CHAPTER 1.

INTRODUCTION

Joe is a 35-year-old financial analyst who lives in the West Village and works at the Federal Reserve Bank in Lower Manhattan. He is also a long time resident of New York City. Every day Joe climbs out of the 1/9 subway station at Rector Street, a briefcase and a Wall Street Journal in his hands, strides east on Rector, then north on Broadway, and takes a right onto Maiden Lane, toward his office. Joe's total walking distance from the subway to work is around 1,950 feet. Along the way, he likes to stop at his favorite coffee stand, buying a coffee and a bagel with cream cheese at a coffee cart at the intersection of Broadway and Liberty Streets. Over the years, Joe has determined that it takes him approximately eleven minutes to get from the subway stop to his office, including waiting in line at the coffee stand and buying his breakfast. He likes to arrive at the office just before 9am, which is when his boss comes in. He has always wished that there was a fruit stand next to the coffee vendor, as he would like to buy a piece of fruit with his coffee and bagel. Sometimes he is frustrated by people talking on their cell phones while walking; they tend to weave and slow down abruptly, and Joe finds that they impede him in his 11-minute walk-time goal to the office. The area around where Joe works is highly interesting to New York's visitors. Joe thinks tourists are even worse than cell phone talkers in their walking habits. They travel in large groups and occupy too much sidewalk space; they take pictures, slow down and point often. Today as Joe leaves the coffee stand, he almost spills his coffee on Mildred.

Mildred is a 70-year-old enthusiastic visitor to New York. She retired a few years ago and is coming with two friends to see the Big Apple for the first time. They are eager to enjoy the museums, Broadway shows, and shopping in Manhattan. The density of skyscrapers, traffic, and people in the city are amazing to Mildred and her friends. Because they have so much to do in a day, Mildred and her friends wake up early on the second day of their trip to visit the World Trade Center site. After seeing Ground Zero, they stroll over to Dey Street then turn on Broadway, heading south toward Wall Street, where they hope to see the Stock Exchange. Total distance: 1,950 feet. Even though Mildred's backpack is a little heavy for all the walking, she does not mind; she enjoys taking in the sights and chatting with her friends. She pauses often to take pictures, look at storefronts, and browse at souvenir vendors. Mildred often wonders why she can not make it across the street during the green signal time; she wonders if she is walking too slowly or if the pedestrian green light time is too short. She thinks that more greenery downtown, especially sidewalk planters with flowers and trees, would help to beautify this part of the city. She also thinks that a sidewalk café on Broadway or Wall Street would improve her visiting experience; she could sit and enjoy the sights without having to rush down the busy streets. Mildred pauses in front of the coffee stand on Broadway and Liberty Street where Joe gets his coffee and she puzzles over her map about which direction she should take to Wall Street. There is Joe.

Joe and Mildred, two very different pedestrians using the same sidewalk, represent a microcosm of New York City's array of walking individuals, all with different expectations of acceptable sidewalk conditions. Their story is a simplified example of the challenges and complexities of pedestrian sidewalk planning in New York City; there are so many different needs to address within such limited space. Joe is irritated by cell phone users and tourists, who are potential roadblocks to his 11 minute walking timeframe. However, he patronizes a busy coffee cart, whose morning queue of like-minded professionals takes up sidewalk space and contributes to the impedance of pedestrians like him. Joe also desires an additional vendor adjacent to his favorite coffee cart, so he can buy fruit for breakfast, but does not realize the implications of pedestrian traffic impedance that this additional stand might introduce to his commute. Mildred has as much right to walk on the sidewalk as Joe, but does not realize the problems she and her tourist group, with their bulky backpacks and confused sense of direction, introduce to the sidewalk traffic flow. In addition, Mildred desires certain tourist and elderly pedestrian-related amenities like sidewalk cafes and longer crosswalk signal timing, which would introduce further complexity to sidewalks that serve a primarily business-oriented population (especially during the morning rush), but must also accommodate those who visit the area for its considerable number of important civic attractions.

For these reasons, the personal characteristics of pedestrians are important to study in detail, because who is walking on sidewalks greatly affects the performance of the sidewalk and its traffic flow. If we become intimately familiar with the variety of New York City pedestrian characteristics, the information could help to make important decisions in planning for pedestrians.

A. New York City and the Pedestrian

New York City is the largest city in the United States in terms of population. According to the census, 7,322,564 people lived in the city in year 1990, a number that increased to 8,008,278 people in year 2000 – a 9.4% increase.

New York is also by far the city with the highest population density in the country: in 2000, the city's density was 26,403 people per square mile, as opposed to the 16,634 people/sq.mi. of San Francisco (second highest population density in the country) or the 12,750 people/sq.mi. of Chicago (third highest population density).

In the year 2000, 88% of workers over 16 years old in the U.S. used a car, truck or van to commute to work, while approximately 5% used public transportation and 3% walked to work. However, New York City represented a very different journey-to-work scenario: 34% of workers went to their workplace by car, truck or van, while 55% used public transportation and 9% walked.

The city of New York is composed of five different boroughs, each with a very different urban fabric and character. In Manhattan, the borough with the highest population density (66,940 people/sq.mi. in year 2000; 1,564,798 inhabitants) and concentration of business and tourist destinations, only 18% of the working population drove to work in 2000, while 72% used public transportation and 8% walked. When we look at the commuting characteristics of Manhattan central business districts (CBD) in comparison to those of the rest of the country, these numbers are even more striking. One good example is that of the Lower Manhattan CBD. According to Census data from 2000, in Community District 1 (the area south of Canal Street), 77.4% of workers used public transportation to get to their workplace, while 3.4% walked and 18.1% drove. In the Midtown CBD– the area lying between 42nd and 59th streets, and 3rd and 8th avenues – only 12.1% of workers drove to work, while 80.7% used public transportation and 6.4% walked.

Another characteristic of New York City, and particularly Manhattan, is a high concentration of civic activities and destinations, which translates into high volumes of traffic, both vehicular and pedestrian. On any given afternoon in the city, workers, shoppers, and tourists share the same sidewalk space on the way to various destinations. In the CBDs and the main shopping and entertainment areas in New York, there is often sidewalk congestion and overcrowding. As a result, walking on certain sidewalk segments sometimes becomes an inefficient, uncomfortable, and even unsafe activity, with pedestrians occasionally spilling onto the roadbed. In addition, on some sidewalks, street furniture and vendors take up space, reducing the width that is actually available for pedestrians to move.

After 9/11, several government and private office buildings have placed new devices such as bollards, delta barriers, jersey barriers and planters on sidewalks for security reasons. These devices help to provide protection for the buildings, but impede pedestrians walking on adjacent sidewalks. Meanwhile, special congestion conditions occur around points of access to public transportation, such as subway entrances and/or exits and heavily used bus stops.

This is the built environment which, through informed planning, would ideally provide efficient and comfortable everyday access to work for our financial analyst Joe, while at the same time presenting a welcoming, safe and attractive strolling environment for Mildred and her tour group.

B. Measuring Pedestrian Level of Service

The Highway Capacity Manual (HCM) by the Transportation Research Board is used as the transportation engineering and planning standard in evaluating transportation facilities. According to the TRB, it is a division of the National Research Council "which serves as an independent adviser to the federal government and others on scientific and technical questions of national importance." The TRB is administered by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine jointly and its mission is to "promote and progress in transportation through research." In order to evaluate sidewalk facilities for pedestrians such as Joe and Mildred, engineers and planners use the HCM to calculate a pedestrian level of service (LOS). LOS may be used, for example, to evaluate the performance of a sidewalk and determine the need to redesign it (change its width, relocate, replace or remove street furniture, etc.); to analyze the efficiency of a sidewalk after a proposed sidewalk change, like the introduction of a sidewalk café or beautification/security elements; or to design new sidewalks in areas of proposed development.

Pedestrian LOS, as defined in the Highway Capacity Manual, is calculated by counting pedestrians who cross a point over a certain period of time (usually 15 minutes), reducing that figure to pedestrians per minute and then dividing by the effective width of the sidewalk. The resulting figure is called the flow rate. A planner may then look up the flow rate in a table to determine the pedestrian LOS grade, ranging from A (free flow) to F (virtually no movement possible). A detailed description of the HCM pedestrian LOS methodology is in Chapter 2 of this report.

The pedestrian LOS measurement has tremendous advantages—it is relatively easy to collect data for its calculation, and the subsequent LOS is easy to calculate. The HCM methodology strives to provide a universal measurement, with an index comparable between places and times. But there are studies in the transportation planning and engineering field that show that the current HCM method of analyzing pedestrian LOS does not accurately reflect the complex pedestrian experience under some circumstances. Most importantly, the HCM method does not take into account many physical, environmental, and psychological factors which affect the pedestrian walking experience.

In the above story about Joe and Mildred, we see that pedestrian characteristics (age, gender), trip characteristics (trip purpose, activities such as the use of a cell phone), and the walking environment (presence of obstacles and amenities, surrounding land use, time of day) work together to change

pedestrians' travel expectations and needs. However, the HCM pedestrian LOS methodology does not adequately address the environmental and personal variables that make up a New York City sidewalk. As we have seen above, New York City is unique in the U.S. with regard to its density and its transportation modal distribution.

C. Goals and Objectives

Based on the review of the pedestrian literature and the Department of City Planning's experience with pedestrian studies in the past, the TD concluded that there is a need for a fresh look at the pedestrian LOS calculation and, specifically, how it is applied in New York City. Evidence suggests that the LOS methodology may need to be recalibrated to more accurately measure conditions on the city's sidewalks.

The purpose of this study is to:

- Analyze the suitability of the HCM pedestrian LOS methodology for New York City;
- Empirically measure the factors that contribute to pedestrian congestion on the sidewalks of Lower Manhattan; and
- Recommend pedestrian policy changes based on the study's findings and propose additional opportunities for pedestrian research in New York City.

D. Report Overview

In Chapter 2 of this report the current HCM methodology for pedestrian LOS analysis and vehicular analysis is discussed, and the two analyses are compared. The strengths and weaknesses of the HCM pedestrian LOS methodology are also outlined.

In Chapter 3, the existing literature on pedestrian behavior and level of service is reviewed. Pedestrian research is summarized under five topic headings: analysis of pedestrian characteristics, analysis of environmental characteristics, analysis of flow characteristics, data collection techniques, data analyses and simulation models. In each area, the current HCM LOS methodology is compared to approaches by other researchers.

In Chapter 4 the TD's data collection methodologies are explained. First of all, the methodology for collecting pedestrian characteristics and speeds in the field while also conducting pedestrian counts is described. Second, the video capture and analysis procedure, which is used to study pedestrian impedance and walking behavior, is detailed. A methodology to determine the "shy distances" which people walk away from specific sidewalk obstacles is also outlined.

In Chapter 5 the gathered data is analyzed, and a summary of findings is provided, including pedestrians' speeds by age, gender, group size, and more. Possible ways for defining pedestrian LOS other than flow rate, such as in terms of delay or impedance are also explored. Finally, the merits of each of the study's data collection methods are explored, and potential improvements for the next stage of this project are discussed.

Chapter 6 concludes the report with a summary of the report's findings based on the literature review and data analysis. Then, the TD's proposals for future study, including data collection and recommendations finalization, are introduced. A summary of the peer review comments is presented in Appendix K.

The flow chart in Figure 1.1 provides an overview of the project.

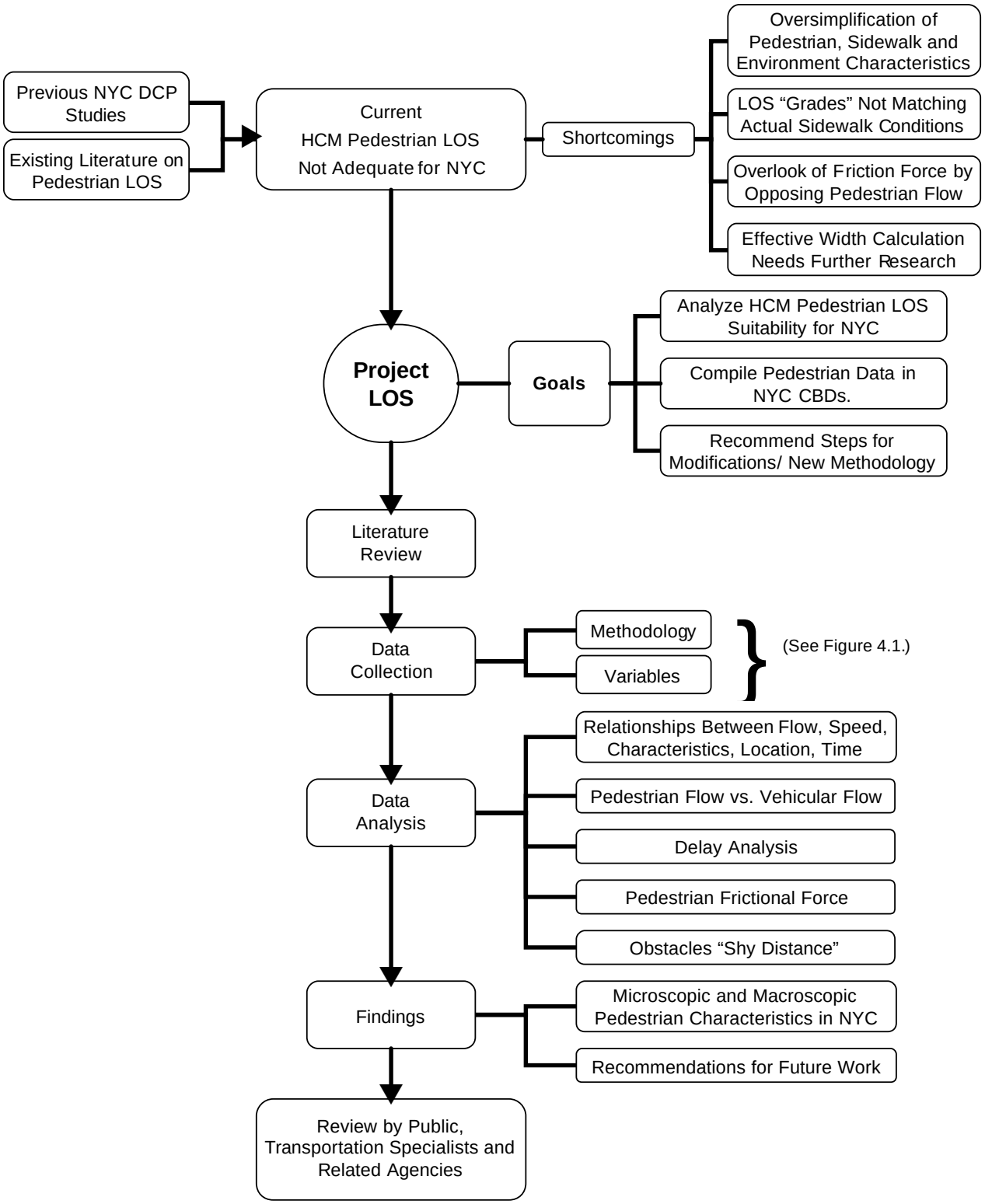

Figure 1.1. Pedestrian HCM LOS Methodology Review Overview

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