Off-peak Urban Goods Deliveries: 
Transport Efficiency in a Stockholm Pilot Study

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Extended abstract

Objectives and motivation
Stockholm is a fast growing city in Europe, and the demand for goods that need to be distributed increases constantly. Studies show that commercial traffic is a major contributor to peak-period congestion in metropolitan areas throughout the world. Several large cities have started to examine the effects by shifting goods deliveries from peak to off-peak hours, targeting receivers and carriers of goods in urban areas. Successful examples include the New York City Off-hour Delivery Project (Holguin-Veras et al, 2011) and the freight transport legacy in London during the Olympic Games in 2012 (Browne, M., et al. 2014). Shifting commercial vehicle deliveries from daytime to off-peak hours is a challenging task since it involves many interacting stakeholders. The transport carriers and receivers are identified as the key stakeholders (Holguin-Veras et al, 2005). Results from previous studies showed potential benefits in switching goods deliveries to off-peak hours. Examples of the benefits are for instance reduced waiting time for deliveries from the perspective of receivers, and for the goods carriers off-peak deliveries means higher productivity, less fuel costs and reduced number of trucks and crews. Furthermore, the drivers can complete the same delivery route in less time during off-peak hours, and the loading/unloading times reduce significantly.

The City of Stockholm initialized the Off-peak goods transport project in 2014 in order to achieve a more efficient and environmentally-friendly delivery system. One hybrid electric/diesel truck equipped with silent technology is given permit to deliver goods during off-hours in the Stockholm inner city. Transport efficiency, environmental impacts and noise levels are the main factors that are measured and evaluated continuously during the project period. This paper examines the preliminary results obtained from the pilot study in terms of transport efficiency by transferring goods deliveries from the peak to the off-peak hours in urban areas in Stockholm. The hypothesis to be tested in this study is that transport efficiency is higher during off-peak hours compared to peak hours; in particular that average driving speeds are higher, that arrival times at the receivers are more reliable, and that unloading times are shorter.

General description
Analytical modeling and a comprehensive dataset collected during the project period are employed to understand the impact of off-peak deliveries on transport efficiency. The dataset used in our analysis includes multiple types of data:

- high-frequency (1 Hz) Global Positioning System (GPS) records from the delivery vehicle,
- event-based records of the vehicle/driver status, including fuel consumption, from the fleet management system,
- information regarding the transported goods from the goods receivers (grocery stores),
- link speed in the Stockholm road network throughout different times of day, estimated from probe vehicle data.

Indicators such as average driving speed (from warehouse to customer and from customer to customer), driving time, service time (time spent at customer location making deliveries), vehicle kilometers traveled, vehicle hours traveled, delivered volume per hour and km, and fuel consumption are examined. Service time is studied here since it provides an insight into delays associated with deliveries (looking for parking, waiting for person to receive delivery, loading and unloading, etc.).

Increased travel times and uncertainty caused by congestion affects the efficiency of logistic operations (Figliozi, M. A., 2010). Data from the off-peak truck are evaluated against data from probe vehicle data from the same route during regular hours. The impact of congestion is evaluated regarding:

- the change in average travel time
- the change in travel time and arrival time variability
- the interaction effect between a simultaneous decrease in average travel time and variability

Results and conclusions
The outcome of the study is an evaluation of the transport efficiency of the off-peak pilot study in Stockholm so far, in terms of the indicators listed above. Based on the analysis, the potential gains in transport efficiency from off-peak deliveries are discussed. The implications and generality of the findings are addressed, and the results are assessed in relation to other aspects contributing to the potential of off-peak deliveries, including noise emissions and public acceptability, customer business benefits, as well as urban freight transport policy.
References


Keywords: Goods transport; urban freight; off-peak; transport efficiency.