	Palma
Pedestrian areas	Athens, Celje, Crete, Vratsa
Governance measures	
Public Private Partnership (PPP)	Paris
Cooperation among municipalities in city logistics	RER, Athens, Crete

Transport Policy / Measures	Cities implementing the measures
Awareness	
Freight transport awareness campaigns	Athens, Crete
Infrastructural measures	
Urban Consolidation Centre (UCC)	RER
Espace Logistique de Proximite (ELS)	Paris
Loading / unloading areas	Palma
Parking	Athens, Celje, Crete, Poznan
ITS and technical measures	
Freight transport management systems and technologies	RER
Noise techniques and equipment financing	RER
Traffic management systems	RER, Athens, Crete, Poznan, Usti
Traffic detection techniques	RER, Celje, Poznan, Usti
Rail transport for city logistics	Paris
Environmentally friendly vehicles and fuels	Celje, Poznan
Technologies for control and enforcement	Celje
Modelling tools measures	
Data acquisition and analysis	Paris, RER, Athens, Palma, Poznan, Vratsa
Modelling city logistics for solution definition	Athens, Crete
Traffic detection techniques	Athens
Supply chain management measures	
UCC and distribution channels	RER
Van sharing	RER
Night deliveries	Athens
Freight transport management systems and technologies	RER
Information measures	
Websites	Paris, RER
Signing (informing), conventional VMS	Athens

Transport Policy / Measures	Cities implementing the measures

2.6 TURBLOG (2009-2011)

The FP7 funded TURBLOG[9] project aimed to extend, expand and transfer existing knowledge from European urban logistics experience (e.g. BESTUFS, CIVITAS) to other countries globally, but with a particular focus towards Latin America. The TURBLOG project acted as a coordination and action support platform with key objectives:

- To provide an international network of experts and a platform for the exchange of ideas, information and policies on the urban logistics fields;
- To select a number of case studies for potential transferability;
- To compare different business concepts and models across the selected case studies;
- To develop transferability guidelines targeting each type of city logistics stakeholder.

The TURBLOG project introduced a number of concepts to characterise urban logistics issues: "Stakeholder" typology (Table 6), "Logistic Profile" typology (please see Section 4 for further detail) and steps to evaluate cities based on urban logistics characteristics. It should be noted that the TURBLOG approach focussed on defining urban logistics concepts and transferability (as opposed to Best Practices approach discussed in other projects such as BESTUFS, BESTFACT or SUGAR).

Table 6: TURBLOG urban logistics' Stakeholder typology (extracted from TURBLOG, 2011)

Stakeholder	Role	Main concerns	Needs
Supplier/ Producer	**Production of things for sale**	**Profitability**	**Deliver product to customers in perfect condition**
Urban logistics operators/ service	**Distribution, warehousing, and other support**	**Profits, stock management and performance**	**Availability of loading/ unloading parking spaces, EFV investment**
Public authorities	**Enforcing and promoting regulations; traffic management; land use management**	**Consensus building among urban logistics stakeholders**	**Addressing social and environmental impacts of freight movements; improving public Quality of Life (QoL)**

[9] *http://www.turblog.eu/*

Retailers/ Customers	**End receiver of product / service**	**Have deliveries according Purchase Order**	**Have accessible, punctual and reliable delivery with the expected quality**
Citizens	**Society at large becoming more and more aware of urban environment issues**	**Road safety and time spent on congestion and pollution (air/noise)**	**Good quality of space, and healthy environment with acceptable pollution level**

TURBLOG defined 10 steps to evaluate a city and to transfer good practice:

1. Diagnosis of the problems;
2. Characterisation of the city;
3. Analysis of the city context and implications of problems identified;
4. Looking around for similar contexts;
5. Selecting examples of origin/sources urban context;
6. Identifying measures with potential for transferring;
7. Packaging and dimensioning the measures for transferring;
8. Ex-ante assessment of measures to transfer;
9. Identifying a need for adjustment;
10. Implementing measures and steering results.

9 case study cities were evaluated based on the above typologies, drawing out a number of city logistics measures / interventions, as can be seen in Table 7:

Table 7: TURBLOG case study cities and city logistics measures

Transport policy measures / established business models	City
Freight Oriented Urban Master Plan	Paris
Chronopost (postal delivery service)	Paris
Monoprix Rail project (supermarket chain using rail)	Paris
La petite Reine (parcel delivery service, perishable goods)	Paris
Low Emission Zone	Utrecht
The City Distribution Centre (UCC)	Utrecht
The Beer Boat (cargo delivery with boat)	Utrecht
Cargohopper (cargo delivery with environmentally friendly road rail vehicle)	Utrecht

Transport policy measures / established business models	City
Loading and unloading spaces	**Belo Horizonte**
Lorry route	**Belo Horizonte**
Public policies for urban logistics	**Mexico City**
Albertis Logistics Park (Urban Consolidation Centre)	**Santiago de Chile**
Shinjuku joint delivery systems	**Tokyo**
Beijing Tobacco Logistics Centre (distribution system)	**Beijing**
Off-hour delivery programme	**New York**
The Mumbai Dabbawalas (catering distribution system)	**Mumbai**

2.7 FREILOT (2009-2012)

The EU-ICT Policy Support Programme (PSP) funded the **Urban Freight Energy Efficiency Pilot** (FREILOT[10]) project, aimed at increasing the energy efficiency of urban freight through the deployment of Intelligent Transport Systems (ITS). The ITS targeted traffic control (energy efficiency optimised intersections); vehicles (adaptive acceleration/speed limiter); drivers (enhanced eco-driving support); and fleet operators (real-time delivery space booking). Four cities were piloted: Lyon (France); Helmond (the Netherlands); Krakow (Poland); and Bilbao (Spain), with the combination of the measures shown in Table 8.

Table 8: FREILOT city logistics cases

Measures	Lyon	Helmond	Krakow	Bilbao
Intersection control	✓	✓	✓	
Acceleration/speed limiter	✓	✓		✓
Eco-driving support	✓	✓	✓	✓
Delivery space booking	✓			✓

[10] *http://www.transport-research.info/project/urban-freight-energy-efficiency-pilot*

2.8 CITYLOG (2010-2012)

The EU-FP7 funded **Sustainability and Efficiency of City Logistics** (CITYLOG[11]) project aimed at increasing the sustainability and the efficiency of urban delivery of goods, through adaptive and integrated mission management and innovative vehicle solutions. CITYLOG drew attention to three types of technology domain that can improve city logistics system:

- Logistics-oriented telematics service, expected to make a decisive contribution to improving mission planning processes through optimised routing and driver support systems; 4 solutions were formulated:
    - Pre-trip planner;
    - Dynamic navigation service;
    - Last mile tracking service; and
    - Additional map attributes.
- Vehicle technologies that are expected to increase the operational flexibility of lorries and vans; 2 solutions were drawn:
    - Delivery van;
    - Freight bus.
- Innovative load units, carefully designed to operate, like the vehicles, to suit different missions; 2 solutions were formulated:
    - Bentobox (packstation);
    - Basic container solutions.

CITYLOG demonstrated the application of some of the above technologies, at three test sites: Berlin, Germany; Lyon, France; and Turin (Regione Piemonte), Italy. From its application/demonstration across the three sites, CITYLOG was able to promote the adoption of city logistics supporting technologies in the form of:

- Dynamic navigation server;
- On-board telematics unit;
- Delivery van (equipped with a telematics unit and a pedestrian detection system);
- Freight bus (with interoperable load units and vulnerable road user detention system);
- Static and dynamic map attribute;
- Pre-trip planner;
- Real-time information message service;
- Bentobox (a pack-station which allow great flexibility in the delivery process by separating courier driver activity and the receiver activity); and
- Transhipment concept, combining any of the above measures.

[11] *http://www.transport-research.info/project/sustainability-and-efficiency-city-logistics*

2.9 C-LIEGE (2011-2013)

The **Clean Last Mile Transport and Logistics Management** (C-LIEGE[12]) project was a showcase for good practices, with the aim to define an integrated framework for energy efficient UFT management and planning. The project was funded by the Intelligent Energy Europe (IEE) programme of the EU, to address clean and energy efficient UFT in European cities. The project drew attention to a number of key issues linked to the current EU transport policy agenda:

- Transport related energy consumption is estimated to grow by 30% by 2030;
- Half of all road transport fuel is combusted in urban areas;
- The European Council has set a target to reduce European greenhouse gas emissions by 20%, by 2020;
- The negative impacts of urban goods distribution are mainly caused by the vehicles used (e.g. diesel powered) and low system efficiency (e.g. low loading factor, lack of cooperation);
- Accessibility in urban areas remains a vital issue, as well as local policy.

The C-LIEGE project promoted a methodology to adopt city logistics measure based on "push and pull" demand oriented measures. A "push" measure is one that is imposed on operators, with a view to influencing delivery or operational practice; these can be divided into financial instruments (e.g. higher parking charges, road tolls, etc.) and technical and regulatory constraints (e.g. access restrictions). A "pull" measure is designed to encourage more sustainable and energy-efficient freight traffic, by offering various additional services (e.g. improved mapping), facilities (e.g. preferential access to leading bays for 'clean' vehicles), or incentives (e.g. access to priority lanes) to operators or shippers. Seven pilot cities, across six European Countries, experimented with such measures.

The C-LIEGE project established a number of key components towards the development of roadmaps for local government (in the form of transferability plans) to adopt city logistics measures. C-LIEGE components include:

- Good practices (identifying and evaluating existing UFT implemented in European cities);
- Stakeholder (engagement) manual (description of UFT key stakeholders and the engagement process);
- Toolbox (a decision support tool for Local Authorities to plan, implement and monitor appropriate push and pull measures of integrated and energy-efficient freight transport demand management and planning, in urban areas, and to establish the functions and roles of a City Logistics Manager, supporting EU promotion of the decarbonisation of European cities and regions);

[12] *http://www.c-liege.eu/*

- Guidelines for an urban freight mobility plan (description of how UFT can be included in the urban mobility plan);
- Push and pull measures database (45 measures of push and pull freight transport demand-oriented measures);
- Quality partnership (description of freight partnership establishment within C-LIEGE pilot cities);
- EU action plan (analysis of UFT policies towards EU level transport policy);
- Roadmap for local governments (transferability plan for local governments).

The 45 push and pull C-LIEGE measures derived from reviewing 98 city logistics cases (including many EU funded projects) across European cities, categorised into 'soft' and 'hard' measures. Soft measures implied relatively low cost investment (regulatory and governance interventions), while hard measures implied relatively high cost investment (infrastructural and technological interventions). Table 9 shows the list of measures collected in the C-LIEGE project.

Table 9: C-LIEGE measures

Measures	Category	Cities
Push measures		
Distribution Plans to reduce frequency of deliveries in public procurement	Organisational, awareness, governance	UK cities
Time window restrictions	Administrative (access restriction)	Bristol, Amsterdam, Barcelona, Bologna
Mobility credit	Financial (congestion charging)	Genoa
Electronic access control	Financial (congestion charge)	Genoa
Environmental zones	Administrative (Low Emission Zone)	Utrecht, Lisbon, Aalborg, Burgos, London, Bremen
Freight noise mapping	Organisational	Bradford
Night deliveries	Organisational (alternative delivery time)	Barcelona
Using building code regulations for off-street delivery areas	Urban planning (conditioned)	Paris
Access restrictions for polluting freight vehicles	Administrative (access restrictions)	London, Paris, Utrecht (adopting LEZ)

Measures	Category	Cities
Pull measures		
Local freight development plans	Administrative, awareness, governance	Bologna
Free-to-use loading bays	Administrative (access incentives)	Widely adopted in EU cities
Free access to public transport lanes	Administrative (access incentives)	Newcastle
Changing traffic regulations to improve freight access	Administrative, awareness, governance	
Financial support for fleet conversion	Awareness (promotional and awareness campaign)	Ravenna
Enactment of access "time windows"	Administrative (access incentives)	Ravenna
Allocation of additional freight parking spaces	Administrative (access incentives)	Ravenna
Ad-hoc routes for freight distribution	Administrative, organisational	Ravenna
Optimising leasing models for clean freight vehicles	Financial (vehicle financing models)	Berlin
Real-time loading space booking	Administrative (advance booking system)	Bilbao
Priority for lorries at selected junctions	Technical (intelligent freight traffic routing)	
ICT support for eco driving	Technical (IT logistics tools), awareness (eco-driving	
Van sharing	Organisational, awareness	Genoa, widely adopted (similar to UCC application)
Collect points	Organisational (alternative delivery systems), awareness	Winchester (negative result)
Pack stations	Organisational, awareness	Szczecin
Freight exchange	Organisational (alternative delivery systems) , technical	

Measures	Category	Cities
Freight map for appropriate routes and vehicular restrictions	Organisational (freight traffic routing info)	
Web-based market place	Technical (IT logistics tools), awareness	
Computer simulation demonstrating efficient distribution of goods		
Online routing tool		
Web promotion of sustainable city logistics		
Virtual Distribution Centre	Technical, awareness	Singapore
Web service to manage preferred delivery locations and times	Technical	
Algorithm to plan deliveries when unexpected events take place	Technical	
Systems for assessments of UFT impacts	Technical	
Signposting freight routes	Organisational	Generally applied
Freight Quality Partnership (FQP)	Governance	London, Paris, Gothenburg
Freight Operators Recognition Schemes (FORS)	Awareness	UK cities
Eco-driver training	Awareness	UK cities
Push-and-pull measures		
Inclusion of freight in urban mobility plan	Administrative, financial, organisational, technical, awareness, governance, urban planning	

Measures	Category	Cities
Construction logistics plan	Administrative, organisational awareness, governance	London
Charging for distribution operations in central areas	Administrative, financial	
Delivery and Servicing Plans	Administrative, organisational	London, Newcastle
Mobility master plans	Governance	UK cities (Local Transport Plan)
Technical guidelines for delivery spaces	Organisational	
Multi-user lanes	Organisational	

2.10 STRAIGHTSOL (2011-2014)

The EU-FP7 funded project **Strategies and Measures for Smarter Urban Freight Solutions** (STRAIGHTSOL[13]) was launched to:

- develop a new impact assessment framework for measures applied to urban-interurban freight transport interfaces;
- support a set of innovative field demonstrations, effectively showcasing improved urban-interurban freight operations in Europe; and
- apply the impact assessment framework to the live demonstrations and develop specific recommendations for future freight policies and measures.

Seven demonstration sites, based on real business case adopted by industry (companies) were drawn up for evaluation towards better understanding of adopting smarter urban freight solutions. The STRAIGHTSOL cases adopted a number of research methods, including:

- quantification of socio-economic and environmental impact;
- multi actor, multi criteria analysis;
- cost benefit analysis.

[13] *http://www.straightsol.eu/*

STRAIGHTSOL found that many methodologies, policies and measures utilised in any one of the demonstration sites, were either already common with, or could be applied to, other demonstration cases. Freight transport urban logistics solutions were grouped into 4 concepts:

1. Urban Consolidation Centre concept;
2. Clean vehicles concept;
3. Supply chain monitoring concept;
4. UFT management concept.

Table 10 shows the measures used by STRAIGHTSOL industry partners.

Table 10: STRAIGHTSOL city logistics cases

Measures	Business entity	Location and City
Urban consolidation centre	DHL (Supply Chain management)	L'Hospitalet de Llobregat, Barcelona
Mobile depot	TNT Express (parcel shipper)	Brussels
Remote 'bring-site' monitoring donation banks	Oxfam (Charity)	(near) London
Rail tracking and warehouse management	Kuehne + Nagel (Shipper)	Thessaloniki
Retail supply management and last mile distribution	GS1 (retail supply management)	Oslo
Loading/unloading operations management and regulation	EMEL (Public Municipal for Parking and Mobility)	Lisbon
Night time deliveries	Colruyt and Delhaize (retail chain)	Brussels

2.11 BESTFACT (2012-2015)

The BESTFACT[14] project built on the work of the two BESTUFS projects, reported in section 2.1, the EU-FP6 funded **Promote Innovative Intermodal Freight Transport** (PROMIT[15]) project, and

[14] *http://www.bestfact.net/*
[15] *http://www.transport-research.info/project/promote-innovative-intermodal-freight-transport*

BESTLOG[16] (EU-FP6 **Logistics Best Practice**). It is a coordination and support action project addressing EU freight transportation challenges including:

- Increasing competitive pressure in the global economy;
- Growing congestion and poorer accessibility (infrastructure gap in the enlarged EU);
- Increasing oil price / persistent oil dependency; and
- Deteriorating climate change and local environment.

The objective of the BESTFACT project was to develop, disseminate and enhance the utilisation of best practices and innovations, in freight transport, that contribute to meeting European transport policy objectives with regard to competitiveness and environmental impact. Three working clusters were established, to identify, collect and process information and knowledge to address three particular areas:

- Cluster 1: UFT
- Cluster 2: Green Logistics and Co-modality
- Cluster 3: eFreight

The above three clusters were chosen as they represent the most pressing issues in freight transport and logistics in terms of economic, social and environmental sustainability, as well as being closely linked to important innovations and developments in freight service provision to meet the needs of European economies. They are also at the core of the Freight Transport Logistics Action Plan (European Commission, 2007). Similar to the BESTFUFS project (see section 2.1), the central aspect of the project is the identification and promotion of best practices that are characterised by the following four core attributes:

- **Innovation and feasibility**: Best practice provides an innovative and feasible approach beyond the common practice. Solutions include products, processes, services, technologies, or ideas that are more effective than previous ones and are accepted by markets, governments, and society.
- **Strategic focus**: Best practice addresses both business and policy objectives. It provides value across actor groups and addresses current challenges and problems.
- **Impact**: Best practices have considerable and measureable positive effects on strategic business and policy targets.
- **Transferability**: Best practice should be transferable to other companies, initiatives or contexts.

BESTFACT adopted a two-stage approach to considering running best practices and to fostering further development. The two stages of best practices are:

[16] *http://www.transport-research.info/project/logistics-best-practice*

- **Evolving Best Practice**: cases with best practice core attributes (as described above) that have been implemented and have demonstrated a high potential for positive impacts and transfer to other regions. Monitoring and evaluation are still in place for these cases.
- **Best Practice**: follows widely the above definition, but requires a matured stage of development that demonstrates proof of its transferability, through implementation outside its original field.

The review in this deliverable focusses merely on the urban freight cluster. A total of 93 cases were reviewed, 15 of which were selected and reported in BESTFACT Handbook 1 (BESTFACT, 2013). Additional cases were drawn and reported in BESTFACT Handbook 2 (BESTFACT, 2015a) and Handbook 3 (BESTFACT, 2015b), totalling 44 cases for the urban freight cluster, 17 of which were analysed in depth, due to the successful business model nature of the cases. Table 11 shows the list of cases from the BESTFACT project.

Table 11 BESTFACT urban freight cases (extracted from BESTFACT, 2013, 2015a, 2015b)

Transport Policy / Measures	City Logistics Solutions	Business Models	Example of cities
Consolidation centres and clean vehicles			
Micro UCC[17] + EV[18] and Electric tricycles	**Best Practice**	**Gnewt Cargo**	**London**
EV (Mercedes Vito E-Cell) use in parcels deliveries	**Evolving Best Practice**	**DPD**	**Stuttgart-Ludwigsburg**
EV use in large urban distribution network	**Evolving Best Practice**	**Distripolis**	**French cities**
UCC + 11 LNG-powered vans	**Best Practice**	**Cityporto**	**Padova**
Solar powered narrow 16m-long road train multi-trailer	**Best Practice**	**Cargohopper**	**Utrecht**
UCC through agreement and consent by city shops	**Best Practice**	**Binnenstad-service**	**Dutch cities**
Inner city distribution with lockers + cargo bike	**Evolving Best Practice**	**Bento Box (FP7-CityLog)**	**Berlin**
Efficient use of public street space with routing and loading bay management			

[17] *Urban Consolidation Centre*
[18] *Electric Vehicle*

Transport Policy / Measures	City Logistics Solutions	Business Models	Example of cities
Intelligent freight logistics w/ Floating Car Data	**Evolving Best Practice**	**Optimisation with new data trial**	**Vienna**
Loading bay availability information service	**Evolving Best Practice**	**Optimisation with new data trial**	**Vienna**
Multiuse lane for freight distribution	**Best Practice**	**Road space/ Parking management by the city**	**Bilbao**
Delivery Management			
Trade fairs efficient delivery system	**Best Practice**	**Efficient delivery syst.**	**Basel**
Urban distribution centres network of 4 major retailers	**Best Practice**	**Collaborative logistics**	**Lithuanian cities**
Waste Management			
Optimised route via algorithm and GIS	**Best Practice**	**Optimisation of travel distance**	**Maribor**
Modal Shift			
Zero emission boat (formerly known as beer boat)	**Best Practice**	**4 breweries and 1 catering to 65 clients along canals**	**Utrecht**
Waterways cargo delivery for chain supermarket	**Evolving Best Practice**	**Franprix en Seine w/ Norbert Dentressangle**	**Paris**
Urban Consolidation centres			
Distribution service to temper historic city centre and LTZ[19]	**Tactical (evolving BP)**	**EcoLogis**	**Brescia**
City Logistics (CL) initiative (Stadleveransen, similar to binnestadservice in NL)	**Strategic BP (matured)**	**City authority**	**Gothenburg**

[19] *Limited Traffic Zone*

Transport Policy / Measures	City Logistics Solutions	Business Models	Example of cities
City Logistics Initiative	**Strategic BP (evolving)**	**City authority**	**Copenhagen**
Electric vehicle distribution			
Micro UCC (green hubs) + EV vans / cargo cycles	**Best Practice**	**The Green Link (TNT/Fed-Ex)**	**Paris**
Micro UCC + Electric cargo cycles	**Best Practice**	**City + Txita**	**San Sebastian**
Electrically assisted cargo tricycles / EV vans for purchases from stores to consumers	**Best practice**	**La petite Reine**	**Paris**
E-Cargo bikes for catering	**Best practice**	**MarleenKookt**	**Amsterdam**
A few more evolving cases of EV / cargo bikes last mile delivery	**Evolving best practice**	**Emakers; Citylog EMF; UPS**	**Karlsruhe**
Parcel distribution infrastructure			
Self-service terminal for parcel services	**Tactical**	**LP EXPRESS 24**	
Receiving box with RFID card for notification to customers	**Tactical**	**Post receiving box**	
Delivery policy and other measures			
Adapted parking meters and loading bay detention sensors	**Operational**	**Transport Authority**	**Lisbon**
Cooperative system for freight management and regulation	**Demo**	**SINTEF Experiment**	**Trondheim**
Freight Operators Recognition Scheme (FORS)	**Tactical**	**Transport for London**	**London**
Lean & Green (sustainable mobility recognition network)	**Tactical**	**Connekt network**	**European logistics industry**

2.12 SMARTFUSION (2012-2015)

The EU-FP7 **Smart Urban Freight Solutions** (Smartfusion[20]) project was a public-private partnership (PPP) focussed project which built upon the existing urban freight development strategies of three demonstration city-regions: Newcastle, UK; Berlin, Germany; and Como, Lombardi region, Italy. The project aimed to:

- introduce the concept of the European Green Car Initiative in last mile operations;
- introduce innovative technology developments in the field of urban freight planning, vehicles and urban-interurban transhipment; and
- develop comprehensive and transferrable impact assessment models for smart urban freight solutions.

Smartfusion adopted a number of methods to comprehend the urban freight demonstration sites:

- Logical Framework Approach to establish a participatory consultation process with city logistics key stakeholders;
- Innovation and development demonstration to address the consulted objectives and internal goals of the private partners, broken down into 4 main sectors: vehicle innovation; green planning and routing; urban-interurban logistics innovation; and policy innovation;
- Impact assessment to deliver a harmonised and standardised analysis of the demonstrations.

Table 12 shows the list of transport policies / measures adopted in Smartfusion cities.

Table 12: Smartfusion city logistics cases

Measures	Business model and operation management	City
Urban consolidation centre	**Newcastle University contract to Clipper Logistics for UCC service before last mile delivery**	**Newcastle**
Electric truck for last mile delivery	**Newcastle University procured EV to deliver goods consolidated at Clipper Logistics**	**Newcastle**
Delivery and Servicing Plan (receiver-led initiative)	**Newcastle University (purchasing function) organised last mile delivery consolidation internally and with suppliers**	**Newcastle**
Coherent Campus built environment (pedestrianisation)	**Newcastle University consulted with all stakeholders about limited vehicle access to Campus**	**Newcastle**

[20] *http://www.smartfusion.eu/*

Measures	Business model and operation management	City
Urban consolidation centre	**Como City and Lombardy Region consulted with city shops to use UCC 'Merci in Centro'**	**Como**
Electric van for last mile delivery	**IVECO (Fiat) provided EV for entering city centre with Limited Traffic Zone (LTZ)**	**Como**
Limited Traffic Zone	**Como City consulted with city shops to adopt UCC with EV to deliver clean last mile logistics**	**Como**
Hybrid Electric truck	**Berlin Senate allied with Freight terminal (BEHALA) to adopt clean last mile with hybrid truck (VOLVO) to avoid pollution in sensitive areas (corridors)**	**Berlin**
Route planning tool	**Operation of hybrid EV truck supported by a route planning tool that can automatically switch the engine into full electric mode in sensitive zones (e.g. school)**	**Berlin**

2.13 SMILE (2013-2015)

The EU-MED PROGRAMME funded the **Smart Green Innovative Urban Logistics for Energy Efficient Mediterranean Cities** (SMILE[21]) project, aimed at increasing major stakeholders' knowledge of the strong impact urban logistics can bring to bear on energy efficiency development. SMILE focussed on the development and implementation of innovative strategies, plans and measures for energy efficient mobility solutions, utilising available technologies, and building upon previous experiences, as well as on-going initiatives regarding technical, cost and other related issues. The SMILE project involved 6 cities in the Mediterranean (MED) region, across 5 countries: Montpelier (France); Bologna (Italy); Barcelona and Valencia (Spain); Piraeus (Greece); and Rijeka (Croatia).

Among the methods used in SMILE were:

- Modelling, measuring and assessing urban freight state-of-the-art needs and performances, through Key Performance Indicators (KPI development);
- Defining transferrable strategies, plans and measures, for innovative, energy efficient urban transport solutions, through Cost Benefit Analysis (CBA); and
- Testing smart urban logistics solutions, through the development of pilot demonstration activities.

[21] *http://smile-urbanlogistics.eu/*

A key objective of smart cities was the development and implementation of intelligent and sustainable mobility solutions. The SMILE project aimed to improve the energy efficiency of Mediterranean cities through the promotion of innovative 'green' and cost effective solutions for urban freight logistics, addressing the target of green and smart urban development set up by the EU[22]. Table 13 shows the list of measures adopted in each SMILE city.

Table 13: SMILE city logistics cases

Measures	SMILE remark	City
Electric mobility and urban consolidation centre		
Parcel distribution with UCC and electrically assisted tricycles	**Adopting the success story of Barcelona through public sector support**	**Valencia (pop: 1M, port city)**
Transhipment terminal and e-tricycles (cargo bikes)	**As part of Sustainable Urban mobility Plan 2013-2018 with 9 actions on urban distribution of goods (VanAPEDAL delivering for TNT, DHL, etc.)**	**Barcelona (pop: >4M, port city)**
Electric bikes and mobile depots (QUADEO)	**Supporting La poste for postal distribution service with civil engineering works (electric socket and parking)**	**Montpellier (pop: 225k)**
ICT tools for efficient urban logistics		
Automatic retractable bollards	**Despite successful demonstration, cooperation with carriers still an issue**	**Piraeus (pop: 170k, port city)**
Automatic bollards	**Operated as entrance control into the pedestrian zone**	**Rijeka (pop: 140k, port city)**
Operative tools for efficient urban logistics		
Reorganisation of waste collection	**Optimisation of routes (saving travel distance)**	**Piraeus**
Waste collection optimisation	**Process management and software application (OptiRoute)**	**Bologna (pop: 1M)**
Marketing tools for efficient urban logistics (Green Labelling)		
Recognition scheme	**Challenged by the involvement of logistics companies (due to voluntary nature of the scheme)**	**Valencia**

[22] *http://ec.europa.eu/clima/policies/strategies/2020/index_en.htm*

Measures	SMILE remark	City
Objectif CO_2 (recognition scheme)	**Despite successful promotion and adoption by the region, the city, with its changing regime, could not easily enforce such a scheme**	**Montpellier**

2.14 SMARTSET (2013-2016)

Sustainable Market driven Terminal Solutions for Efficient Freight Transport (SMARTSET[23]) addressed the need to create and showcase new and innovative solutions for improving the attractiveness of terminals, both for long distance transport and 'last mile' distribution, in city centres. The project aim was to reduce both congestion and energy consumption and to create economically viable business models with the potential to operate fully without any public funding.

The SMARTSET project was structured around three core aspects for creating successful and attractive terminals:

1. Cooperative (market based) business models (through organisational structures, processes and systems) which will create new horizontal solutions for UFT;
2. Regulations and incentives which will alter transport demand in favour of terminals; and
3. Energy efficient vehicles which will significantly reduce the energy consumption of both long distance transport and urban distribution.

Funded through Intelligent Energy Europe (IEE), the SMARTSET project provided examples of good practice that can support cities, regions and countries to contribute to the EU 20-20-20 climate and energy package goals:

- 20% cut in greenhouse gas emissions (from 1990 levels);
- 20% of EU energy from renewables; and
- 20% improvement in energy efficiency.

8 cities, from 6 countries, were evaluated to demonstrate the variety of energy-efficient UFT and concrete actions, centred on the use of an urban freight terminal for consolidating large volumes of freight, improving the access and attractiveness to major transport interchanges, and limiting individual freight deliveries. Table 14 shows the list of measures used in SMARTSET cities.

[23] *http://smartset-project.eu/*

Table 14: SMARTSET city logistics cases

Measures	Typology	Cities
Intermodal city terminal (by rail) via:	Modal shift	Berlin
National funding for intermodal freight		
Low emission zone		
Noise-based speed limitation		
UCC + EV introduction via Freight Quality Partnership	Freight planning	Forli
Access control		
Pedestrian area		
Micro UCC + EV introduction for perishable goods (fish market)	Freight planning + new market	Gothenburg
Time window		
Pedestrian zone		
Cargo bike / EV delivery (shops to customers)	Delivery plan	Graz
Pedestrian area		
UCC + EV via procurement (receiver) policy	Delivery and service plan	Newcastle
Designated loading / unloading bays		
UCC service to include express parcels and controlled temperature goods (perishable goods/medicine)	New market for multimodal freight village	Padova
Time window		
Pedestrian zone		
UFT introduction to targeted pedestrianised zone (w/ LTZ) via: EV, hybrid EV, and micro UCC	Combination: regulation and incentives	Rome
Access charges		
Time window		
Incentives for use of energy efficient vehicles		

Measures	Typology	Cities
Rail (combi) terminal with no support by incentive/regulation	**Modal shift**	**Sundsvall**

2.15 CO-GISTICS (2014-2016)

The EU Competitive and Innovation Programme (CIP) funded the **Cooperative Logistics for Sustainable Mobility of Goods** (CO-GISTICS[24]) project, which was the first European project that was fully dedicated to the deployment of cooperative intelligent transport systems (ITS) focused on logistics. CO-GISTICS objectives were:

- To pilot and to deploy cooperative ITS in European logistics hubs (cities);
- To reduce fuel consumption and the associated CO_2 emissions;
- To improve logistics activities efficiency in urban areas;
- To harmonise testing and drive forward interoperability; and
- To cooperate with logistics and freight public/private bodies.

The CO-GISTICS project recognised the vast number of technologies already available to manage different aspects of goods movement, but with no link to one another and therefore missing the opportunity to optimise the performance of their coordination. Five services of cooperative ITS were deployed across seven cities: Arad (Romania); Bilbao and Vigo (Spain); Bordeaux (France); Frankfurt (Germany); Thessaloniki (Greece); and Trieste (Italy) (Table 15). The services were targeted at key city logistics stakeholders, such as truck drivers, fleet operators, terminal operators, service providers, local/public authorities, and infrastructure operators. The aim was to:

- optimise traffic activities on the route and reduce stops (via real time information on parking availability and provision; the optimisation of truck stops; and the route, queues and delivery);
- optimise and increase the efficiency of cargo transport operations (via planning support and synchronisation between different logistics operations with real time information on delivery);
- use GPS data or CANBUS related data to measure fuel consumption (capturing CO_2 emissions and creating a standard/benchmark);
- use cooperative ITS at (road) intersections to indicate the speed to reduce the number of stops and acceleration (supporting driver with information on speed and therefore reducing fuel consumption);

[24] *http://cogistics.eu/*

- use cooperative ITS to provide time to red/green light at intersections (supporting driver to adopt energy efficient driving style, reducing acceleration and braking).

Table 15: CO-GISTICS deployed measures

Measures	Arad	Bilbao	Bordeaux	Frankfurt	Thessaloniki	Trieste	Vigo
Intelligent truck parking and delivery areas management	✓			✓			✓
Cargo transport optimisation			✓		✓	✓	
CO_2 footprint monitoring and estimation	✓	✓		✓	✓		✓
Priority and speed service	✓		✓		✓	✓	✓
Eco-driving support	✓	✓		✓	✓	✓	✓

2.16 OTHER PROJECTS

Alongside the above reviewed city logistics projects, that have strong links to NOVELOG and its key partners, there are further projects that can be linked to city logistics cases which, while lacking a specific city logistics focus, nevertheless contain within them elements of city logistics. Some of these have not been experienced first-hand by NOVELOG partners.

2.16.1 MOSCA (2001-2003)

The EU-FP5 funded **Decision Support System for Integrated Door-to-Door Delivery: Planning and Control in Logistics Chains** (MOSCA[25]) project was motivated to provide a sophisticated technology that allows the actors involved to collaborate on urban freight distribution. MOSCA project objectives were to provide a set of tools for improving efficiency of door to door transport of goods in urban areas by collaboratively providing demand and supply side information in one single environment/system. MOSCA's set of tools implemented modelling services for shortest path finding, vehicle route planning, on-line vehicle route planning, and urban shop delivery planning. The project

[25] *http://www.transport-research.info/project/decision-support-system-integrated-door-door-delivery-planning-and-control-logistic-chains*

outputs were a validated prototype of demand services and integrated supply-oriented traffic and transport model, together with a user-oriented decision support system (DSS).

Four cites were used to test MOSCA (model) modules: Stuttgart and Chemnitz (Germany); Padova (Italy); and Lugano (Switzerland).

2.16.2 NICHES (2004-2007)

The EU-FP6 funded **New and Innovative Concepts for Helping European transport Sustainability** (NICHES[26]) project was a coordination and support action which facilitated networking among urban transport stakeholders and promoted the uptake of 12 innovative urban transport concepts, throughout Europe. NICHES was followed by NICHES+[27] (EU-FP7 funded follow up project towards NICHES implementation). Four working groups were established to cover those innovations in four thematic areas, one of which was dedicated to city logistics innovative approaches (Table 16). The others were: new seamless mobility services (where measures concepts were: urban lift-sharing services, public bicycles, call-a-bus services); new non-polluting and energy-efficient vehicles (i.e. policy strategy for clean vehicles, biogas in captive fleets, and joint procurement of clean vehicles); and innovative demand management strategies (transportation management association, road pricing schemes, and city-wide campaigns).

Table 16: NICHES innovative UFT concepts

UFT concepts	UFT measures	Cities
Space management for urban delivery		
	Multi use lane with VMS technology	**Barcelona, Cologne**
	Espace de Livraison de Proximite (ELP)	**Bordeaux, Rouen**
	Environmental loading zone (Umweltladepunkt)	**Bremen**
	Access restriction with EV	**La Rochelle**
	Mobile depot (bus) with walking delivery	**Dublin**
	Logistics park	**Monaco / Nice**
	Loading zones	**Berlin**
Inner city night delivery		
	Night delivery scheme	**Barcelona, Dublin**

[26] *http://www.transport-research.info/project/new-and-innovative-concepts-helping-european-transport-sustainability*
[27] *http://www.transport-research.info/project/new-and-innovative-concepts-helping-european-ttransport-sustainability-towards*

UFT concepts	UFT measures	Cities
	Low noise equipment with alternative fuelled vehicle	**Barcelona**
	Power socket above the pavement for van's refrigerating set can be turned on without having to keep the engine running	**Lyon**
	PIEK programme (noise regulation)	**Dutch cities**
Alternative solutions for home delivery		
	Packstation by DHL (free locker box service)	**German cities**
	E-Box boutique (in-door locker box)	**Paris**
	Locker bank ('Not in Home' trial, ceased)	**Some UK cities**

2.16.3 CLOSER (2010-2012)

The EU-FP7 funded **Connecting Long and Short-distance Networks for Efficient Transport** (CLOSER[28]) project addressed the concept of co-modality (efficient use of different transport modes on their own, as well as in combination), promoted by the EU as an essential instrument to achieve a high level of mobility and environmental protection. The CLOSER project focused on:

- Identification of emerging mobility schemes;
- Analysis of interchanges between short and long-distance transport of all different modes for passengers and freight with a slightly higher regard to freight; and
- Examination of the regulatory environment and decision making process.

A number of emerging urban freight concepts were defined:

- Construction developments that increase the reliability of goods being delivered undamaged, and decongestion in the last mile distribution;
- Light rail and electric distribution vehicles towards greener distribution of goods in the last mile;
- Eco-efficient terminals that demonstrated the adjustment of terminal equipment and transfer vehicles and improvement in the sustainability of logistics and operations;
- Low emission zones that address 'greener' distribution in the last mile; and
- Consolidation and collaboration that demonstrated adjustment of terminal technologies and equipment when considered as hubs in the consolidation transport system.

[28] *http://www.closer-project.eu/*

CLOSER used 7 case studies, three of which were weighted for freight cases: airport terminal in Leipzig-Halle (Germany); Port of Helsinki-Vuosaari (Finland); and Constanta port (Romania).

2.16.4 TRAILBLAZER (2010-2013)

The EU-IEE funded **Transport and Innovation Logistics by Local Authorities with a Zest for Efficiency and Realization** (TRAILBLAZER[29]) project was aimed to showcase existing good practices and promote public sector policy interventions that can bring about reduction in energy used in UFT. TRAILBLAZER focussed on encouraging municipalities, in partnership with the private sector, to adopt the Delivery and Servicing Plans (DSP) concept, as promoted by Transport for London as part of the London Freight Plan (Transport for London, 2007).

Cities involved within the project were: Eskiltuna and Vaxjo (Sweden); Vercelli (Italy); and Zagreb (Croatia).

2.16.5 ECOSTARS (2011-2014)

EU-IEE funded the project **Establishing a Common Fleet Recognition Scheme in a number of European Cities and Regions to support Energy Efficient, Cleaner Goods and Passengers Vehicle Movements** (ECOSTARS[30]). This scheme originated in 2009, in South Yorkshire, UK, as part of a larger programme of measures to improve local air quality. As heavy industry in the area had declined, the impact of road transport on local air quality had increased, with commercial vehicles making a significant contribution to local emissions. The results from the project in South Yorkshire were positive and the project has been extended to include other European cities with similar problems. ECOSTARS objectives were:

- To increase the energy efficiency of freight distribution, by giving recognition and publicity to transport operators about using sustainable practices in their procurement and management processes;
- To encourage the faster introduction of vehicles using clean fuel technologies;
- To encourage the development of energy efficient driving schemes and operational management practices;
- To promote the auditing and certification of freight operators, using a Europe-wide approach to sustainable practices in freight operations.

A number of cities across Europe were exposed to the scheme including: Edinburgh (UK); Parma (Italy); South East Sweden region (Sweden); Cantabria (Spain); Euskadi (Basque Country, Spain); Rotterdam (the Netherlands); and Ostrava (Czech Republic). Many of these cities have continued the scheme, using regional government funding for its continued promotion. This scheme is a copycat of

---

[29] *http://www.trailblazer.eu/content.php*
[30] *http://www.ecostars-europe.eu/en/*

the Fleet Operators Recognition Scheme (FORS) promoted by Transport for London; FORS is already promoted at UK national level.

2.16.6 SOLUTIONS (2013-2016)

The EU-FP7 funded **Sharing Opportunities for Low Carbon Urban Transportation** (SOLUTIONS[31]) project was a coordination and support action project with mission to support the up-take of innovative sustainable urban mobility solutions in Europe and other regions of the world, in particular in Asia, Latin America and the Mediterranean. The aim was to bridge the implementation gap between the potential of innovative sustainable mobility and transport solutions, and packages of solutions, and the actual level of up-take and quality of the deployment mechanisms. The SOLUTIONS project organised its activities across six themes, including city logistics. (The rest were: public transport; transport infrastructure; integrated planning / sustainable urban mobility plans; network and mobility management; and clean vehicles.)

The city logistics cluster centred on the promotion of policy options for public authorities to address city logistics issues, such as delivery and collection of goods for local companies, supply of households which include individual travel and home delivery, and more specific supply chains (public works, waste handling, etc.). SOLUTIONS referred to the core city logistics projects BESTUFS, SUGAR and TURBLOG (discussed in previous sections) and listed the measures to be promoted to a number of worldwide cities. Those promoted measures were:

- Urban deliveries with cargo cycles;
- Low emission zones (LEZ);
- Forums, portals, labels and training programmes;
- Promotion of off-hour deliveries;
- Networks of pick up points;
- Larger use of rail and water;
- Urban consolidation centres (UCCs);
- Municipal procurement reorganisation;
- Lorry lanes for UFT; and
- Pricing schemes, taxes and tolls.

Cities included in SOLUTIONS were categorised into a) 'leading' cities: Barcelona (Spain); Bremen (Germany); Budapest (Hungary); Hangzhou (China) and Curitiba (Brazil); b) 'take-up' cities: Belo-Horizonte (Brazil); Guiyang (China); Kochi (India); Leon (Mexico) and Kocaeli (Turkey); and c) 'training' cities: Amman (Jordan); Casablanca (Morocco); Durango (Mexico); Hanoi (Vietnam); La Serena (Chile); Matale (Sri Lanka); Sao Jose dos Campos (Brazil); Sfax (Tunisia) and Xi'an (China).

[31] *http://www.urban-mobility-solutions.eu/*

2.16.7 VIAJEO PLUS (2013-2016)

EU-FP7 funded **International Coordination for implementation of innovative and efficient urban mobility solutions** (Viajeo PLUS[32]) aimed to benchmark outstanding solutions for innovative and green urban mobility in Europe, Latin America, China and Singapore. Viajeo PLUS was the follow up project of FP7's Viajeo project, aimed at more efficient travel and transport planning via an IT-based open platform. As a coordination and support project, Viajeo PLUS organised interactive showcases, meetings and workshops to allow stakeholders to gain first-hand experience of innovative solutions and to exchange knowledge and information.

Viajeo PLUS drew out five best solutions for innovative and green urban mobility in Europe, Latin America, China, Singapore and the Mediterranean countries, via international cooperation projects:

1. Effective mobility management;
2. Clean vehicles;
3. Innovative public transport solutions;
4. Enabling infrastructure; and
5. Sustainable urban logistics.

6 cities were evaluated (via expert knowledge) to represent urban logistics solutions: Utrecht (the Netherlands); Singapore; Shanghai (China); Paris (France); London (UK); and Gothenburg (Sweden).

Table 17: VIAJEO PLUS city logistics measures

Urban logistics solutions	Cities
Environmental zone (LEZ)	**Utrecht**
Innovative delivery vehicle (Cargohopper and the Beer Boat)	**Utrecht**
Vehicle Quota Systems (VQS)	**Singapore**
Retail precinct management	**Singapore**
Warehouse services	**Shanghai**
Land use master plan	**Paris**
Urban consolidation and battery-electric vehicles for last mile (Distripolis)	**Paris**
Intermodal rail for supermarket chain (Monoprix)	**Paris**
Fleet Operator Recognition Scheme (FORS)	**London**
Delivery and Servicing Plans (DSP)	**London**
Construction Logistics Plan	**London**

[32] *http://viajeoplus.eu/*

Urban logistics solutions	Cities
Stadsleveransen (coordinated delivery service for urban last mile)	**Gothenburg**
Logistics terminal (climate smart city distribution)	**Gothenburg**
Micro terminal (micro Urban Consolidation Centre)	**Gothenburg**

3 Defining a city typology for city logistics

This section develops a clear poly-parametric city logistics typology: a NOVELOG typology. The typology is pragmatic, based on the 30+ years of UFT research, the database collected from all previous R&I work, and the typologies that have preceded it. The purpose of the typology is to develop a toolkit in T4.4 that allows cities to select measures for intervention, based on the parameters of their city area, and the impacts that they view as important.

In spatial research, typology-approaches are used to describe, model, analyse, benchmark, and monitor the built environment with respect to buildings, (transport) infrastructure, and the urban structure (Blum and Gruhler, 2011).

The Oxford English Dictionary records usage as "The study of classes with common characteristics; classification, esp. of human products, behaviour, characteristics, etc., according to type; the comparative analysis of structural or other characteristics; a classification or analysis of this kind."[33]

From the research we determined that in city logistics and UFT research and innovation at an EU and local level, typologies have been both single and multi-tiered, often with a variety of parameters making up an overall typology, and each parameter having attributes which define them. In some cases the attributes are subdivided into sub clusters.

We shall therefore define typology as poly-parametric, made up of one or more parameter, each parameter defined by attributes which may also be further divided by sub cluster as illustrated in Figure 1.

[33] *http://www.oed.com/view/Entry/208394?redirectedFrom=typology#eid*

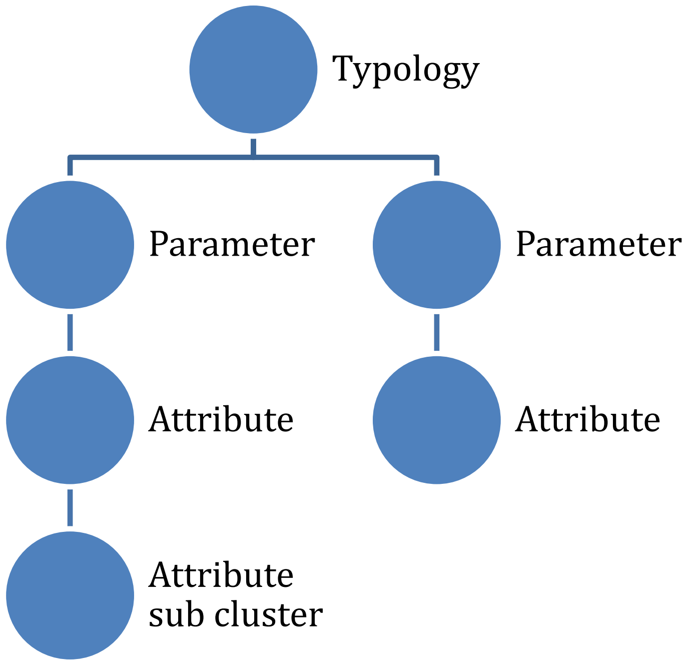


Figure 1: Structure of a Poly-parametric Typology

3.1 Land use typologies

Typologies of the built environment offer a consistent set of (pre-) defined representative buildings, blocks of buildings, street layouts and urban structures that have specific properties regarding issues such as embodied resources, energy demands, typical land coverage, and infrastructure demands, as well as the consumption of resources. Building typologies, for example, classify buildings in terms of construction periods and technologies. Urban structure types classify basic urban spatial units that have a morphological and functionally homogenous character, which is defined by characteristics structures and development patterns of buildings, infrastructures, and open space.

3.1.1 Hesse City Morphology

Freight city typologies (in terms of the role of land use function and location) can be distinguished from three type of measures (Hesse, 1995):

1) Location planning for industrial and commercial sites;
2) Location planning for logistics firm sites; and
3) Mixed use site planning.

Using the information above, it should be possible to identify the type and function of a city, as elaborated into type of goods handling in its urban area. Table 18 demonstrates the seven defined city typologies to characterise different cases of city logistics.

Table 18: Place of Goods Handling in cities (Adapted from: Hesse, 2008)

		Function	Location	Examples
Traditional place	The city as a market place	Traditional place of goods exchange. (The city as a location for regional distribution)	Historical urban centres; temporary use of areas for warehousing and transshipment	Market places, traditional locations for urban retail, warehouses
	Port cities, Inland-Port cities	Traditional place of goods exchange. (The city as a location for long-distance distribution)	Traditionally at shorelines, large inland waterways, intersections of distant trade-routes	Ports and port-infrastructures, storage buildings, warehouses.
	Rail freight terminals	Development of new transshipment points according to the industrial urbanisation	Main stations and their backyards (close to the urban core, e.g. in 'zones of transition')	Rail terminals and railyards, until recently in all major cities with railway access
	Wholesale, Freight Forwarding	Sub-urbanisation of distribution functions out of the core city (first outward drift)	Urban periphery locations, close to highway intersections	Transportation intensive land uses (commercial industrial areas)
Modern place	'New' centres of distribution at the urban periphery	Spatial anchor or magnet of modern logistics and distribution networks (second outward drift)	Areas at motorway intersections with cheap land and workforce, close to the customers' area (urban market)	Shopping malls, 'big box' commercial areas, industrial Distribution Centres (DCs) and warehouses, almost ubiquitous
	Large scale distribution of / for retail	Decoupling of distribution from the urban market place (counter-	Peripheral regions with cheap land, workforce and motorway access	National HUBs of distribution firms, pan-European DCs, inland-ports

		Function	Location	Examples
	wholesale, warehousing	urbanisation related drift)		
	Interregional Main ports	Gateways of the global and international goods flow	Selected sea ports, large freight airports	The ports of LA/Long Beach, Rotterdam, Hamburg, new airfreight hubs in the US Mid-West

A UK study addressing the 'Green Logistics' agenda, using 14 selected urban areas in the UK, has identified one parameter that influences freight distribution journeys to be commercial and industrial land use patterns, and thus location (Allen et al., 2012). A study using 19 French cities demonstrated that the size of the urban area, the settlement density, urban morphology relative to the location of urban consolidation/distribution centres, the development of the city, street design, and the type of housing (collective housing versus individual houses) – are all likely to influence last mile delivery (Ducret, 2014). A case study from Parma, Italy showed that land use characteristics, such as narrow streets, limited on-street parking, and a high number of intersections, are all significantly influencing the performance of freight urban tours, despite the short distance range between an urban consolidation centre and its delivery stops (Tozzi et al., 2014). A hypothetical study to assess the impact of geometrical configurations (such as circular, rectangular and elliptical morphology), on urban consolidation/distribution centres, found that circular morphology is relatively the most effective and efficient, while the rectangle shape is the worst (Faure et al., 2015). A study from Angers, France, used a mixture of land use and socio-economic data to classify different types of land use characteristics (Ducret et al., 2015). Seven variables were used, to categorise 9 zone types:

Variables:

1) Population density;
2) Urban density (linear density of the delivery points (of postal delivery data));
3) Network density (number of street sections);
4) Type of housing (level of verticality);
5) Population income (average annual household income);
6) Land use (part of the professional/employment distribution points); and
7) Age of the population (percentage of the elderly)

Zone types:

1) Industrial and commercial zone;
2) Dense collective housing zone;
3) High density collective housing zone;
4) Medium to dense and mixed centre zone;
5) Dense and mixed centre zone;
6) Medium density residential area;
7) Medium density and mixed residential area;
8) Low density residential area; and
9) Low and very low density residential area.

A follow-on study connecting the above zones typology with freight demand estimation, demonstrated that there is no correlation between spatial typology and freight trip generation patterns (Ducret and Gonzalez-Feliu, 2015). This finding confirms the argument made in the TRB 2016 Freight Day that said Land Use does not produce trips but that economic activity does. For example, a restaurant's square metreage tells us nothing about the number of deliveries it will require. This argument was based on the latest US research on urban freight that demonstrated that 45% of commercial establishments are in freight intensive sectors and responsible for about half the employment involved (Holguín-veras, 2016). The model estimation of the above figure is solely dependent on economic data, particularly on employment by industry sector. However, this fact does not necessarily mean that economic activity is the only variable explaining trip generation. Another study in the US demonstrated that vehicle trip rates - as promoted by the national standard (ITE Trip Generation Manual) - proved to be overestimated, when assessed at residential transit-oriented development (Handy, 2015). There is still scope to make the case that land use and urban form characteristics can explain the differences in urban freight delivery.

3.1.2 TURBLOG

TURBLOG, one of the EU city logistics projects reviewed in Section 2.6, introduced a land use typology to identify urban freight characteristics. The typology was named 'Logistics Profile' and was used to characterise urban land use and logistics and delivery requirements. The concept was based on the hypothesis that it was possible to identify, for some well-defined areas inside a city, reasonably homogenous groups of logistics needs, based on three key points:

- The urban characteristics of the area;
- The requirements of the logistics agents (i.e. the requirements concerning the type of delivery); and
- The characteristics of the products being transacted.

Table 19: TURBLOG Logistics Profile typology (adapted from TURBLOG, 2011b*)*

Logistics profile	City Area features	Product characteristics	Agents/Deliveries profile
A: Cluster of shops specialised in one specific type of service/product	**High commercial density and homogeneity**	**Varies easiness of handling**	**Medium to high frequency of deliveries**
B: Hotels, restaurant, small grocery stores, small neighbourhood markets	**Varied commercial density and logistics accessibility**	**Special conditions, e.g. fragile and perishable**	**Urgent delivery with high frequency and defined routine**
C: Business centre	**High commercial density but low homogeneity with limited access**	**Easy handling without special needs**	**High frequency of deliveries with mixture plan**
D: Large commercial stores	**High commercial density, low homogeneity with good access**	**Varied handling, plus might have special needs**	**Medium to high frequency of deliveries with defined routine**
E: Residential areas with local trade	**Low/medium commercial density and homogeneity with limited access**	**Varied handling, plus might have special needs**	**Low/medium frequency of deliveries**

The TURBLOG project concluded that all city authority partners (the public sector) involved in the project reported that their city was mainly characterised as type C: Business centre. It can perhaps be the case that the private sector, such as shippers or freight forwarders, makes use of the other land use typologies for their particular case, but this was not clearly reported in the project.

3.2 Measures/interventions typologies

3.2.1 CIVITAS Measures

Since NOVELOG is meant to align with the CIVITAS initiative (Cleaner and Better transport in Cities), the CIVITAS policy note (CIVITAS WIKI consortium, 2015) on urban freight has been reviewed. CIVITAS has established a typology of urban freight measures/interventions; this can be seen in Table 20.

Table 20: CIVITAS urban freight measures typology (source: CIVITAS WIKI consortium, 2015)

Measures/interventions cluster	Sub-cluster
Stakeholders' engagement	**Freight Quality Partnership**
	Freight advisory boards and forums
	Designation of a City Logistics Manager
Regulatory measures	**Time access restriction**
	Parking regulation
	Environmental restrictions
	Size/load access restrictions
	Freight-traffic flow management
Market-based measures	**Pricing**
	Taxation and tax allowances
	Tradeable permits and mobility credits
	Incentives and subsidies
Land use planning and	**Adapting on-street zones**
	Using building code regulations for off-street delivery areas
	Nearby delivery areas
	Upgrading central off-street loading areas
	Integrating logistics plans into land use
	Collect points
	Urban consolidation centres
New technologies	**Dynamic routing**
	Real-time information systems
	Traffic control
Eco-logistics awareness raising	**Anti-idling**
	Eco-driving
	Modal shift (water, rail, cycle, walk)
	Staggered work hours
	Recognition and certification programmes

The measures selected (Table 20) have been presented as a toolkit that offers a variety of possible (tested) solutions to be implemented by local, small-to-medium sized European cities, in order to achieve more sustainable UFT. The sustainable UFT goals were to 'reduce the use of conventionally fuelled vehicles in urban traffic and to achieve essentially CO_2 free city logistics in major urban centres by 2030', as set out in the EU transport White Paper (European Commission, 2011).

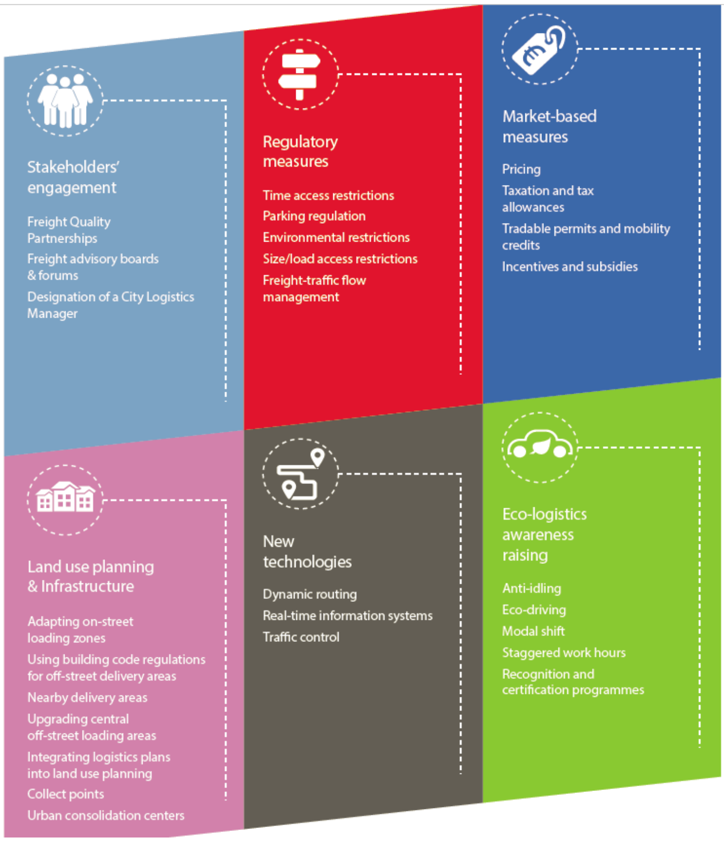


Figure 2: CIVITAS UFT measures typology as illustrated in CIVITAS WIKI consortium (2015)

The CIVITAS UFT measures were derived from previous CIVITAS initiatives that drew on 44 urban freight logistics measures, developed in 30 cities, to tackle problems caused by freight deliveries; these were supported by UFT expert knowledge of the successful implementation of UFT solutions (CIVITAS WIKI consortium, 2015).

Prior to the establishment of the CIVITAS measures, a number of EU funded urban freight projects specifically aimed to collect various UFT cases to be demonstrated as best practices. Some of those projects also developed UFT typologies to fit into their research objectives. Two projects (SUGAR and C-LIEGE, as discussed in the next section) were clear in defining their typologies to characterise UFT measures, and these are evaluated within NOVELOG WP4.

The SUGAR project's UFT typology is centred on the role of the city authority. SUGAR promoted the exchange, discussion and transfer of policy experience, knowledge and good practices through policy and planning levers in the field of urban freight management, between and among Good Practice and

Transfer sites. As section 2.5 makes clear, there are 9 types of measures/field application category and most cases, if not all, contain a multiple of these characteristics: (1) administrative, (2) urban planning, (3) governance, (4) awareness, (5) infrastructure, (6) ITS & technical, (7) modelling, (8) supply chain, and (9) information.

3.2.2 C-LIEGE

The C-LIEGE project's UFT typology (Section 2.9) centred on the mechanism of soft/hard and push/pull measures

Mobility Management is considered to encompass freight transport and measures concerning UFT are part of a mobility plan that also include passengers. Legislation, pricing incentives and disincentives are part of both passengers and goods mobility management. Mobility Management (MM) is a concept to promote sustainable transport and manage the demand for car use by changing travellers' attitudes and behaviour. At the core of Mobility Management are "soft" measures like information and communication, organising services and coordinating activities of different partners. "Soft" measures most often enhance the effectiveness of "hard" measures within urban transport (e.g., new tram lines, new roads and new bike lanes). Mobility Management measures (in comparison to "hard" measures) do not necessarily require large financial investments and may have a high benefit-cost ratio.[34]

A "Push" measure is one that is imposed on operators with a view to influence delivery or operational practices. These can be divided into financial instruments (e.g. higher parking charges and road tolls) and technical and regulatory constraints (e.g. access restrictions). "Push" measures are closely related to more efficient and equitable transport pricing which seeks to require transport users (including freight operators) to bear a greater proportion of the real costs of their journeys, including costs of pollution, accidents and infrastructure. A "Pull" measure is designed to encourage more sustainable and energy-efficient freight traffic by offering various additional services (eg, improved mapping), facilities (e.g., preferential access to loading bays for "clean" vehicles) or incentives (e.g., access to priority lanes) to operators or shippers. In many cases, the measures are combined with information and publicity campaigns designed to further reinforce the good practice measures. "Push" and "Pull" measures involve a combination of the two, aimed at providing incentives for good practice whilst simultaneously using fiscal or technical tools to deter practices we wish to discourage.

Each of these measures was interwoven within 45 cases of either push, pull, or push-and-pull mechanisms, and were sub-clustered from 23 distinctive measures (15 soft measures and 8 hard measures), as can be seen in Table 21.

---

[34] *The Definition of Mobility Management and the Categorisation of Mobility Management Measures as approved by the MAX-consortium and EPOMM, 2009.*

Table 21: C-LIEGE UFT measures typology (adapted from C-LIEGE, 2012)

	Soft	Hard
Push	**Access restrictions (for polluting freight vehicles), time windows** **(Extending) Environmental zones** **Mobility credits scheme and electronic passes (electronic access control)** **Urban Logistics Plans (using building code for off-street delivery areas)** **Distribution plan-scheme (to reduce frequency of deliveries in public procurement)** **Alternative delivery systems (night deliveries)**	**Measure to tackle noise (Freight noise mapping)**
Pull	**Advance booking with incentive (via Local Freight Development Plans, enactment of access time windows)** **Access with incentives (free-to-use loading bays, free access to public transport lanes, changing traffic regulations to improve freight access, allocation of additional freight parking spaces)** **Promotional-incentives campaign (financial support for fleet conversion)** **Optimisation of routes (ad-hoc routes for freight distribution, freight map)** **Innovative financing models (optimising leasing models for clean freight vehicles)** **Advance booking (real-time loading space booking)**	**Intelligent Transport Systems (priority for lorries at selected junctions)** **IT logistics tools (ICT support for eco-driving; on-line system designed to reduce back loading; web-based market place; virtual distribution centre; web service to manage preferred delivery location and times; algorithm to plan deliveries when unexpected events take place; systems for assessment of UFT impacts)**

	Soft	Hard
	Alternative delivery systems (Van sharing service; collection points; pack station; freight exchange)	
	Signposting freight routes	
	Freight Quality Partnership	
	Freight Operators Recognition Scheme	
	Driver behaviour (Eco-driver training)	
Push + Pull	Inclusion of Freight in Urban Mobility Plans	Supported with Urban freight hubs at the edge of the city
	Construction Logistics Plans	
	Charging for distribution operation in central areas	With use of Intelligent Traffic Management
	Deliver and Servicing Plans	Supported with environmentally friendly vehicles
	Mobility Master Plans	Including modal shift
	Technical guidelines for delivery spaces	Supported with distribution micro-platforms in the inner city
	Multi-user lanes	

3.3 UFT markets and traffic flows typology

In the previous sections, the defined typologies touched two areas of analysis: the city structure (including city morphology) and the infrastructure existing in the city. In this section, the focus is goods flows and the UFT demand generated within cities. CIVITAS (CIVITAS WIKI consortium, 2015) defined urban freight logistics as all movements of goods in to, out from, through or within the urban area made by light or heavy vehicles, including service transport and demolition traffic as well as waste and reverse logistics. Household purchasing trips are not considered to be part of UFT, as these are considered to be passenger transport trips. UFT trips, therefore, include a huge variety of different transport operation and logistics activities and requirements, with the common factor that they take place in an urban area (geographical aspect) and concern the movement of goods (transportation aspect) and service related trips by commercial entities (commodity aspect such as transport of things as distinct from people).

3.3.1 UFT Markets

One way to classify different forms of UFT is by market sector served. It is important to look at the market, as the sectors represent the sources of demand for UFT and its supply in terms of the main distribution practices that can be observed in urban areas. A well-established typology, based on a study funded by EC DG MOVE, reported by (MDS Transmodal and Centro di recerca per il Trasporto e la logistica (CTL), 2012), and also promoted by the CIVITAS urban freight logistics Policy note (CIVITAS WIKI consortium, 2015), divided the UFT market into 5 sectors, that can be seen in Table 22. Additionally, in NOVELOG D2.1 (Campagna et al., 2015) which developed a framework for UFT data collection for NOVELOG cities, four dimensions of data pillars were defined to characterise UFT. Two of the pillars were related to the goods flow and UFT demand generation that also make reference to the aforementioned study funded by the DG MOVE.

CIVITAS (CIVITAS WIKI consortium, 2015) notes 2 further market sectors that are intertwined with the five sectors below; these are described as: offices, and service-related trips, to these sectors.

Table 22: UFT markets (source: MDS Transmodal and Centro di recerca per il Trasporto e la logistica (CTL), 2012)

Markets	Sub-cluster
Retail	**City distribution; food products; milk deliveries; bakery products; goods on pallets; and beverages**
Express, courier and post	**Postal and package deliveries; city distribution; parcels; goods on pallets; and money deliveries**
Hotel, restaurant and catering	**Food products; beverages; fast food deliveries; and laundry services**
Construction and road services	**Waste disposal services; utility services; and gardening services**
Waste	**Waste disposal services; and recycling materials**

3.3.2 AASHTO Level of Service

With regard to traffic flows typology, one of the well-known units of measure for traffic congestion is Level of Service (LOS). LOS is a qualitative measure used to relate the quality of traffic service. LOS is used to analyse highways (which are mainly the backbone of urban transport network with various type of access: e.g. residential district, industrial district, commercial district, office and business district, etc.), by categorising traffic flow and assigning quality levels of traffic, based on performance measures such as speed and density of vehicles relative to road capacity. This rating is used to define transportation problems and prioritise transportation system improvements, resulting in resources being directed at highway expansion (VTPI, 2015[35]). Transportation engineers often produce maps showing roadway links and intersections considered to have excess traffic congestion, which are used to prioritise roadway expansion projects. LOS standards have been established in the Highway Capacity Manual and in the AASHTO (American Association of State Highway and Transportation Officials) Geometric design of highways and streets, using the letters A through F, with A being the best and F the worst. These are shown in Table 23.

While the unit was introduced in the USA, the adoption of such measures has entered global use, since transport network modelling frameworks are commonly used, in many cities across the world, to simulate traffic congestion problems and to forecast traffic growth. This methodology is criticised as being technically flawed and biased, because it ignores other transportation problems besides traffic congestion, such as parking congestion, traffic accidents and the tendency to increased vehicle traffic volume and the negative impacts that wider roads and increased vehicle speeds tend to have on walking and cycling (VTPI, 2015).

Table 23: LOS based on Highway Capacity Manual / AASHTO (http://hcm.trb.org)

LOS level	Description
A: free flow	Traffic flows at or above the posted speed limit and motorists have complete mobility between lanes. The average spacing between vehicles is about 550 ft (167 m) or 27 car lengths. Motorists have a high level of physical and psychological comfort. The effects of incidents or point breakdowns are easily absorbed. LOS A generally occurs late at night in
B: reasonably free flow	LOS A speeds are maintained; manoeuvrability within the traffic stream is slightly restricted. The lowest average vehicle spacing is about 330 ft (100 m) or 16 car lengths. Motorists still have a high level of physical and
C: stable flow, at or near free flow	Ability to manoeuvre through lanes is noticeably restricted and lane changes require more driver awareness. Minimum vehicle spacing is about 220 feet (67 m) or 11 car lengths. Most experienced drivers are comfortable, roads remain safely below but efficiently close to capacity, and posted speed is maintained. Minor incidents may still have no effect but localized service will have noticeable effects and traffic delays will form behind the incident. This is the target LOS for some urban and most

[35] *http://www.vtpi.org/tdm/tdm129.htm*

LOS level	Description
D: approaching unstable flow	Speeds slightly decrease as traffic volume slightly increases. Freedom to manoeuvre within the traffic stream is much more limited and driver comfort levels decrease. Vehicles are spaced about 160 ft (50m) or 8 car lengths. Minor incidents are expected to create delays. Examples are a busy shopping corridor in the middle of a weekday, or a functional urban highway during commuting hours. It is a common goal for urban streets during peak hours, as attaining LOS C would require prohibitive cost and
E: unstable flow	Flow becomes irregular and speed varies rapidly because there are virtually no usable gaps to manoeuvre in the traffic stream and speeds rarely reach the posted limit. Vehicle spacing is about 6 car lengths, but speeds are still at or above 50 mi/h(80 km/h). Any disruption to traffic flow, such as merging ramp traffic or lane changes, will create a shock wave affecting traffic upstream. Any incident will create serious delays. Drivers' level of comfort becomes poor. This is a common standard in larger urban
F: forced or breakdown flow	Every vehicle moves in lockstep with the vehicle in front of it, with frequent slowing required. Travel time cannot be predicted, with generally more demand than capacity. A road in a constant traffic jam is at this LOS, because LOS is an average or typical service rather than a constant state. For example, a highway might be at LOS D for the AM peak hour, but have traffic consistent with LOS C some days, LOS E or F others, and

3.4 Impact typologies

CIVITAS (CIVITAS WIKI consortium, 2015) acknowledged the high level of complexity of UFT with economic, environmental and social consequences. These consequences are known as impacts, as cities are confronted with more traffic, congestion, noise and pollution derived from various sources, including among others: inadequate road infrastructure; inefficient logistics process from a low load factor; long dwell times; and high numbers of individual deliveries.

The relevance of these impacts varies according to city size, and there are differences between large conurbations and small- or medium sized cities. CIVITAS described impact typologies as fourfold: economic (road congestion, inefficiency, and waste of resources); environmental (pollutant emissions, use of non-renewable fossil-fuel, land and aggregates, and waste production); social (physical consequences of pollutant emissions on public health, traffic accidents, noise, visual intrusion, and other quality of life issues); and impacts of scale (few resources, lack of co-operations, fewer policy considerations, few logistics providers based in cities, and little infrastructure).

We have adopted some of these typologies to assess city logistics cases (Table 24).

Table 24: City logistics cases impact typology

Impacts	Unit measured
Environmental	**CO_2 emissions**
	Noise pollution
Economic and Energy	**Costs**
	Energy consumption
Social	**Number of accidents**
	Service level
Transport and mobility	**Traffic reduction**
	Vehicle kms
	Load factor

In completing the impacts information, we recognised the difficulty of the accuracy of the data that would dictate how projects were implemented. More often than not, cases have not recorded impacts information. It was therefore decided to ask responsible partners, who would be closely linked to a case, to validate its impact variables, using a qualitative assessment. A five point Likert scale was established, from negative to positive, using smiley face emoticons (see Table 25) in order to measure the impacts variables.

Table 25: Ordinal scale with smiley face emoticons for measuring reported impacts

Impacts	☹☹	☹	😐	☺	☺☺
Category	Very bad	Bad	Neutral	Good	Very good

3.5 New parameters

Alongside the above typologies and constituent parameters described, we have also looked at the common framework of the databases from the reviewed city logistics projects. All good
require a clear definition of the problems to be solved and the objectives to be reached. As
has now researched a greater number of UFT interventions than any previous review we identified the absence of standardised parameters in previous work. We have analysed the data and have defined novel parameters for NOVELOG. (

Table 26).

Table 26: Problems and Objectives shortlisted parameters

Standardised Problems	Standardised Objectives
A: Congestion (time & money)	**A: Increase efficiency of operations**
B: Uncoordinated delivery (environment, including (low) loading/unloading activities)	**B: Coherent built environment (coordinated delivery; suppress illegal parking; reduce times and the search for delivery space; and optimise the use of street space)**
C: Historical town (environment)	**C: Sustainable city (no congestion or air pollution and increase economic performance)**
D: Sensitive areas (environment, including local up to city scale	**D: Environmentally friendly (no noise and air pollution)**
E: Specified case (e.g. waste management, route optimisation)	**E: Experiment (e.g. data collection)**
F: Data (time, efforts and cost)	
G: Last mile solutions	
H: Administrative (governance)	

Whilst the UFT Logistics Profile parameter from CIVITAS WIKI has great value, it is apparent that the actual nature of the stakeholders engaged in an UFT intervention is also key, as such we have defined a stakeholder parameter. Note that some stakeholders *will have multiple rôles.*

Table 27: Stakeholders parameter

Stakeholders	Description
Shippers	**(manufacturers, wholesalers, central retailer units)**
Logistics providers	**(third party logistics providers, warehouse companies)**
Administrators	**(national, state, and city level authority)**
Citizens	**(consumers and residents)**
Receivers	**(offices, retail units, manufacturers, local retail units, homes)**

We also feel that when assessing city logistics projects, it is important to recognise the level of implementation. For this reason we have also defined an 'implementation level' typology, with 4 levels (see Table 28).

Table 28: Level of implementation parameter

Level of implementation	Description
PLAN	**The case is described in the description of work of the project with expected benefit but never implemented**
IN PILOT	**The case is described in the description of work for a limited period of time and is still in trial with tentative output**
IMPLEMENTED	**The case is described in the description of work for a limited period of time and has reported its benefits, as well as barriers to commercial operation**
ON-GOING COMMERCIALLY	**The case is described with its origin and the circumstances that enable the achievement and often used as best practice**

3.6 Conclusion on city typologies

After reviewing a number of well-established city typologies as described above, it becomes clear that different pre-existing typologies were defined to serve different purposes and different user groups. For instance, land use typologies were defined to characterise land use in the context of UFT. While this typology seems useful for the public sector (regional authority) to categorise its UFT land use within their territory, this typology might not necessarily be helpful for city logistics manager or the private sectors (shippers, forwarders, 3PLs, etc.) to understand their problems, and design objectives and solutions. There is also a dichotomy between the definition of place, as seen by receivers, residents and shippers, and that of activity, as seen by shippers and to a lesser extent cities.

We can conclude that typologies for city logistics can be constructed for specific audiences, and that the choices of parameters[36] that make up those typologies have been key and well developed within UFT typology to date so far. What is clearly missing from previous typologies is a typology intended for use by the widest range of interested stakeholders. Rather than losing the combined knowledge developed by previous research, NOVELOG will build upon the achievements of the past and utilise the parameters and within that the attributes[37] of the parameters. With these parameters we have built a new NOVELOG poly parametric city typology, containing the most appropriate parameters, and also developing new parameters previously missing.

Referring to the three basic areas of analysis for the development of a clear city typology[38], the **city structure** (including city morphology) and the **infrastructure** existing in the city can be represented with the land use typologies described in section 3.1. For the **goods flows** and **UFT demand** generated within city, UFT markets and traffic flows typologies (as described in 3.3) would serve well for the purpose; but it requires further work to ascertain which parameter set to adopt. **Measures** (described in 3.2) have been assigned parameters in various typologies, and we shall proceed to identify which are most appropriate for the needs of NOVELOG. It can be seen that **problems**, **objectives** (section **Error! Reference source not found.**), and **impacts** (section 3.4) are not standardised in previous research, and we have harmonised these as novelties based on the previous research. As stated in the DoA, we shall continue to harmonise impacts with WP3, thereby adopting a standardised set of impacts parameters within NOVELOG.

A correlation between a city's specific characteristics and its current and future needs, with measures that consider the anticipated degree of improvement (or even deterioration) has yet to be widely addressed by UFT projects. In this research, a poly-parametric toolkit was proposed, to provide a single window on city logistics and enable information and experience sharing, advising and reporting.

---

[36] Land use, measures, type of intervention, etc..

[37] For example an attribute of the TURBLOG Logistics Profile parameter is "A: Cluster of shops.."

[38] as described in the NOVELOG WP4 Description of Work (DoA) Task 4.2 as outlined in the Introduction (section 1)

We determine from the research and the expert knowledge of the team that in city logistics and UFT research and innovation at an EU and local level, typologies have been both single and multi-tiered, often with a variety of parameters making up an overall typology, and each parameter having attributes which define them. In some cases the attributes are subdivided into sub clusters.

We shall therefore define typology as poly-parametric, made up of one or more parameter, each parameter defined by attributes which may also be further divided by sub cluster.

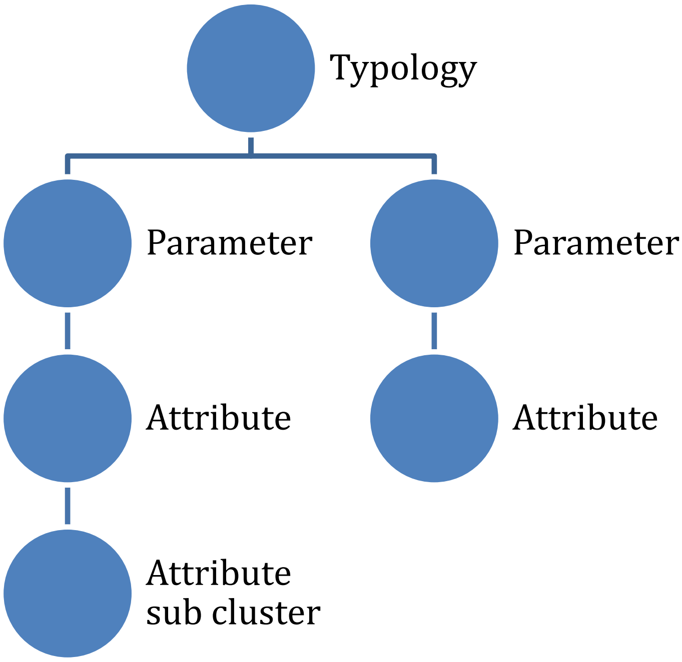


Figure 3: Poly-parametric typology

Since 'Where, What, How and Why' (including who/ to whom) are a key part of urban freight, the toolkit was at first envisaged to comprise 4 dimensions.

It is clear from the research which is mainly based in Newcastle in UK, Como in Italy and Berlin in Germany (for references please see for example: (Leonardi et al., 2014; Österle et al., 2015; Zunder et al., 2014, 2016) that successfully influences wider research community (see for example: (Aditjandra et al., 2016; Balm et al., 2016; Mcleod et al., 2015), that the toolkit needs to be 5 dimensional, with the dimensions sequenced in a logical flow for use by actors, e.g.

Why are we doing this? What problems do we have, and what are our objectives?

Where are we doing this? What is the physical shape of the spatial area we are addressing in a city?

Who shall do this and to whom shall it be done? In an approach that defines actors by the nature of the supply chains they operate in, we aim to understand who is involved in this process.

What shall we do? What are the measures that we shall undertake? Will this be a mixture of hard and soft measures, or will soft measures be part of the next section?

How shall we do it? Will this be a process of regulation, of voluntary co-operation?

With these dimensions we can construct a toolkit in T4.4 to allow localised solutions derived from local problems within local societies, informed by the body of knowledge built up over the last two decades.

3.7 Dimension: Why

In all productive endeavour it is good practice to understand why the activity is being carried out. In city logistics which faces many challenging problems including high levels of traffic congestion, negative environmental impacts, high energy consumption and a shortage of labour, the perceived problems are complex, multi-layered and perceived very differently through the lens of different stakeholders. As evidenced in the Smartfusion project (Österle et al., 2015), a first step should be to agree the problems that are to be solved, and the objectives to be measured, so that success can be determined in a mutually agreed fashion.

Previous research shows little standardisation of the dimension **Why**, often since it was seen as self evident and uncontested, but also since many localised stakeholder approaches generate localised definitions and common understandings. This can be commended, but it requires a pan European toolkit to have a novel approach. Therefore NOVELOG has developed the Problems and Objectives parameters of this dimension and populated them in

Table 26 above.

3.8 Dimension: Where

Where an intervention is to take place is crucial in the complex geo-political landscape of the long developed European cityscape. It is not just the geography of the land, the urban layout of streets, but also the politics and cultures of the people who dwell and work in, as well as visit and deliver to an urban area. It is clear that with any urban area of note, that is important to talk of the '*area*' of interventions, it is impossible to apply a meaningful category to the mosaics that form cities new or ancient.

The context for this dimension concerns distinguishing cities into certain profiles which might have included:

- Density of economic activity represented by:
  - Infrastructure density;
  - Density of GDP or suitable proxy per capita in city.
- Degree of integration of freight-generating activity, such as the presence of a few large employers in a city;
- Political culture (certain political cultures generate a different degree of regulation and compliance);
- Culture, e.g. night time activities (not applicable to all communities);
- Degree of logistics sprawl;
- Legal and regulatory framework, local constraints.

In that NOVELOG always wishes to build on the past successes and good practice of research and innovation that has come before, we have chosen to adopt the HESSE city morphology detailed in SECTION 3.1 above. This land use approach needs to be complemented with a parameter that defines the activity that is being carried out in the place, and we have adopted the UFT Logistics Profile parameter developed by TURBLOG. We considered the use of the ASSHTO level of service parameter, as well know. It is also often criticized and introduces an element of 'when' into the dimensions, which may be a level of complexity too far.

3.9 Dimension: Who

As we have observed in the previous research, the construction of typologies has been informed by the audiences that they were developed for, and in many cases, by whom. All decisions in a city are political, and as such the interplay of different types of UFT and different stakeholders makes up a significant factor to incorporate in the NOVELOG typology.

To that end we feel the best way to parameterise the supply chains in the data we have, is to adopt the CIVITAS WIKI UFT Markets parameters. We can see that the extensive and wide ranging parameters developed in WP2 could derive a series of nuanced attributes for this dimension, but the purpose of the toolkit is *commence* the process of research and analysis that WP2 envisages, and as such these broader brush attributes fit the purpose better.

Given the lack of a standardised view of stakeholders we feel it is important that the typology incorporate a standardised parameter for stakeholders and we use the one we defined in Section 3.5 above.

3.10 Dimension: What

Having defined the dimensions above, we now need a clean coherent parameter to define the **What** dimension. Here the obvious choice is the multi layered CIVITAS WIKI parameter Measures, which is sub layered with attributes and within attributes sub clusters. It is likely that for the toolkit that measures will be an output of the enquiry, but that also for ongoing analysis and development it shall be a key parameter for analysis.

3.11 Dimension: How

There are many ways to implement change, and the C-LIEGE project was most concerned with how city logistics could be changed using the language and methodologies of wider mobility management. We would suggest that the core definitions adopted by C-LIEGE and detailed in Section 3.2 above are sound, but that perhaps the categorisation of measures in the final databases of the project less so. Our interest is in the core definitions, and so we adopt the idea that interventions can be Push/Pull, or Soft/Hard.

3.12 NOVELOG Poly-parametric City Logistics Typology and Toolkit dimensional structure

The NOVELOG **Poly-parametric City Logistics Typology and Toolkit dimensional structure** that shall be used for UFT intervention choice by cities are essentially built from a common core. The dimensional structure therefore follows the same core pattern as the typology detailed below. Note that in each case the attributes for each parameter are either inherited from previous state of the art work, or have been extrapolated from the desktop research and the conclusions of the experts in WP4. At this stage these are a coherent set, but we recognise that future work may reveal or suggest variant attributes, where they do not duplicate or reduce the clarity of the typology.

1) NOVELOG TYPOLOGY
   i) Why (Dimension)
      (a) Problems* (Parameter)
         (i) Congestion (time & money)
         (ii) Uncoordinated delivery (environment, including (low) loading/unloading activities)
         (iii) Historical town (environment)
         (iv) Sensitive areas (environment, including local up to city scale level)
         (v) Specified case (e.g. waste management, route optimisation)
         (vi) Data (time, efforts and cost)
         (vii) Last mile solutions (sustainability)
         (viii) Administrative (governance)
      (b) Objectives* (Parameter)
         (i) Increase efficiency of operations
         (ii) Coherent built environment (coordinated delivery; suppress illegal parking; reduce times and the search for delivery space; and optimise the use of street space)
         (iii) Sustainable city (no congestion or air pollution and increase economic performance)
         (iv) Environmentally friendly (no noise and air pollution)
         (v) Experiment (e.g. data collection)
   ii) Where (Dimension)
      (a) City Morphology (adopted from HESSE) (Parameter)
         (i) The city as a market place
         (ii) Port cities, Inland-Port cities
         (iii) Rail freight terminals
         (iv) Wholesale, Freight Forwarding
         (v) 'New' centres of distribution at the urban periphery
         (vi) Large scale distribution of / for retail wholesale, warehousing
         (vii) Interregional Main ports
         (viii) Combination of the above
      (b) UFT Logistics Profiles (adopted from TURBLOG) (Parameter)
         (i) Cluster of shops specialised in one specific type of service/product
         (ii) Hotels, restaurant, small grocery stores, small neighbourhood markets
         (iii) Business centre

(iv) Large commercial stores
(v) Residential areas with local trade

iii) Who (Dimension)
   (a) UFT Markets (adopted from CIVITAS WIKI) (Parameter)
      (i) Retail
      (ii) Express, courier and post
      (iii) Hotel, restaurant and catering
      (iv) Construction and road services
      (v) Waste
   (b) Key stakeholders* (Parameter)
      (i) Shippers
      (ii) Logistics providers
      (iii) Administrators
      (iv) Citizens
      (v) Receivers

iv) What (Dimension)
   (a) Measures (adopted from CIVITAS WIKI) (Parameter)
      (i) Stakeholders' engagement
         1. Freight Quality Partnership
         2. Freight advisory boards and forums
         3. Designation of a City Logistics manager
      (ii) Regulatory measures
         1. Time access restriction
         2. Parking regulation
         3. Environmental restrictions
         4. Size/load access restrictions
         5. Freight-traffic flow management
      (iii) Market-based measures
         1. Pricing
         2. Taxation and tax allowances
         3. Tradeable permits and mobility credits
         4. Incentives and subsidies
      (iv) Land use planning and infrastructure
         1. Adapting on street zones
         2. Using building code regulations for off street delivery areas

3. Nearby delivery areas
4. Upgrading central off-street loading areas
5. Integrating logistics plans into land use planning
6. Collect points
7. Urban consolidation centres

(v) New technologies

1. Dynamic routing
2. Real-time information systems
3. Traffic control

(vi) Eco-logistics awareness raising

1. Anti-idling
2. Eco-driving
3. Modal shift
4. Staggered work hours
5. Recognition and certification programmes

v) How (Dimension)

(a) Nature of Implementation (definitions adopted from C-LIEGE) (Parameter)

(i) Push-Soft

(ii) Push-Hard

(iii) Pull-Soft

(iv) Pull-Hard

* This denotes a parameter defined in NOVELOG from the work in WP4.

Note that in many cases a dimension may have zero, one or more parameter defined with one or multiple attributes.

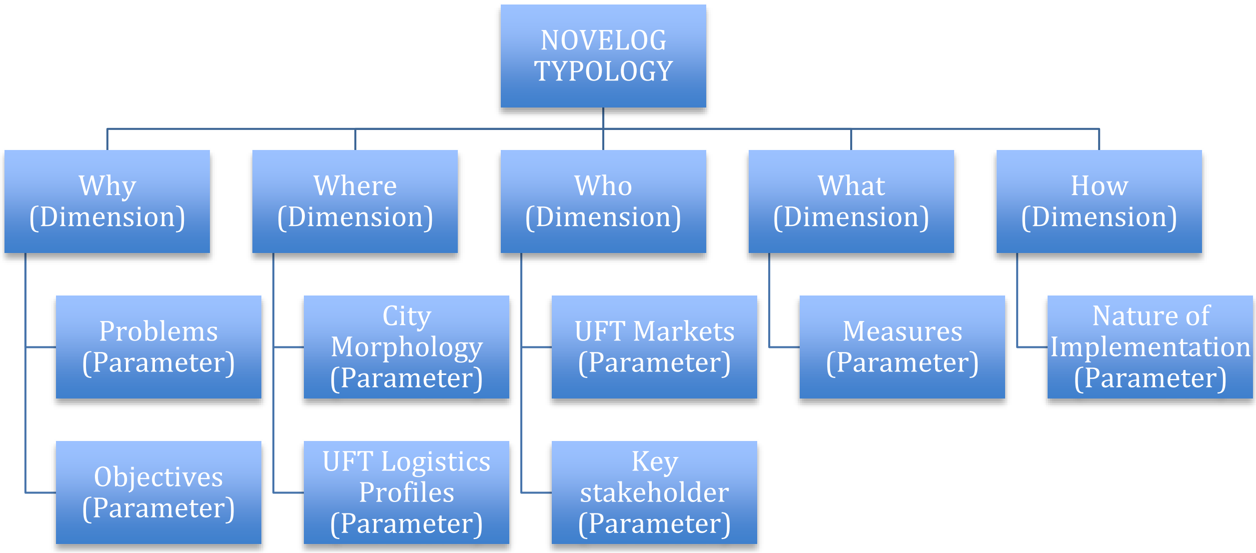


Figure 4: NOVELOG Poly-parametric City Logistics Typology

This section has detailed a clear poly-parametric city logistics typology: a NOVELOG typology. The typology is pragmatic, based on the 30+ years of UFT research, the database collected from all previous R&I work, and the typologies that have preceded it. The purpose of the typology is to develop a toolkit in T4.4 that allows cities to select measures for intervention, based on the parameters of their city area, and the impacts that they view as important.

4 Data collection methodology

This section describes the way the above theoretical typologies, *and more importantly the parameters within them*, were used to populate the database of city logistics cases. At this stage of the research, all of the pre-existing typologies, not just the NOVELOG typology were used to characterise the city logistics cases, in order that we capture the maximum dimensional data for future analysis and revision..

4.1 Developing the data collection framework

In the light of the number of typologies associated with the city logistics cases, as discussed above, an Excel based data collection framework has been developed, with the idea of allowing the assessment and validation of each city logistics case, by the relevant NOVELOG partners.

All the typologies described have been included in the data collection framework, together with further additions such as qualitative information about a particular measure/intervention being used in a specific case; geographical information about a case study city (e.g. city size, population, land use information and other socio-economic indicators); information about the period of demonstration; other remarks that could not be included within the typologies selected; and a link to the information source, e.g. website, report, contact etc.).

The final composition of the data collection framework is illustrated in Table 29.

Table 29: NOVELOG WP4 Data collection framework

No	Description	Instruction	Example of expected answer
1	**Project initiative name / reference**	**Populated by Project coordinator + WP4 partners**	**Smartfusion**
2	**NOVELOG partners involved/ allocated task to review the case**	**Defined by WP4 leader**	**Newcastle University (UNEW)**
3	**Pilot City**	**Defined by WP4 leader and revised/validated by responsible partners**	**Newcastle upon Tyne**
4	**Problems (standardised)**	**Pick up to 2 (out of 9, ranging from A to I)**	**B: Uncoordinated delivery (Environment)**

No	Description	Instruction	Example of expected answer
5	Objectives (standardised)	Pick up to 2 (out of 5, ranging from A to E)	A: Increase efficiency of operations, B: Coherent built environment
6	Measure/policy implemented	Complete 'free text' space	Coordinated delivery services
7	Level of	Pick 1 (out of 4)	On-going
8	Land Use typology (standard)	Only for area of intervention (ranges from A	A: the city as a market place
9	CIVITAS measures typology (standard)	Pick 1 (out of 7)	Land use planning and infrastructure
10	CIVITAS measures typology sub-cluster (standard)	Pick 1 (out of different ranges of particular measures)	Integrating logistics plans into land use planning
11	Logistics profiles (TURBLOG) typology (standard)	Only for area of intervention (ranges from A to E)	C: Business Centre
12	UFT market (DG MOVE) typology (standard)	Pick 1 (out of 5)	Retail
13	UFT market typology (sub-cluster (standard)	Pick 1 (out of various ranges of particular market	City distribution
14	Traffic congestion (level of service by HDM / AASHTO)	Pick 1 (out of 6)	B: reasonably free flow
15	SUGAR (city authority centred) typology (standard)	Pick multiple (from ranges of 9 types as applicable)	Administrative, Urban planning, Governance, Infrastructure, Awareness
16	C-LIEGE (push/pull mechanism) typology (standard)	Pick HARD or SOFT	SOFT measures
17	C-LIEGE sub-cluster typology (standard)	Pick 1 (out of ranges of the sub cluster types)	Distribution plan scheme
18	Environmental impact (CO_2 emission)	Free text for information and remark of negative/positive impacts	-20% (AM) and -40% (PM); ☺☺

No	Description	Instruction	Example of expected answer
19	Environmental impact (Noise pollution)	Free text for information and remark of negative/positive impacts (smiley emoticons)	Much reduction due to land use change (pedestrianisation and limited car parking); ☺
20	Economy and Energy impacts (costs)	Free text for information and remark of negative/positive impacts (smiley emoticons)	Fee paid by the University to use UCC run by Clipper Logistics; ☹☹
21	Economy and Energy impacts (energy consumption)	Free text for information and remark of negative/positive impacts	-0.26 GWh/year (based on SMARTSET project calculator); ☺
22	Social impacts (number of accidents)	Free text for information and remark of negative/positive impacts (smiley emoticons)	Possibly fewer accidents due to changing land use but nothing measured; 😐
23	Social impacts (service level)	Free text for information and remark of negative/positive impacts	Sustainable city campaign (image), environmental award;
24	Transport and mobility impacts (traffic reduction)	Free text for information and remark of negative/positive impacts	Car traffic is generally reduced due to change of land use; ☺☺
25	Transport and mobility impacts (vehicle kms)	Free text for information and remark of negative/positive impacts	83% (trip saved from using UCC based); ☺
26	Transport and mobility impacts (load factor)	Free text for information and remark of negative/positive impacts	20% capacity was reached and increasing; ☺
27	Geography: city size, population, land use characteristics, etc.	Free text to complete	pop: 1.1m (Tyne & Wear); conurbation; services industry on the increase with support from 2 big universities totalling 50k students; the capital of the North
28	Period of demonstration	Free text to complete	9 months (pilot between 2014-2015) and now on-going

No	Description	Instruction	Example of expected answer
29	**Key stakeholders involved**	**Free text to complete**	**Newcastle University procurement and Estate Service functions; Clipper Logistics, City Council**
30	**Other qualitative**	**Free text to complete**	
31	**Link to sources**	**Free text to complete**	**Tom Zunder / Paulus Aditjandra**

The data collection framework was first populated by the WP4 coordinator. Over 250 cases of city logistics projects were logged in and reviewed. A list of City Logistics and related projects were reviewed and 60 projects were analysed, as shown in Table 30.

Table 30: List of research projects identified for data collection (no particular order)

	Project Title and Acronym	NOVELOG Partner(s) Involved	Type of Project	Comments
1	**SMILE - Smart Green Innovative Urban Logistics for Energy Efficient Mediterranean Cities**	**CERTH, ITL, CENIT, Barcelona**	**EU - MED**	**Good for impact analysis**
2	**STRAIGHTSOL - Strategies and Measures for smarter urban freight solutions**	**CERTH, CENIT, K+N**	**EU - FP7**	**Good for impact analysis**
3	**CO-GISTICS - Cooperative Logistics for sustainable mobility of goods**	**ERTICO, CERTH**	**EU - FP7**	
4	**FREILOT - Urban Freight Energy Efficiency Pilot**	**ERTICO, CERTH**	**EU - FP7**	
5	**SOLUTIONS - Sharing opportunities for Low Carbon Urban Transportation**	**CERTH**	**EU - FP7**	
6	**CITYFREIGHT - Inter- and Intra-Urban Freight Distribution Networks**	**UNEW**	**EU - FP5**	
7	**BESTUFS I/II – Best urban freight solutions**	**UNEW**	**EU-FP5/6**	
8	**IDIOMA - Innovative Distribution with Intermodal Freight Operation**	**UNEW**	**EU-FP4**	
9	**Smartfusion - Smart urban freight solutions**	**UNEW, POLIS, PANTEIA**	**EU - FP7**	**For impact analysis**

	Project Title and Acronym	NOVELOG Partner(s) Involved	Type of Project	Comments
10	SMARTSET - Efficient UFT	UNEW, BIM, Graz, RSM,	EU – IEE	
11	BESTFACT – Best practice factory for freight transport	UNEW, POLIS, PANTEIA	EU – FP7	Collection of measures
12	VIAJEO Plus – International coordination for implementation of innovative and efficient urban	ERTICO, UNEW	EU-FP7	
13	CITYLOG – sustainability and efficiency of city logistics	ERTICO, Turin	EU - FP7	
14	SMARTFREIGHT – smart freight transport in urban areas	POLIS	EU-FP7	
15	SUGAR - Sustainable Urban Goods Logistics Achieved by regional and local policies	POLIS, ITL, RER, Barcelona	EU - FP7	Collection of measures
16	C-LIEGE – Clean last mile transport and logistics management	ITL, MUS	EU - IEE	Collection of measures
17	ECOSTARS – Establishing a common fleet recognition scheme in a number of European Cities and Regions to support energy efficient, cleaner goods and passengers vehicle movements	POLIS	EU-IEE	
18	Centre of Excellence Sustainable Urban Freight Systems	ITL	VREF	Can possibly provide input for cities outside the
19	TURBLOG – Transferability of urban logistics concepts and practices from a worldwide perspective	PANTEIA	EU-FP7	Can possibly provide input for cities outside the
20	MEDUSA - Efficient terminals for sustainable urban distribution of goods	CENIT	National	
21	MERCI – electric vehicle distribution in city	D'APPOLONIA	Local	
22	CityTech – design and implementation of automatic detection of vehicles (RFID)	D'APPOLONIA	Local	
23	CIVITAS CARAVEL	D'APPOLONIA	EU	

	Project Title and Acronym	NOVELOG Partner(s) Involved	Type of Project	Comments
24	MOP – Mulloptimierung (Waste collection point)	BIM	National	Waste collection pilot
25	CLOSER - Connecting Long and short distance networks for efficient transport	CERTH, UTH (subcontract)	EU - FP7	
26	Environmentally friendly UFT in Kavala, Greece	UTH	Local	
27	LOGeco - Ecologic Logistics	CTL, RSM	Local	
28	Innovative solutions to freight distribution in the complex large urban area of Rome	CTL	International	VREF (Volvo Research and Educational
29	VELUD – electric vehicle for sustainable urban logistics	RENAULT	Local	
30	Cityports	RER	EU - FP7	
31	CIVITAS MIMOSA – making innovation in mobility and sustainable actors	RER	International	CIVITAS Plus
32	Green City logistics Graz	Graz	International	CIVITAS Trendsetter
33	Delivery of goods to the shops	Graz	International	CIVITAS Trendsetter
34	Innovation project "City Logistics"	Copenhagen	National	
35	Pilot "Off hour delivery"	Copenhagen	National	
36	ECO Mobility	Copenhagen	INTERREG 4C	North Europe
37	Sant Andreu Micro-Platform Pilot	Barcelona	Local	
38	CIVITAS CATALIST – the dissemination and best practice transfer action of the CIVITAS initiative	Gothenburg	International	CIVITAS
39	START – Short term actions to reorganise transport of Goods	Gothenburg		
40	CIVITAS TELLUS – Transport and Environment Alliance for urban Sustainability	Gothenburg	International	CIVITAS I – includes UFT pilot

	Project Title and Acronym	NOVELOG Partner(s) Involved	Type of Project	Comments
41	Sustainable Urban Transports	Gothenburg	Local / National	
42	Cycle Logistics II	Mechelen	EU - IEE	
43	PUMAS – Planning sustainable regional – urban mobility in the Alpine space	Turin	EU INTEREG Alpine Space	
44	SUCCESS – Smaller Urban Communities in CIVITAS foe Environmentally Sustainable	POLIS		
45	Compass4D	ERTICO		
46	NICHES – New and Innovative Concepts for Helping European Transport Sustainability	POLIS	EU – FP6	
47	TRAILBLAZER – Transport and Innovation Logistics by Local Authorities with a Zest for Efficiency		EU – IEE	
48	MOSCA - Decision Support System for Integrated Door-to-Door Delivery: Planning and Control in Logistics	CERTH, UTH	EU – FP5	
49	INTERACTION	MUS		
50	Sustainable Freight Distribution in Historic Centre (Dublin)	MUS		
51	Urban truck navigation	MUS		
52	FIDEUS – the development of a complementary set of vehicles and equipment	MUS		
53	CIVITAS ARCHIMEDES			
53	CIVITAS RENAISSANCE			
54	LEAN	UTH		
55	FREIGHTWISE	UTH		
53	SILENCE – measures to reduce noise level	UTH		
54	NICHES+ mainstreaming urban transport innovation	POLIS	EU – FP7	

	Project Title and Acronym	NOVELOG Partner(s) Involved	Type of Project	Comments
55	**CLAIX – Consolidation of the city-bound deliveries**	**MUS**		
56	**HOST – daytime freight collection and distribution and night time garbage collection**	**MUS**		
57	**RegLog – Consolidation centre for final delivery**	**MUS**		
58	**CIVITAS ELAN / MODERN / SMILE**	**POLIS**		
59	**Connected Cities: Clear Zone**	**UNEW**	**National**	
60	**Environmentally friendly UFT**	**UTH**	**Part of Cityport project**	

From all the projects reviewed, over 250 city logistics measures/interventions cases have been logged into the database, using an MS Excel programme. These were key projects which had the objective to collect best practices that provided many of the city logistics measures/interventions, such as BESTFACT (section 2.11) which provided 52 cases, SUGAR (section 2.5) with 42 cases, and CIVITAS with 28 cases. There were also projects that tested ITS (Intelligent Transport Systems) applications in a number of cities and populated a significant number of cases, such CO-GISTICS (section 2.15) with 19 cases. The distribution of the number of cases across projects is illustrated in Figure 5.

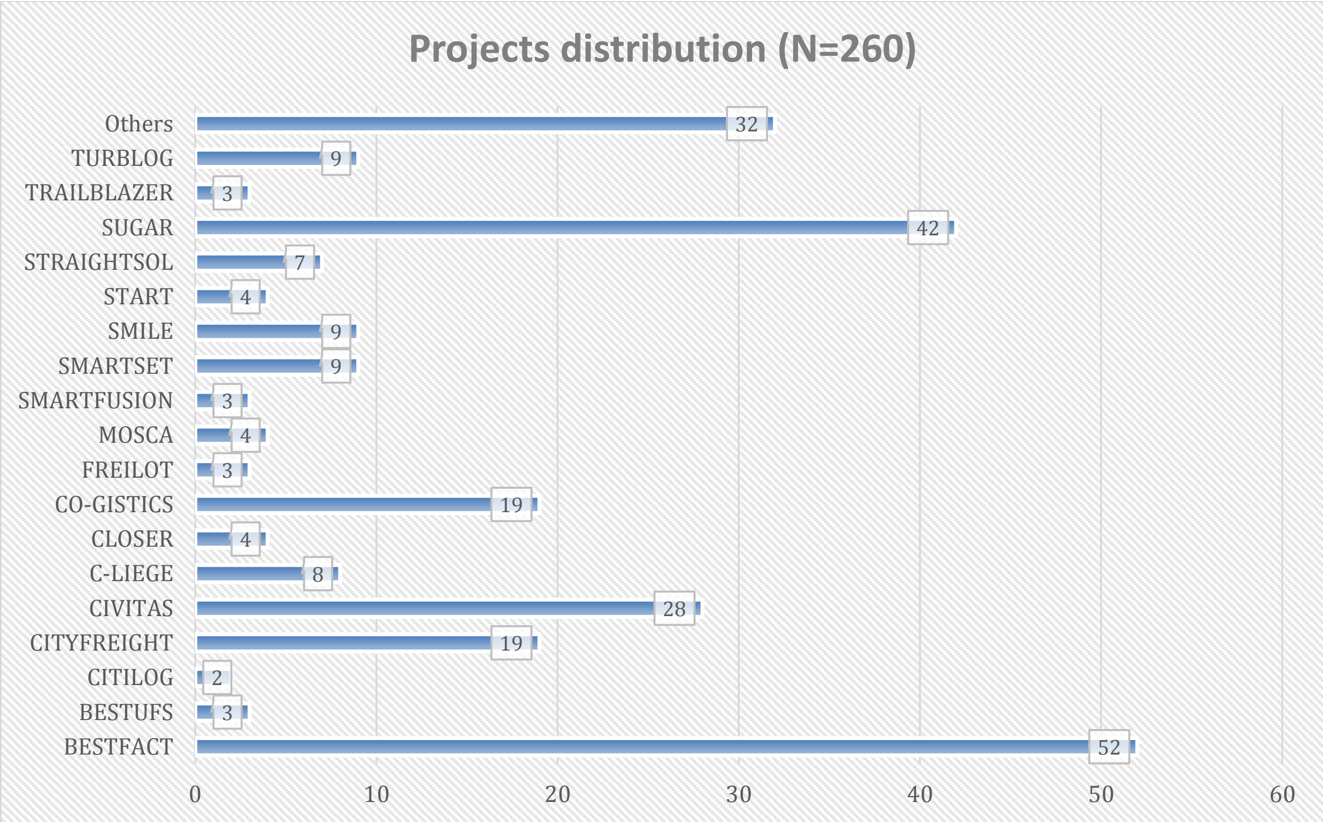


Figure 5: NOVELOG WP4 city logistics projects distribution

4.2 Data validation

When the city logistics cases have been populated in MS Excel table file, efforts were made to any available information from any source (mainly projects' Deliverable documents retrieved of the reviewed projects to complete the Excel file. But some of the information reported in the deliverable were not always clear and therefore validation of this information is needed. Since NOVELOG partners were formed from a number of experienced (European) city logistics experts, many of the reviewed projects were first hand delivered in some way or another by NOVELOG partners. We use this knowledge to distribute the validation of city logistics cases to NOVELOG partners as can be seen in

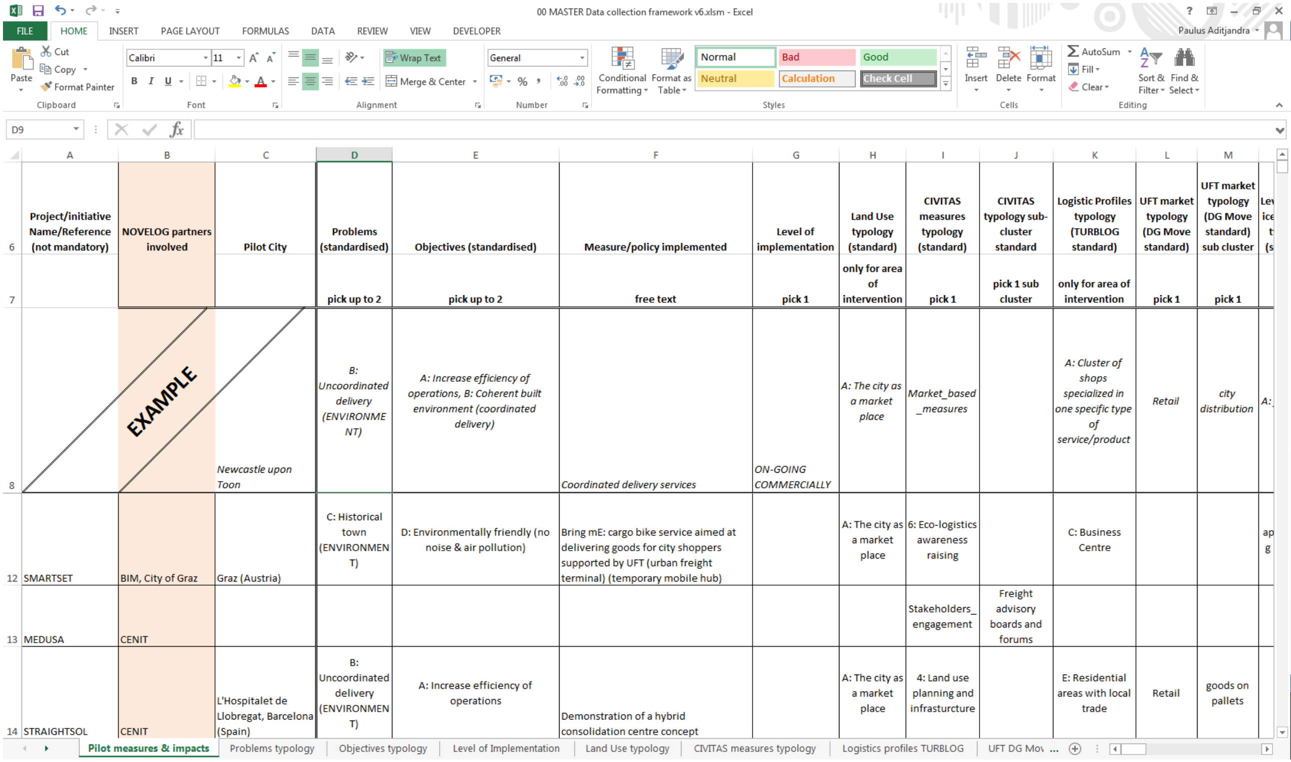
Table 31.

Table 31: NOVELOG partners validating WP4 data core

No	NOVELOG partners	City logistics (key) projects validated
1	Newcastle University (UNEW)	CITYFREIGHT, BESTFACT, SMARTFUSION, SMARTSET
2	Centre for Research and Technology Hellas (CERTH)	SMILE, STRAIGHTSOL, FREILOT
3	Institute for Transport and Logistics, Bologna (ITL)	SUGAR
4	PANTEIA BV, Zoetemeer, the Netherlands	C-LIEGE, TURBLOG
5	European Road Transport Telematics Implementation Coordination Organisation (ERTICO)	CO-GISTICS, FREILOT
6	Promotion of Operational Links with Integrated Services (POLIS)	CIVITAS, NICHES
7	Maritime University of Szczecin (MUS)	C-LIEGE
8	Centre for Transport and Logistics, Rome (CTL)	Rome based cases
9	Venice International University (VIU)	BESTUFS
10	D'Appolonia Spa., Genoa, Italy (DAPP)	Turin based cases
11	Center for Innovation in Transport, Barcelona (CENIT)	Barcelona based cases
12	Mobility consulting and engineering, Graz (BIM)	Graz based cases
13	University of Thessaly (UTH)	CLOSER, MOSCA,

The MS Excel database files have been managed and organised to accommodate database validation at ease, with multiple validation functions such as drop down lists, selecting multiple items from the drop down list, and dependent drop down lists. Visual Basic for Applications (VBA) has been used to programme the file. A circa 20-minute video training for populating as well as validating, by partners, the database has been developed and appended.

This database has then been divided into a number of individual MS Excel files and distributed to the NOVELOG WP4 partners, to be re-reviewed and validated. The 20-minute long video training was appended with the file to all partners to ensure consistency across partners when completing the data validation process. An illustration of the Excel file data format can be seen in Figure 6.



	Project/initiative Name/Reference (not mandatory)	NOVELOG partners involved	Pilot City	Problems (standardised)	Objectives (standardised)	Measure/policy implemented	Level of implementation	Land Use typology (standard)	CIVITAS measures typology (standard)	CIVITAS typology sub-cluster standard	Logistic Profiles typology (TURBLOG standard)	UFT market typology (DG Move standard)	UFT market typology (DG Move standard) sub cluster	Lev ice t (s
7				pick up to 2	pick up to 2	free text	pick 1	only for area of intervention	pick 1	pick 1 sub cluster	only for area of intervention	pick 1	pick 1	
8		EXAMPLE	Newcastle upon Toon	B: Uncoordinated delivery (ENVIRONMENT)	A: Increase efficiency of operations, B: Coherent built environment (coordinated delivery)	Coordinated delivery services	ON-GOING COMMERCIALLY	A: The city as a market place	Market_based_measures		A: Cluster of shops specialized in one specific type of service/product	Retail	city distribution	A:
12	SMARTSET	BIM, City of Graz	Graz (Austria)	C: Historical town (ENVIRONMENT)	D: Environmentally friendly (no noise & air pollution)	Bring mE: cargo bike service aimed at delivering goods for city shoppers supported by UFT (urban freight terminal) (temporary mobile hub)		A: The city as a market place	6: Eco-logistics awareness raising		C: Business Centre			ap g
13	MEDUSA	CENIT							Stakeholders_engagement	Freight advisory boards and forums				
14	STRAIGHTSOL	CENIT	L'Hospitalet de Llobregat, Barcelona (Spain)	B: Uncoordinated delivery (ENVIRONMENT)	A: Increase efficiency of operations	Demonstration of a hybrid consolidation centre concept		A: The city as a market place	4: Land use planning and infrasturcture		E: Residential areas with local trade	Retail	goods on pallets	

Figure 6: Segment of data collection framework in MS Excel file format

A two-week time window was given for each partner to complete and validate the database and 17 partners were given an individually tailored file. The partners involved in this process are well experienced in city logistics projects in Europe.

By the end of June 2016, all validated data had been gradually returned and these were merged into one large file. There were a number of issues with the programming of the file, but these can be considered minor and fixable. A number of new projects/cases were submitted along with the returned data files, taking the number of cases so far in the completed, validated database to 260, in more than 120 cities across Europe, with some of these taken to a higher (e.g. nationwide) level. This is discussed further in the next section.

novelog

5 Preliminary descriptive analysis

This section aims to report descriptive statistics of the survey designed in the previous section. After entering the data from partners into a single database, a descriptive analysis of each unit's measures was made. As earlier noted, 260 cases were registered and validated. 121 cities have been logged in, as the bases where city logistics measures/interventions have occurred. Some cities are represented with more measures/interventions than others; this is especially true for major cities such as Paris (14 cases), London, Brussels, Amsterdam (7 cases each), and Barcelona (6 cases). A medium-sized city with relatively more cases is represented by Utrecht (6 cases).

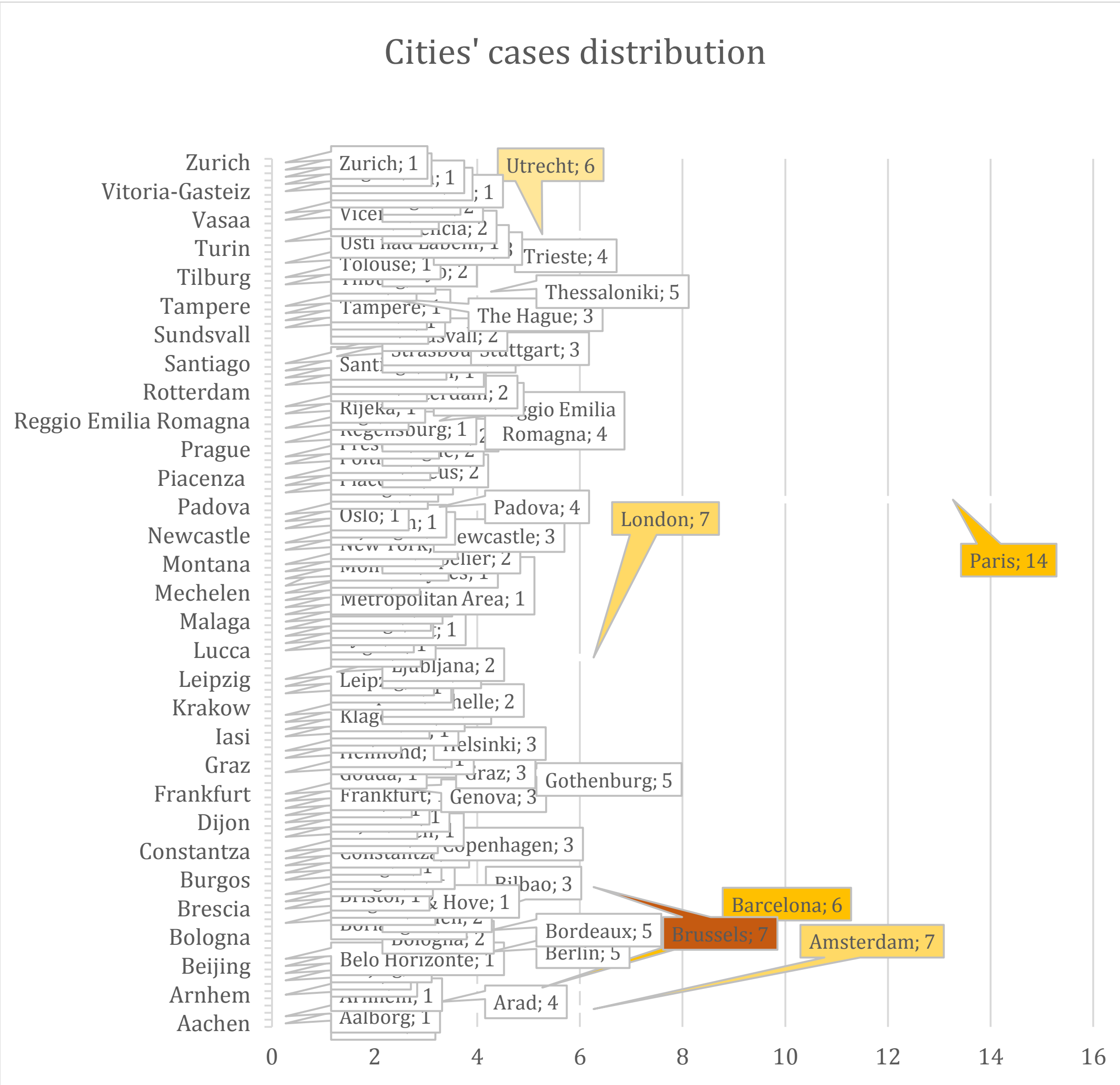


Figure 7: City cases frequency distribution with cities with more city logistics cases highlighted

It is interesting to note that the region Reggio Emilia Romagna (RER) has provided 10 cases, through a few connected medium-sized and small cities (Bologna, Parma, Forli and Ravenna). This is comparable to the Randstad area in the Netherlands that connects Amsterdam (7), The Hague (3), Utrecht (6) and Rotterdam (2), providing 18 cases altogether.

Each of the city (logistics) typology frequency analysis is presented in the following sub-sections. The order of presentation is based on section 3 for ease of reading.

5.1 The city structure & impact on city logistics cases

From the perspective of the urban design theories that form the underlying construct of the city structure, there are four types of city characteristics that are normally considered; these are described in (Marshall, 2012) as:

1) Image of the city, with five types of elements: paths, edges, districts, nodes and landmarks;
2) Townscape, with aesthetic elements through, for example, a mixture of collective buildings in a space that can give visual pleasure which none could give separately;
3) Density of population and building population, diversity (mixture of land use) and design (aesthetic and function to accommodate mass transport);
4) Structure of the city - or even unstructured, as a city could be unplannable in principle.

The above structure components have been found to be influential on passenger journeys, determining the way passengers perceive their trip, and thus also their mode selection, timing, and frequency of travel (Aditjandra, 2008). For freight journeys however, the role of land use can be considered secondary, as the sole purpose of the journey is transporting goods from one point in the supply chain to another (Allen et al., 2012). At each of these points in the supply chain, goods are either worked on, stored, or sold. Furthermore, decisions about the nature of these freight journeys are made by the owners of these goods, the customers they do business with, and the freight transport companies that carry them. Despite that observation, freight journeys are thought to be influenced to some extent by factors including the size, density and layout of a city, albeit the magnitude of influence is likely to be less important than for passengers because (source: Allen et al., 2012):

1) Fewer modal options exist for freight than for passengers (with the vast majority of urban freight transported by road);
2) The demand for freight transport is more inelastic with respect to price than passenger transport (and therefore less likely to alter or stop when the price changes); and
3) Most goods are transported along major roads, rather than through residential neighbourhoods that have distinctive development patterns and road layouts.

Alongside the likely influence of settlement size, density and commercial and industrial land use patterns (as part of land use characteristics as discussed in section 3.1), freight activity in urban areas is likely to be influenced by the strategic organisation of product supply chains (in terms of the location of warehousing facilities within the chain) and the logistics management of road freight transport operations to meet the requirements of the goods.

Following a series of teleconference meetings with relevant partners, held between April-June 2016, WP4 adopted two land use typologies to characterise the city logistics projects and cases. The two typologies were extracted from literature review supported with NOVELOG partners previous experience dealing with city logistics projects. In fact there are no other land use typologies that specifically defined to characterize UFT (as far as we are concerned) unless the two and hence we decided to adopt as such. The frequency distribution for the UFT Land Use typology, based on (Hesse, 2008), is illustrated in Figure 8, while Figure 9 shows the Logistics Profile typology, based on the TURBLOG project. Looking at the first typology, it can be concluded that the city logistics cases collected from the database were concerned mainly with the 'city land use as a market place' (52% of the cases), followed by the 'combination of land use patterns' (33%). The remaining UFT land use types were somewhat minor - not necessarily because there are fewer cases, but rather that those areas fall within the domain of private businesses, rather than the public sector (e.g. city authorities). We are able to conclude that the city logistics cases collected in our database fall mainly into city land use areas that affect wider city stakeholders (i.e. citizens, shopkeepers, authorities, etc.), rather than these small business, which are under-represented. The huge proportion of the reported city logistics problems that derive from historic city centres, spaces shared between passenger and freight, with environmental pollution from UFT activities (as reported in the previous section) certainly explains why the majority of city logistics cases belong to the land use typology 'city as a market place'.

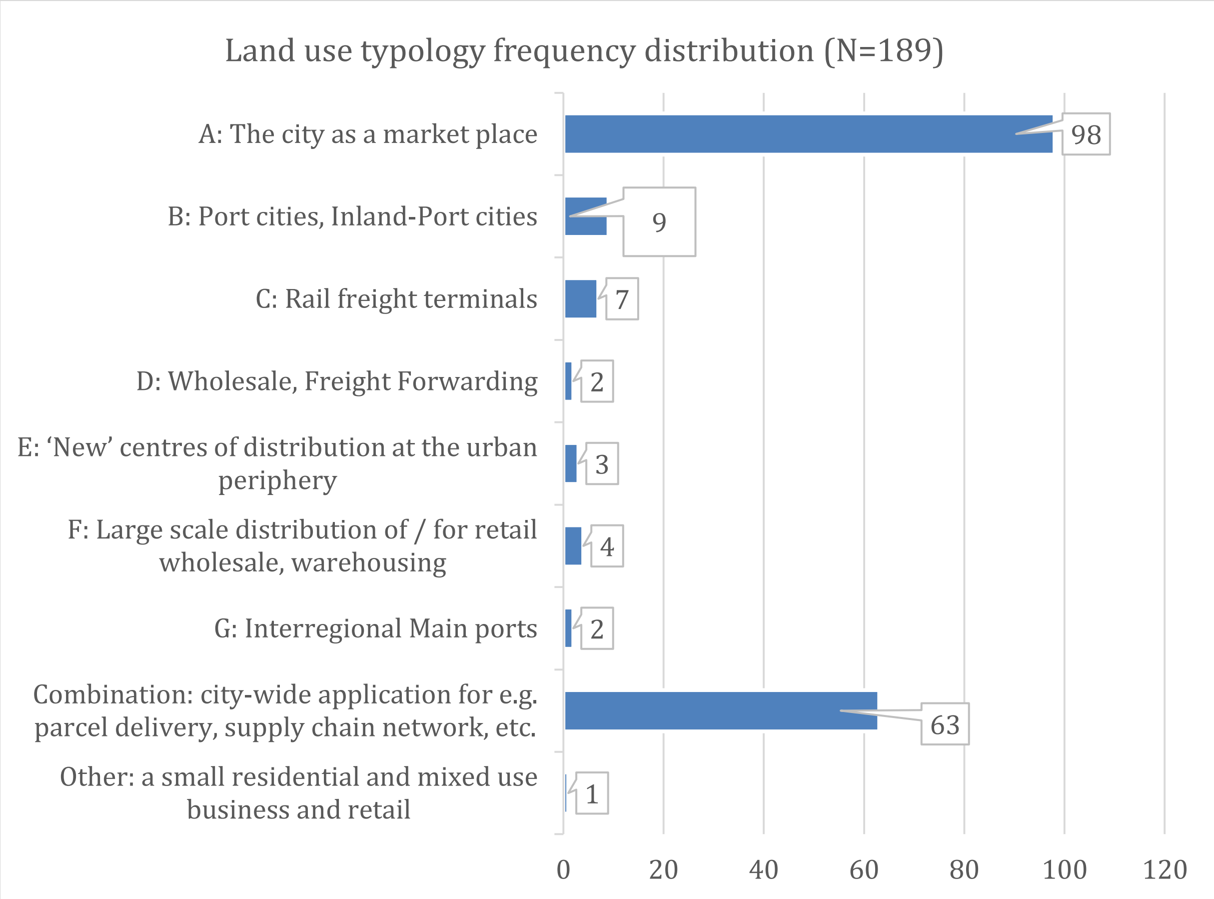


Figure 8: UFT Land use typology (based on Hesse, 2008) frequency distribution

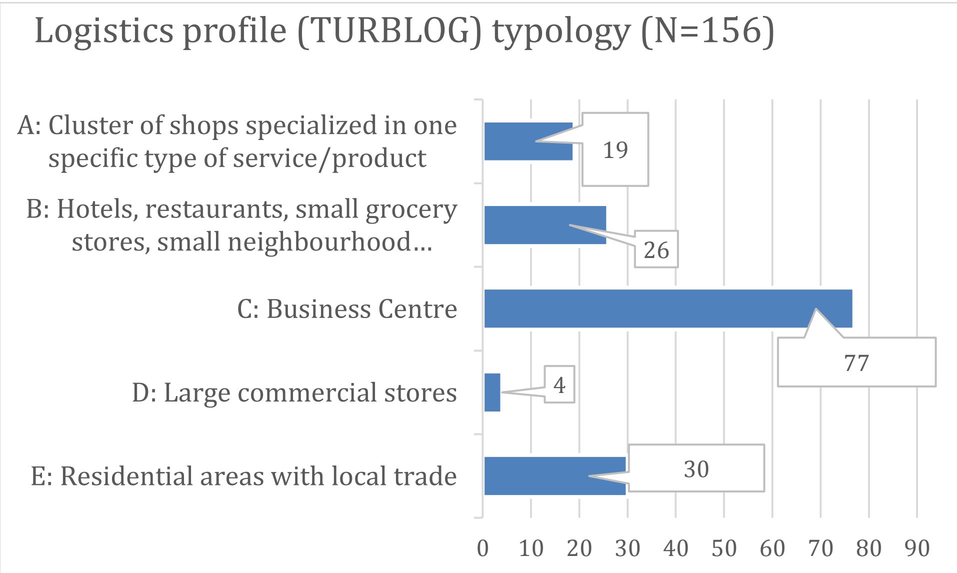


Figure 9: UFT Logistics profile typology (based on TURBLOG project) frequency distribution

The frequency distribution of the second land use typology (TURBLOG based) demonstrated similar patterns, with the majority of the city logistics cases classified in the business centre type of land use

(49%). The distribution of the remaining land use types was much more revealing, with ‘residential with local trade’ (19%), ‘hotels, restaurants and small grocery stores’ (17%), and ‘cluster of shops in one specific type of service/product’ (12%) representing virtually all of the rest. The ‘large commercial’ land use type was represented only marginally (3%) and, similar to the above remark about the unrevealed UFT cases from the private business sector, this is evidence that such UFT operations are under-represented in our database[39].

5.2 City logistics measures/interventions

NOVELOG D2.1 (Campagna et al., 2015) defined the other 2 pillars (of the data collection framework) as linked to organisational and procedural methodologies to address city logistics issues. While the organisational pillar (Pillar 3) relates mainly to the definition and role of key UFT stakeholders, the procedural methodologies pillar (Pillar 4) concerns the typology of UFT measures/interventions. Six types of measures or interventions have been adopted in NOVELOG 2.1: (1) regulatory; (2) market-based; (3) land use planning; (4) infrastructure; (5) new technologies; and (6) management and others. These types are as defined by (MDS Transmodal and Centro di recerca per il Trasporto e la logistica (CTL), 2012); the typology is also adopted by CIVITAS, to address UFT issues, as reported in (CIVITAS WIKI consortium, 2015), albeit with additions such as eco-logistics awareness and stakeholder engagement. The typology frequency distribution can be seen in Figure 10. The biggest share comes from ‘new technologies’ (23%), followed by ‘land use planning and infrastructure’ (21%), ‘regulatory measures and eco-logistics awareness’ (18% each), and stakeholder engagement (11%). The minor share of ‘market based measures’ (2%), is quite popular in the passenger transport areas, but perhaps less relevant in UFT areas.

[39] *Our database is not a sampling of UFT but a record of EU Research and Innovation (R&I), so we can draw little about UFT reality, but we can say something about EU R&I*

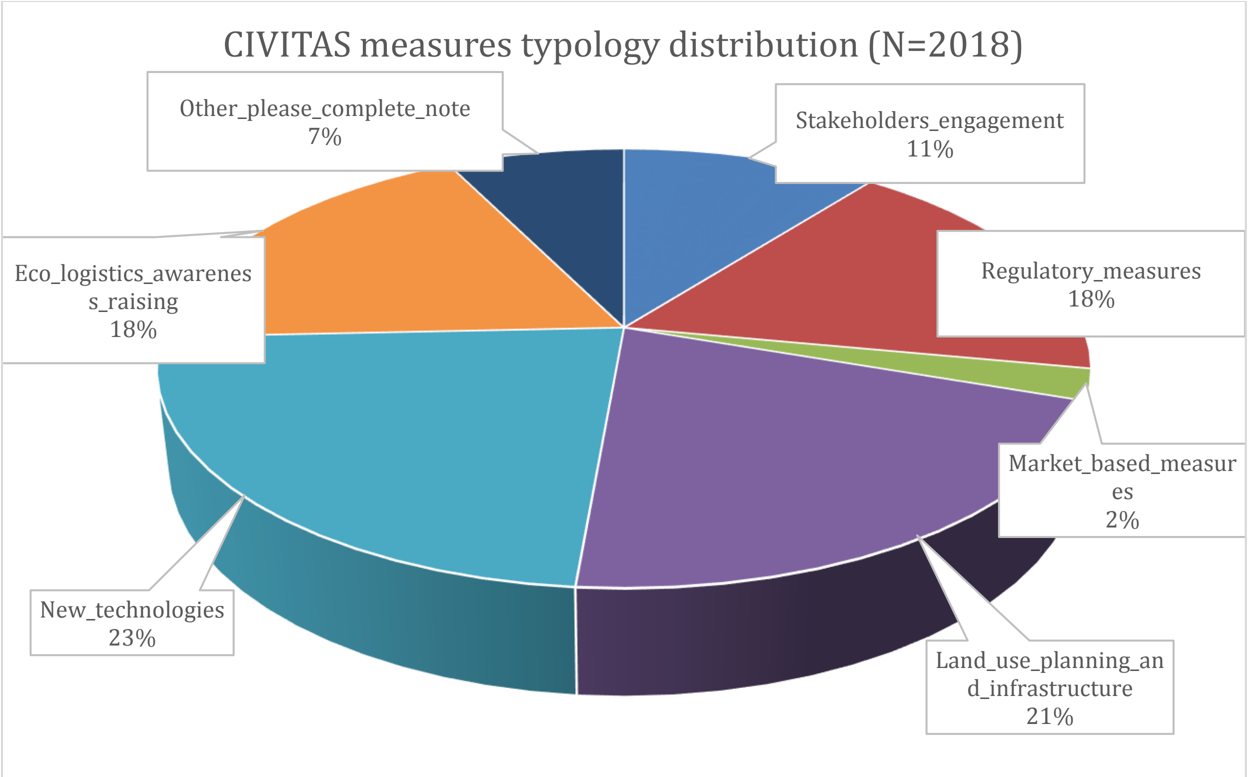


Figure 10: Frequency distribution of CIVITAS UFT measures typology

The relatively well spread share distribution of UFT measures/interventions typology, shown in Figure 10, demonstrates the relative effectiveness of the concept to be used by cities (authorities), as promoted in the CIVITAS network. The frequency distribution of the sub-cluster[40] of the CIVITAS UFT measures typology, that uses a smaller data sample (N=114), can also be seen, in Figure 11. Here, 'real time information systems' (23%), 'urban consolidation centres' (12%), and 'freight quality partnership' (10%) form the three major measures typologies.

We have also adopted a further UFT measures/interventions typology to explore the variance within this area, using the previous UFT projects SUGAR and C-LIEGE - both of which developed typologies to characterise UFT measures/interventions.

[40] See section 3.2 and Table 20 for further detail

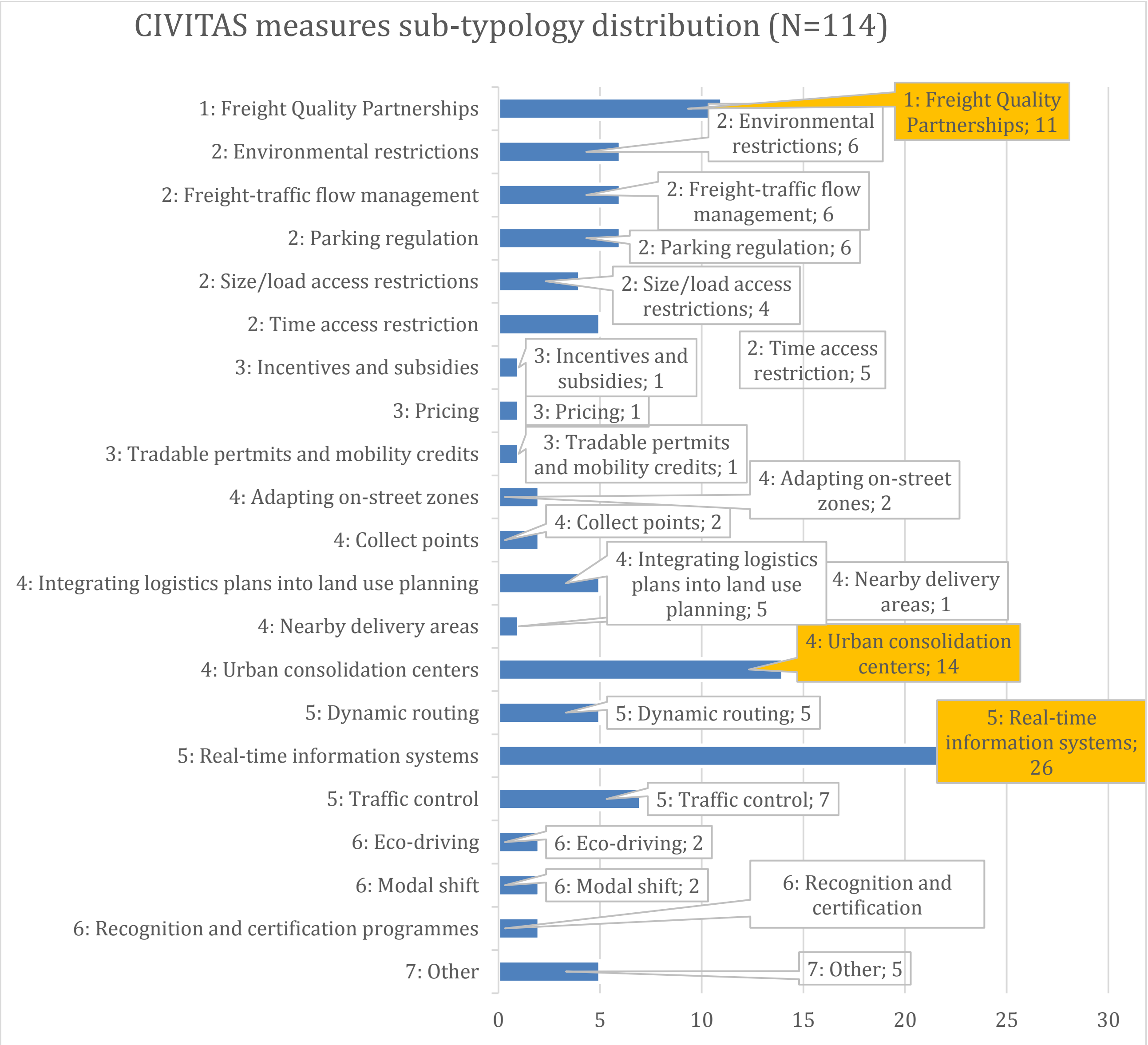


Figure 11: Frequency distribution of CIVITAS UFT measures sub-cluster typology

The SUGAR project was centred on the promoting role of city authorities to accommodate city logistics support. The project recognised the importance of multiple issues covered by city logistics cases, and therefore a typology was formed to help city authorities to gain better understanding of the issues raised from UFT cases. The frequency distribution of cases using the SUGAR typology is illustrated in Figure 12 and Figure 13 and, from both these figures, it can be concluded that the key issues of UFT cases are well spread across different areas. Figure 12 illustrates the distribution when only *single* types (of the SUGAR typology) are selected (based on the first selected category), and shows three major aspects: ‘administrative’, ‘urban planning’ and ‘governance’ (totalling 62%). This figure also demonstrates the city authorities’ centred approached in the typology concept introduced in the project. The illustration changes when *multiple* issues are considered, as demonstrated by Figure 13, where a relatively equal representation of UFT aspects are associated with the cases.

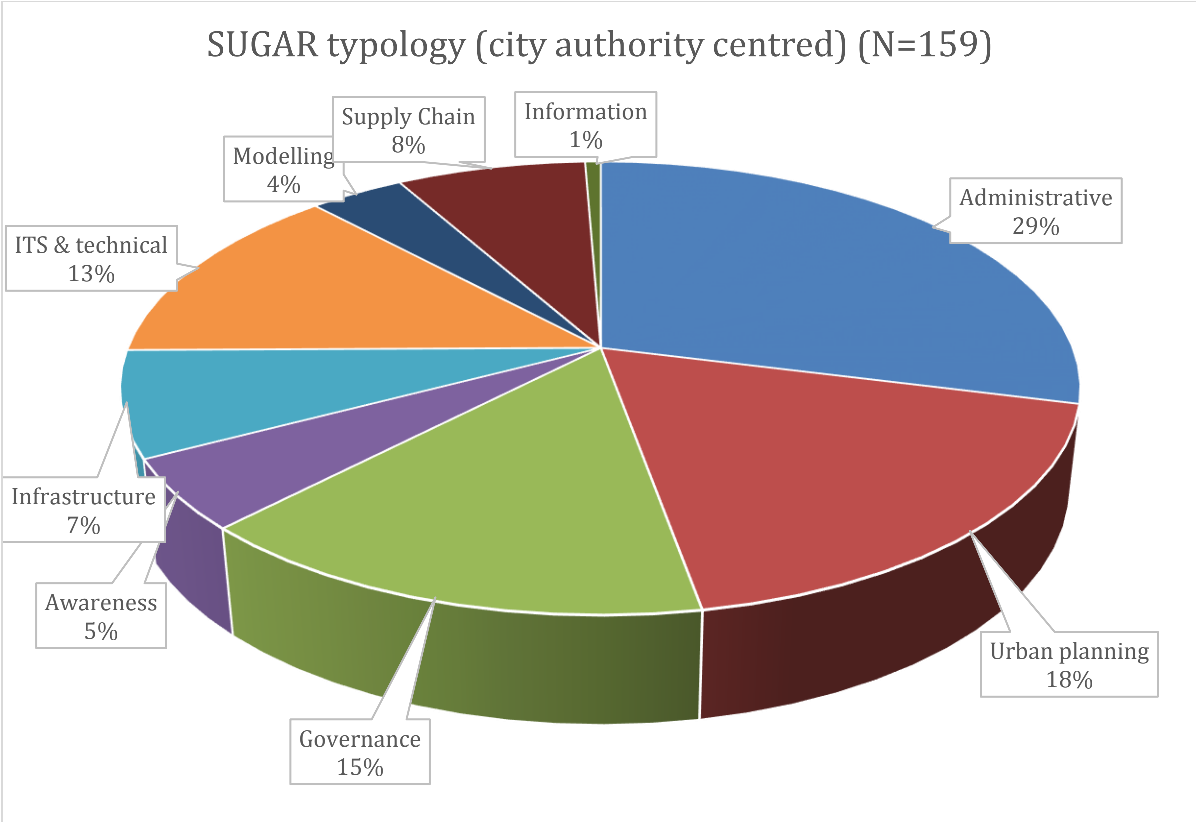


Figure 12: Frequency distribution of SUGAR UFT measures typology

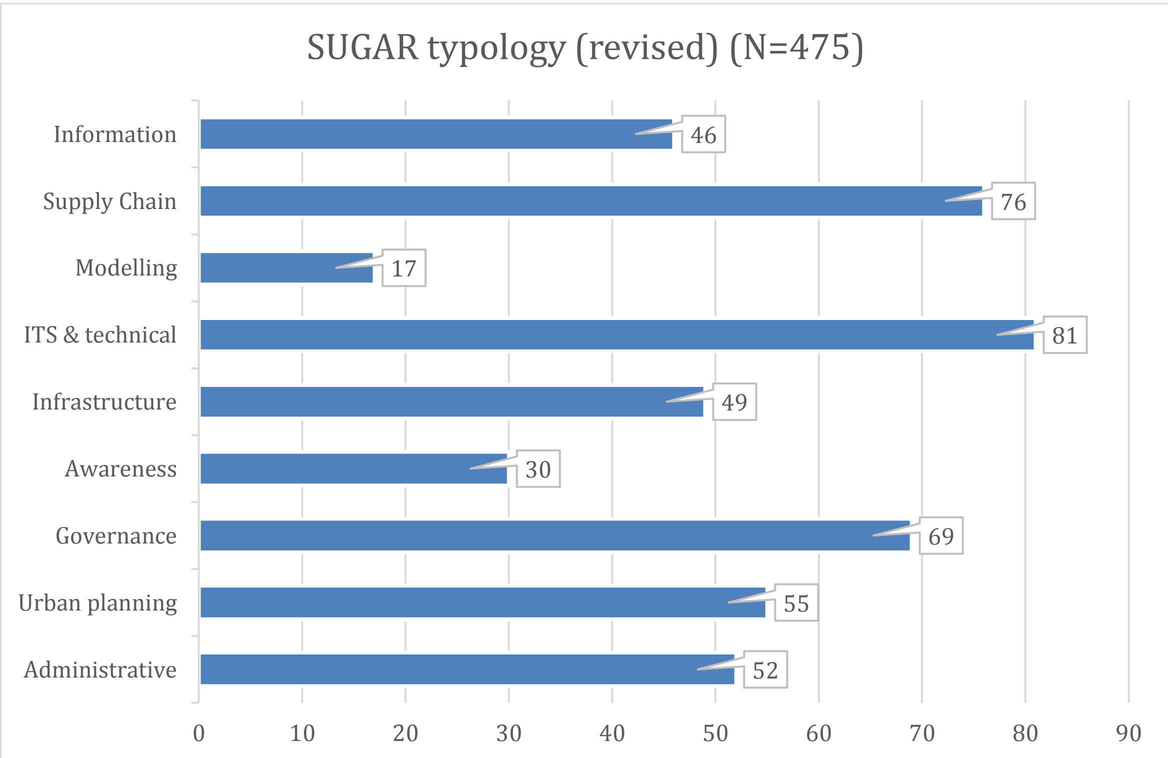


Figure 13: Frequency distribution of SUGAR UFT measures sub-cluster typology

This changed perspective is characterised by 'ITS & technical' becoming the most important aspect, with a 17% share, followed by 'supply chain' (16%), 'governance' (14%), 'urban planning' (12%), 'administrative' (11%), 'information' (10%) and 'infrastructure' (10%).

The C-LIEGE project typology had focused on the mechanism of the pull- or push approach, and defined quite detailed types of UFT measures to characterise its cases. Figure 14 shows the frequency distribution of the typology, with 'Intelligent Transport Systems (ITS)' having the highest share (15%) - consistent with the findings of the SUGAR typology. 'Access restriction' was the second most popular measure (14%), followed by 'distribution micro-platform in the inner city' (11%).

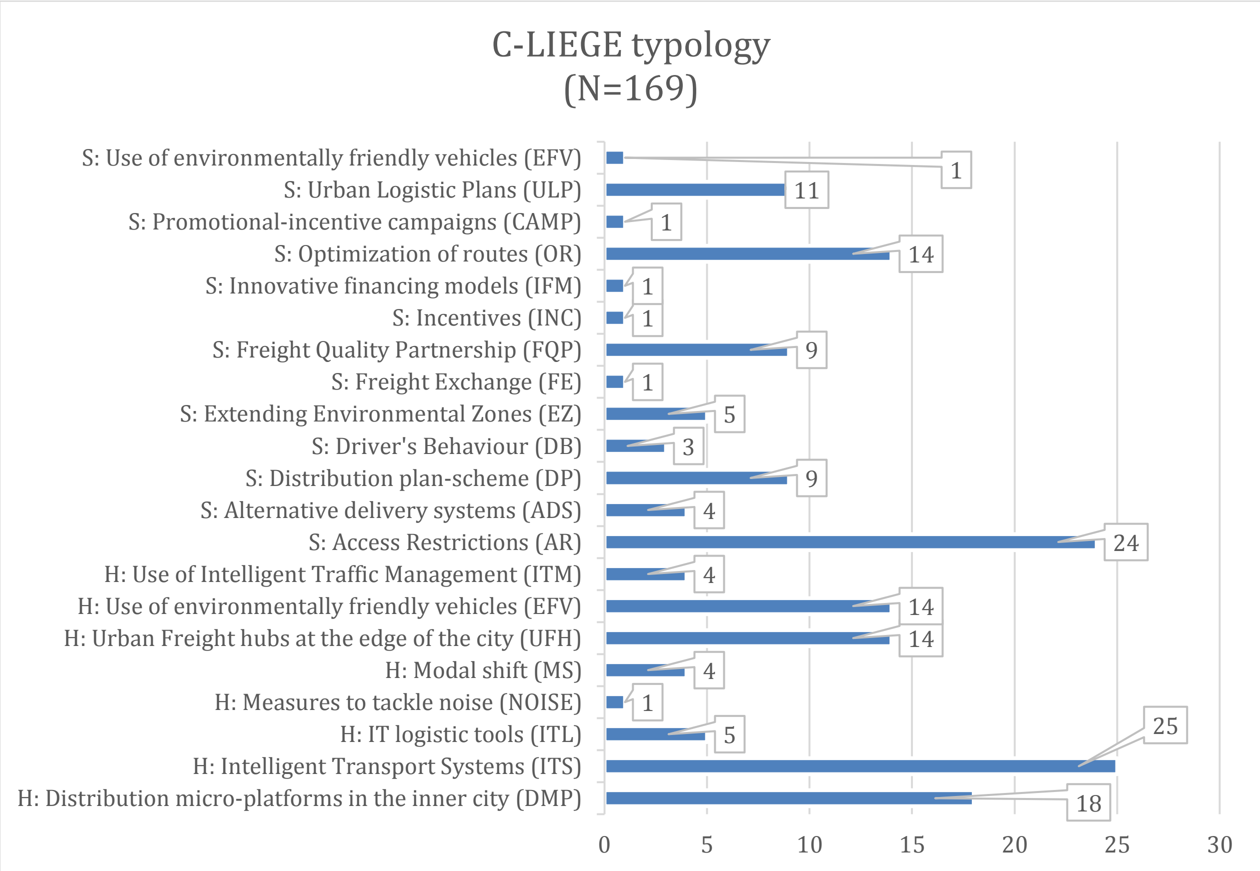


Figure 14: Frequency distribution of C-LIEGE UFT measures typology

The pool of measures/interventions from the database is appended in the Excel file.

5.3 The goods flows and UFT demand generated

As pointed in Section 3.3, NOVELOG D2.1 (Campagna et al., 2015) made specific reference to typify the goods flow and UFT demand generation. While NOVELOG D2.1 focusses on the data collection framework of UFT, NOVELOG D4.1 focusses on the UFT cases typologies. For this reason, we have adopted the UFT typologies to suit the purpose and so this section looks at the goods flow and UFT demand generation parameters. The first typology is based on well-defined UFT markets (MDS

Transmodal and Centro di recerca per il Trasporto e la logistica (CTL), 2012), as also adopted in the CIVITAS UFT policy note (CIVITAS WIKI consortium, 2015), although in the CIVITAS note, two additional markets were described: ‘offices’ and ‘services’ sectors. Figure 15 demonstrates the pattern of city logistics cases from the database. It is clear that the majority of city logistics cases were based in the ‘retail’ related market (61%). This is followed by the ‘express, courier and post’ market, with 28% share, and ‘hotel, restaurant and catering’, with (7%). Further, in the frequency distribution of the UFT market sub-cluster, as illustrated in Figure 16, it is clear that the ‘city distribution’ type of the retail market dominated (59%) and when combined for all sectors the percentage of ‘city distribution’ is even higher with total 61% share (59% from sector 1 (retail) + 1% from sector 2 (express courier and post) + 1% from non-reported sector). Food products market has taken a total of 5% share derived from retail (3%) and hotel, catering and restaurant (2%) sectors (Figure 16).

For the ‘express, courier and post’ market, the sub-cluster was divided between ‘goods on pallets’, ‘parcels’, and ‘postal and package deliveries’ (forming a total share of 27%). Based on our database, we can conclude that retail market city distribution is the main source of UFT demand generation that causes city logistics problems. Certainly this observation should be taken with care as our database was formed from EU funded research projects and should not be generalised as such.

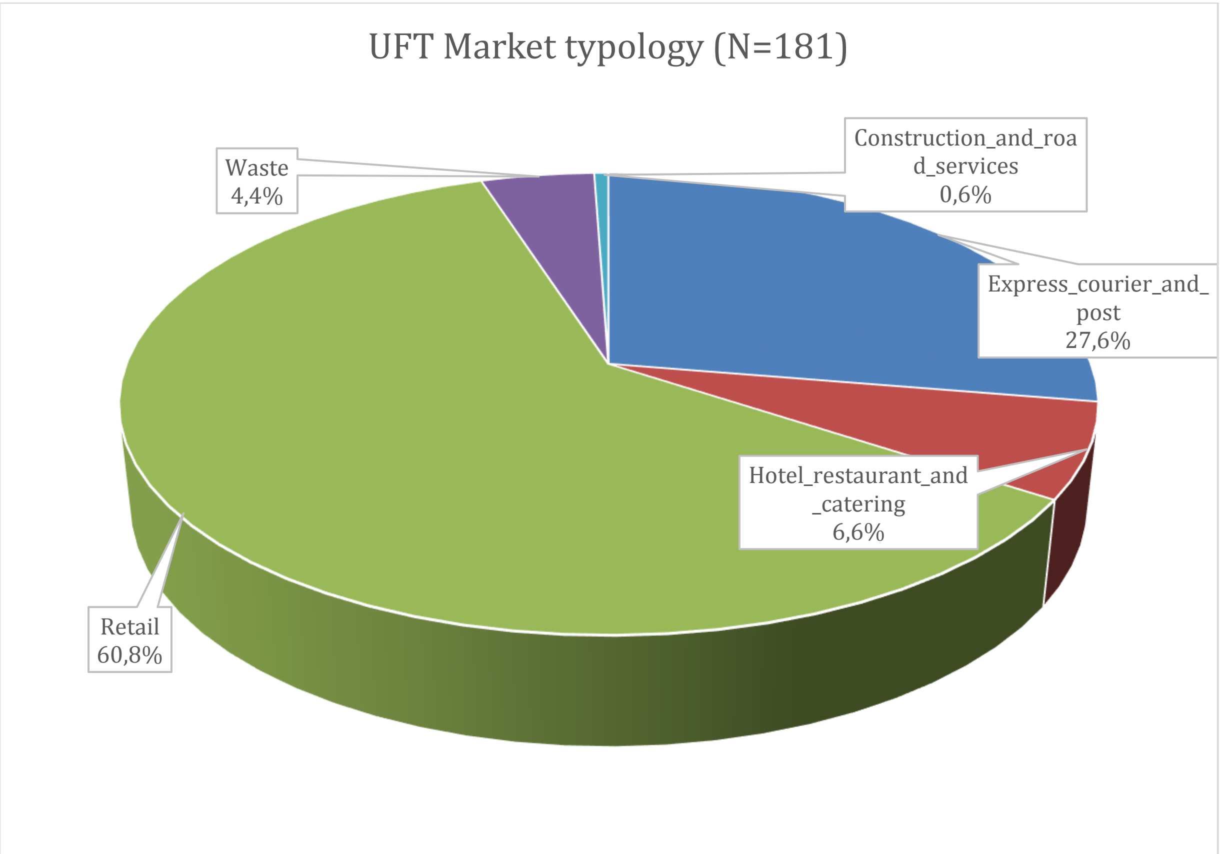


Figure 15: Frequency distribution of UFT markets typology

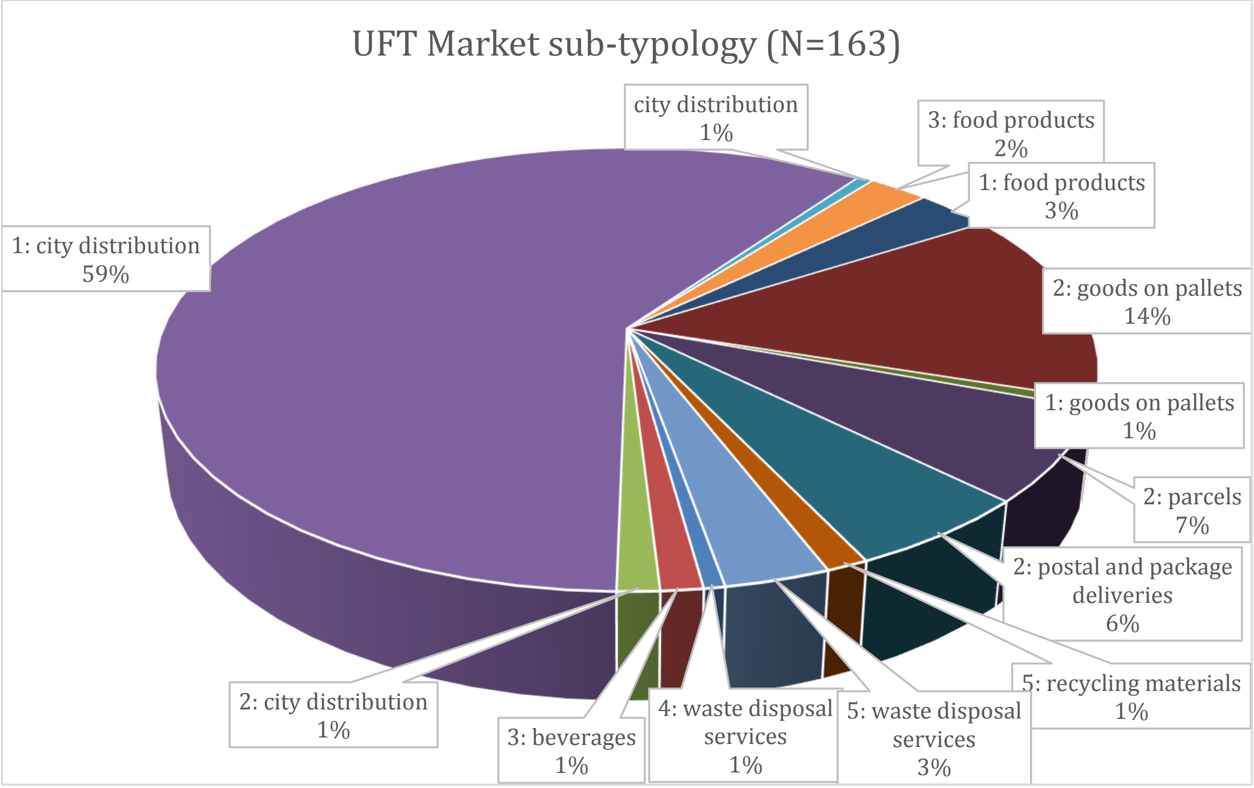


Figure 16: Frequency distribution for sub-cluster of UFT market

For measuring goods flow, we have analysed[41] a common unit of measure for traffic flows, in the form of the level of service (LOS) of road capacity, as defined by the Highway Design Manual endorsed by the AASHTO, as discussed in section 3.3. As we see in Figure 17, the distribution is mainly explained by three levels of service: 'approaching unstable flow' (44%), 'unstable flow' (31%), and 'free flow' (18%). It is quite understandable that the majority of the cases in our database began with the aim of addressing congestion problems, and we can see that these are associated with either approaching unstable flow, or unstable flow. Nevertheless, we also have city logistics cases that have reported the 'free flow' category as characteristic of their city, and special care should be applied to these when using the data analysis.

[41] *But we did not adopt this for the NOVELOG typology.*

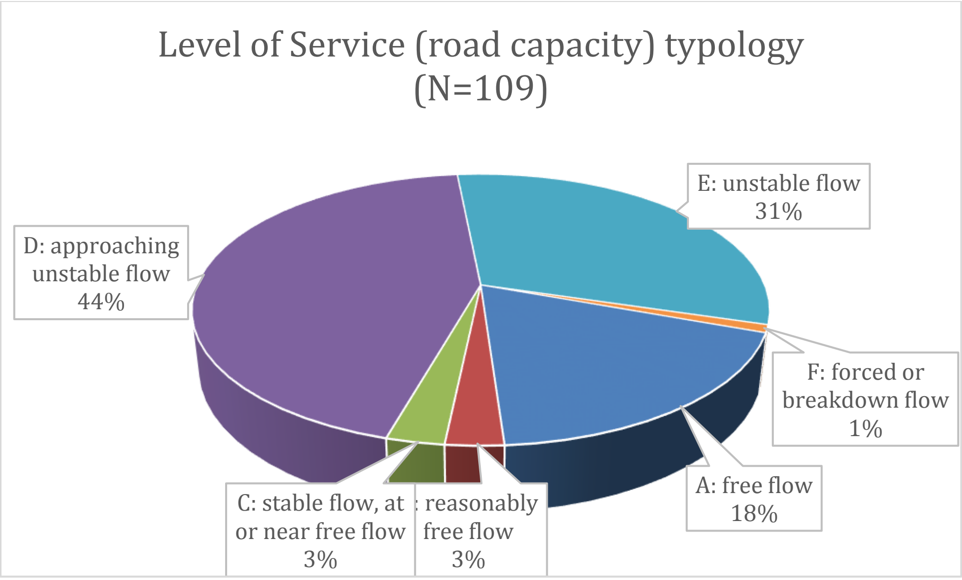


Figure 17: frequency distribution of level of service of road capacity typology

5.4 City logistics problems and objectives

'Problems' and 'Objectives' typologies have been formed, by consolidating collective information about individual cases reported in the reviewed projects. The original intention was to list the various problems and objectives that have always been the main reasons behind project funding. However, it was realised that the nature of many of the funded projects concerned *multiple* problems, or *multiple* objectives. The design of the database drop-down list has therefore embedded the selection of multiples, in its list function. A frequency analysis showed this to be more the case for objectives (41) than for problems (28), although there were more 'single' problems than there were 'single' objectives (9 vs 5).

For the problems typology, the frequency distribution of a single problem (defined as the first selected problem from the list registered by the WP leader and validated by the partners) can be seen in Figure 18; similarly, Figure 19 shows the distribution of the objectives typology. Figure 18 shows 'congestion (time and money)' as the largest problem (30%), followed by 'sensitive areas (environment)' (17%), then 'historical town (environment)' and 'coordinated delivery (environment)' with 12% each. Combining these last three into a single indicator of '(city built) environment' provides 41% of the problems of city logistics cases. This fact demonstrates the general city logistics challenges faced by many European cities.

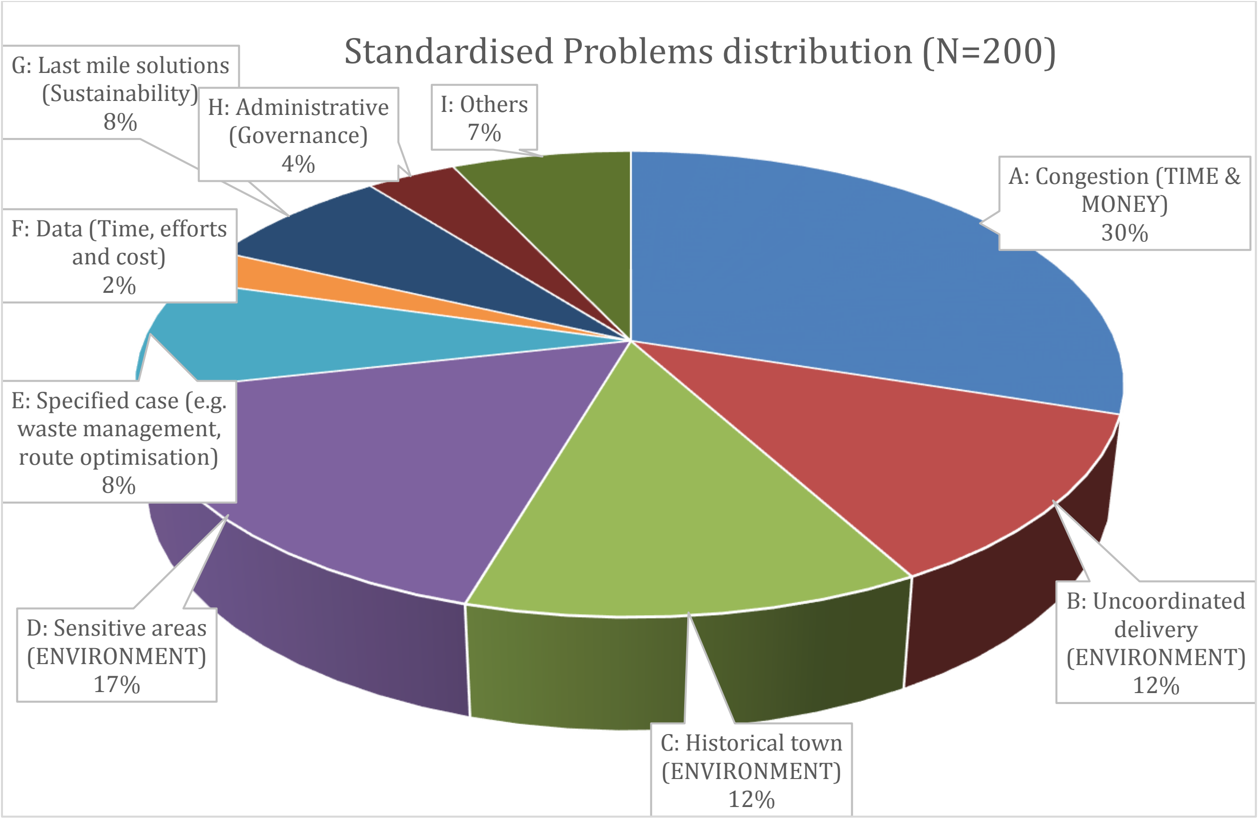


Figure 18: Problems typology frequency distribution

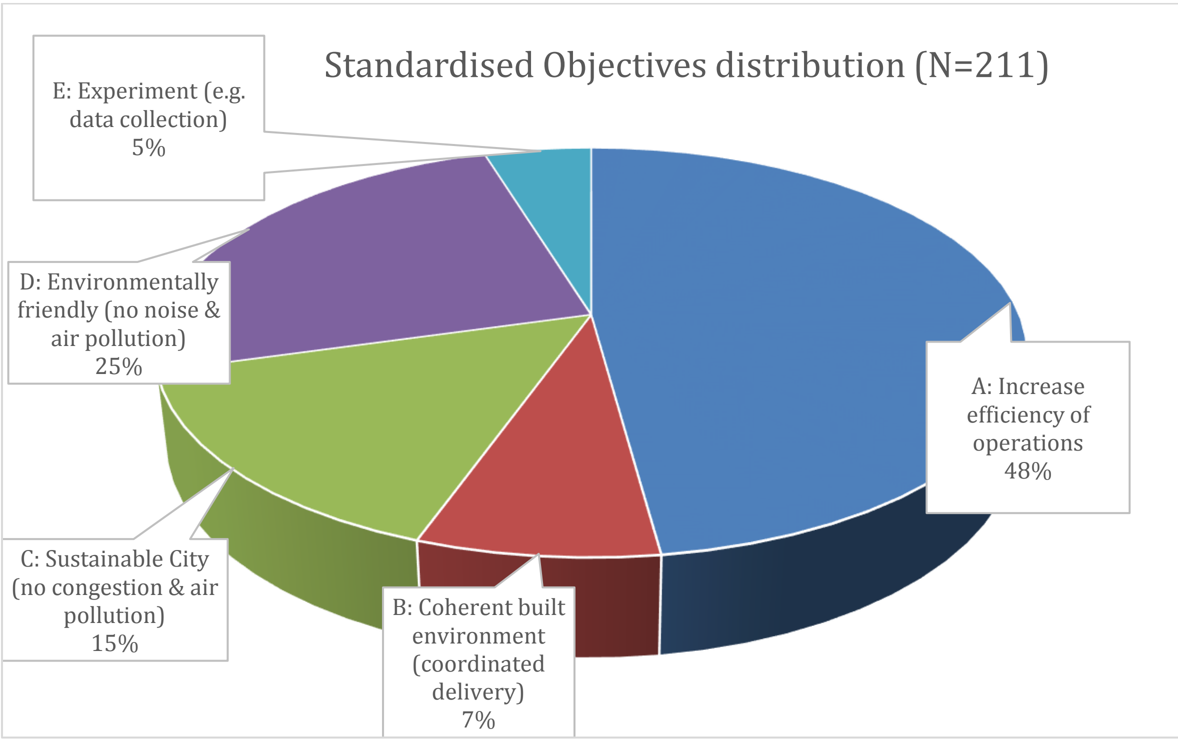


Figure 19: Objectives typology frequency distribution

For the objectives frequency distribution, the major issue is how to 'increase efficiency of operations', at 48%. If we combine typologies B (coherent built environment), C (sustainable city with no congestion and air pollution) and D (environmentally friendly with no noise and air pollution), the environmental objectives are represented by a similar magnitude, at 47%.

5.5 City logistics level of implementation

Assessing its level of implementation is one way of measuring the usefulness of a stated city logistics measure/intervention. The earlier city logistics projects we have reviewed, funded under EU FP4, FP5 and FP6 (for example), were at a rather early stage of identifying the potential application of their city logistics measures/interventions, being based on previous experience or knowledge from the general market, and rather prescriptive in nature. Many of these projects were then promoted to a wider network and became something of a toolkit for cities to engage with their logistics issues, but with variable design, process and outcomes. For this reason, the output, where an idea has been successfully implemented, may not necessarily reflect the original plan. The CIVITAS city network is one of Europe's biggest, with many successfully implemented city logistics cases, a significant number of which have been logged into our database. However, little information can be drawn about how specific measures been implemented and not much about the impacts. It should be noted that the CIVITAS network works to promote best practices, not to evaluate research exercises. When cleaning up the database, effort has been made to merge city logistics cases that repeatedly appear in a number of projects. It is remarkable to see some of the cases from earlier projects reappearing in later projects, as the level of implementation progresses from 'plan', to 'pilot', to 'completed' and finally to 'on-going commercially'. However, such cases are rare.

In the later period, FP7 and IEE funded city logistics projects (for example) have been specifically geared towards addressing the sustainability agenda. Impacts data have become more obvious and quantified, though some of these are hypothetical rather than empirical. The frequency distribution can be seen in Figure 20. Only 35% of the cases were reported to be at the expected level of 'on-going commercially'. A list of such projects could certainly be considered for further analysis in WP7 - business model development.

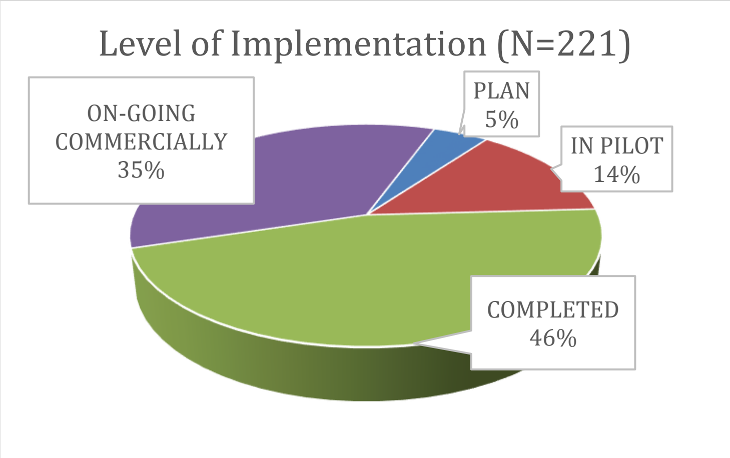


Figure 20: Frequency distribution of the level of implementation

5.6 City logistics impacts

As described in section 3.4, the data collected on the impact of city logistics measures and combinations of measures, implemented around Europe in previous projects was quantitative quantitative. In some cases there were no data available whatsoever. Data available to the project partners from their involvement in the identified projects was collected on the four impact areas the 9 impact indicators. Each project and/or initiative followed a different assessment methodology and assessed different impacts of the measures. Therefore, data available on the measures was not always in the unit used for the assessment of the impact, as required by the NOVELOG Evaluation Framework (D3.1). Moreover, in many cases data on specific impacts was not collected so the only way to get an assessment of these from the measures was through the personal experience of the partners who were involved in the project.

Table 31presents the list of partners responsible for recording the impact of measures from city logistics projects.

The data collected for each indicator was sorted first in terms of quantitative data and then in terms of qualitative data. After the data was sorted the validity of the quantitative data in relation to the indicator unit was examined. In terms of the validity, the unit of the data provided was compared to the unit of the indicator and where possible the data was converted to the indicator's unit. A desktop research was performed to investigate the possibility to convert data of other formats to the unit of the indicator.

The valid quantitative data was analysed and used to define the quantitative ranges of the Likert scale assessment of each impact category. Thus, the qualitative assessment associated with quantitative data was examined and the qualitative data was converted into normalised indicator ranges. Where the valid data was not substantial to define these ranges for the qualitative assessment, the limits were defined from a desktop research performed. Table 32 presents these normalisation limits for the qualitative information provided/

Table 32: City Logistics Measures Impacts Data Collected

Impact Categories	**Normalisation Limits**				
	--	-	Neutral	+	++
	⍰⍰	⍰	⍰	⍰	⍰⍰
CO2 emissions	>15%	>5%	5% to -5%	<-5%	<-15%
Noise Pollution	>40%	>5%	5% to -5%	<-5%	<-40%
Costs	>15%	>3%	3% to -3%	<-3%	<-15%
Energy Consumption	>10%	>3%	3% to -3%	<-3%	<-10%
Number of Accidents	>15%	>5%	5% to -5%	<-5%	<-15%
Service Level	<-10%	<-5%	-5% to 5%	>5%	>10%
Vehicle Kms	>15%	>5%	5% to -5%	<-5%	<-15%
Load Factor	<-30%	<-10	-10% to 10%	>10%	>30%
Traffic Reduction	>50%	>15%	15% to -15%	>-15%	>-50%

Originally the qualitative assessment of the impacts where completed by the project partners on the basis of their 'empirical' understanding of the magnitude and importance of the impact achieved by the measures. This however does not necessarily correspond to the limits defined from the analysis. Therefore, once these ranges were established, all partners which had provided or validated data in the data core on the impacts of measures, were asked to re-assess their qualitative assessment of the cases where quantitative data did not exist using the normalised limits to define in a quantitative way the Likert scale. The final revised database formed from this second validation procedure forms the initial database for the development of the NOVELOG Toolkit (D4.2).

6 Determining the relative success or failure of interventions and measures

This section aims to design a mathematical model of the data gathered from the previous section. One way to measure the performance of a parameter is through impact evaluation. In NOVELOG, impacts evaluation is being developed via WP3, but will be analysed separately and drive the toolkit to be developed in T4.4 and drive the toolkit to delivered in the Deliverable 4.2. For this reason, we will use parameters developed within WP4, adopting the 'level of implementation' parameter to measure the city logistics cases against how they have been reported. We aim to develop a prototype in T4.4 to model this parameter against other variables, to address the vision and model we have developed in this section of D4.1.

The prototype model shall be based on a cross-tabulation table that can test a relationship between two categorical variables (i.e. does the amount of 'on-going commercially' level of implementation – the arbitrary measure of success – relate to two type of measures or interventions). Let's simulate this with a contingency table as can be seen in Table 33.

Table 33: Contingency table showing how many unit of success relate to different measures used

		Measures used		
		UCC+	FQP+	Total
Success/failure use of measure	Yes*	2	2	4
	No**	12	9	21
	Total	14	11	25

Note: *counted from 'on-going commercially' level of implementation; **counted from 'others' level of implementation; +counted from CIVITAS city logistics measures typology sub-cluster

The Pearson's chi-square test is the most well-known for this purpose as it is an elegant statistic based on the simple idea of comparing the frequencies observed in certain categories to the frequencies as expected in those categories by chance. The base model of Pearson's chi square can be seen in Equation (1):

$$X^2 = \sum \frac{(Observed_{ij} - Model_{ij})^2}{Model_{ij}}$$

For relationship beyond two times two table as described above, analysis of variance (ANOVA) can be used to test the relationship between categorical variables. But in ANOVA, the model uses group means and this is not quite appropriate for categorical variables. One way to address this is by using 'expected values' as can be seen below where n is the total number of observations:

$$Model_{ij} = E_{ij}\frac{Row\ Total_i \times Column\ Total_j}{n}$$

The projected expected values for the four cells would be:

Model $_{\text{UCC, Yes}}$ = (4*14)/25 = 2.24

Model $_{\text{UCC, No}}$ = (21*14)/25 = 11.76

Model $_{\text{FQP, Yes}}$ = (4*11)/25 = 1.76

Model $_{\text{FQP, No}}$ = (21*11)/25 = 9.24

Putting all this number together we can sum up the X^2:

$X^2 = (2-2.24)^2/2.24 + (12-11.76)^2/11.76 + (2-1.76)^2/1.76 + (9-9.24)^2/9.24 = 0.05955$

Since the degree of freedom (*df)* is 1 (can be calculated as (r-1)(c-1) in which r is the number of rows and c is the number of columns), the critical values are 3.84 (p=.05) and 6.63 (p=.01) and so because the observed chi squared is smaller than these values it is not significant. This exercise can be done for other variables to support the development of the toolkit as will be delivered in D4.2.

The second model proposed here will be based on multivariate statistical analysis - an examination of observed behaviour that attempts to explain, rather than merely describe, what is going on (Zunder et al., 2014). We will use our 'level of implementation' parameter as the dependent variable, testing that against other variables, such as impact variables (environmental, economic, social, transport and mobility). Since the parameter definition uses an ordinal scale i.e. plan, pilot, completed, and on-going commercially (as described in section **Error! Reference source not found.** and section **Error! Reference source not found.**), an ordinal regression model is projected. The base model can be shown in Equation (2), where y is the ordinal dependent variable, x is independent variable, and ε is the error term.

$$y_i^* = x_i\beta + \varepsilon_{i,} \tag{2}$$

$$y_i = m \text{ if } \tau_{m-1} \leq y_i^* < \tau_{m,}\ m = 1, \ldots, J. \tag{3}$$

Assuming the $\tau_0 = -\infty$ and $\tau_j = \infty$, then the latent variable is the propensity of city logistics impacts to be good indicators of performance in the measurement model:

$$y_i = \begin{cases} 1 \rightarrow plan & \text{if} \quad \tau_0 = -\infty \leq y_i^* < \tau_{1,} \\ 2 \ \rightarrow in\, pilot & \text{if} \quad \tau_1 \leq y_i^* < \tau_{2,} \\ 3 \rightarrow implemented & \text{if} \quad \tau_2 \leq y_i^* < \tau_{3,} \\ 4 \rightarrow ongoing\ commercially & \text{if} \quad \tau_3 \leq y_i^* < \tau_4 = \infty \end{cases} \tag{4}$$

This model can also be exercised to support the development of D4.2 but next we will discuss the conceptual outline of the toolkit (as will be delivered in D4.2).

7 Reflections & Future Work

This section aims to wrap the deliverable with brief introduction to the development of the D4.2.

This deliverable (D4.1) aims to study the enabling determination of optimum policies and measures, based on the city logistics typologies and objectives. We have comprehensively reviewed the entire EU funded (and beyond where available) city logistics related projects and completed a pool of measures/policies of UFT applied (at various level) in cities across the globe (most notably are European cities which benefit from EU funding mechanism). Next, we have reviewed typologies of city logistics based on land use, type of transport policies/measures, UFT markets and traffic flows, and city logistics problem/objectives and other attributes. We have integrated the pool of measures/policies with the typologies and we have validated the analysis through the NOVELOG city logistics expert partners' survey. We concluded that those various developed typologies from the previous work were designed to suit certain target stakeholder audiences. NOVELOG D4.1 develops a city logistics poly parametric typology that is useable by all significant UFT stakeholders, in doing so we built the novel city typology using a mixture of parameters from previous works, combined with impact parameters from WP3 (evaluation framework), and novel parameters with attributes, developed from analysis of the past data and the expert analysis of city logistics experts. NOVELOG typology is a taxonomy of city logistics typologies embedded in the five dimensional structure of production process good practice of why, where, who, what and how framework. A prototype of mathematical model is also proposed within this deliverable to determine the relative success or failure of interventions and measures.

7.1 Reflections on the Conclusions

It is worth noting that many previous typologies were either one dimensional or matrices. In many cases there was a blurring between the stated definitions of the parameters and typologies with the effective nature of how they were researched and deployed. Therefore one might quibble about the relative positioning of UFT Logistics Profiles and UFT Markets within the dimensional structure of the NOVELOG typology, and yet close examination of the relevant data suggest the positioning is correct.

One might question why we have chosen to adopt what are, in some cases, less than perfect parameters. The reason is simple, there is an accumulated 250+ cases of city logistics research and innovation in the domain of EU UFT research. These have been assessed, coded and parameterised by experts close to the work, and with access to data and insights no longer repeatable. In many cases in UFT research there is a sparsity of data that would enable re-analysis redundant. Where there is a need for novelty, we have adopted it, where the needs of the toolkit for broad brush categorisation we have adopted the best fit from the sources.

The impacts detailed in Section 3.4 are not a replacement for the work in WP3, but rather the underlying parameters and attributes which will be used in the final toolkit and which have been extensively mapped, adjudged and utilised in T4.3-T4.4 and detailed in Sections 4-6 above.

7.2 Future Work

The toolkit is not a research tool. It will require further analysis in T4.3 and T4.4 to refine the underlying algorithms of the toolkit and to ensure that as the database is added to, the underlying logic can accommodate new input. However the toolkit needs a typology that is simple enough for a competent politician, city planner or logistics manager to easily access, understand and use it to start the process of city logistics, where the deeper analysis tools of WP2 and the impact analysis of WP 3 will apply.

It is likely that the toolkit will not develop algorithms that use all of the parameters or attributes, but the database we have built holds all of the typology and more, allowing flexibility in the toolkit development.

The next tasks shall be to further analyse any statistical correlation between parameters and impacts, to write a functional specification for the toolkit, for the underlying algorithms and database to be coded and built, and for the functionality to be delivered.

References

Aditjandra, P.T. (2008), *The Relationship Between Urban Form and Travel Behaviour: A Micro-analysis in Tyne and Wear*, Newcastle University, available at: http://scholar.google.co.uk/scholar?q=aditjandra&hl=en&as_sdt=1,5&as_sdtp=on#3.

Aditjandra, P.T., Galatioto, F., Bell, M.C. and Zunder, T.H. (2016), "Evaluating the impacts of urban freight traffic: application of micro-simulation at a large establishment", *European Journal of Transport and Infrastructure Research*, Vol. 16 No. 1, pp. 4–22.

Allen, J., Browne, M. and Cherrett, T. (2012), "Investigating relationships between road freight transport, facility location, logistics management and urban form", *Journal of Transport Geography*, Elsevier Ltd, Vol. 24 No. September, pp. 45–57.

Allen, J., Thorne, G. and Browne, M. (2007), *BESTUFS Good Practice Guide on Urban Freight Transport*, BESTUFS consortium, PTV AG.

Balm, S., Amstel, W.P. van, Habers, J., Aditjandra, P. and Zunder, T.H. (2016), "The Purchasing Behavior of Public Organizations and its Impact on City Logistics", *Transportation Research Procedia*, Elsevier B.V., Vol. 12 No. June 2015, pp. 252–262.

BESTFACT. (2013), *Best Practice Handbook 1, Deliverable 2.2*, available at: http://www.bestfact.net/wp-content/uploads/2014/01/BESTFACT_BPH.pdf.

BESTFACT. (2015a), *BESTFAC D2.3 Best Practice Handbook 2*, available at: http://www.bestfact.net/wp-content/uploads/2015/09/BESTFACT_D2.3_BP_Handbook_2_v1.0_20150205.pdf.

BESTFACT. (2015b), *BESTFACT D2.4 Best Practice Handbook 3*, available at: http://www.bestfact.net/wp-content/uploads/2016/01/BESTFACT_D24_BPH_final.pdf.

Blum, A. and Gruhler, K. (2011), "Typologies of the Built Environment and the Example of Urban Vulnerability Assessment", in Müller, B. (Ed.),*German Annual of Spatial Research and Policy 2010*, Springer-Verlag, Berlin Heidelberg, pp. 147–150.

Campagna, A., Baraglia, F., ERTICO and CERTH. (2015), *NOVELOG D2.1: Framework for Data, Information and Knowledge Collection for Urban Freight and Service Demand Understanding*, Rome.

CIVITAS WIKI consortium. (2015), *Making urban freight logistics more sustainable*, *CIVITAS POLICY NOTE*, www.eltis.org, available at: http://www.eltis.org/resources/tools/civitas-policy-note-making-urban-freight-logistics-more-sustainable.

C-LIEGE. (2012), *IEE C-LIEGE Deliverable 4.2 C-LIEGE Toolbox for the establishment of the city logistics manager*.

Ducret, R. (2014), *Nouvelles organisations de la distribution urbaine des colis sur le dernier kilomètre :*

innover par une approche spatiale de marchandises en ville, Ecole Nationale Superieure des Mines de Paris.

Ducret, R. and Gonzalez-Feliu, J. (2015), “Connecting demand estimation and spatial category models for urban freight : First attempt and research implications”, in Taniguchi, E. and Thompson, R.G. (Eds.),*The 9th International Conference on City Logistics*, Institute for City Logistics, Tenerife, Vol. IX, pp. 154–168.

Ducret, R., Lemarie, B. and Roset, A. (2015), “Cluster Analysis and Spatial Modeling for Urban Freight: Identifying Homogeneous Urban Zones based on Urban Form and Logistics Characteristics”, in Taniguchi, E. and Thompson, R.G. (Eds.),*The 9th International Conference on City Logistics*, Institute for City Logistics, Tenerife, Vol. IX, pp. 358–373.

European Commission. (2007), *Freight Transport Logistics Action Plan*, Brussels.

European Commission. (2011), *2011 WHITE PAPER Roadmap to a Single European Transport Area*.

Faure, L., Burlat, P. and Marques, G. (2015), “Evaluate the Viability of an Urban Consolidation Centre with regards to Urban Morphology”, in Taniguchi, E. and Thompson, R.G. (Eds.),*The 9th International Conference on City Logistics*, Institute for City Logistics, Tenerife, pp. 412–421.

Handy, S. (2015), “Trip generation : Introduction to the special section”, *The Journal of Transport and Land Use*, Vol. 8 No. 1, pp. 1–4.

Hesse, M. (1995), “Urban space and logistics: on the road to sustainability?”, *World Transport Policy and Practice*, Vol. 1 No. 4, pp. 39–45.

Hesse, M. (2008), *The City as a Terminal: The Urban Context of Logistics and Freight Transport*, Ashgate Publishing Ltd, Farnham.

Holguín-veras, J. (2016), “Accomodating What Freight?”, *TRB 95th Annual Meeting*, The National Academy of Sciences, Engineering, and Medicine, Washington D.C., available at: https://vimeo.com/151957163.

Leonardi, J., Browne, M., Allen, J., Zunder, T. and Aditjandra, P.T. (2014), “Increase urban freight efficiency with delivery and servicing plan”, *Research in Transportation Business & Management*, Vol. 12, pp. 73–79.

Marshall, S. (2012), “Science, pseudo-science and urban design”, *URBAN DESIGN International*, Nature Publishing Group, Vol. 17 No. 4, pp. 257–271.

Mcleod, F., Cherrett, T., Bailey, G., Allen, J., Browne, M., Leonardi, J., Aditjandra, P., et al. (2015), “Sustainable Procurement for Greener Logistics in the Higher Education Sector”, *Proceedings of the 20th Annual Logistics Research Network (LRN) Conference*, The Chartered Institue of Logistics and Transport (UK), University of Derby, pp. 1–8.

MDS Transmodal and Centro di recerca per il Trasporto e la logistica (CTL). (2012), *DG MOVE European Commission : Study on Urban Freight Transport Final Report*.

Österle, I., Aditjandra, P.T., Vaghi, C., Grea, G. and Zunder, T.H. (2015), “The role of a structured stakeholder consultation process within the establishment of a sustainable urban supply chain”, (Gary Graham, D.,Ed.)*Supply Chain Management: An International Journal*, Emerald Group Publishing Limited, Vol. 20 No. 3, pp. 284–299.

SUGAR. (2011), *SUGAR Sustainable Urban Goods Logistics Achieved by Regional and Local Policies*, (Dablanc, L.,Ed.), European Regional Development Fund, Bologna, available at: https://halshs.archives-ouvertes.fr/halshs-01069813/file/handbook_sugar_1.pdf.

Tozzi, M., Corazza, M.V. and Musso, A. (2014), “Urban goods movements in a sensitive context: The case of Parma”, *Research in Transportation Business and Management*, Elsevier Ltd, Vol. 11, pp. 134–141.

Transport for London. (2007), “Transport for London London Freight Plan sustainable freight distribution : a plan for London Foreword by Mayor”, *Transport*, London, available at: http://www.tfl.gov.uk/microsites/freight/documents/London-Freight-Plan.pdf.

TURBLOG. (2011a), *Handbook on Urban Logistics - TURBLOG_ww*, Lisbon.

TURBLOG. (2011b), *FP7 TURBLOG Deliverable 2 Business Concepts and Models for urban logistics*, Lisbon.

Zunder, T.H., Aditjandra, P.T. and Carnaby, B. (2014), “Developing a Local Research Strategy for City Logistics on an Academic Campus”, *International Journal of Urban Sciences*, Vol. 18 No. 2, pp. 262–277.

Zunder, T.H., Aditjandra, P.T., Schoemaker, J.T., Vaghi, C., Laparidou, K. and Oesterle, I. (2016), “Engaging city stakeholders to achieve efficient and environmentally friendly urban freight movements”, in Blanquart, C., Clausen, U. and Jacob, B. (Eds.),*Towards Innovative Freight and Logistics Vol. II*, John Wiley &Sons, Inc., Paris, pp. 275–287.

APPENDIX A

Video training to complete and validate the city logistics cases database

NOVELOG WP41467291415.mp4

APPENDIX B

Excel table with the city logistics cases with integrated pool of measures/interventions database

Microsoft Excel
Worksheet