



## A GENERIC TOOL TO EVALUATE THE ECONOMIC VIABILITY OF CITY DISTRIBUTION CENTERS

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### Introduction

Large cities face serious problems nowadays with respect to congestion and pollution resulting from all the vehicle movements in their city centers. In order to cope with these problems, many city halls have taken measures to regulate access to their city centers. At the same time, the fast development of e-sales has led to a large increase in the volume of parcels that have to be delivered at private houses, including private houses in city centers. As a result, transportation firms in parcel delivery face serious problems with the timely and profitable delivery of parcels in city centers, and simultaneously increase the problem.

Traditionally, parcel delivery is specialized into different categories, depending on parcel type, size, and urgency. Moreover, parcel delivery is a service offered by different commercial firms, some of which may have sufficient volume to operate economically in city centers for some or all parcel types, but some may not. In view of this, it has often been proposed to combine delivery of different parcel types, or even different service providers, in city centers. However, combining delivery of the different parcel types in so-called City Distribution Centers (CDC) requires additional operations, namely the unloading, combining, and reloading of parcels with a destination in the city center. It also changes the upstream processes to facilitate these additional operations. It will be clear that the benefits to be gained from efficient delivery in the city center must outweigh the cost of installing and operation the CDC.

This report describes a tool that enables a parcel delivery firm to estimate whether it is economically viable to operate a city distribution center for combined package delivery in a city center. The tool allows the delivery firm to take into account its existing parcel distribution network and the relevant characteristics of the city center.

The design project in which the tool was developed was commissioned by Dinalog and PostNL. The tool is built on existing tools at PostNL and estimates the costs of delivery as a function of area characteristics. The tool has been integrated in an easy-to-use system and can be evaluated through [www.ABCD.nl](http://www.ABCD.nl).

### Scope

This report focuses on a single parcel delivery firm, on a single city center, and on all parcel delivery streams of this single firm to destinations in this city center. As a starting scenario, it takes the loading and travelling of vans for delivery of different parcel types, which may contain parcels with a destination in the city center. For the delivery of parcels it is possible to select different types of vehicles.

### Description of the tool

The tool consists of an Excel spreadsheet which is fed by a number of Excel input pages in which the relevant characteristics of the area, the parcel types, the city distribution center including its geographical position, and the vehicle types are specified. In addition, access constraints for vehicles and time windows for delivery can be specified.

Performance measures are:

- Total pick-up-and-delivery cost (PUD cost)
- PUD cost per piece
- PUD cost per stop
- Line haul cost
- CDC cost
- Additional income from 3rd parties
- Number vehicle kilometres per day
- Number of vehicle kilometres per round
- Number of rounds per day
- Number of hours per round per day
- Number of stops and number of pieces per round per day
- Total emissions per year

The tool allows for the calculation of the values of these performance measures with respect to the parcels delivered in the city center, given the current delivery networks for the separate parcel types, the current set of vehicles used for delivery, and given the locations of the distribution centers for each parcel type. The performance measure excludes possible fixed costs and set up costs, since these will not be affected by taking care of the delivery in the city center in a different way, and will remain to exist for the network as a whole.

In addition, the tool allows for splitting up of the city center into non- overlapping zones for combined delivery. The tool calculates the performance measures when parcels are consolidated in the CDC and delivered in the city center with a specific vehicle.

The tool distinguishes the following parcel types:

- Parcels
- Courier
- Car mail bag
- Car mail trolley
- Cargo
- One man delivery

The tool distinguishes the following traditional vehicle types:

- Large delivery van
- Large delivery van with load lift
- Truck with load lift
- Trailer with load lift

Furthermore, the following sustainable vehicles are distinguished:

- Cargo bike
- Goupil
- Renault kangoo
- CNG fueled large delivery van with load lift
- Iveco hybrid
- Smith truck
- Floating depot

For each of these vehicle types, it can be specified which parcel type delivery it can serve.

The tool can calculate the performance measures for the following combinations of parcel types:

- Parcels and Car mail bag
- Parcels and Courier
- Parcels and One man delivery
- Parcels and Car mail bags and Courier
- Parcels and Courier and One man delivery
- Parcels and Courier and One man delivery
- Parcels and Car mail bag and Courier and One man delivery.

These are combinations of small parcels that can be served with a small vehicle.

The tool can also calculate the performance measures for the following combinations of large parcels:

- Car mail trolley and Cargo
- Car mail trolley and One man
- Cargo and One man
- Car mail trolley and Cargo and One man.

Core for the fast calculation of the pickup and delivery cost for each of these scenarios is the capability to provide reliable estimates of the number of drops and travelling speeds in the city center areas. To do so, the tool contains a special developed module that gives the estimates, based on scientific models developed by Daganzo (1984, 2005)