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Foreword

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LIST OF ACRONYMS

BTS	Bureau of Transportation Statistics
CBD	Central Business District
MPH	Mile Per Hour
MPO	Metropolitan Planning Organization
NY	The state of New York
NYC	The city of New York (New York City)
NYCDOT	New York City Department of Transportation
NYMTC	New York Metropolitan Transportation Council
OHD	Off-hour deliveries (7 PM to 6 AM)
USA	United States of America
USDOT	United States Department of Transportation

EXECUTIVE SUMMARY

The issue of congestion is a problem for many metropolitan areas around the world. One approach to reducing congestion is to reduce the number of freight vehicles using the road network during peak travel times. This has been accomplished in various cities by the use of regulations restricting freight movements during certain hours of the day or by the use of (road) pricing. The problem with such policies is that they are often unpopular with the carriers of goods and, in the case of pricing, not as useful in achieving the desired level of congestion reduction due to the fact that carriers are not able to unilaterally decide when they will make deliveries. In fact, the receiver has the most influence on delivery time.

The off-hour delivery (OHD) program discussed in this report is a voluntary program which provides a financial incentive to receivers in exchange for their commitment to accept off-hour deliveries (between 7 PM and 6 AM). The report discusses a pilot test of the program in the borough of Manhattan in New York City (New York, New York.) The report discusses two of the main traffic problems in New York City: congestion and curb availability as well as some programs implemented by the New York City Department of Transportation (NYCDOT) such as freight delivery windows and the pricing of parking.

The off-hour delivery program presented complements the NYCDOT programs and further assists in reducing congestion and improving curb availability. Additionally the program increases the competitive position of Manhattan by enabling carriers and receivers to be more efficient and profitable.

The pilot test of the program showed improved travel speeds and service times in Manhattan for the carriers. The improved travel speeds also benefited all road users by reducing the average trip time by five minutes per trip. Overall, the program could provide benefits of more than $250 million per year depending on the extent of the implementation. Taking into account the cost of the incentives that will be provided, it could result in possible net benefits of over $70 million, depending on the incentive level.

The program is not only financially beneficial but also has wide spread support from governmental agencies as well as from the industry. The participants in the pilot test were pleased with their experience and many continued receiving off-hour deliveries upon completion of the pilot test even without a financial incentive provided. This indicates that the receivers, which are the main decision makers regarding delivery times, directly benefit from receiving deliveries in the off-hours.

1 INTRODUCTION

1.1 OBJECTIVE OF THE REPORT

The objective of this report is to provide an overview of a program that was successfully piloted in New York City. The purpose of the program is to reduce congestion by encouraging off-hour deliveries via providing financial incentives to the receivers of goods in exchange for them requesting that their deliveries be made during the off-hours. The report shows the benefits of such a program and its transferability to other metropolitan areas experiencing significant congestion.

1.2 SCOPE AND METHODOLOGY

The program discussed in this report was pilot tested in Manhattan, which is one of the five boroughs that make up New York City (New York, New York) in the United States of America. Manhattan was chosen for the program due to its significant level of congestion and the difficulties incurred by the freight industry in delivering goods in Manhattan. The pilot test was conducted during the end of 2009 and work continues on developing a larger implementation of the program. The program is a measure designed to reduce congestion and increase curb availability[1] by encouraging off-hour deliveries.

1.3 REPORT STRUCTURE

The report consists of six chapters including this introduction. Chapter 2 provides a general overview of the United States of America and New York City, along with some of the urban transportation problems being faced. Chapter 3 discusses the institutional framework at the national level and at the local level. Chapter 4 provides information on measures currently being implemented in New York City to address the current transportation issues. Chapter 5 deals with the off-hour delivery program that was pilot tested in Manhattan. Chapter 6 presents an evaluation of the program including the various impacts that resulted as well as issues related to the implementation of the program.

[1] Curb availability refers to both areas designated as parking zones and loading/unloading zones where parking is not allowed.

2 OVERVIEW OF THE UNITED STATES OF AMERICA AND NEW YORK CITY (NEW YORK, NEW YORK)

2.1 NEW YORK CITY IN THE MACRO CONTEXT

2.1.1 Country profile[2]

The United States of America (USA) is a North American country bordered on the west by the North Pacific Ocean and on the east by the North Atlantic Ocean. The USA is located between the countries of Canada and Mexico and covers a geographical area of 9,826,675 km^2.

Figure 1 - Map of the United States of America

Source: https://www.cia.gov

The total population is 307,212,123 people (July 2010 estimate) which results in a population density of 31.26 people/ km^2. 82 percent of the population lives in urbanized areas (2008 estimate.) The economy is highly diversified with a per capita GDP of $46,400.

[2] All figures and statistics were taken from the Central Intelligence Agency's The World Factbook (https://www.cia.gov/library/publications/the-world-factbook/geos/us.html)

2.1.2 Urban freight data collection in the country

There are no regularly scheduled programs to collect urban freight data in the United States. For the most part, each municipality decides if and when to collect urban freight data. There are two main rationales for collecting freight data: 1) demand modelling / planning and 2) network performance. The United States Department of Transportation's (USDOT) Bureau of Transportation Statistics (BTS) collects general transportation statistics. The data collected by the BTS tends to be aggregated data and is not detailed enough to be useful at the local level. Consequently, data to be used at the local level is typically collected by the state and/or local transportation authority directly or by subcontracting the work to transportation consulting agencies. Data is also collected by researchers, but is typically highly specific to the research proposal and is thus of limited use on the national level. The table below shows different types of data to be collected and the purpose of that data in the modelling process.

Table 1 - Data categories

Data class	Items
Information/insight into logistical pattern of flows	
Freight generation data (amount of commodities, vehicle trips, deliveries)	Production
	Consumption
Delivery tours	Sequence of stops
	Location of deliveries
	Commodity, vehicle-trip OD flows
	Empty trips
Economic characteristics of participating agents	Shippers, warehouses, forwarders
	Carriers
	Receivers
Spatial distribution / Location of participating agents	Shippers, warehouses, forwarders
	Carriers
	Receivers
Network characteristics	Travel times, costs
	Use restrictions
	Capacity
	Traffic volumes
Special choice processes	Mode choice
	Delivery time
	Mode attributes
Other economic data	Production functions
	Demand functions
	Input-Output technical coefficients

For the New York City metropolitan area, five sources of "Very Useful" data have been identified by José Holguín-Veras and his colleagues at Rensselaer Polytechnic Institute as part of a study done for the New York Metropolitan Transportation Council regarding freight planning data needs. The five sources are: 1) ZIP (Postal) Code / County Business Patterns (US Census Bureau), 2) U.S. County Level Freight Movement Data (IHS Global Insight), 3) Regional Economic Information System (Bureau of Economic Analysis), 4) Highway Performance Monitoring System (Federal Highway Administration), and 5) Vehicle Inventory and Use Survey (US Census Bureau) (discontinued).

2.2 URBAN FREIGHT IN NEW YORK CITY

New York City is located in the state of New York on the north eastern Atlantic coast of the United States of America. The city consists of five boroughs (Manhattan, The Bronx, Queens, Brooklyn and Staten Island) and has a total land area of 785[3] Km^2, and an estimated (July 2009) population of 8,391,888[4] people (10,682 people/ km^2). New York City's location, on the coast where the Hudson River flows into the Atlantic Ocean, has resulted in the region being home to one of the world's largest ports. New York City and the surrounding metropolitan area had a 2005 GDP of $1.056[5] trillion. The New York City metropolitan area includes three airports, dozens of container terminals, and intermodal yards thus making the area one of the highest concentrations of transportation facilities in the world (Holguín-Veras, 2000).

According to analyses performed by Holguín-Veras and Thorson (2001) for the New York Metropolitan Transportation Council (NYMTC), a total of 170 million tons of freight was transported in and out of the NYMTC region in 1996 with 78 million tons of the total being destined to one of the five boroughs of New York City. The mode shares are shown in Figure 2. The authors indicated that most of the freight transported by water was bulk commodities which did not have an alternative mode available and if this freight was excluded from the analyses that the share of freight transported by truck would increase to 98.38%. This illustrates that the region relies heavily on trucks to transport freight.

[3] U.S. Census Bureau, Census 2000 Summary File 1

[4] U.S. Census Bureau (http://www.census.gov/popest/cities/tables/SUB-EST2009-05-36.xls)

[5] U.S. Department of Commerce Bureau of Economic Analysis: (http://www.bea.gov/histdata/Releases/Regional/2005/GDP/metroArea/prototype_September-26-2007/GDPMetro_2005.xls)

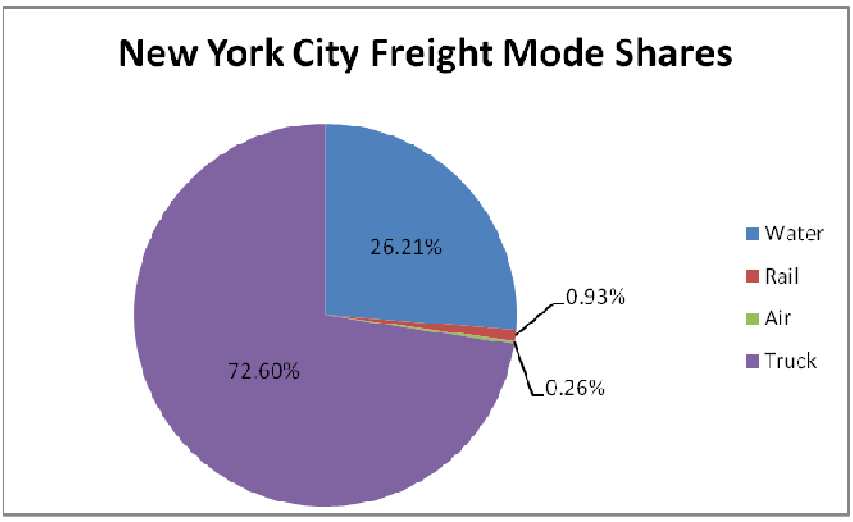


Figure 2 – New York City Freight Mode Shares.

Source: Holguín-Veras and Thorson, 2001

Within New York City, the New York City Department of Transportation (NYCDOT) is responsible for the 5,800 miles of street, 789 city-owned bridge structures, and 48 miles of bus lanes. NYCDOT also manages 80,000 on-street and 10,000 off-street metered parking spots (Holguín-Veras et al., 2010c).

The borough of Manhattan, which is the focus of this case study, is an island with a total land area of 59.5 km^2 and an estimated (July 2009) population of 1,537,195 people (25,850 people/ km^2.) The fact that it is an island has resulted in the situation in which the majority of freight in New York City is transported by truck.

The figure below shows the locations of Central Business Districts (CBD), industrial areas, and neighbourhood retail corridors in New York City. The two CBDs in Manhattan are the largest (Midtown) and third largest (Lower Manhattan) CBDs in the country.

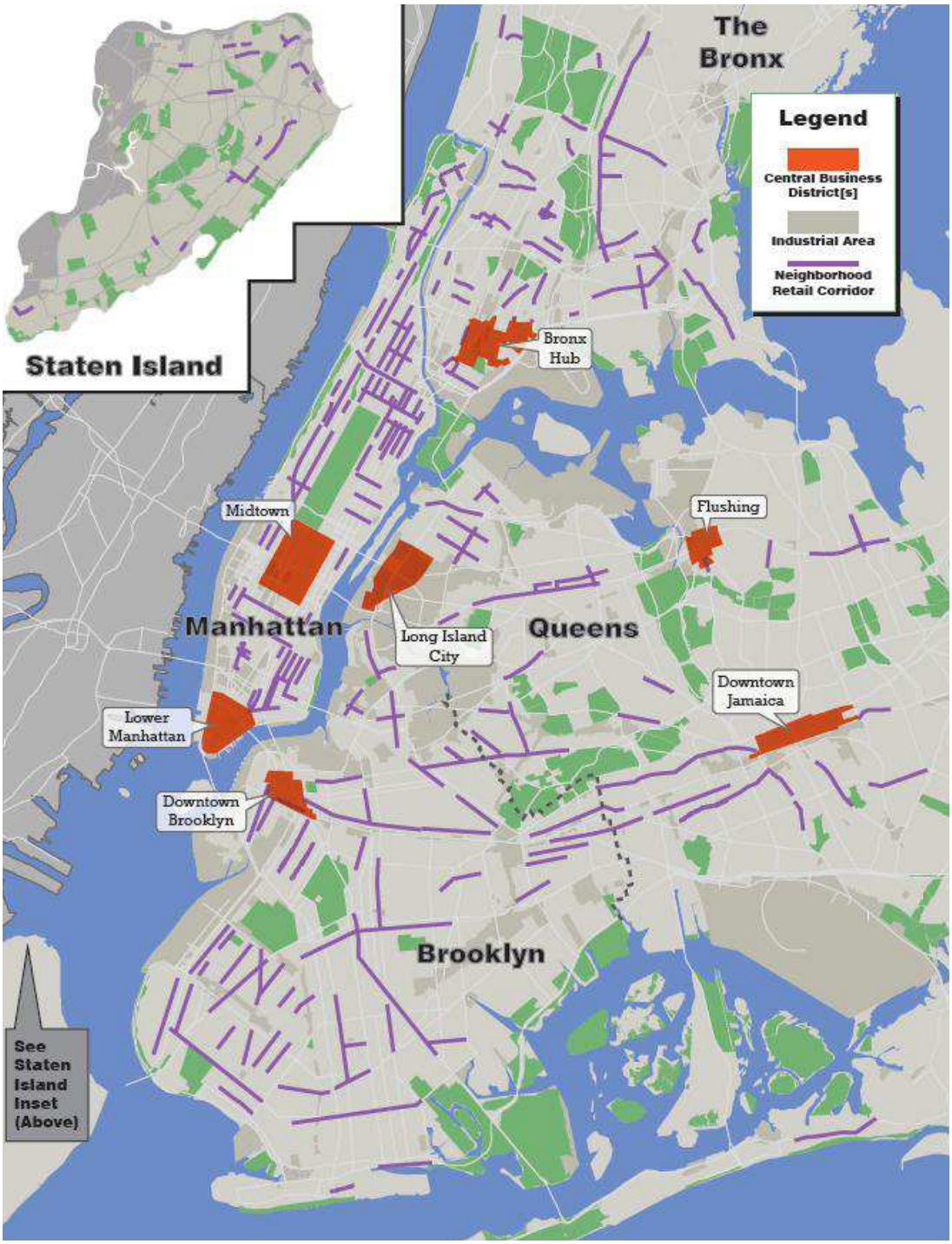


Figure 3 - New York City's commercial districts[6]

[6] Source: HOLGUÍN-VERAS, J., TORRES, C. & BAN, J. 2010c. On the Comparative Performance of Urban Delivery Vehicle Classes *Transportmetrica,* (in print).

Three-quarters of trips originating or terminating in Midtown are made via public transit and/or walking (Donnelly, 2010). Consequently, the number of private cars in Midtown is relatively small. The majority of vehicles in Midtown are commercial vehicles (e.g., taxis, trucks.) The freight vehicles involved in the transporting of goods perform most of the loading and unloading at the curb due to the lack of alleys and the limited number of loading docks in Midtown (Holguín-Veras et al., 2010c).

Downtown Manhattan is the home to the nation's financial centre, New York City Hall, the State and Federal court systems, and offices for many state and city governmental agencies. While the number of private cars in Downtown Manhattan is still relatively small, a significant portion of curbside parking is designated for use by the various governmental entities. This makes the loading and unloading of goods by commercial vehicles more difficult as, like the case in Midtown, most of the activity takes place at the curb due to a lack of loading docks. Compounding the problem is the layout of the street network in Downtown Manhattan. The network contains few avenues and most of the streets are narrow and winding due to the historical development of the area (Holguín-Veras et al., 2010c).

Holguín-Veras et al. (2006a) collected data from 360 carriers and 388 receivers in New York City as part of a project to determine the potential for off-hour deliveries in New York City. The collected data was used to calculate delivery rates based on industry type and/or number of employees for businesses in New York City. The rates were applied to data collected by the US Census Bureau regarding the type and size of businesses in New York City. The industry type was identified using Standard Industrial Codes (SIC). The SICs were grouped into eleven categories of which eight were considered freight related.

It is estimated that the NYMTC region receives 443,156 daily deliveries with Manhattan receiving 113,069 of those. In Manhattan, 24.1% of the daily deliveries are received by food related industries, 25.6% are in the durable goods wholesale trade industry, with 20.3% in the non-durable goods wholesale trade industry (Holguín-Veras et al., 2010a).

2.3 URBAN TRANSPORT PROBLEMS IN MANHATTAN

2.3.1 State of the art

The New York City borough of Manhattan is the focus of this case study. The dense concentration of population and business activity has led to significant problems for urban freight. Two of the predominant issues in Manhattan are the level of congestion and the lack of available curb space.

Although the proportion of private cars on the road in Manhattan is low, the large number of taxis and other commercial vehicles has led to a transportation network that experiences high levels of congestion during various periods of the day, particularly in the central business districts previously mentioned. As part of this study on off-hour deliveries, travel speed data was collected. The figure below shows the space mean speeds for trips between customers in the study area; the numbers do not include trips directly between the depot and a customer. It can be seen that for the majority of the day the average space mean speed is only 3 miles[7] per hour (mph).

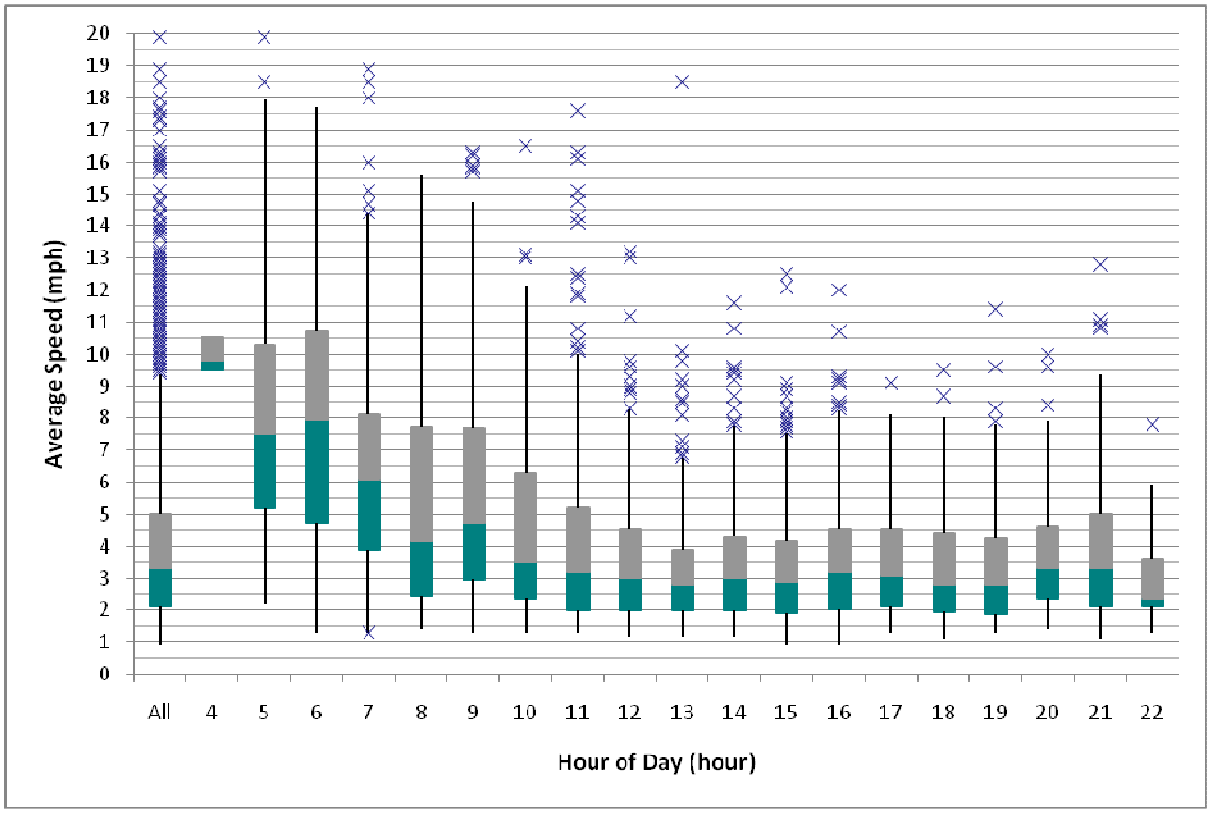


Figure 4 – Customer-to-Customer Space Mean Speeds (mph) by Time of Day
Source: Holguín-Veras et al., 2010b, Holguín-Veras et al., 2011

In addition to the sheer number of vehicles on the roads, the lack of available curb space significantly contributes to the level of congestion.

[7] 1 mile = 1.609 km

Since most of the loading and unloading of goods happens at the curb, the lack of curb space is a very significant problem. This lack of curb space contributes to congestion by causing some vehicles to double park and by forcing vehicles to drive around in search of a legal parking spot thus keeping them in the traffic flow. While these behaviours occur for both passenger and freight vehicles, it is particularly problematic in the case of freight vehicles. Not only are freight vehicles typically larger than passenger vehicles, but the number of times a freight vehicle needs curb access is significantly higher than that of a passenger vehicle. In a survey conducted by Holguín-Veras (2006b), it was found that in New York City, carriers pay an average of $1,000 per truck per month in parking fines. In interviews with carriers, the study authors were told repeatedly that it "was a cost of doing business in New York City." Parking fines contribute to the additional costs incurred by delivering to New York City, which have been estimated to be 30 percent higher than delivering in comparable locations (New York Metropolitan Transportation Council, 1998). In addition to fines, the lack of curb space forces carriers to park farther away from the establishment where they are to load or unload goods. These results in additional time required at each stop along the route. Figure 5 shows the amount of time spent servicing the customer at each stop. During the late morning, the mean service time reaches 1.8 hours. This is drastically higher than the mean service times that reach as low as 0.5 hours during the off-peak hours where there are less parking restrictions as well as fewer vehicles.

Both congestion and lack of available curb space result in increased transportation costs for both passenger and freight users. These increased costs include both internal costs (e.g. travel time costs) and external costs (e.g. increased emissions).

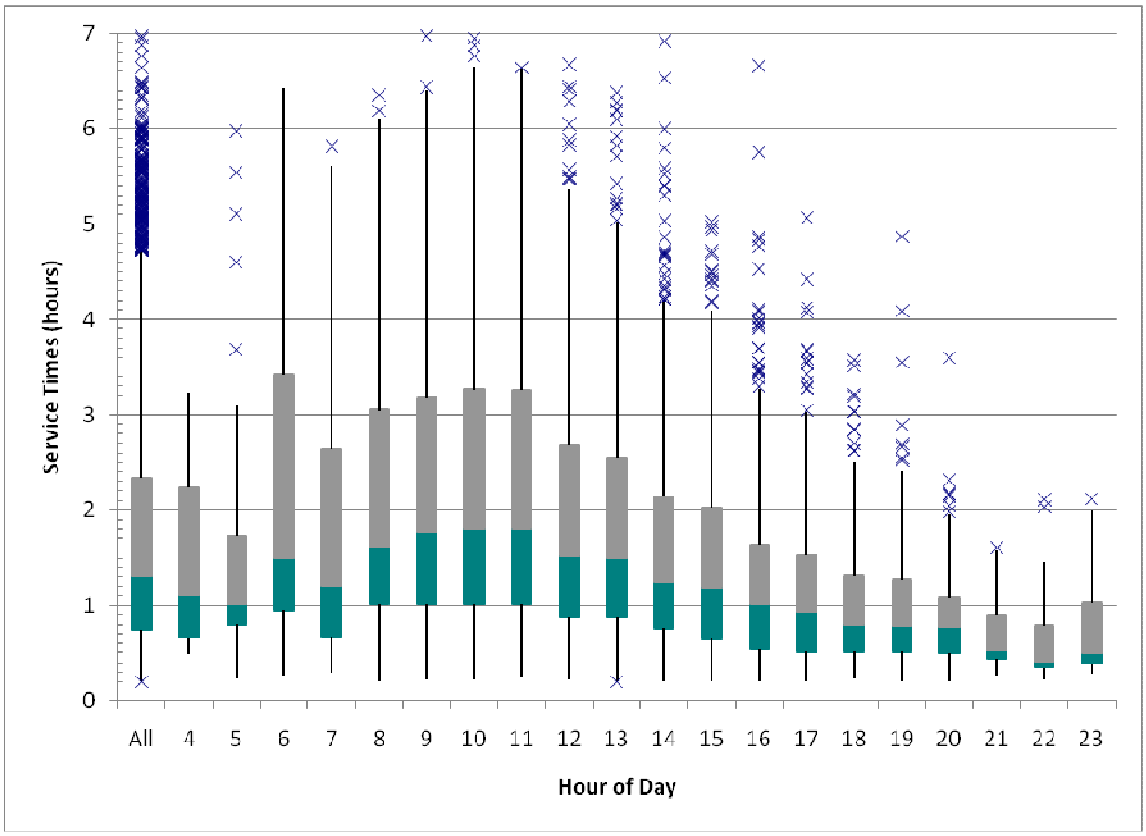


Figure 5 - Service Times by Time of Day

Source: Holguín-Veras et al., 2010b, Holguín-Veras et al., 2011

2.3.2 Expected urban transport problems in the future

The density of the region makes building new facilities extremely difficult and costly. Thus the current urban freight issues in New York City will increase in magnitude as the population of the metropolitan area continues to grow. The New York City Department of Planning[8] predicts that the population of Manhattan will grow to 1.8 million by 2030 with the population of New York City growing to 9.1 million. These numbers represent an increase of 18.8% and 13.9%, respectively, from the 2000 population numbers. In terms of the entire metropolitan region, the Metropolitan Transportation Authority predicts a 17.6% increase over 2005 estimates in the region's population by 2030 to 26.1 million[9].

[8] http://www.nyc.gov/html/dcp/pdf/census/projections_report.pdf

[9] http://www.mta.info/mta/planning/rsr/rsr_061807_pcac.pdf

3 INSTITUTIONAL FRAMEWORK AND CURRENT TRANSPORT AND LOGISTICS POLICIES

3.1 NATIONAL LEVEL

3.1.1 Institutional framework at the national level

The USDOT is the transportation authority at the national level.

"The mission of the Department of Transportation, a cabinet-level executive department of the United States government, is to develop and coordinate policies that will provide an efficient and economical national transportation system, with due regard for need, the environment, and the national defense. It is the primary agency in the federal government with the responsibility for shaping and administering policies and programs to protect and enhance the safety, adequacy, and efficiency of the transportation system and services.

The Department of Transportation consists of the Office of the Secretary and eleven individual Operating Administrations: the Federal Aviation Administration, the Federal Highway Administration, the Federal Motor Carrier Safety Administration, the Federal Railroad Administration, the National Highway Traffic Safety Administration, the Federal Transit Administration, the Maritime Administration, the Saint Lawrence Seaway Development Corporation, the Research and Innovative Technologies Administration, the Pipeline and Hazardous Materials Safety Administration, and the Surface Transportation Board. The Homeland Security Act of 2002 authorized the establishment of the Department of Homeland Security, which, on March 1, 2003, assumed management of the United States Coast Guard and the Transportation Security Administration, formerly DOT Operating Administrations." [10]

The USDOT, through its various Operating Administrations, helps create national transportation policies and distributes federal transportation funds to state and local transportation agencies.

3.1.2 National transport policy

The USA has no specific national transportation policy. The majority of transportation policy decisions are made by the individual state transportation departments and the local Metropolitan Planning Organization (MPO). MPOs are federally mandated local transportation

[10] http://dotlibrary.dot.gov/Historian/history.htm

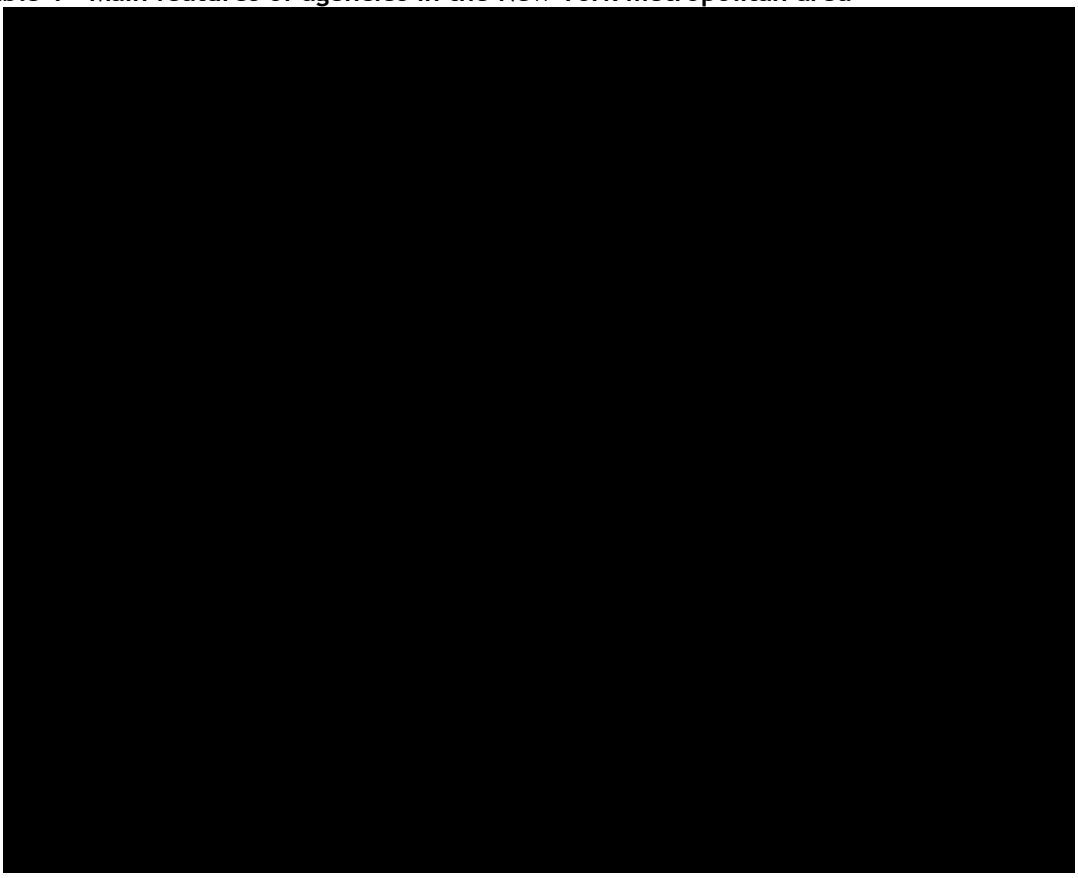
policy making organizations required for all metropolitan areas with a population of larger than 50,000. The MPOs for the New York City metropolitan area will be discussed later.

3.2 URBAN LEVEL (NEW YORK CITY LEVEL)

3.2.1 Institutional framework at the urban level of New York City

The institutional framework for transportation in the New York City metropolitan area consists of a group of mega-agencies from both the state of New York (NY) and the state of New Jersey (NJ). These agencies include the New York State Department of Transportation (NYSDOT), the Metropolitan Transportation Authority (MTA), the Port Authority of New York and New Jersey (PANYNJ), the New York City Department of Transportation (NYCDOT), the New York Metropolitan Transportation Council (NYMTC; which is the regional MPO), the New York City Economic Development Corporation (NYC EDC), the North Jersey Transportation Planning Authority (NJTPA; which is the Northern New Jersey MPO), the New Jersey Department of Transportation (NJDOT) and New Jersey Transit (NJT) (Holguín-Veras, 2000). The table below shows the main features of the various agencies in the New York metropolitan area.

Table 1 - Main features of agencies in the New York metropolitan area



Source: Holguín-Veras, 2000

The complex institutional structure is a result of various pieces of legislation with each agency having a particular purpose. Each agency maintains some level of independence from the other agencies and controls a particular aspect of the transportation system. The historical development of the agencies has led to a situation where there are many various agencies that tend to focus on one particular mode of transportation. This fragmented structure consisting of multiple agencies, each with their own particular agendas for the transportation system, makes it more difficult to maximize the efficiency of the system as a whole. For an in-depth review of the institutional structure of the New York City metropolitan area, the reader is referred to Holguín-Veras (2000).

3.2.2 Urban transport policy

The previous section presented a brief overview of the institutional framework for transportation in the New York City metropolitan area. The fragmented nature of the institutional framework has resulted in an environment where there is no overall policy for the metropolitan area. As a result, the various agencies have concentrated their efforts on their own operational domains in relative independence of the others. For the most part, their main efforts on the area of urban distribution are:

- The Port Authority of New York and New Jersey's time of day pricing implementations: The main goal here is to reduce urban freight traffic during the congested day hours. However, as amply demonstrated in Holguín-Veras et al.[11], time of day pricing has not achieved the intended effect;
- New York City Department of Transportation's curbside management programs: NYCDOT has implemented a significant effort on curbside (parking) management, with the net effect of increasing the availability of (priced) parking to commercial vehicles. This has benefited the delivery industry by making parking available and reducing the amount of parking fines.

[11] Holguín-Veras, 2006, #86

4 MEASURES USED IN NEW YORK CITY

4.1 INTRODUCTION

The New York City Department of Transportation (NYCDOT) is continually trying to address the issues of congestion and curb space availability. NYCDOT has undertaken several endeavours to address these issues throughout the city with some of them focusing specifically on Manhattan where the problems are most pronounced. The programs include parking pricing policies aimed at improving the availability of parking in retail corridors located in residential area as well as in commercial areas, the development of delivery windows and the encouragement of off-hour freight deliveries. These will be discussed in the following section.

4.2 MEASURES USED IN NEW YORK CITY

Passenger trips in Manhattan are predominantly made via transit, walking, or taxis, resulting in a low proportion of private cars. Even with this being the case, this small proportion is attempting to utilise an equally small amount of parking. To address this issue, NYCDOT is currently running pilot tests of its PARK Smart program which increases parking rates for on-street metered parking during peak hours. The goal is to reduce the time and miles associated with searching for on-street parking by decreasing occupancy and increasing turnover. The less time required to find a parking spot translates into fewer vehicles driving on the street contributing to congestion. This program is specifically aimed at retail and commercial corridors located in predominantly residential areas in the city. For the predominantly commercial areas, NYCDOT is implementing paid commercial parking.

The first pilot of paid commercial parking was implemented in 2000. Paid commercial parking charges trucks and commercial vehicles a per hour rate that increases as the number of hours increases. The pilot showed a decrease in double parking and congestion and an increase in turnover (Muller and Mendelsohn, 2007). Paid commercial parking has been expanded over the years to where it is implemented for most commercial parking spaces between 14th Street and 60th Street in Manhattan. The increased availability of curb space has made the process of loading and unloading freight more efficient.

NYCDOT has also been working with merchants in retail corridors to establish dedicated delivery windows. By providing time and location specific curb regulations based on the needs of the local businesses, curb availability is increased and congestion is decreased. The first

implementation of delivery windows was part of the development of one of New York City's Select Bus Service (bus rapid transit) routes. The delivery window concept is a time and location targeted program. For a broader impact on curb availability and congestion, NYCDOT is encouraging off-hour deliveries in Manhattan.

In 2009, NYCDOT partnered with a consortium of research institutions led by Rensselaer Polytechnic Institute in a pilot test of a program to encourage off-hour deliveries in Manhattan. The pilot test was part of a USDOT funded project aimed at developing an integrated freight demand management program utilising GPS tracking and off-hour deliveries. The pilot test involved eight carriers and twenty-five receivers. The pilot program offered a financial incentive to receivers in exchange for them requesting off-hour deliveries. The pilot test showed a dramatic decrease in travel times and service times. NYCDOT is currently working to expand this program.

With all programs, NYCDOT made sure to work with the stakeholders to develop the policies. For example, in the case of the PARK Smart program, NYCDOT had goals and an overall implementation plan for the program but decided on the specifics (e.g., rates, peak times, geographical area) in cooperation with the stakeholders. The reader is referred to Schaller et al. (2010c) for more specific details on these programs and others aimed more specifically at passenger movements.

5 SELECTED GOOD PRACTICE

5.1 INTRODUCTION

In this chapter, the OHD program will be discussed in more detail. This grame has the potential to significantly reduce the number of freight deliveries during the regular hours thus reducing congestion for all network users and improving the competitive position of the region. It has been selected as a good practice example for this document, not only for its benefits, but also for its ability to be implemented in a variety of situations where severe congestion is an issue.

5.2 MEASURE(S)

The practice addressed in the study was the use of a financial incentive to receivers of goods to request deliveries in the off-hours. The goals and objectives of this measure are to:

(1) Induce a significant shift of truck traffic to the off-peak hours (preliminary estimates suggest that, in some industry segments, the shift could reach 20% of local day truck traffic) (Holguín-Veras et al., 2006);

(2) Bring about significant improvements in traffic congestion and environmental conditions;

(3) Increase the competitiveness of NYC via tax deductions to local businesses, productivity increases from improved traffic conditions, and significant reductions in parking fines (that frequently exceed $1,000 per truck per month).

The measure to be implemented is providing a financial incentive, in the form of a tax break, to the receivers of goods in Manhattan to induce them to request deliveries for the off-hours. The objective is to reduce congestion during the regular hours by reducing the number of freight vehicles utilising the road network and curb side parking during the day. This in turn will improve economic competiveness by: (1) reducing the cost for carriers making deliveries during the off-hours due to the improved efficiency of making deliveries in non-congested conditions, (2) providing a financial incentive to receivers to cover any additional costs associated with receiving off-hour deliveries, and (3) reducing the costs incurred by all road users that result from congested conditions.

This concept was successfully pilot tested in Manhattan. The pilot study consisted of eight carriers/vendors and twenty-five receivers participated. Of the participating receivers,

seventeen were in the Food Industry with the remaining eight being in the Retail Industry. The participants consisted of three groups:

- Group 1 was a set of receivers from a retail chain and one of their vendors;
- Group 2 consisted of food retailers that shared a common vendor who was one of the participating carriers;
- Group 3 was a set of locations of a national grocery store chain (already utilising some off-hour deliveries) and a set of their vendors. Each group switched their delivery operations to the off-hours for the period of one month.

5.3 STAKEHOLDERS

The policy has numerous stakeholders. Some of the stakeholders include the businesses participating in the program, the residents living near participating establishments, various worker unions, trade organizations, and business improvement districts (BID) and the various transportation agencies in the region.

It should be obvious that the stakeholders most impacted by the OHD program are the participating businesses. In particular, the businesses need to ensure that they are not decreasing their profits and market position through their participation. This is particularly true for the receivers as they are the ones who will incur additional costs by receiving deliveries in the off-hours. The largest obstacle to the full implementation of the proposed OHD program is the financial aspect of the incentives. Not only does there need to be a source of the funds for the financial incentive, but the funds need to be distributed appropriately. In the research project, the financial incentive was proposed as a tax incentive which would necessitate the cooperation of the agency dealing with the administration of the tax credit. As previously mentioned, the research team disbursed the one-time financial incentive to the participating establishments in the pilot test.

5.4 FINANCIAL ASPECTS

In exchange for the participation of the different groups, the establishments were provided a financial incentive. The incentive proposed in the research was a tax break of $10,000 per year for the participating receivers. In the pilot test, the receivers were provided $2,000 for the one month period. This amount is higher than that proposed in the research for a long term commitment to off-hour deliveries in order to compensate the establishments for the inconvenience of switching their operations at the beginning and end of the pilot test. The

Group 1 carriers and Group 2 carriers were provided $3,000 for their participation due to the extensive work performed by high level executives in coordinating the pilot test. The Group 3 participating carriers were provided $300 per participating route to compensate them for setup costs associated with switching operations. The carriers could be provided lower incentives as their operations stood to financially benefit from off-hour deliveries. The total amount paid in incentives for the pilot test was $56,800. The funds were part of the research funding and were distributed by the project team.

The proposed financial incentive would need to be provided from toll revenues collected on the bridges and tunnels operated by the Metropolitan Transportation Authority. Implementing congestion pricing in Manhattan could also be used to fund the measure. Such a congestion toll was proposed by Mayor Michael Bloomberg in 2006 but was not voted on by the State Assembly by the 2008 deadline as required and was thus not implemented. As of this time, no such policy is implemented in New York City. The overall cost of the program would depend on the proposed incentive level and the resulting number of businesses participating.

5.5 TRANSFERABILITY POTENTIAL OF THE SELECTED GOOD PRACTICE

The proposed policy is transferable to any area which does not have current restrictions on deliveries during the off-hours. In order for the policy to be economically feasible, the level of congestion and freight traffic must be significant enough to merit the financial costs associated with the policy. As with any policy that contains expenditures, a source of funding must be available. With all programs, policy makers must make sure to work with the stakeholders to develop the policies.

5.6 OTHER ASPECTS

The use of unassisted delivery methods may reduce or eliminate the need for a financial incentive. Unassisted deliveries are deliveries that do not require the assistance or presence of staff from the receiving establishment. Unassisted deliveries can take multiple forms such as the use of double doors in a secure area which allows the carrier to deliver to the secure area without being able to access the establishment, drop boxes where goods may be left during the off-hours to be retrieved during the regular hours, or by the receiver providing the carrier direct access to their establishment during the off-hours for the purpose of making deliveries. The latter method was the one utilised by half of the participating receivers. The pilot test of the program showed that receivers utilising unassisted deliveries during the off-

hours experienced significant benefits that resulted in them requesting unassisted off-hour deliveries even without a financial incentive being present.

6 EVALUATION OF THE GOOD PRACTICE

6.1 INTRODUCTION

This chapter will discuss the impact of the OHD program on the transportation network as well as the impact on the participating businesses. The impact of the program on network performance and travel cost will be addressed. The survey responses of participants regarding their experience with off-hour deliveries during the pilot test will also be discussed. Finally, the economic impacts of the proposed program on Manhattan will be presented.

6.2 SPECIFIC URBAN FREIGHT DATA COLLECTED

During the pilot program, travel data was collected utilising GPS enabled smartphones that were provided to the participating carriers in the pilot test. Some of the participating carriers provided additional tracking data that was collected as part of their business operations. Upon completion of the pilot test, surveys were given to all participants regarding their experience with utilising off-hour deliveries. A number of participants were also interviewed in depth regarding their experience.

6.3 IMPACTS

6.3.1 Transport impacts

The limited size and duration (each group participated for one month) of the pilot program did not provide enough data to directly measure the impacts on the transportation network. The impact of the program on the transportation network is determined by the observed change in travel speeds during the off-hours and the estimated number of deliveries that would shift to the off-hours in a full implementation.

It was estimated that with the increase in travel speeds for depot-to-customer and customer-to-customer trips an average of 48 minutes of travel time per *delivery route* would be saved by moving to the off-hours. Additionally, for the proposed incentive level, a noticeable decrease in congestion would occur resulting in a travel time savings of approximately five minutes *per trip* for all road users. The change in travel speeds from the regular hours to the off-hours can be seen in the figure below showing the customer-to-customer space mean speeds in mph.

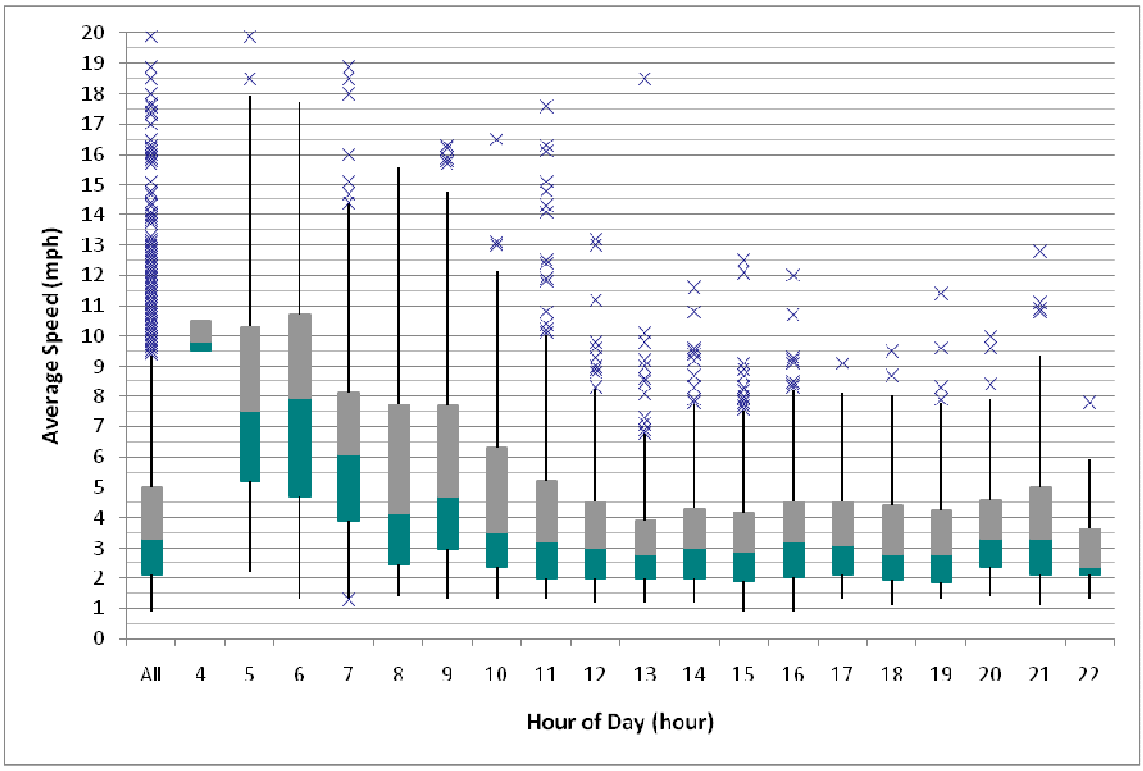


Figure 6 – Customer-to-Customer Space Mean Speeds by Time of Day

Source: Holguín-Veras et al., 2010b, Holguín-Veras et al., 2011

In addition to a reduction in travel times, the amount of time required at each stop was significantly lower during the off-hours. As seen in the figure below, the mean service time during the late morning was 1.8 hours as compared to mean service times as low as 0.5 hours in the off-hours. While not all service times' differences are of that magnitude, consider a reduction in service time of only 15 minutes per stop. A delivery truck that saves 15 minutes at each of the six deliveries, that on average carriers make, will save a total of 1.5 hours (which represents a reduction of $60 per tour). A carrier that saves an average of half an hour per delivery, would save about three hours. Regardless of the assumption made, the economic savings are substantial. The savings are even greater when considering that carriers indicated that the service times were reduced even though the deliveries tended to be larger during the off-hours.

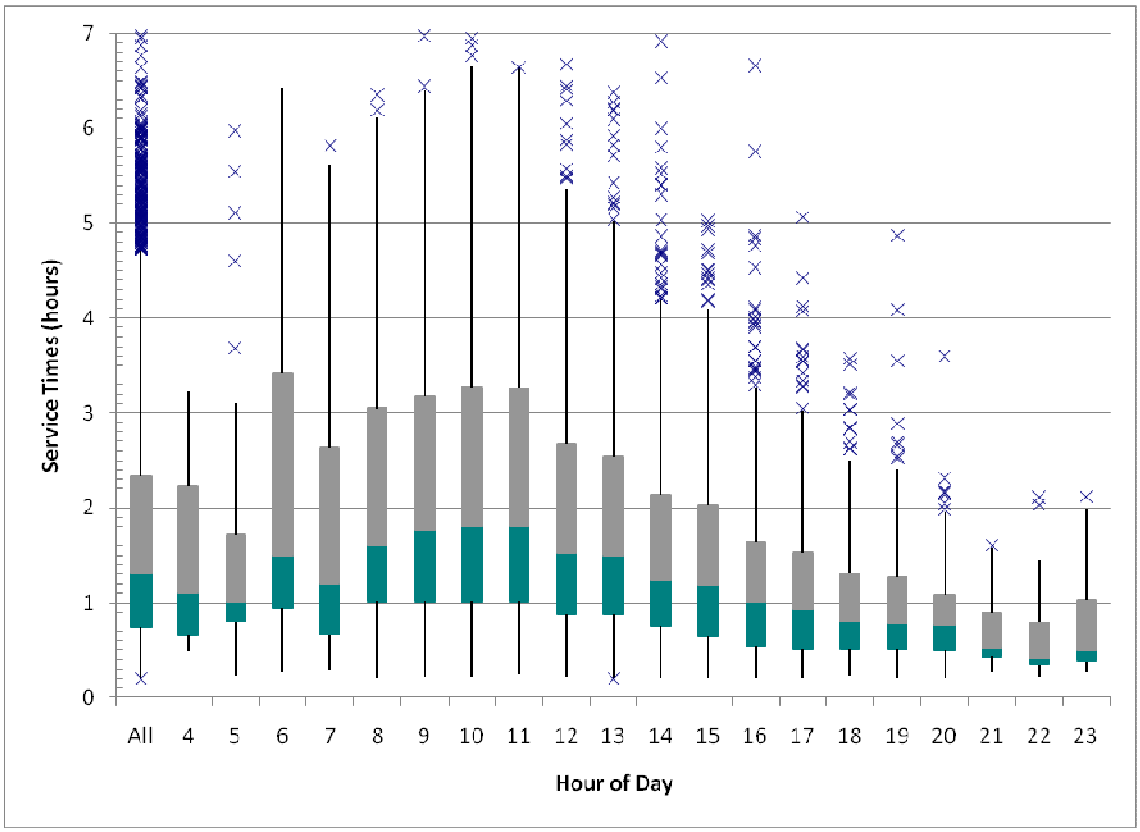


Figure 7 - Service Times by Time of Day

Source: Holguín-Veras et al., 2010b, Holguín-Veras et al., 2011

6.3.2 Economic impacts

The economic impacts of the proposed OHD program can be looked at in terms of the impacts on the carriers and receivers and on society at large. The carriers benefitted from the reduced cost of making deliveries during the off-hours. In a full implementation, carriers indicated that they could further reduce costs by being able to use the same truck and trailer for a regular-hour delivery route and an off-hour delivery route.

Receivers benefitted not only from the financial incentive provided but also by the productivity increases that off-hour deliveries enabled. The economic benefits were of course greater for those receivers utilising unassisted deliveries as they did not have the added expense of providing staff during the delivery process.

The overall economic impact to Manhattan is based on the economic benefits experienced by the road users and the economic costs associated with the implementation of the program.

The table and figure below show the economic impact for various incentive levels. The figure provides a graphical representation of the information presented in the table.

Table 2 - Economic Analysis Results (in million $/year)

	Cost to receivers	Benefit to carriers	Benefit to road users	Total benefits	Total Incentive Costs	Net benefits	Marginal B/C (ΔB/ΔC)
Financial incentive to food and retail sectors							
$5,000	(16.20)	$28.72	$57.10	$85.81	($16.20)	$69.62	5.30
$10,000	(76.07)	$63.20	$84.42	$147.62	($76.07)	$71.55	1.03
$15,000	(172.91)	$93.39	$100.24	$193.63	($172.91)	$20.72	0.48
$20,000	(284.13)	$113.23	$146.15	$259.38	($284.13)	($24.75)	0.59
Targeted programs aimed at Large Traffic Generators							
Large Buildings [1]	?	$24.75	$24.36	$49.11	?	?	?
Large Bldgs. & 250+ [1]	?	$53.02	$53.60	$106.62	?	?	?
Unassisted deliveries							
Security incentives	?	?	?	?	?	?	?
Bonded deliveries	?	?	?	?	?	?	?

Notes: (1) Assume 100% participation in OHD.

Source: Holguín-Veras et al., 2010b, Holguín-Veras et al., 2011

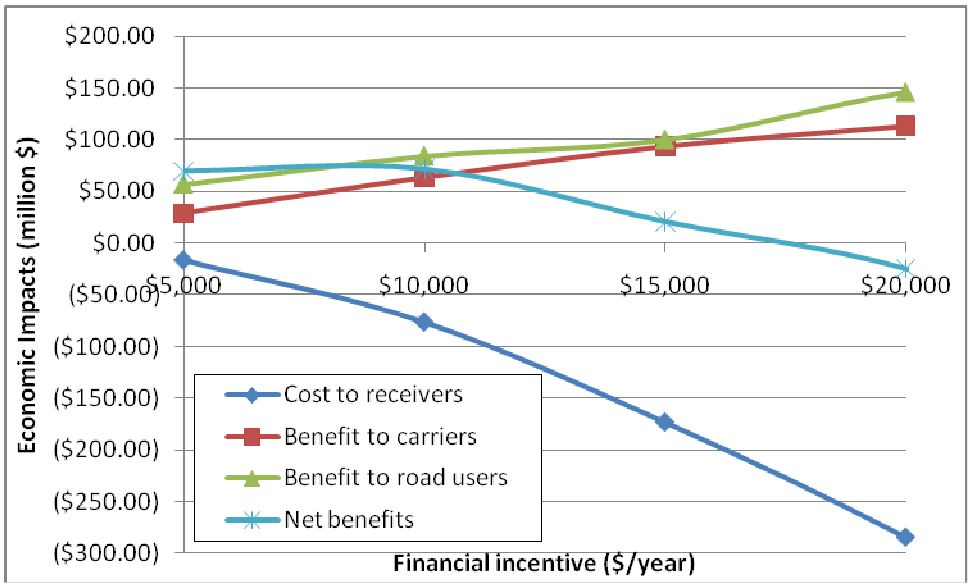


Figure 8 - Cost and Benefits

Source: Holguín-Veras et al., 2010b, Holguín-Veras et al., 2011

It is clearly seen that the overall economic benefits are maximized at a financial incentive level of $10,000 per year. The overall impact continues to be positive up to the $17,500 level.

The benefits brought about by the program result in a more competitive region by reducing the cost of doing business and travelling in New York City.

The previously mentioned increased travel speeds and reduced service times have major implications in terms of economic impacts. The most obvious one is that reducing service times will increase the profitability of delivery operations and, ultimately, lower the cost of the products consumed in New York City. While the carriers obviously are expected to benefit from making deliveries during the off-hours, receivers also experienced productivity benefits.

Many of the receivers in the pilot test indicated that receiving deliveries during the off-hours helped them to be more efficient due to the reliability of the delivery times and the reduced number or order errors. This was particularly evidenced by receivers that decided to utilise unassisted deliveries. These receivers indicated that unassisted deliveries enabled them to be more productive and efficient in their operations. This is evidenced by the fact that the majority of receivers utilising off-hour deliveries continued to do so upon completion of the pilot test even without the financial incentive. With that said, this was possible due to the trust that the receivers had for the participating carrier. In a full implementation, security and liability issues will have to be addressed.

6.3.3 Environmental impacts

While some of the participants indicated that part of the reason for their participation was due to the positive environmental impacts of the program, direct measurement of the environmental impacts of the program was not in the scope of the project. The environmental impacts (e.g. emissions, fuel savings) were calculated using formulas based on changes in travel conditions. Rather than being absolute values or percent reductions of emissions, the outputs of the formulas were dollar values of the environmental impacts. These values were incorporated into the overall economic impact of the program.

In regard to environmental noise pollution which was not measured or accounted for in an indirect manner, stakeholders had initial concerns regarding increased noise levels since many of the participating establishments were located on the lower floors of residential buildings. Upon completion of the pilot test, none of the participating businesses indicated any noise complaints associated with their participation.

6.3.4 Social impacts

The impacts of the OHD program were assessed by utilising a post-pilot test satisfaction survey along with in-depth phone interviews with a number of the participants. Each participating establishment was asked to fill out the satisfaction survey. An addition survey

was given to the drivers of the participating carriers who drove the off-hour routes. The purpose of the driver survey was to assess the impact off-hour deliveries had on their driving conditions.

The table below provides a summary of the responses given by the receivers and carriers. Group 1 receivers are part of a retail chain and their participation was facilitated through the regional corporate office. The fact that a financial incentive was being provided was not conveyed to the individual stores by the headquarters and consequently the managers had numerous complaints about the added costs of off-hour deliveries. This is reflected in their survey responses. Group 2 consists of food retailers that shared a common vendor who was one of the participating carriers. A large portion of these receivers utilised unassisted deliveries. Group 3 is part of a national grocery store chain and already received their distribution centre deliveries during the off-hours.

Table 3 - Summary of Survey Responses from Receivers and Carriers

Survey Question and Respondent	Number for Each Type of Response					Mean
	Very Favorable 1	Favorable 2	Neutral 3	Unfavorable 4	Very Unfavorable 5	
Group 1 Receivers ***(were not aware of the financial incentive being provided)***						
What was your impression of off-hour deliveries?	0	1	1	4	2	3.88
If it were up to you, how likely are you in the future to request deliveries from your vendors in the off-hours?	0	1	3	2	2	3.63
Group 2 Receivers						
What was your impression of off-hour deliveries?	6	6	0	0	0	1.50
If it were up to you, how likely are you in the future to request deliveries from your vendors in the off-hours?	9	1	2	0	0	1.42
If all liability issues were addressed, would you be interested in receiving unassisted deliveries?	2	3	0	0	1	2.17
Group 3 Receivers						
What was your impression of off-hour deliveries?	0	2	2	0	0	2.50
If it were up to you, how likely are you in the future to request deliveries from your vendors in the off-hours?	1	2	1	0	0	2.00
If all liability issues were addressed, would you be interested in receiving unassisted deliveries?	0	1	0	3	0	3.50
Carrier Management						
What was your impression of off-hour deliveries?	2	4	1	1	0	2.13
If it were up to you, how likely are you to make deliveries during the off-hours if requested from your customers?	3	4	0	1	0	1.88
How did making off-hour deliveries affect your costs?*	0	3	3	2	0	2.88

Note: * Scale of responses was 1 = "Moderate Decrease" to 5 = "Moderate Increase"

Source: Holguín-Veras et al., 2010b, Brom et al., 2011

Taking into account the communication lapse in Group 1 regarding the financial incentive, the participants in the pilot test from all three groups had an overall favourable response to off-hour deliveries. As expected, the receivers utilising unassisted deliveries had the most favourable response.

The table below provides the responses to the driver surveys. As one would expect, the impact of making off-hour deliveries on the drivers is very favourable. For most questions, the

vast majority of the drivers responded with a “Very Favourable” or “Favourable” response. The one question where this is not the case is the question regarding safety where nearly half of the responses were “Neutral.” This bears mentioning that one of the primary concerns of the managers of the carriers was the safety of their drivers. This is one issue that would need to be addressed in a full implementation of the program.

Table 4 - Driver Survey Responses

Survey Question	Number for Each Type of Response					Mean
	Very Favorable 1	Favorable 2	Neutral 3	Unfavorable 4	Very Unfavorable 5	
Preference for Off-Hour Deliveries*	10	1	0	0	1	1.42
Availability of Parking	10	2	0	0	0	1.17
Level of Congestion	10	2	0	0	0	1.17
Level of Stress from Driving	10	2	0	0	0	1.17
Average Travel Speed	6	6	0	0	0	1.50
Amount of Time Needed to Complete the Delivery Route	6	5	1	0	0	1.58
Length of Time Needed at Each Stop to Deliver Goods	5	5	2	0	0	1.75
How Safe Do You Feel Making Off-Hour Deliveries	3	3	5	0	1	2.42

Note: * Scale of responses was 1 = "Strongly Prefer Off-Hours" to 5 = "Strongly Prefer Regular Hours"

Source: Holguín-Veras et al., 2010b, Brom et al., 2011

6.4 IMPLEMENTATION OF MEASURES

6.4.1 Specific changes needed to implement measures

The program presented in this document is a new approach to reducing congestion in metropolitan areas by providing a financial incentive to receivers in order to encourage off-hour deliveries. To implement such a program, the funding and incentive distribution mechanisms must be established. The structure of these mechanisms would greatly depend on the source of funding and type of incentive to be provided. In the case of unassisted

deliveries which were shown to provide benefits to both the carrier and receiver without additional costs being incurred, liability and security issues would need to be addressed for a large scale implementation.

6.4.2 Integration aspects

While the pilot test of the program was not integrated with any other NYCDOT program, an expanded program is being considered that would integrate the OHD program along certain corridors where other programs are being implemented (e.g. delivery windows).

6.4.3 Acceptability

The proposed measure enjoys broad support. As the measure is a voluntary program, no significant resistance was encountered. There was some concern regarding noise issues but no complaints were received during the pilot program although there is sure to be some initial resistance by residents that live near establishments receiving off-hour deliveries if the policy was to be fully implemented.

6.4.4 Bottlenecks/barriers

The barriers to implementation for various individual establishments approached to be a part of the pilot test included such things as building restrictions, neighbourhood regulations, unions and elevator access. All of these were factors that prevented establishments from participating in the pilot test. For a full implementation, establishments indicated that they would need a commitment from the governmental agency administering the program regarding a minimum time period for the program. Concerns were expressed regarding an establishment going through considerable effort to change their operations only to have the program discontinued.

6.4.5 Success and failure factors

The biggest factor in the success of the pilot test is that it was a situation in which all participants benefitted; the carriers reduced costs, the receivers were provided a financial incentive, and the transportation network saw reduced congestion due to a reduced number of trucks during the regular hours. This was particularly evident in the cases in which the receivers utilised unassisted deliveries as demonstrated by the fact that the majority continued to receive off-hour deliveries after the pilot test was completed.

While the pilot test did not experience any failure factors, a full implementation faces the considerable obstacle of the financing and administration of the financial incentive to be provided to the receivers.

6.4.6 Other factors

The pilot test of the program targeted individual food and retail establishments and their vendors. While targeting individual establishments proved to be effective, the project team identified large traffic generators as a potentially significant focus of further work on such a policy. A large traffic generator (LTG) is considered to either be a single business that receives a large number of deliveries (e.g. universities, large hospitals) or a building that houses a large number of individual businesses that receive deliveries. For the purpose of analyses, the research team identified businesses with more than 250 employees as LTGs as well as buildings that were assigned their own unique postal code. The sheer density of business activity in Manhattan results in a larger than usual number of LTGs than seen in other metropolitan areas.

In Manhattan there are 89 buildings with their own postal code and these 89 buildings account for 4 percent of the freight deliveries to Manhattan. It should be noted that there are numerous other buildings that house a large number of individual establishments that were not identified as LTGs in the study (e.g., Grand Central Terminal, Javits Center) because they did not have a unique postal code. All total, LTGs could account for as much as 8 percent of the daily freight deliveries in Manhattan.

The attractiveness of LTGs as a target for implementing a policy to encourage off-hour deliveries also is influenced by the fact that many of the LTGs have central receiving areas with loading docks. By targeting this select group of receivers and developing programs to encourage the deliveries be made to the central receiving area during the off-hours with the final delivery being made to the receiver during the day, the additional cost of staffing in the off-hours is limited to the staffing of the central receiving area rather than being required of all the individual establishments. This would dramatically reduce the total amount of incentives being provided with similar impacts to a policy that targets individual businesses. Due to the many advantages of targeting LTGs, the project team is pursuing the development of such a program for use in Manhattan.

7 CONCLUSIONS

This report has provided an overview of a program to encourage off-hour deliveries in metropolitan areas by providing a financial incentive to the receivers of goods in exchange for requesting deliveries during the off-hours. The report showed the results from a pilot test of the program conducted in New York City in 2009. The results indicated not only the feasibility of such a program but that benefits of over $250 million per year were achievable depending on the extent of the implementation and incentive level. Taking into account the cost of the incentives provided results in possible net benefits of over $70 million depending on the incentive level.

Participants in the pilot test saw improvement in their operations due to utilising off-hour deliveries. Carriers saw reductions in cost resulting from travel speeds in the off-hours that were twice those during the regular hour and reductions in service times of over one hour per stop in some cases. Receivers utilising unassisted deliveries were able to improve the efficiency of their operations due to increased reliability of deliveries and a reduction in order errors. These benefits are evidenced by the fact that the majority of participants utilising off-hour deliveries continue to receive off-hour deliveries even though the financial incentive is no longer being provided.

The New York City Department of Transportation is currently looking to perform a limited implementation of the program in select corridors in Manhattan in conjunction with some of its other programs (e.g. bus rapid transit). The program is suitable for any metropolitan area that suffers from significant congestion. The largest hindrance to the implementation of the program is the funding of the incentive. This hurdle can best be overcome by combining the implementation of the program with the implementation of time of day road pricing. This provides the funding for the incentives and further reduces congestion by providing an additional deterrence for travelling during the congested hours of the day.

The program outlined in this report provides a new approach to encouraging off-hour deliveries in metropolitan areas. The program is effective because it targets the actual decision maker in the delivery process, while at the same time enjoying broad support by agencies and the freight industry.

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