RTD Fact Sheet Template

SMARTFREIGHT FREIGHT FLOW AGGREGATION SIMULATION AND FIELD EXPERIENCE IN BOLOGNA - RTD FACT SHEET*	
Reference Measure	7.1 BOL City Freight Delivery Plan
Date of Submission	31/1/2011
Date of Review	04/03/2011
Date of Approval	04/03/2011 (by ISIS)
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Context and Purpose

The "City Freight delivery Plan" promotes a step-by-step approach in order to reduce inefficiency in freight distribution with particular reference to small operators that represent a relevant share of freight operators. The steps comprehends:

1. the introduction of faster procedures in the release of access permissions, new pricing policies and the enforcement of new policies related to the city centre access;
2. the "pay-to-access" LTZ area service;
3. the "Van Sharing" (funded by another project[1]) that foresees to set up a "Technological transit point[2]" to be tested in a specific area of the LTZ zone. The Bologna project aims to set up a virtual structure, making the same task via a technological centre, that has in charge to collect orders, organise loading and unloading trips, search for optimal path, dynamically redirect activities and book the reserved parking slots.

Within this third Measure step the RTD analysis consisted in study aimed (i)at correctly describe the current situation on freight distribution in the city, (ii)at illustrate the SMARTFREIGHT-based platform in Bologna and the process adopted, and (iii)at conduce some tests to verify the Van Sharing efficiency and effectiveness.

Description of RTD Activity

Due to the current goods' distribution condition in the city, studies and analysis conducted by the Municipality of Bologna (in collaboration with Emilia-Romagna Region and the University of Bologna) showed that a good solution to cope with present freight distribution issues, following SMARTFREIGHT specifications, would consist in the creation of a light-shape consortium made by a group of small operators that don't have the economic power to invest in physical relevant infrastructures: the involved operators (i.e. small operators) would join together in a consortium to provide goods' delivery in the city centre. The process implementation comprehends the combination of the following elements:

- The Van Sharing System[3] (that takes advantage of the availability of the CISIUM system, owned by Bologna Municipality), developed and managed by Gestione Servizi Interporto SRL, a company fully owned by Gruppo Interporto S.p.A., a public-private company whose main shareholders are the Bologna Municipality (35,10%) and the Provincia di Bologna

[1] The Smartfreight EU Project, aimed at develop Information and Communication Technology systems for urban freight distribution in order to support freight operators by optimizing the cargo capacity and reducing the carrying capacity and distances covered.
[2] A transit point is normally a site where goods, coming from the producer or the main distributor, are stocked and there is a detailed organization about when and how they will be sent to the final destination.
[3] The SMARTFREIGHT-based IT platform which represents the core of the Bologna's implementation of SMARTFREIGHT guidelines and specifications

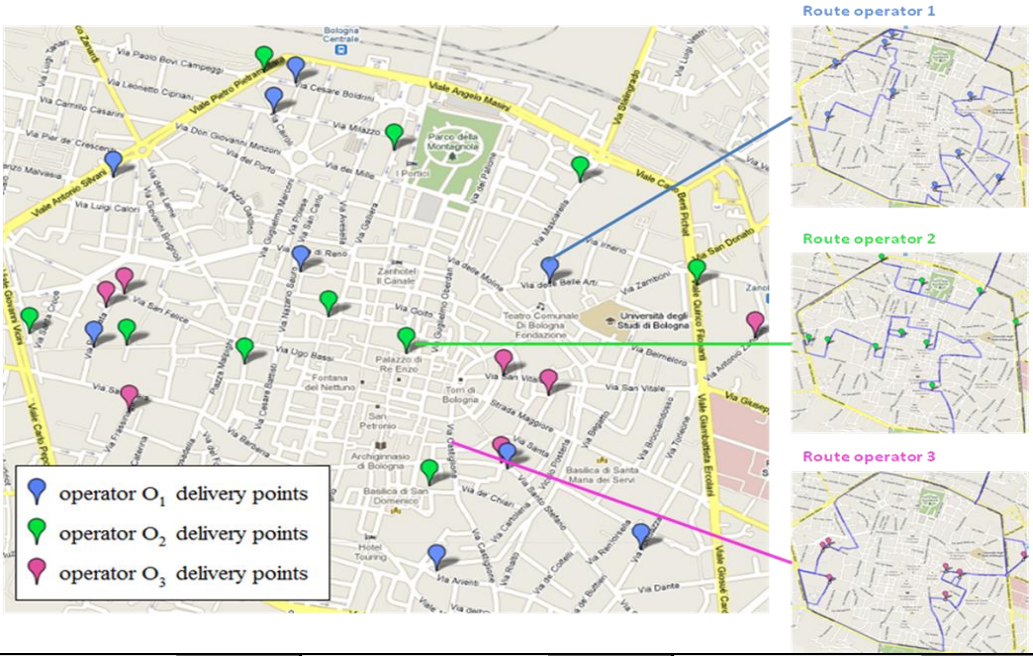
(17,56%).

- The Bookable loading bays, implemented and managed by ATC, public-private company that manages Local Public Transport services in the municipalities of Bologna and Ferrara, whose mail shareholders are, again, the Bologna Municipality (59,65%) and the Provincia di Bologna (37,15%).

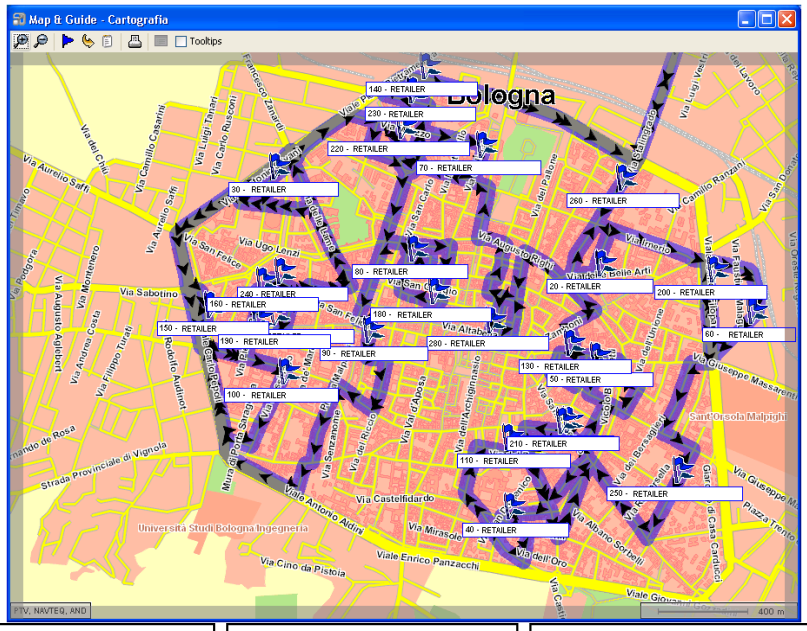
Within the RDT analysis field tests and simulations have been conducted to verify the effectiveness of the Van Sharing system and the benefits that could be derived from its full deployment.
It accounts for two different methodologies, that configure two separate tests:
Test nr. 1 reports the experimental evidence of a practical field testing of the Van Sharing System, to the extent it is already running and actively used in the present pilot phase.
The case compares a "before case", whereby three different operators perform independently their set of delivery orders (supported by a simple route optimization tool), with an "after case" whereby the same set of orders is performed by Van Sharing vehicles, using the actual Platform to conduct route planning. This experimentation is effectively demonstrating in a real case the positive impacts of orders' aggregation and, in general, of vehicle routing optimization executed by Van Sharing travel planning engine, to accomplish the same deliveries, in terms of:

- overall time spent;
- overall distance travelled;
- number of accesses to the city centre.

This test considered the actual case that took place in March 2010 where a series of delivery orders were posted by three different medium-size operators (O_1, O_2, O_3), subdivided in a each set of delivery orders (D_1, D_2, D_3) for a total of 26 ones. In the case that we consider all Operators have their headquarter at Interporto (both in case of the single Operators and of the Van Sharing operator); furthermore, there is a single picking point for all deliveries, located at the outskirts of the city of Bologna, which represent, de facto, a very relevant Transit Point in the Bolognese inter-modal network. For each route the first stop has to be at the picking point P, that happened to be the loading site for all of the 26 orders.
The picture represent the delivery's points for each operator and their route choice compared with the optimization realized with the Van Sharing System.



route data	route R_1		route data	route R_3		route data	route R_2	
overall distance travelled	49,00	km	overall distance travelled	48,00	km	overall distance travelled	49,35	km
whereof in the city centre	12,80	km	whereof in the city centre	11,80	km	whereof in the city centre	13,15	km
overall trip duration	1h 23		overall trip duration	1h 17		overall trip duration	1h 25	
whereof in the city centre	0h 36		whereof in the city centre	0h 30		whereof in the city centre	0h 38	
approximated total unload time	0h 45		approximated total unload time	0h 35		approximated total unload time	0h 50	
total shipment time	2h 08		total shipment time	1h 52		total shipment time	2h 15	
total time spent in the city centre	1h 21		total time spent in the city centre	1h 05		total time spent in the city centre	1h 28	



retailer		
order	code	address
1	18	Via Mascarella, 77
2	1	Via delle Belle Arti, 21
3	17	Viale Quirico Filopanti, 4
4	20	Via Antonio Zanolini, 29
5	9	Via Fondazza, 55
6	2	Via Pompeo Scipione Dolfi, 4
7	12	Via de' Poeti, 5
8	24	Via Luigi Carlo Farini, 37
9	5	Via Santo Stefano, 25
10	3	Via Arienti, 37
11	22	Via San Vitale, 11
12	16	Via Parigi, 4
13	4	Via Schiavonia, 11

retailer		
order	code	address
14	11	Via Alfredo Testoni, 5
15	21	Via Frassinago, 4
16	15	Via del Pratello, 45
17	6	Via del Pratello, 64
18	14	Via Monaldo Calari, 7
19	23	Via Pietralata, 17
20	25	Via San Felice, 48
21	19	Vicolo Fantuzzi, 5
22	7	Via Cairoli, 3
23	10	Via Galliera, 66
24	8	Via Cesare Boldrini, 16
25	13	Viale Pietro Pietramellara

route data	route	V
overall distance travelled	72,00	km
whereof in the city centre	35,80	km
overall trip duration	2h 28	
whereof in the city centre	1h 41	
approximated total unload time	2h 10	
total shipment time	4h 38	
total time spent in the city centre	3h 51	

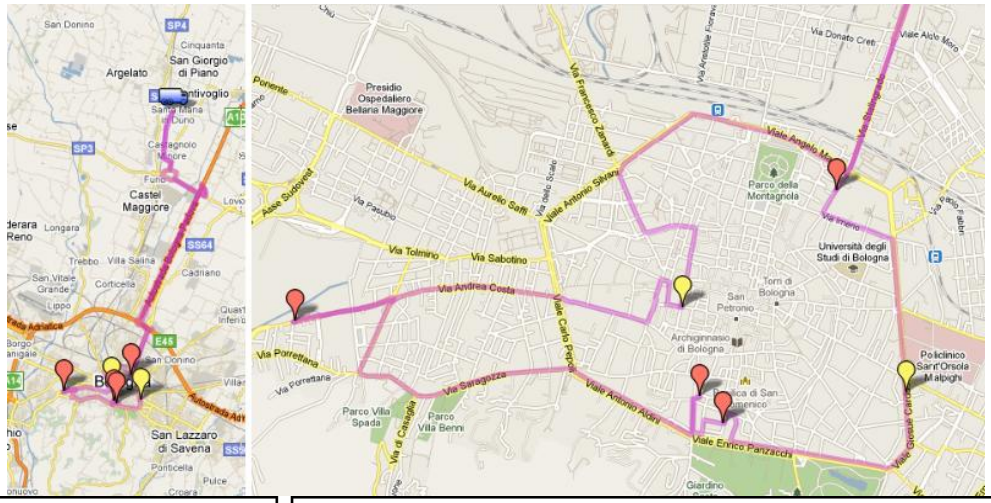
Test nr. 2 consisted in a desk simulation, supported by a generic route optimization tool, to account for a more complex mix of pick-up and delivery points and introducing van capacity constraints, which confirms the benefits of freight flow aggregation. The simulation focuses on a slightly more complete example, whereby more variable are considered:

- the saturation levels of the vans;
- a wider range of operators, with two relatively structured operators (BIG_1 and BIG_2 owning storage facilities and vans of different capacities) and 3 smaller operators (A, B and C), whose vans have a more limited capacity and with no storage space (hence performing same-day-pickup-and-delivery shipments);
- a more heterogeneous mix of deliveries, pickup and pickup-and-delivery shipments have to be performed.

For each of the above mentioned operators, it was found the characterization for what concerns, as shown as example for one operator in the tables:

- location of operational base;
- shipments to perform, in terms of pickup location and delivery location addresses;
- description of followed shipment route, in terms of:
  - route map;
  - route progress (visit order and load progress);
  - route analysis.

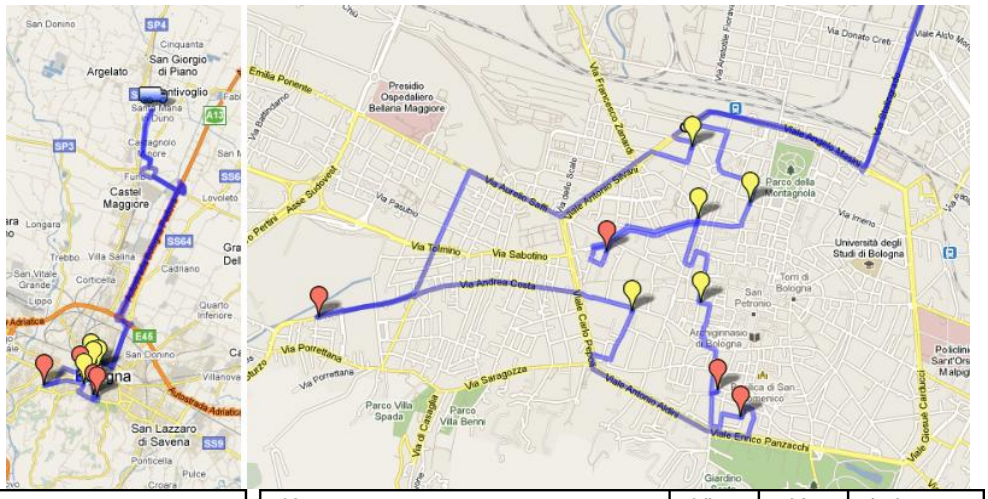
operator	BIG_1				
operational base address and code	TP1		100		
orders detail					
pickup location		delivery location		load units	order type
code	address	code	address		
1	Via Andrea Costa, 202, Bologna	2	Via 4 Novembre, 9, Bologna	1	P&D
3	Via Mirasole, 39, Bologna	100	TP1	1	P
4	Via Massimo D'Azeglio, 51, Bologna	100	TP1	1	P
5	Via Mascarella, 104, Bologna	100	TP1	1	P
100	TP1	6	Viale Giosuè Carducci, 3, Bologna	1	D



BIG1		
overall distance travelled	51,40	km
whereof in the city centre	10,60	km
overall trip duration	1h 17	
whereof in the city centre	0h 25	
approx. total load/unload time	0h 50	
whereof in the city centre	0h 25	
total shipment time	2h 07	
total time spent in the city centre	0h 50	

visit order	code	address	delivery from codes	pickup to codes	load progress (load units)
0	100	TP1		6	
1	5	Via Mascarella, 104, Bologna		100	
2	6	Viale Giosuè Carducci, 3, Bologna	100		
3	3	Via Mirasole, 39, Bologna		100	
4	4	Via Massimo D'Azeglio, 51, Bologna		100	
5	1	Via Andrea Costa, 202, Bologna		2	
6	2	Via 4 Novembre, 9, Bologna	1		
7	100	TP1	5, 3, 4		

The sum of single operator's choice are compared with the test optimization, relized with vans' sharing, reported in the picture post under.



V1		
overall distance travelled	53,00	km
whereof in the city centre	12,70	km
overall trip duration	1h 26	
whereof in the city centre	0h 33	
approx. total load/unload time	1h 20	
whereof in the city centre	0h 45	
total shipment time	2h 46	
total time spent in the city centre	1h 18	

visit order	code	address	delivery from codes	pickup to codes	load progress (load units)
0	100	TP1		14	
1	14	Via Fratelli Rosselli, 15, Bologna	100		
2	1	Via Andrea Costa, 202, Bologna		2, 16, 15	
3	15	Via Frassinago, 2, Bologna	1		
4	3	Via Mirasole, 39, Bologna		17, 100	
5	4	Via Massimo D'Azeglio, 51, Bologna		100	
6	2	Via 4 Novembre, 9, Bologna	1		
7	17	Via Guglielmo Marconi, 45, Bologna	3		
8	9	Via San Rocco, 4, Bologna		100	
9	16	Via Galliera, 34, Bologna	1		
10	100	TP1	3, 4, 9		

Outputs and Results

The following table illustrates the results of comparison between before and after solutions. As expected, by reducing the number of shipment trips necessary to accomplish the entire orders set, we have relevant reductions of overall trip duration and overall covered distance. Furthermore, we also obtain some percentage points reduction in distance covered/time spent in the city centre.

		before case solution	after case solution	percentage comparison
number of accesses to the city centre		3	1	-66,67%
overall distance travelled	km	146,35	72,00	-50,80%
whereof in the city centre	km	37,75	35,80	-5,17%
overall trip duration		4h 05	2h 28	-39,59%
whereof in the city centre		1h 44	1h 41	-2,88%
approximated total unload time		2h 10	2h 10	
total shipment time		6h 15	4h 38	-25,87%
total time spent in the city centre		3h 54	3h 51	-1,28%

The second table in this paragraph underlines the differences occurred in test number two, between before case solution and the after one with Van Sharing Platform optimization.

		before case solution	after case solution	percentage comparison
number of vehicles accessing the city centre		5	2	-60,00%
overall distance travelled	km	125,20	102,80	-17,89%
whereof in the city centre	km	33,55	23,50	-29,96%
overall trip duration		3h 35	2h 42	-24,65%
whereof in the city centre		1h 39	1h 05	-34,34%
approx. total load/unload time		2h 40	2h 40	
whereof in the city centre		1h 30	1h 30	
total shipment time		6h 15	5h 22	-14,13%
total time spent in the city centre		3h 09	2h 35	-17,99%

From the two tests done by Bologna's Municipality is clear the importance of a structured system which allows a more efficient service for delivery. The results underline how important should be the effects of a Technological Centre for the optimization of goods deliveries, allowing a reduction of 60% of number of vehicles accessing the city centre (66% in test one), -25% of shipment time for the first simulation, -14% in the second case and a sensible decrease of overall distance travelled.

Resulting Decision-making

The practical next steps to develop the Van Sharing system into its full deployment require strong political commitment and some investment capacity:

- develop the commercial proposition into a fully attractive package, to induce the biggest possible number of operators to buy the service;
- develop the consortium to include an increasing number of members, in order to achieve a wide and effective set of resources affiliated to the Van Sharing system;
- complete the investment in the fleet of low impact vehicles, up to the expected total of 30 vehicles (with an optimal mix between different kind of capacities and functionalities);
- complete the investment in the On Board Units, to ensure all members of the consortium are fully equipped with adequate enabling technology;
- reinforce the organizational structure dedicated to the Van Sharing system management, to allow gradual but full development up to the planned regime status;
- consolidate integration between the Van Sharing Platform and CISIUM;
- implement the network of bookable loading bays, integrating the booking engine within the overall Van Sharing platform.

Possibly the most important factor to allow all the above is a clear strengthening of specifically targeted policies by the Municipality of Bologna to enforce restriction in access to the city centre and usage of load/unload bays for eco-friendly vehicles only, which represents the real

“commercial proposition” of the whole system.

Lessons Learnt

The freight distribution rationalization techniques put in practice by the Van Sharing system aim at impacting on average saturation levels of vehicles used for shipments in the city centre by aggregating orders coming from different logistic operators – who use Van Sharing system to perform Last-Mile service– and optimizing pickup and/or delivery routes.
This allows to significantly decrease the number of shipment routes, with immediate consequences in terms of overall time spent and overall distance travelled, which is of economic interest by itself and, most importantly, allows a decrease in the number of accesses to the city centre to reach all of pickup/delivery locations, and even to reduce time spent and distance travelled by freight vehicles in such sensitive area.
Even though the Van Sharing system has been deployed only partially, the presence of a small number of operators who have already joined the system have allowed to feed the Van Sharing system with real orders, to be achieved with real-case shipment routes. The practical field tests conducted show that the Van Sharing platform is performing effectively and the overall Van Sharing aims have been accomplished in practice, which is an extraordinary success.
Freight flows aggregation, combined with integration to advanced Urban Traffic Management Systems and the availability of Bookable Loading bays is confirmed to be a very effective approach to achieve:

- economically efficient pick-up and delivery service within cities centre;
- reduction of traffic in the city context;
- reduction of pollution, and thus reduction of environmental impact;
- more efficient overall usage of parking spaces in the city.

Cost-effectiveness

The RTD activity, with particular reference to the simulations made, confirmed the power of the instrument (the average reduction of KM driven with the new IT platform is 36%).
The results are extremely significant and allow important information considering different kind of scenarios in terms of time delivery, operator and community’s costs.

Dissemination and Exploitation

The above results shown clearly how the realization of a core freights centre dedicated to a more efficient and sustainable cargo delivery is extremely important for the general reduction of traffic congestion in the city centre.
The development of new information systems for deliveries route, that is the choice of a better path in function of instant traffic situation, should be implemented for *every kind of delivery* in the big cities because of more frequent congestion events. The simulation presented shows how the use of algorithm for “shortest path” (with the on-line information about traffic status) improve journey times even without joining of the van sharing consortium. However creating a shared service delivery, permits to avoid the overlapping of routes taken by individual operators, to improve the performance of the entire system, to ensure the best times for a single order.
The solution to a problem like that, that is the shortest path shared with the vehicle, it is also applicable to other similar mobility services such as PT, school bus or waste paths then the optimal solutions researched can be extended to other intervention areas.