URBAN FREIGHT TRANSPORT: THE FURBOT DELIVERY SYSTEM

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Characteristics of the current urban freight distribution

Receivers are commercial activities and consumers.

The dimension of **commercial activities** in historical city centres is small. Often commercial activities have not a store area or, if they have one, it is small. Therefore the number of required deliveries is high. The number of packages/delivery is low (5-6 packages, from data about some Italian urban centres).

High increase of **home deliveries** due to e-commerce. Rapid deliveries are the most required. The receivers are often single people, especially students and time-poor professionals, who purchase products online but are not normally at home at daytime to accept deliveries.

Transport is operated by many operators, often with not green vehicles.

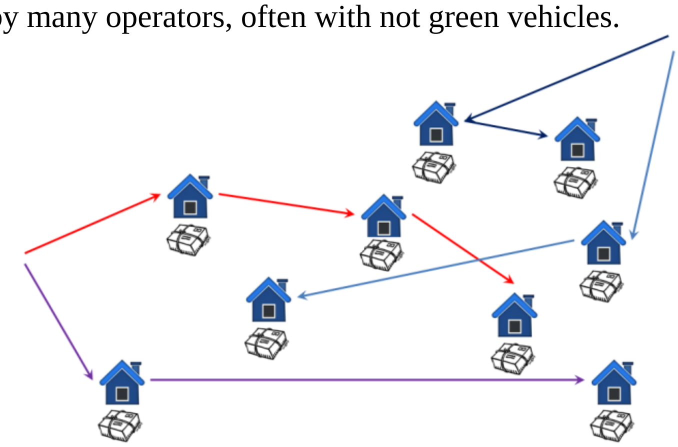

Fig. 1. A schema of urban freight distribution with high fragmentation of both demand and supply.

Problems of urban freight transport

Inefficiency in distribution in urban areas can be exhibited in the following ways:

- Low load factors and empty running;
- A high number of deliveries made to individual premises within a given time period;
- Long dwell times at loading and unloading points.

Inefficiency in distribution leads to additional costs for transport operators, which would normally be passed on to receivers/shippers (in the case of third party operators) or absorbed as costs for own account operators. These costs are ultimately borne by the wider economy.

The FURBOT urban freight transport

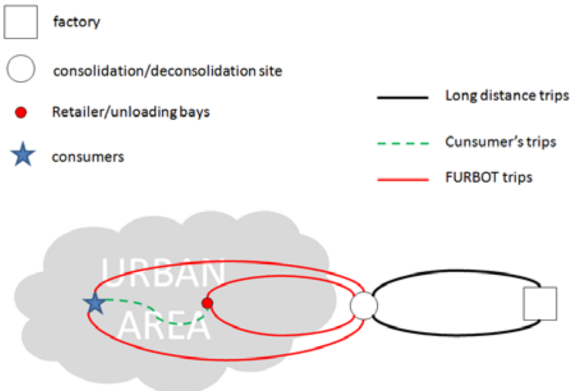

Fig. 2 The logistic of the FURBOT freight distribution

In order to improve the efficiency of urban freight transport, a FURBOT freight transport system has been proposed.

1. Freight arrives at the UDC (Urban Distribution Center). Freight could be packages or pallets. Pallets are addressed to commercial activities. Packages could be addressed to commercial activities or consumers.
2. **FURBOT box consolidation at the UDC**.
   a. Each pallet is fit in FBL (Full Box Load) Furbot box, the unloading bay of the box coincides with the pallet address (commercial activity place).
   b. Packages are divided in clusters according to their addresses and their dimensions and each cluster is fit in a LBL (Less than full Box Load) FURBOT box. An unloading bay is assigned to each LBL box, according to the addresses of the packages there contained. We assume that a receiver has to travel from the address of their package (for instance their home address) to the unloading bay where the LBL box, containing it, has been unloaded. Text messages are sent to the receivers informing them that the freight has been delivered, indicating where it has been delivered, the PIN code to access it and the time window available to collect the freight.

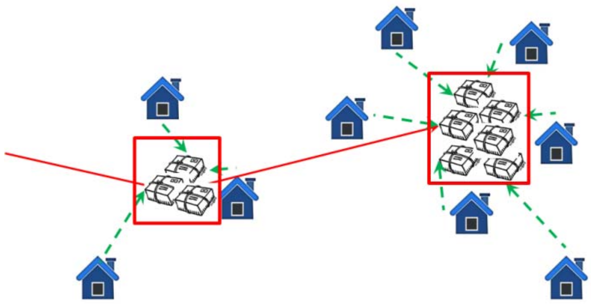

Fig. 3. A schema of urban freight distribution with the FURBOT transport system.

3. **FURBOT vehicle consolidation at the UDC**. Each FURBOT vehicle could be loaded with two FURBOT boxes and a route is assigned to each vehicle, according to the unloading bays of the boxes assigned to it.

FURBOT box consolidation at the UDC

The FURBOT delivery service is inspired to the Packstation. Packstation is a service run by DHL Parcel Germany. It provides automated booths for self-service collection of parcels and oversize letters as well as self-service dispatch of parcels 24 hours a day, seven days a week. The FURBOT service inherits all the vantages of the Packstation concept and add new ones, as shown in Fig. 4. Basically we have a mobile Packstation that has not a fixed position. It is consolidated at the UDC and it is temporary unloaded in the location where it is currently required.

Fig. 4 the LBL FURBOT box idea has its root in the Packstation concept (Courtesy DHL)

Therefore in the FURBOT project, the problem we are facing is the daily clustering of the packages at the UDC into a given number of LBL boxes. The LBL boxes are divided in parcels (Fig. 5). Each parcel accommodates packages for a receiver. Differently from the Packstation, the LBL FURBOT box has a modular structure: it is possible to reorganize its internal space changing the parcel dimensions according to the actual needs. To each cluster, and therefore to each LBL box, an address is assigned, which is the “centre” position of the addresses of the packages within the cluster. Among all the possible clusters we select the ones that minimize the distances the receivers have to walk for collecting their packages (and therefore the distances from the addresses of the packages to the cluster centre).

The cluster centre will be the unloading bay of the box. Actually, each urban area has a list of possible places that can be used as unloading bays. These places should be accessible from the FURBOT vehicle and the receivers, and the impact of the FURBOT box, temporary placed there, on pedestrian flows and vehicular flows, should be minimum.

We have other constraints to our problem, one is related to the box’s capacity and another is related to the maximum distance the receivers can walk (in order to collect their packages in the box).

An optimization algorithm has been developed for assessing the clusters and the unloading bay of each cluster. The code has been written with Matlab and the fuzzy logic has been adopted for solving the problem. In figure 6 an application of the algorithm to an illustrative problem is shown. The small dot locations refer to the addresses of 85 packages (demand). In this case of study we assumed a supply of 4 LBL boxes. The location of the unloading bay assigned to each box is marked in the figure with a big dot. The colors refer to the clusters: all the small bots with a given color will be fit in the LBL box (big dot) of the same color. The receivers have therefore to walk from the small dot to the big dot of the same color.

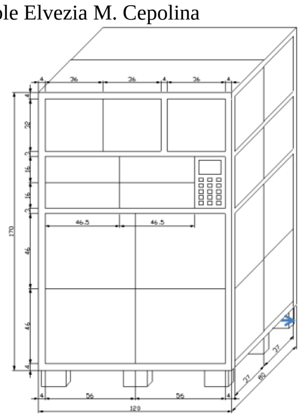

Fig. 5 the LBL FURBOT box design

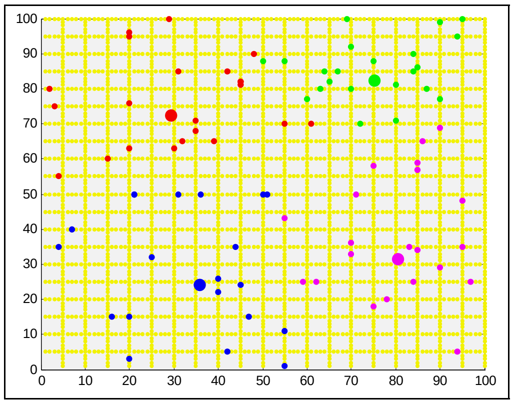

Fig. 6. Output of the clustering algorithm.

Papers:

CEPOLINA ELVEZIA MARIA, FARINA ALESSANDRO, LUPI MARINO,OVERVIEW ON FACILITIES, POLICIES AND STRATEGIES FOR BETTER FREIGHT DELIVERY IN URBAN AREAS, 15th International Conference on Transport Science, ICTS 2012,Transport, Maritime, Logistics Science, pp 1-11, Portorose, Slovenia,2012

CEPOLINA ELVEZIA MARIA, FARINA ALESSANDRO, AN OPTIMIZATION METHODOLOGY FOR THE CONSOLIDATION OF URBAN FREIGHT BOXES, The International Conference on Harbor, Maritime & Multimodal Logistics Modelling and Simulation (HMS 2013 accepted)

CEPOLINA ELVEZIA MARIA, FARINA ALESSANDRO, An urban freight distribution schema for the FURBOT project and the assessment of its performance, submitted to TRA2014 Transport Research Arena 2014 Transport Solutions: from Research to Deployment-Innovate Mobility, Mobilise Innovation, 14-17 Apr 2014 Paris La Défence (France) (accepted)