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# Freight Demand Management and the Potential of Receiver-Led Consolidation programs

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ABSTRACT

The paper defines the field of Freight Demand Management (FDM), and positions it as an important component of transportation policy and management. To establish the rationale for FDM, the paper studies the effects of the agent interactions at the core of supply chains, and identifies the important role played by the receivers of supplies in determining when and how deliveries are made. The paper classifies the various modalities of FDM, and summarizes the real-life experiences of their implementation. To illustrate the potential of FDM, the paper analyzes Receiver-Led Consolidation (RLC) programs. The paper provides background on consolidation programs, and estimates a behavioral model to shed light on the factors explaining receivers' interest in cargo consolidation. The resulting model is used to estimate expected participation in a RLC program in New York City. These results are complemented with freight-trip generation analyses, and a behavioral micro-simulation to estimate potential reductions in freight traffic and vehicle-miles-traveled. The results show that RLC programs could bring significant benefits to large metropolitan areas, reducing freight vehicle-miles-traveled and congestion levels.



## 1. Introduction

Growing concerns about the impacts of human activity on climate change have added enormous pressure to increase the sustainability of transportation systems. The emphasis on transportation is undoubtedly well placed, as the sector consumes 27.8% of the total energy and 70% of the petroleum; and produces 53% of the carbon monoxide, 31.3% of the nitrogen oxide, 24.2% of the volatile organic compounds, and 39.3% of the carbon dioxide (Bureau of Transportation Statistics, 2012a). Freight transportation, particularly trucking, represents a sizable portion of these totals, as trucks, though only 4.3% of all motor vehicles registered, generate 9.8% of the vehicle-miles-traveled (VMT), consume 26.5% of the fuel (Davis et al., 2012), and produce 41% of the greenhouse gas emissions (Environmental Protection Agency, 2012). Yet, freight transportation is a crucial component of modern economies; without an efficient and timely flow of supplies modern life would not be possible. Transportation accounts for 9.8% of the US Gross Domestic Product and 7.2% of the total employment in the country (Bureau of Transportation Statistics, 2012b; Davis et al., 2012). Modern societies need to judiciously balance freight transportation's oppositional forces, as both a major source of negative externalities and a pillar of modern economies.

In its quest to improve living conditions, the public sector can enact a wide range of *initiatives* (e.g., strategies, policies, programs, projects) that can be organized in a continuum, with supply-oriented actions at one end, and demand-centered

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efforts at the other (Holguín Veras et al., 2015b). This arrangement leads to eight major groups: infrastructure management, which are initiatives that improve the facilities used by freight activity; parking and loading areas management, which attempt to enhance the way freight vehicles use urban spaces for pick-ups and deliveries; vehicle-related initiatives, which use the regulation of vehicle-characteristics to reduce externalities; traffic management activities, which work to improve traffic using traffic regulation and control; pricing, incentives, and taxation, which use economic and financial mechanisms to manage demand to minimize the externalities produced; logistical management, which modify the way in which logistics take place, so that the activity is more consistent with livability and sustainability goals; and freight demand and land-use management, which alter the demand for freight to improve the overall performance of freight transportation systems.

Freight Demand Management (FDM), the counterpart of passenger demand management, is defined in this paper as: "...the area of transportation policy that seeks to induce the demand generator to enact changes in demand patterns to increase economic productivity and/or efficiency; and/or enhance sustainability, quality of life, and/or environmental justice..." This definition deserves discussion. Strictly speaking, both FDM and land use management seek to modify demand. However, they do so in different ways and time scales. FDM seeks to induce changes in the demand for freight at commercial establishments and even households, within a given land use pattern by altering the frequency, timing and mode of deliveries. In contrast, land use management influences the geographical distribution and type of economic activities that could take place in sections of a city—typically by zoning regulations and a permitting process—without necessarily focusing in great detail on the freight demand that materializes at these locations. FDM is an activity that impacts the short-term, while land use management is a process with medium to long-term impacts. The main focus of this paper is FDM.

It is worth mentioning that there is confusion about the term "freight demand management," as it has been used to refer to efforts to control freight traffic (Matsumoto, 2003; Holloway and Spahr, 2013; CIVITAS, 2014). It is not correct to equate freight traffic with freight demand, as traffic is an expression of transportation supply. Strictly speaking, initiatives that seek to manage freight traffic belong to the category of traffic management (Holguín Veras et al., 2015a). Modifying freight traffic does not necessarily lead to changes in the underlying freight demand. For instance, raising tolls at a tolled highway may lead to a traffic diversion to un-tolled alternatives. However, this diversion may not necessarily change freight demand, as the amount and temporal pattern of the cargo remain the same. The distinction between freight traffic and freight demand is important for other reasons. In economic terms, the consumption of normal goods is considered essentially a beneficial activity, while freight traffic is associated with numerous private and external costs. See Holguín-Veras et al. (2015c) for details.

FDM initiatives are unique because they focus on changing the behavior of the receivers of supplies, those who generate the demand. Examples include: off-hour delivery programs that incentivize receivers to accept deliveries in the off-hours; staggered pick-up/delivery programs that induce receivers to spread their deliveries throughout the day; and Receiver-Led Consolidation (RLC) programs that encourage receivers to reduce their Freight Trip Generation (FTG).

FDM has great potential to improve the economic, social, and environmental performance of urban freight systems. First, since most public-sector efforts have focused on the supply side (e.g., infrastructure, traffic, parking and loading areas, logistics, vehicles), the demand side has been overlooked. As a result, FDM holds a good chance of improving the overall performance of the freight system because "easy gains" are likely to exist. Second, since receivers are the primary customers in supply chains, they have a great deal of influence on setting the operational constraints that must be satisfied by carriers and shippers. Convincing receivers to enact changes in their demand patterns is likely to have upstream impacts on supply chains. A third reason is the geographic location of receivers. In most cases, congestion and pollution are most acute in commercial areas. This fact, undoubtedly a reflection of the FTG at commercial establishments and households, indicates that modifying key aspects of freight demand at these locations (e.g., temporal patterns, mode, frequency of deliveries) could have a noticeable effect where these changes will have the highest impacts. Another important reason is the sensitivity of receivers to quality-of-life concerns. Receivers in commercial areas have a vested interest in enhancing quality of life and sustainability, as these changes may translate into more attractive shopping districts and increased profits. Although they may not feel inclined to absorb large expenses to benefit society, the evidence suggests that they may be convinced to modify their demand patterns if public policy, in the form of pricing and/or incentives, is used. These stimuli are essential to overcome business inertia.

These considerations suggest that FDM should play a prominent role in the arsenal of transportation policy and planning tools. Regrettably, as revealed by the comprehensive literature review conducted by the authors (Holguín Veras et al., 2015a), FDM has largely been overlooked by policy makers and researchers. Moreover, there is a severe lack of knowledge about the roles played by the various economic agents involved in supply chains, and consequently, the most effective ways to enact change. However, a handful of research projects and innovative implementations have started to create a body of knowledge that sheds light on the potential of FDM. This paper builds on that insight to help further clarify and define the field.

The main objectives of this paper are to: establish the role and rationale of FDM as a field in freight transportation planning and management; discuss the role played by the agent interactions at the core of modern supply chains; identify the potential modalities of FDM; and review the documented experience. To illustrate the potential of FDM, the paper presents the findings of authors' research on Receiver-Led Consolidation (RLC). This paper is the first comprehensive analysis of FDM reported in the literature. It has seven sections: background is provided in Section 2; the potential FDM initiatives and ordering policies enacted by receivers are presented in Section 3; an overview of consolidation initiatives is provided in Section 4; and the potential of RLC in NYC is presented in Section 5. The last two sections discuss policy implications (Section 6) and conclusions (Section 7).